AMIGA™ ROM Kernel Reference Manual: Libraries and Devices

Commodore Business Machines, Inc.

Amiga

ROM Kernel Reference Manual

Libraries and Devices

Commodore Business Machines, Inc.

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This book is dedicated to all those "busy guys" who made Amiga and who are Amiga.

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PREFACE

System Software Architecture

The Amiga kernel consists of a number of system modules, some of which reside permanently in the protected *kickstart* memory and others that are loaded as needed from the system disk. Figure P-1 illustrates how the various modules interact with one another. At the top of the hierarchy are Workbench and the Command Line Interface (CLI), the user-visible portions of the system. Workbench uses Intuition to produce its displays and AmigaDOS to interact with the filing system. Intuition, in turn, uses the input device to retrieve its input and the graphics and layers library routines to produce its output.

AmigaDOS controls processes and maintains the filing system and is in turn built on Exec, which manages tasks, task switching, interrupt scheduling, message-passing, I/O, and many other functions.

At the lowest level of the hierarchy is the Amiga hardware itself. Just above the hardware are the modules that control the hardware directly. Exec controls the 68000, scheduling its time among tasks and maintaining its interrupt vectors, among other things. The trackdisk device is the lowest-level interface to the disk hardware, performing disk-head movement and raw disk I/O. The keyboard and gameport devices handle the keyboard and gameport hardware, queuing up input events for the input device to process. The audio device, serial device, and parallel device handle their respective hardware. Finally, the routines in the graphics library handle the interface to the graphics hardware.

Programming

The functions of the kernel were designed to be accessed from any language that follows the Amiga's standard interface conventions. These conventions define the proper naming of symbols, the correct usage of processor registers, and the format of public data structures.

REGISTER CONVENTIONS

All system functions follow a simple set of register conventions. The conventions apply when any system function is called; programmers are encouraged to use the same conventions in their own code.

The registers D0, D1, A0, and A1 are always scratch; they are free to be modified at any time. A function may use these registers without first saving their previous contents. The values of all other data and address registers must first be preserved. If any of these registers are used by a function, their contents must be saved and restored appropriately.

If assembly code is used, function parameters may be passed in registers. The conventions in the preceding paragraphs apply to this use of registers as well. Parameters passed in D0, D1, A0, or A1 may be destroyed. All other registers must be preserved.

If a function returns a result, it is passed back to the caller in D0. If a function returns more than one result, the primary result is returned in D0 and all other results are returned by accessing reference parameters.

The A6 register has a special use within the system, and it may not be used as a parameter to system functions. It is normally used as a pointer to the base of a function vector table. All kernel functions are accessed by jumping to an address relative to this base.

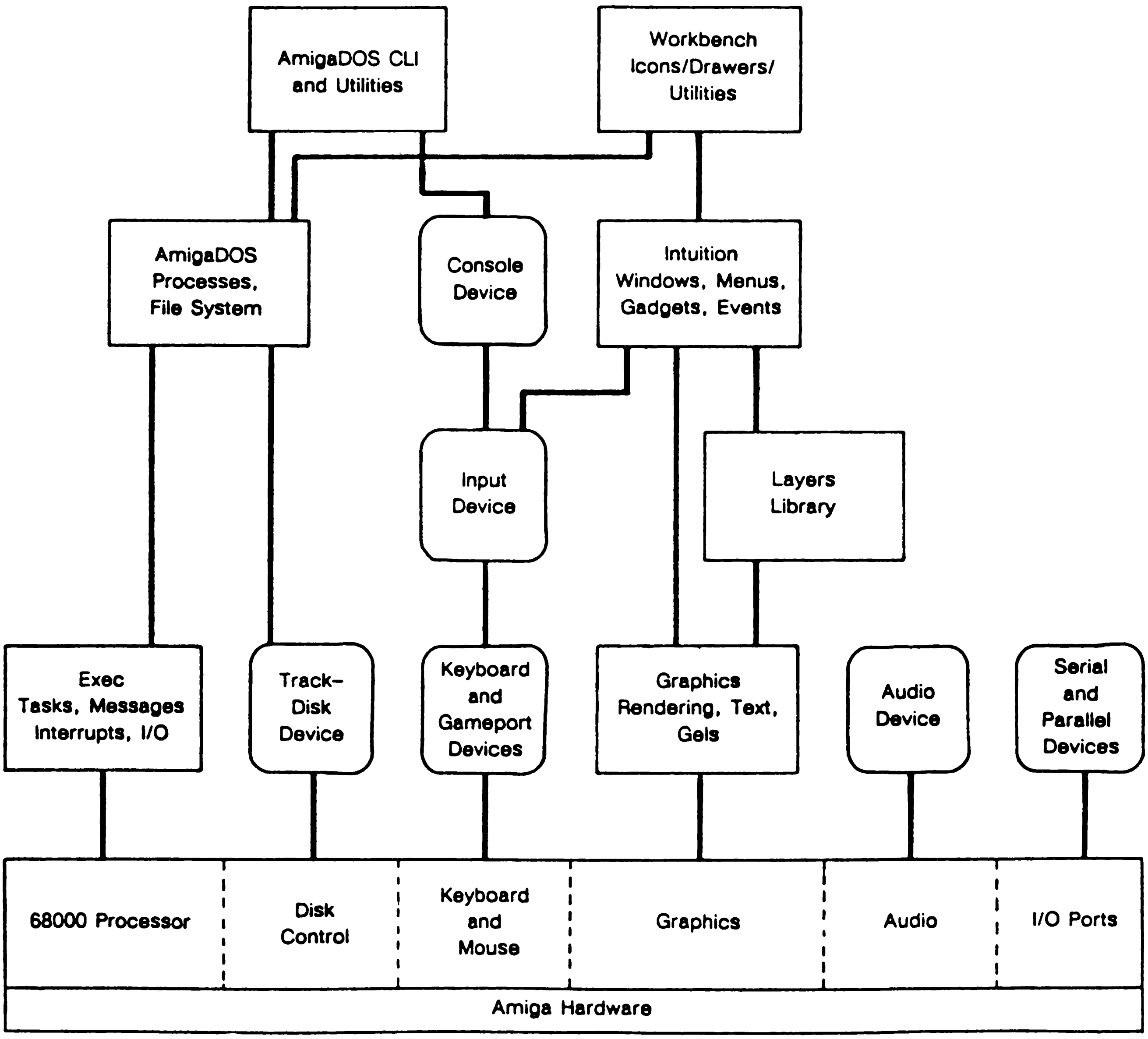

Figure P-1: Amiga System Software Modules

DATA STRUCTURES

The naming, format, and initial values of public data structures must also be consistent. The conventions are quite simple and are summarized below.

1. All non-byte fields must be word-aligned. This may require that certain fields be padded with an extra byte.

2. All address pointers should be 32 bits (not 24 bits) in size. The upper byte must never be used for data.

3. Fields that are not defined to contain particular initial values must be initialized to zero. This includes pointer fields.

4. All reserved fields must be initialized to zero (for future compatibility).

5. Data structures to be accessed by custom hardware must not be allocated on a program stack.

6. Public data structures (such as a task control structure) must not be allocated on a program stack.

7. When data structures are dynamically allocated, conventions 3 and 4 above can be satisfied by specifying that the structure is to be cleared upon allocation.

OTHER PRACTICES

A few other general programming practices should be noted.

1. Never use absolute addresses. All hardware registers and special addresses have symbolic names (see the include files and *amiga.lib*).

2. Because this is a multitasking system, programs must never directly modify the processor exception vectors (including traps) or the processor priority level.

3. Do not assume that programs can access hardware resources directly. Most hardware is controlled by system software that will not respond well to interference. Shared hardware requires programs to use the proper sharing protocols.

4. Do not access shared data structures directly without the proper mutual exclusion. Remember, it is a multitasking system and other tasks may also be accessing the same structures.

5. Most system functions require a particular execution environment. For example, DOS functions can be executed only from within a process; execution from within a task is not sufficient. As another example, most kernel functions can be executed from within tasks, but cannot be executed from within interrupts.

6. The system does not monitor the size of a program stack. Take care that your programs do not cause it to overflow.

7. Tasks always execute in the 68000 processor user mode. Supervisor mode is reserved for interrupts, traps, and task dispatching. Take extreme care if your code executes in supervisor mode. Exceptions while in supervisor mode are deadly.

8. Do not disable interrupts or multitasking for long periods of time.

9. Assembly code functions that return a result do not necessarily affect the processor condition codes. By convention, the caller must test the returned value before acting on a condition code. This is usually done with a **TST** or **MOVE** instruction. Do not trust the condition codes returned by system functions.

68010 AND 68020 COMPATIBILITY

If you wish your code to be upwardly compatible with the 68010/68020 processors, you must avoid certain instructions and you must not make assumptions about the format of the supervisor stack frame. In particular, the **MOVE SR,<ea>** instruction is a privileged instruction on the 68010 and 68020. If you want your code to work correctly on all 680x0 processors, you should use the **GetCC()** function instead (see the Exec library function descriptions in the "Library Summaries" appendix of this book.

Contents of This Manual

This manual describes the graphics support routines (including text and animation), the I/O devices, the Workbench (an environment for running programs), and the floating point mathematics library. For information about the multitasking executive, see *Amiga ROM Kernel Reference Manual: Exec.*

The discussion of the data structures and routines in this manual is reinforced through numerous C-language examples. The examples are kept as simple as possible. Whenever possible, each example demonstrates a single function. Where appropriate, there are complete sample programs.

Boldface type is used for the names of functions, data structures, macros, and variables. System header files and other system file names are shown in italics.

For more information about system software, see *Amiga Intuition Reference Manual*, *AmigaDOS User's Manual*, *AmigaDOS Developer's Manual*, and *AmigaDOS Technical Reference Manual.*

Contents

PART I

PART I

Chapter 1

Graphics Primitives

This chapter describes the basic graphics tools. It covers the graphics support structures, display routines, and drawing routines. Many of the operations described in this section are also performed by the Intuition software. See the book called *Intuition: The Amiga User Interface* for more information.

Introduction

The Amiga has two basic types of graphics support routines: display routines and drawing routines. These routines are very versatile and allow you to define any combination of drawing and display area you may wish to use.

The first section of this chapter defines the display routines. These routines show you how to form and manipulate a display, including the following aspects of display use:

- How to identify the memory area that you wish to have displayed

- How to position the display area window to show only a certain portion of a larger drawing area

- How to split the screen into as many vertically stacked slices as you wish

- Whether to use high-resolution (640 pixels across) or low-resolution (320 pixels across) display mode for a particular screen segment, and whether to use interlaced (400 lines top to bottom) or non-interlaced (200 lines) mode

- How to specify how many color choices per pixel are to be available in a specific section of the display

The next section of the chapter explains all of the available modes of drawing supported by the system software, including how to do the following:

- Reserve memory space for use by the drawing routines

- Define the colors that can be drawn into a drawing area

- Define the colors of the drawing pens (foreground pen, background pen for patterns, and outline pen for area-fill outlines)

- Define the pen position in the drawing area

- Draw lines, define vertex points for area-filling, and specify the area-fill color and pattern

- Define a pattern for patterned line drawing

- Change drawing modes

- Read or write individual pixels in a drawing area

- Copy rectangular blocks of drawing area data from one drawing area to another

- Use a template (predefined shape) to draw an object into a drawing area

COMPONENTS OF A DISPLAY

In producing a display, you are concerned with two primary components: sprites and the playfield. Sprites are the easily movable parts of the display. The playfield is the static part of the display and forms a backdrop against which the sprites can move and with which the sprites can interact.

This chapter covers the creation of the background. Sprites are described in chapter 3, "Animation."

INTRODUCTION TO RASTER DISPLAYS

The Amiga produces its video displays on standard television or video monitors by using raster display techniques. The picture you see on the video display screen is made up of a series of horizontal video lines stacked one on top of another, as illustrated in figure 1-1. Each line represents one sweep of an electronic video beam, which "paints" the picture as it moves along. The beam sweeps from left to right, producing the full screen one line at a time. After producing the full screen, the beam returns to the top of the display screen.

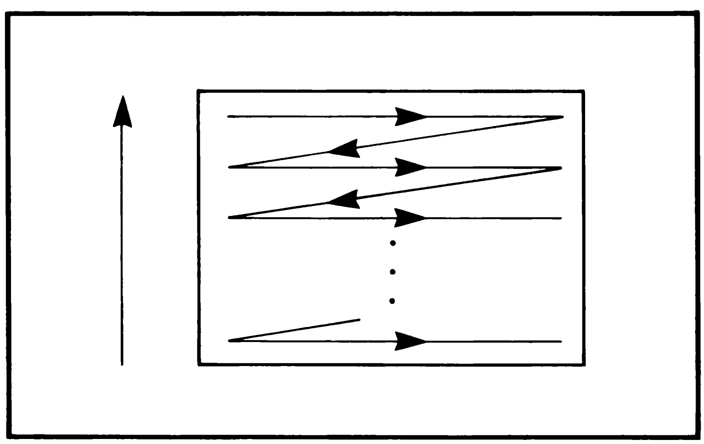

Figure 1-1: How the Video Display Picture Is Produced

The diagonal lines in the figure show how the video beam returns to the start of each horizontal line.

Effect of Display Overscan on the Viewing Area

To assure that the picture entirely fills the viewable region of the screen, the manufacturer of the video display usually creates a deliberate *overscan*. That is, the video beam is swept across a larger section than the front face of the screen can actually display. The video beam actually covers 262 vertical lines. The user, however, sees only the portion of the picture that is within the center region of the display, which is about 200 rows, as illustrated in figure 1-2 below. The graphics system software lets you specify more than 200 rows.

Overscan also restricts the amount of video data that can appear on each display line. The system software allows you to specify a display width of up to 352 pixels (or 704 in high-resolution mode) per horizontal line. Generally, however, you should use the standard values of 320 (or 640 in high-resolution mode) for most applications.

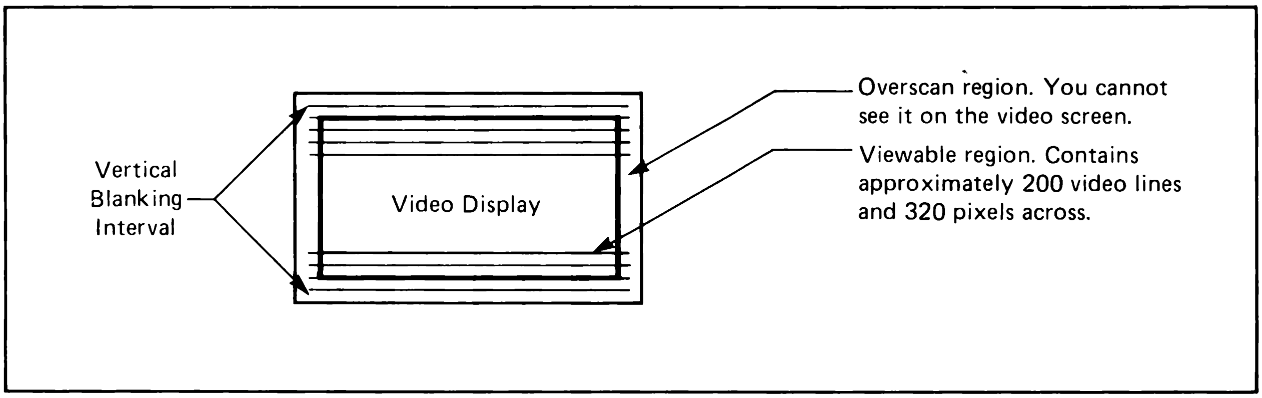

Figure 1-2: Display Overscan Restricts Usable Picture Area

The time during which the video beam is in the region below the bottom line of the viewable area and above the top line of the next display field is called the *vertical blanking interval.*

Color Information for the Video Lines

The hardware reads the system display memory to obtain the color information for each line. As the video display beam sweeps across the screen producing the display line, it changes color, producing the images you have defined.

INTERLACED AND NON-INTERLACED MODES

In producing the complete display (262 video lines), the video display device produces the top line, then the next lower line, then the next, until it reaches the bottom of the screen. When it reaches the bottom, it returns to the top to start a new scan of the screen. Each complete set of 262 lines is called a *display field.* It takes about 1/60th of a second to produce a complete display field.

The Amiga has two vertical display modes: *interlaced* and *non-interlaced.* In non-interlaced mode, the video display produces the same picture for each successive display field. A non-interlaced display normally has about 200 lines in the viewable area (for a full-screen size display).

To make the display more precise in the vertical direction, you use interlaced mode, which displays twice as much data in the same vertical area as non-interlaced mode. Within the same amount of viewable area, you can display 400 video lines instead of 200.

For interlaced mode, the video beam scans the screen at the same rate (1/60th of a second per complete video display field); however, it takes two display fields to form a complete video display picture. During the first of each pair of display fields, the system hardware shows the odd-numbered lines of an interlaced display (1, 3, 5, and so on). During the second display field, it shows the even-numbered lines (2, 4, 6 and so on). These sets of lines are taken from data defining 400 lines. During the display, the hardware moves the second display field's lines downward slightly from the position of the first, so that the lines in the second field are "interlaced" with those of the first field, giving the higher vertical resolution of this mode. For an interlaced display, the data in memory defines twice as many lines as for a non-interlaced display, as shown in figure 1-3.

DATA AS DISPLAYED	DATA IN MEMORY
Odd field – Line 1	Line 1
Even field – Line 1	Line 2
Odd field – Line 2	Line 3
Even field – Line 2	Line 4
.	.
	.
Odd field – Last line	Line 399
Even field – Last line	Line 400

Figure 1-3: Interlaced Mode — Display Fields and Data in Memory

Figure 1-4 shows a display formed as display lines 1, 2, 3, 4, ... 400. The 400-line interlaced display uses the same physical display area as a 200-line non-interlaced display.

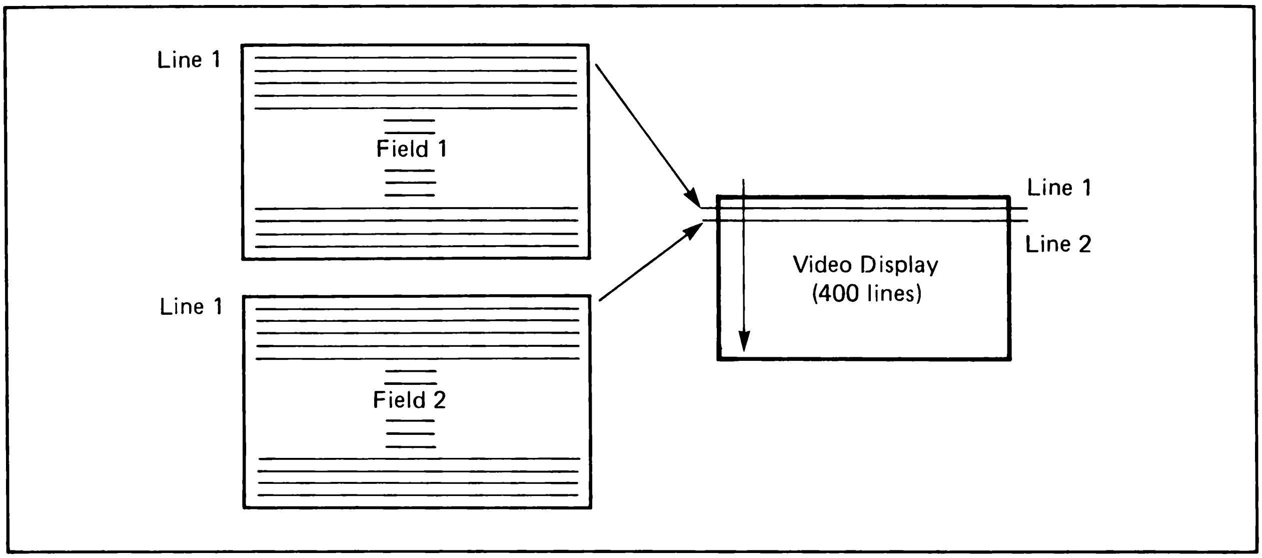

Figure 1-4: Interlaced Mode Doubles Vertical Resolution

During an interlaced display, it appears that both display fields are present on the screen at the same time and form one complete picture. This phenomenon is called *video persistence*.

HIGH- AND LOW-RESOLUTION MODES

The Amiga also has two horizontal display modes: *high-resolution* and *low-resolution*. High-resolution mode provides (nominally) 640 distinct pixels (picture elements) across a horizontal line. Low-resolution provides (nominally) 320 pixels across each line. Low-resolution mode allows up to 32 colors at one time, and high-resolution mode allows 16 colors (out of 4,096 choices) at one time.

One other display mode affects the number of colors you can display at one time: *hold-and-modify*. Hold-and-modify mode allows you to display all 4,096 colors on the screen at once.

FORMING AN IMAGE

To create an image, you write data (that is, you "draw") into a memory area in the computer. From this memory area, the system can retrieve the image for display. You tell the system exactly how the memory area is organized, so that the display is correctly produced. You use a block of memory words at sequentially increasing addresses to represent a rectangular region of data bits. Figure 1-5 shows the contents of three example memory words: 0 bits are shown as blank rectangles, and 1 bits as filled-in rectangles.

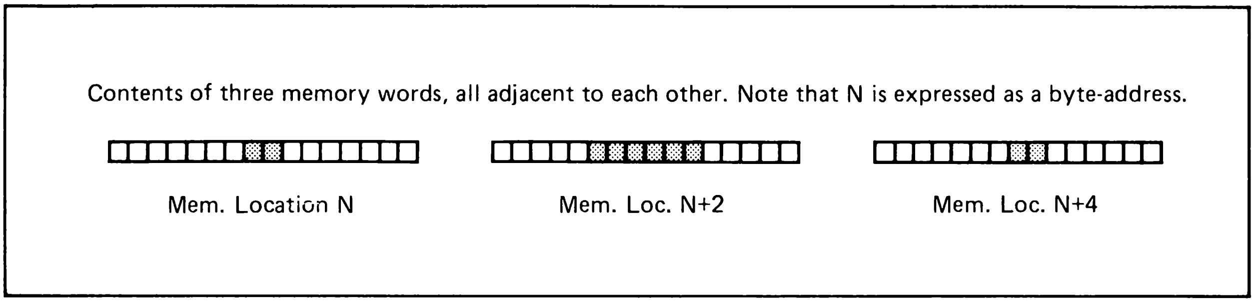

Figure 1-5: Sample Memory Words

The system software lets you define linear memory as rectangular regions, called *bit-planes*. Figure 1-6 shows how the system views the same three words as a bit-plane, wherein the data bits form an x-y plane.

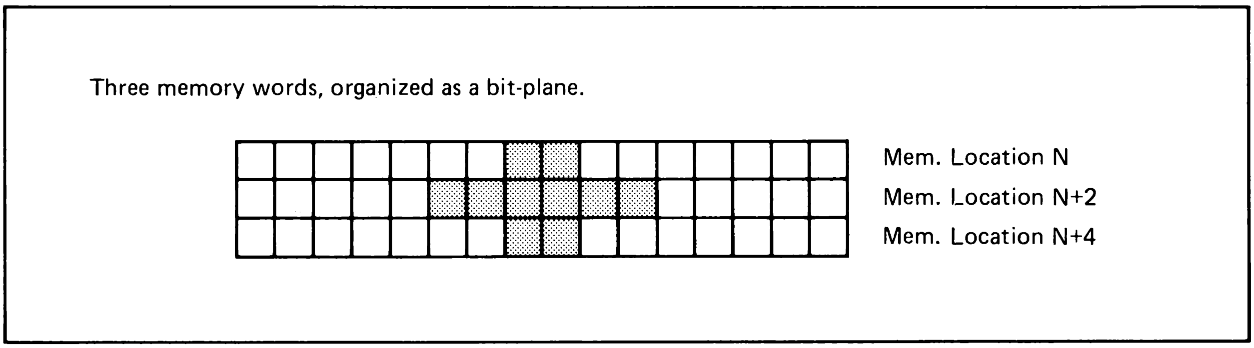

Figure 1-6: A Rectangular "Look" at the Sample Memory Words

Figure 1-7 shows how 4,000 words (8,000 bytes) of memory can be organized to provide enough bits to define a single bit-plane of a full-screen, low-resolution video display (320 x 200).

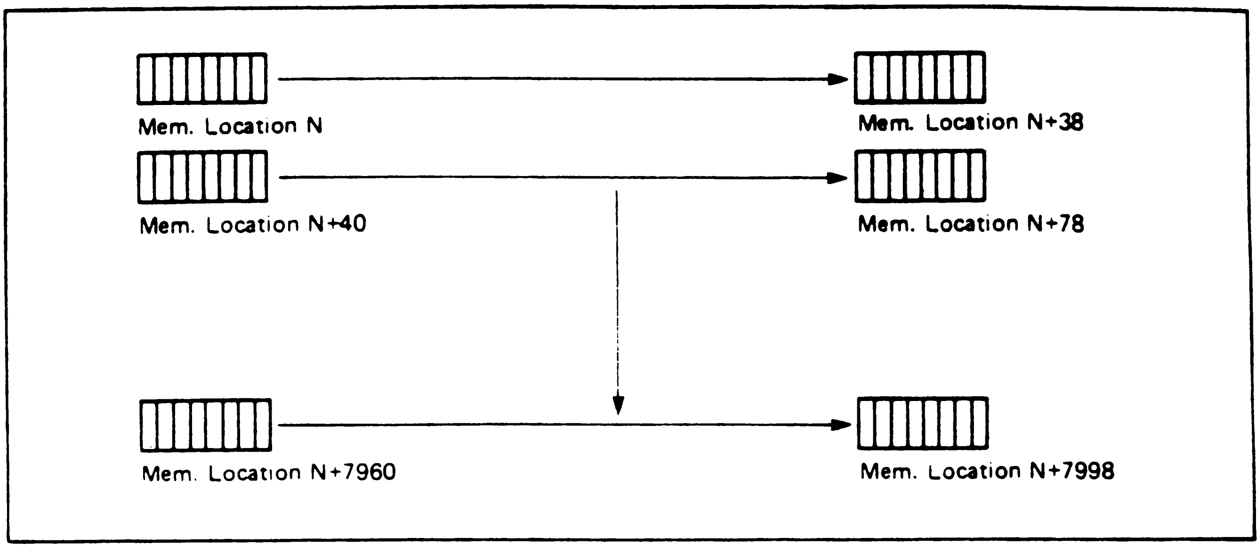

Figure 1-7: Bit-Plane for a Full-screen, Low-resolution Display

Each memory data word contains 16 data bits. The color of each pixel on a video display line is directly related to the value of one or more data bits in memory, as follows:

- o If you create a display in which each pixel is related to only one data bit, you can only select from only two possible colors, because each bit can have a value of only 0 or 1.

- o If you use two bits per pixel, there is a choice of four different colors because there are four possible combinations of the values of 0 and 1 from each of the two bits.

- o If you specify three, four, or five bits per pixel, you will have eight, sixteen, or thirty-two possible choices of a color for each pixel.

To create multicolored images, you must tell the system how many bits are to be used per pixel. The number of bits per pixel is the same as the number of bit-planes used to define the image.

As the video beam sweeps across the screen, the system retrieves one data bit from each bit-plane. Each of the data bits is taken from a different bit-plane, and one or more bit-planes are used to fully define the video display screen. For each pixel, data-bits in the same x,y position in each bit-plane are combined by the system hardware to create a binary value. This value determines the color that appears on the video display for that pixel. (See figure 1-8.)

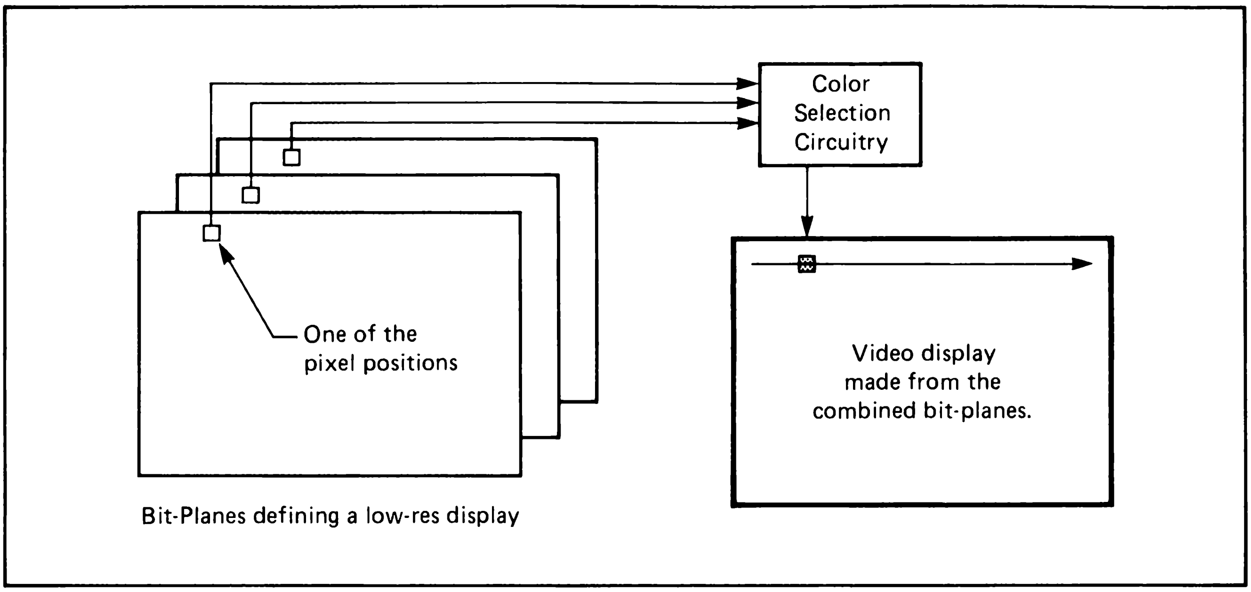

Figure 1-8: Bits from Each Bit-Plane Select Pixel Color

You will find more information showing how the data bits actually select the color of the displayed pixel in the section called "ViewPort Color Selection."

ROLE OF THE COPPER (COPROCESSOR)

The Amiga has a special-purpose coprocessor, called the *Copper*, that can control nearly the entire graphics system. The Copper can control register updates, reposition sprites, change the color palette, and update the blitter. The graphics and animation routines use the Copper to set up lists of instructions for handling displays, and advanced users can write their own "user Copper lists."

Display Routines and Structures

Caution: This section describes the lowest-level graphics interface to the system hardware. If you use any of the routines and the data structures described in these sections, your program will essentially take over the entire display. It will not, therefore, be compatible with the multiwindow operating environment, known as Intuition, which is used by AmigaDOS.

The descriptions of the display routines, as well as those of the drawing routines, occasionally use the same terminology as that in *Intuition: The Amiga User Interface*. These routines and data structures are the same ones that Intuition software uses to produce its displays.

The computer produces a display from a set of instructions you define. You organize the instructions as a set of parameters known as the **View** structure. Figure 1-9 shows how the system interprets the contents of a **View** structure. This drawing shows a complete display composed of two different component parts, which could, for example, be a low-resolution, multicolored part and a high-resolution, two-colored part.

A complete display consists of one or more **ViewPorts**, whose display sections are separated from each other by at least one blank line. The viewable area defined by each **ViewPort** is a rectangular cut from the same size (or larger) raster. You are essentially defining a display consisting of a number of vertically stacked display areas in which separate sections of graphics rasters can be shown.

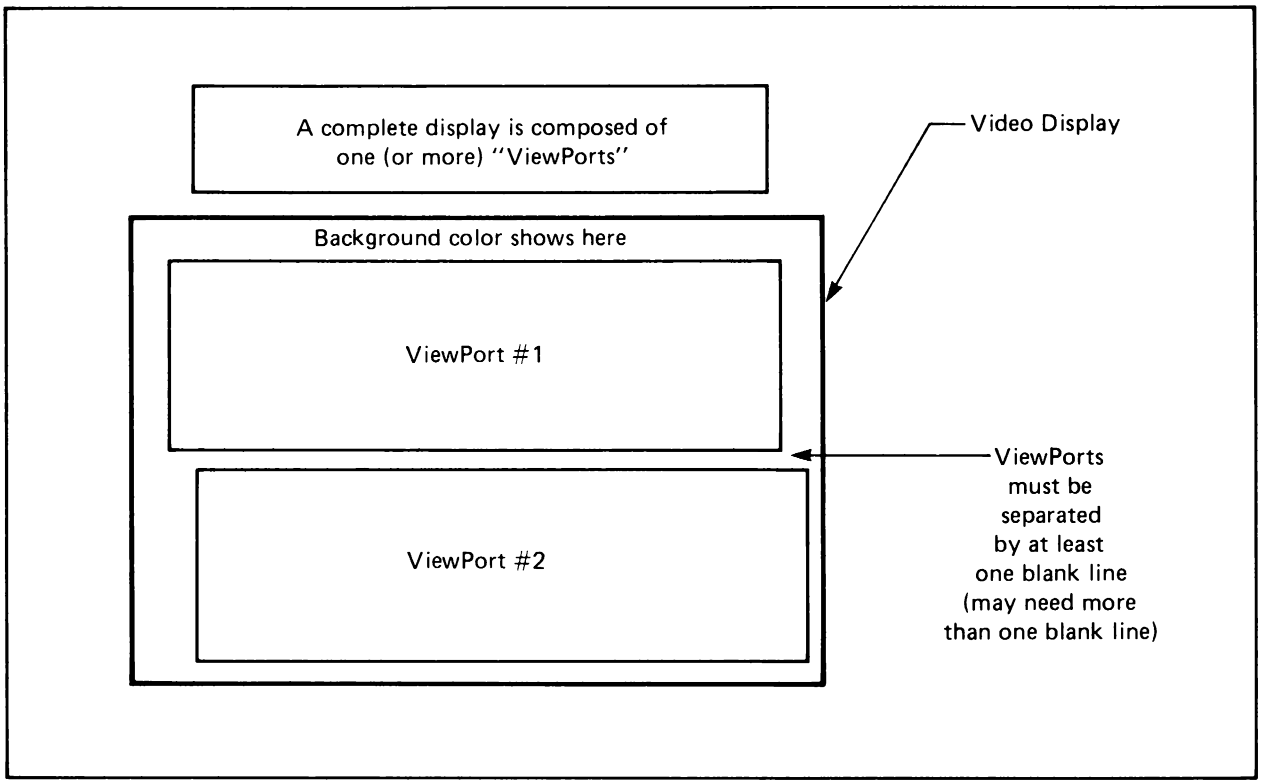

Figure 1-9: The Display Is Composed of ViewPorts

LIMITATIONS ON THE USE OF VIEWPORTS

The system software for defining **ViewPorts** allows only vertically stacked fields to be defined. Figure 1-10 shows acceptable and unacceptable display configurations. If you want to create overlapping windows, define a single **ViewPort** and manage the windows yourself within that **ViewPort**.

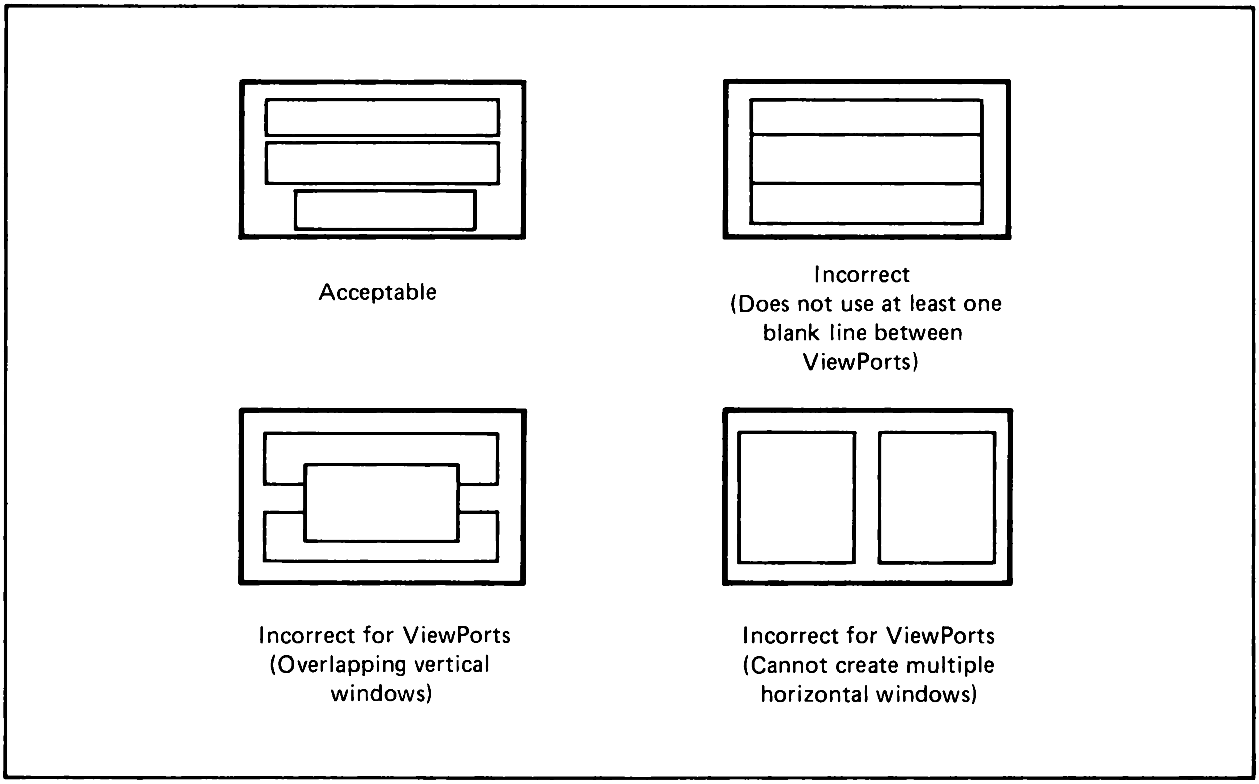

Figure 1-10: Correct and Incorrect Uses of ViewPorts

A **ViewPort** is related to the custom screen option of Intuition. In a custom screen, you can split the screen into slices as shown in the "correct" illustration of figure 1-10. Each custom screen can have its own set of colors, use its own resolution, and show its own display area. Within a **ViewPort**—actually within its associated **RastPort** (drawing area definition)—it is possible to split the display into separate drawing areas called *windows*. The **ViewPort** is simply an indivisible window into a possibly larger complex drawing area.

CHARACTERISTICS OF A VIEWPORT

To describe a **ViewPort** fully, you need to set the following parameters: height, width, and display mode.

In addition to these parameters, you must also tell the system the location in memory from which the data for the **ViewPort** display should be retrieved, and how to position the final **ViewPort** display on the screen.

VIEWPORT SIZE SPECIFICATIONS

Figure 1-11 illustrates that the variables **DHeight**, and **DWidth** specify the size of a **ViewPort**.

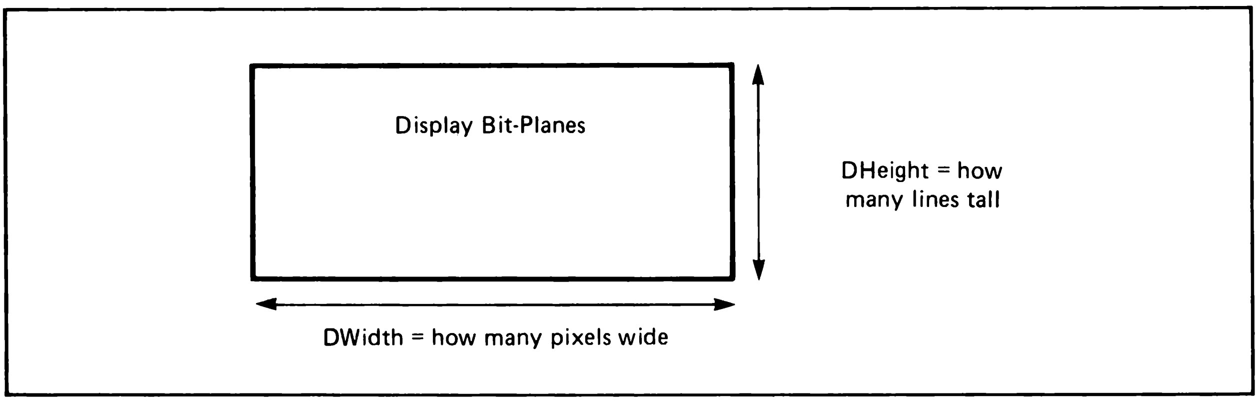

Figure 1-11: Size Definition for a ViewPort

ViewPort Height

The variable **DHeight** determines how many video lines will be reserved to show the height of this display segment. The size of the actual segment depends on whether you define a non-interlaced or an interlaced display. An interlaced display is half as tall as a non-interlaced display of the same number of lines.

For example, a **View** consisting of two **ViewPorts** might be defined as follows:

- o **ViewPort** #1 is 150 lines, high-resolution mode (uses the top three-quarters of the display).

- **ViewPort** #2 is 49 lines of low-resolution mode (uses the bottom quarter of the display and allows the space for the required blank line between **ViewPorts**).

The user interface software (Intuition) assumes a standard configuration of 200 rows (400 in interlaced mode).

ViewPort Width

The **DWidth** variable determines how wide, in current pixels, the display segment will be. If you are using low-resolution mode, you should specify a width of 320 pixels per horizontal line. If you are using high-resolution mode, you should specify a width of 640 pixels. You may specify a smaller value of pixels per line to produce a narrower display segment.

Although the system software allows you define low-resolution displays as wide as 352 pixels and high-resolution displays as wide as 704 pixels, you should not exceed the normal values of 320 or 640, respectively. Because of display overscan, many video displays will not be able to show all of a wider display, and sprite display may be affected. If you are using hardware sprites or VSprites with your display, and you specify **ViewPort** widths exceeding 320 or 640 pixels (for low- or high-resolution, respectively), it is likely that hardware sprites 5, 6, and 7 will not be rendered on the screen. These sprites may not be rendered because playfield DMA (direct memory access) takes precedence over sprite DMA when an extra-wide display is produced.

VIEWPORT COLOR SELECTION

The maximum number of colors that a **ViewPort** can display is determined by the depth of the **BitMap** that the **ViewPort** displays. The depth is specified when the **BitMap** is initialized. See the section below called "Preparing the BitMap Structure."

Depth determines the number of bit-planes used to define the colors of the rectangular image you are trying to build (the raster image) and the number of different colors that can be displayed at the same time within a **ViewPort**. For any single pixel, the system can display any one of 4,096 possible colors.

Table 1-1 shows depth values and the corresponding number of possible colors for each value.

Table 1-1: Depth Values and Number of Colors in the ViewPort

Colors	**Depth Value**	
2	1	
4	2	
8	3	
16	4	(Note 1)
32	5	(Notes 1,2)
4,096	6	(Notes 1,2,3)
32	6	(Notes 1,2)

Notes:

1. Single-playfield mode only—**ViewPort** mode not DUALPF

2. Low-resolution mode only—**ViewPort** mode not HIRES

3. Hold-and-modify mode only—**ViewPort** mode = HAM

The color palette used by a **ViewPort** is specified in a **ColorMap**. See the section called "Preparing the ColorMap" for more information.

Depending on whether single- or dual-playfield mode is used, the system will use different color register groupings for interpreting the on-screen colors. Table 1-2 below details how the depth and the **Modes** variable in the **ViewPort** structure affect the registers the system uses.

Table 1-2: Single-playfield Mode (**Modes** variable not equal to DUALPF)

Depth	**Color Registers Used**	
1	0,1	
2	0-3	
3	0-7	
4	0-15	
5	0-31	
6	0-16	(if modes = HAM)

Table 1-3 shows the five possible combinations when the **Modes** variable is set to DUALPF.

Table 1-3: Dual-playfield Mode (**Modes** variable = DUALPF)

Depth (PF-1)	**Color Registers**	**Depth (PF-2)**	**Color Registers**
1	0,1	1	8,9
2	0-3	1	8,9
2	0-3	2	8-11
3	0-7	2	8-11
3	0-7	3	8-15

The system has seven different display modes that you can specify for each **ViewPort**. The seven bits that control the modes are DUALPF, PFBA, HIRES, LACE, HAM, SPRITES, and VP_HIDE. A mode becomes active if you set the corresponding bit to 1 in the **Modes** variable of the **ViewPort** structure. After you initialize the **ViewPort**, you can set the bit(s) for the modes you want. (See the section called "Preparing the ViewPort Structure" for more information about initializing a **ViewPort**.)

Modes DUALPF and PFBA are related. DUALPF tells the system to treat the raster specified by this **ViewPort** as the first of two independent and separately controllable playfields. It also modifies the manner in which the pixel colors are selected for this raster.

When PFBA is a 1, it specifies that a second playfield has video priority over the first one. Playfield relative priorities can be controlled when the playfield is split into two overlapping regions. Single-playfield and dual-playfield modes are discussed in "Advanced Topics" below.

HIRES tells the system that the raster specified by this **ViewPort** is to be displayed with 640 horizontal pixels rather than 320 horizontal pixels.

LACE tells the system that the raster specified by this **ViewPort** is to be displayed in interlaced mode. If the **ViewPort** is non-interlaced and the **View** is interlaced, the **ViewPort** will be displayed at its specified height and will look only slightly different than it would look when displayed in a non-interlaced **View**. See "Interlaced Mode versus Non-interlaced Mode" below for more information.

HAM tells the system to use "hold-and-modify" mode, a special mode that lets you display up to 4,096 colors on screen at the same time. It is described in the "Advanced Topics" section.

SPRITES tells the system that you are using sprites in this display (either VSprites or Simple Sprites). This bit, when a 1, tells the software to load color registers for sprites. See chapter 3, "Animation," for more information about sprites.

VP_HIDE tells the system that this **ViewPort** is obscured by other **ViewPorts**. When a **View** is constructed, no display instructions are generated for this **ViewPort**.

EXTRA_HALFBRITE is reserved for future use.

Single-playfield Mode versus Dual-playfield Mode

When you specify single-playfield mode (see figure 1-12), you are asking that the system treat all bit-planes as part of the definition of a single playfield image. Each of the bit-planes defined as part of this **ViewPort** contributes data bits that determine the color of the pixels in a single playfield.

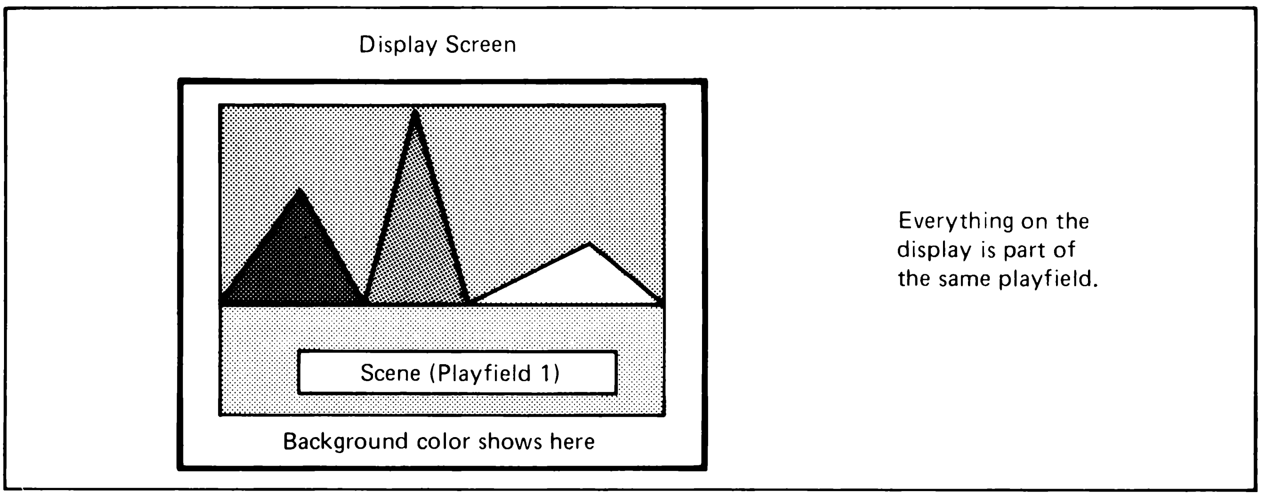

Figure 1-12: A Single-playfield Display

If you use dual-playfield mode (**ViewPort.Modes** = DUALPF), you can define two independent, separately controllable playfield areas (see figure 1-13).

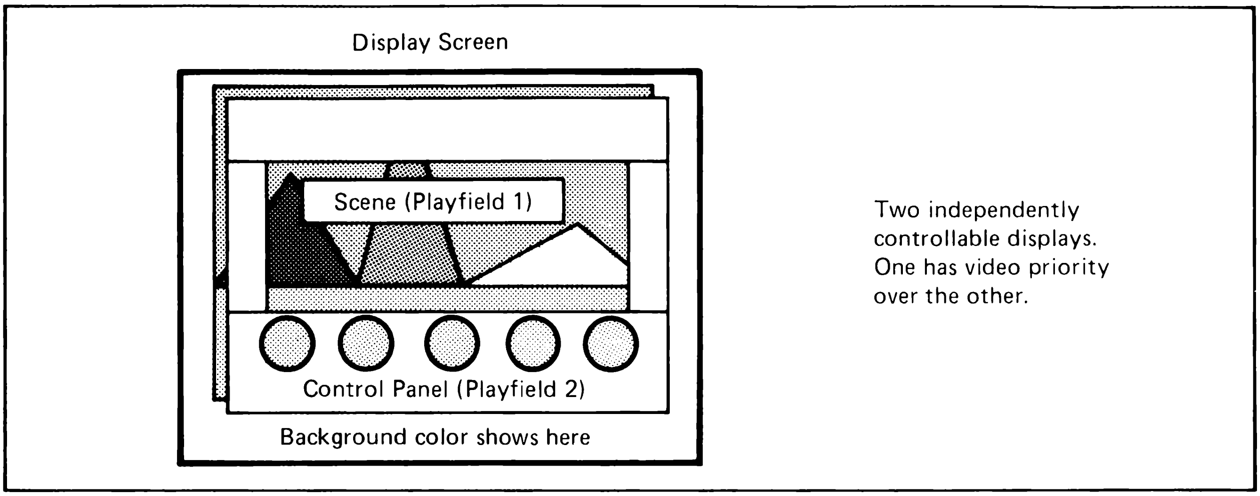

Figure 1-13: A Dual-playfield Display

In figure 1-13, the display mode bit PFBA is set to 1. If PFBA = 0, the relative priorities will be reversed; playfield 2 will appear to be behind playfield 1.

Low-resolution Mode versus High-resolution Mode

In low-resolution mode, horizontal lines of 320 pixels fill most of the ordinary viewing area. The system software lets you define a screen segment width up to 352 pixels in this mode, or you can define a screen segment as narrow as you desire. In high-resolution mode (also called "normal" resolution), 640 pixels fill a horizontal line. In this mode you can specify any width from 0 to 704 pixels. Overscan normally limits you to showing only 0 to 320 pixels per line in low-resolution mode or 0 to 640 pixels per line in high-resolution mode. Intuition assumes the nominal 320-pixel or 640-pixel width (see figure 1-14).

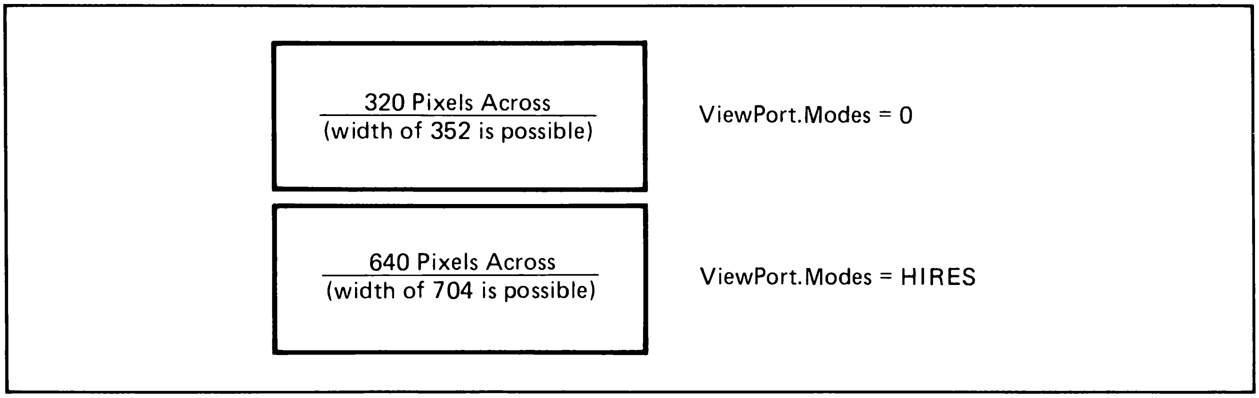

Figure 1-14: How HIRES Affects Width of Pixels

Interlaced Mode versus Non-interlaced Mode

In interlaced mode, there are twice as many lines available as in non-interlaced mode, providing better vertical resolution in the same display area (see figure 1-15).

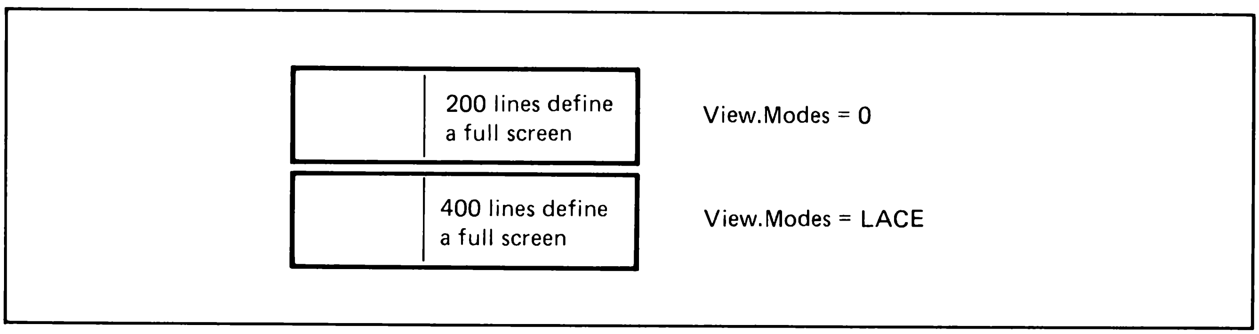

Figure 1-15: How LACE Affects Vertical Resolution

If the **View** structure does not specify LACE, and the **ViewPort** specifies LACE, you may see only every other line of the **ViewPort** data. If the **View** structure specifies LACE and the **ViewPort** is non-interlaced, the same **ViewPort** data will be repeated in both fields. The height of the **ViewPort** display is the height specified in the **ViewPort** structure. If both the **View** and the **ViewPort** are interlaced, the **ViewPort** will be built with double the normal vertical resolution. That means it will need twice as much data space in memory as a non-interlaced picture for this display.

VIEWPORT DISPLAY MEMORY

The picture you create in memory can be larger than the screen image that can be displayed within your **ViewPort**. This big picture (called a raster and represented by the **BitMap** structure) can have a maximum size of 1,024 by 1,024 pixels. Because a picture this large cannot fit fully on the display, you specify which piece of it to display. Once you have selected the piece to be shown, you can specify where it is to appear on the screen.

The example in figure 1-16 introduces terms that tell the system how to find the display data and how to display it in the **ViewPort**. These terms are **RHeight**, **RWidth**, **RyOffset**, **RxOffset**, **DHeight**, **DWidth**, **DyOffset** and **DxOffset**.

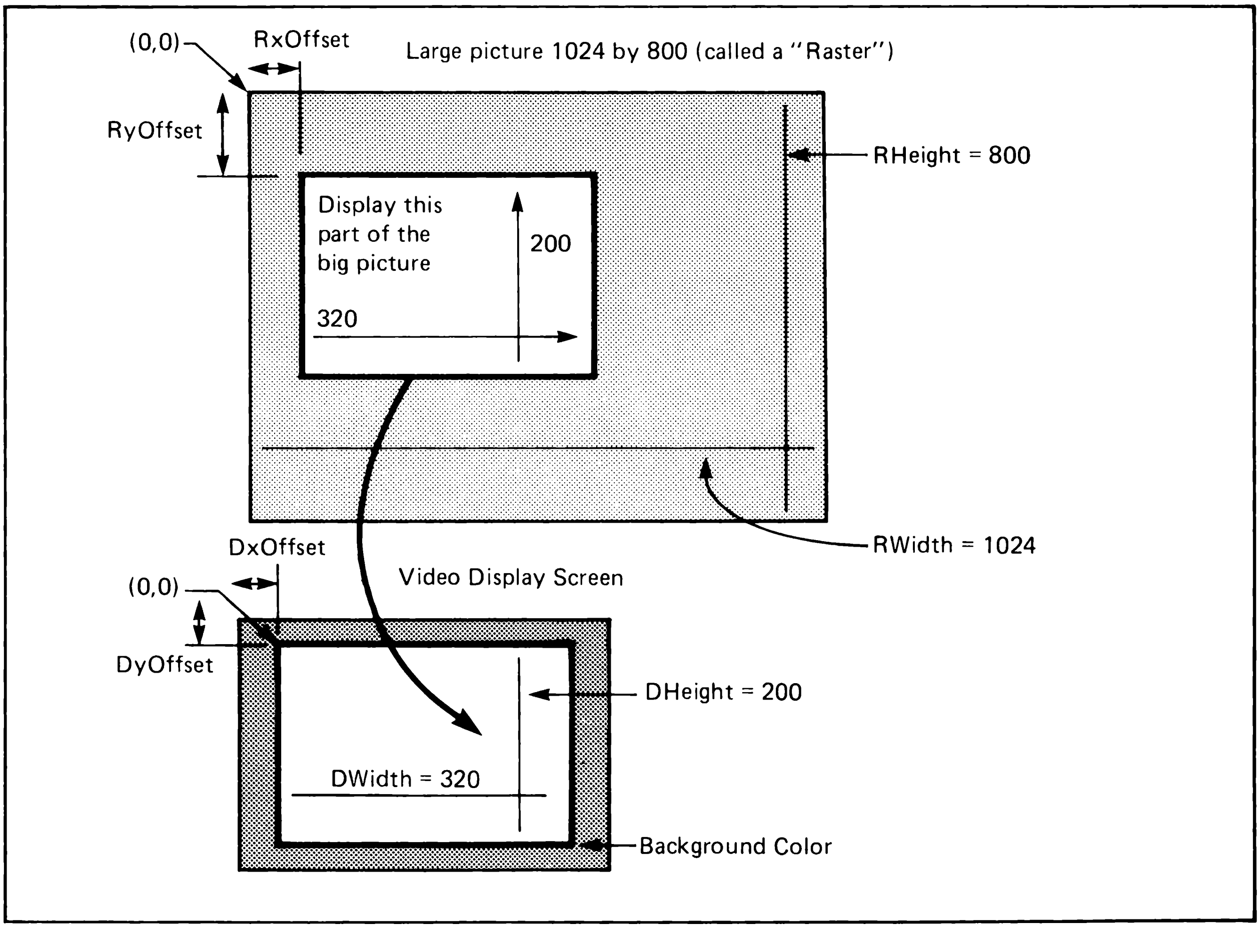

Figure 1-16: ViewPort Data Area Parameters

The terms **RHeight** and **RWidth** do not appear in actual system data structures. They refer to the dimensions of the raster and are used here to relate the size of the raster to the size of the display area. **RHeight** is the number of rows in the raster, and **RWidth** is the number of bytes per row times 8. The raster shown in the figure is too big to fit entirely in the display area, so you tell the system which pixel of the raster should appear in the upper left corner of the display segment specified by your **ViewPort**. The variables that control that placement are **RyOffset** and **RxOffset**.

To compute **RyOffset** and **RxOffset**, you need **RHeight**, **RWidth**, **DHeight**, and **DWidth**. The **DHeight** and **DWidth** variables define the height and width in pixels of the portion of the display that you want to appear in the **ViewPort**. The example shows a full-screen, low-resolution mode (320-pixel), non-interlaced (200-line) display formed from the larger overall picture.

Normal values for **RyOffset** and **RxOffset** are defined by the formulas:

$$0 <= \text{RyOffset} <= (\text{RHeight - DHeight})$$
$$0 <= \text{RxOffset} <= (\text{RWidth - DWidth})$$

Once you have defined the size of the raster and the section of that raster that you wish to display, you need only specify where to put this **ViewPort** on the screen. This is controlled by the variables **DyOffset** and **DxOffset**. A value of 0 for each of these offsets places a normal-sized picture in a centered position at the top, bottom, left and right on the display screen. Possible values for **DyOffset** range from -16 to +200 (-32 to +400 if **View.Modes** includes LACE). Possible values for **DxOffset** range from -16 to +352 (-32 to +704 if **ViewPort.Modes** includes HIRES).

The parameters shown in the figure above are distributed in the following data structures:

- **RasInfo** (information about the raster) contains the variables **RxOffset** and **RyOffset**. It also contains a pointer to the **BitMap** structure.

- **View** (information about the whole display) includes the variables that you use to position the whole display on the screen. The **View** structure contains a **Modes** variable used to determine if the whole display is to be interlaced or non-interlaced. It also contains pointers to its list of **ViewPorts** and pointers to the Copper instructions produced by the system to create the display you have defined.

- **ViewPort** (information about this piece of the display) includes the values **DxOffset** and **DyOffset** that are used to position this slice relative to the overall **View**. The **ViewPort** also contains the variables **DHeight** and **DWidth**, which define the size of this slice; a **Modes** variable; and a pointer to the local **ColorMap**. Each **ViewPort** also contains a pointer to the next **ViewPort**. You create a linked list of **ViewPorts** to define the complete display.

- **BitMap** (information about memory usage) tells the system where to find the display and drawing area memory and shows how this memory space is organized.

You must allocate enough memory for the display you define. The memory you use for the display may be shared with the area control structures used for drawing. This allows you to draw into the same areas that you are currently displaying on the screen.

As an alternative, you can define two **BitMaps**. One of them can be the active structure (that being displayed) and the other can be the inactive structure. If you draw into one **BitMap** while displaying another, the user cannot see the drawing taking place. This is called *double-buffering* of the display. See "Advanced Topics" below for an explanation of the steps required for double-buffering. Double-buffering takes twice as much memory as single-buffering because two full displays are produced.

To determine the amount of required memory for each **ViewPort** for single-buffering, you can use the following formula.

bytes_per_ViewPort = Depth * RASSIZE (Width, Height);

RASSIZE is a system macro attuned to the current design of the system memory allocation for display rasters. See *graphics/gfxmacros.h* for the formula with which RASSIZE is calculated.

For example, a 32-color **ViewPort** (depth = 5), 320 pixels wide by 200 lines high uses 40,000 bytes (as of this writing). A 16-color **ViewPort** (depth = 4), 640 pixels wide by 400 lines high uses 128,000 bytes (as of this writing).

FORMING A BASIC DISPLAY

This section offers an example that shows how to create a single **ViewPort** with a size of 200 lines, in which the area displayed is the same size as the big picture (raster) stored in memory. The example also shows how this **ViewPort** becomes the single display segment of a **View** structure. Following the description of the individual operations, the "Graphics Example Program" section pulls all of the pieces into a complete executable program. Instead of linking these routines to drawing routines, the example allocates memory specifically and only for the display (instead of sharing the memory with the drawing routines) and writes data directly to this memory. This keeps the display and the drawing routines separate for purposes of discussion.

Here are the data structures that you need to define to create a basic display:

```
struct View v;          /* The name used here for a View is v,
struct ViewPort vp;      * for a ViewPort is vp,
struct BitMap b;         * for a BitMap is b,
struct RasInfo ri;       * and for a RasInfo is ri. */
```

Opening the Graphics Library

Most of the system routines used here are located in the graphics library. When you compile your program, you must provide a way to tell the compiler to link your calling sequences into the routine library in which they are located. You accomplish this by declaring the variable called **GfxBase**. Then, by opening the graphics library, you provide the value (address of the library) that the system needs for linking with your program. See the "Libraries" chapter in the *Amiga ROM Kernel Reference Manual: Exec* for more information.

Here is a typical sequence:

```
struct GfxBase *GfxBase;      /* declare the name *GfxBase as a
                               * pointer to the corresponding library */
```

Preparing the View Structure

The following code section prepares the **View** structure for further use:

```
InitView( &v );               /* initialize the View structure */
v.ViewPort = &vp;/* tell the View structure where to find the
                  * first ViewPort in a possible list of Viewports */
```

Preparing the ViewPort Structure

The following code section prepares the **ViewPort** structure for further use:

```
InitVPort( &vp );          /* initialize the structure (set up default values) */

vp.DWidth = WIDTH;  /* how wide is the display */
vp.DHeight = HEIGHT;/* how tall is the display for this ViewPort */
vp.RasInfo = &ri;          /* pointer to a RasInfo structure */
vp.ColorMap = GetColorMap(32);       /* using a 32-color map */
```

The **InitVPort()** routine presets certain default values. The defaults include:

- **Modes** variable set to zero—this means you select a low-resolution display.

- **Next** variable set to zero—no other **ViewPort** is linked to this one. If you want to have multiple **ViewPorts** in a single **View**, you must create the link yourself. The last **ViewPort** in the chain must have a **Next** value of 0.

If you have defined two **ViewPorts**, such as

```
struct ViewPort vpA;
struct ViewPort vpB;
```

and you want them to both be part of the same display, you must create a link between them, and a NULL link at the end of the chain of **ViewPorts**:

```
vpA.Next = &vpB;     /* tell first one the address of the second */
vpB.Next = NULL;     /* after this one, there are no others */
```

Preparing the BitMap Structure

The **BitMap** structure tells the system where to find the display and drawing memory and how this memory space is organized. The following code section prepares a **BitMap** structure, including allocation of memory for the bit-map. For this example, this memory is used only for the display and is not shared with any drawing routines. The example writes directly to the display area.

```
                  /* initialize the BitMap structure */
InitBitMap( &b, DEPTH, WIDTH, HEIGHT );
                  /* now allocate some memory that can be
                   * be linked into the BitMap for display purposes */
for( i=0; i<DEPTH, i++)
{
    b.Planes[i] = (PLANEPTR)AllocRaster(WIDTH, HEIGHT);
}
```

This code allocates enough memory to handle the display area for as many bit-planes as the depth you have defined. This code segment does not include the error-checking that is present in the full example later on.

Preparing the RasInfo Structure

The **RasInfo** structure provides information to the system about the location of the **BitMap** as well as the positioning of the display area as a window against a larger drawing area. Use the following steps to prepare the **RasInfo** structure:

```
ri.BitMap = &b;       /* specify address of the BitMap structure */
ri.RxOffset = 0;
ri.RyOffset = 0;      /* match the upper lefthand corner of the
                       * display area with the upper left corner of
                       * the drawing area - see figure 1-16 */
ri.next = NULL;       /* for a single playfield display, there
                       * is only one RasInfo structure present */
```

Preparing the ColorMap Structure

Interrupts should be used to display this **ViewPort**. When the **View** is created, Copper instructions are generated to change the current contents of each color register just before the topmost line of a **ViewPort** so that this **ViewPort**'s color registers will be used for interpreting its display.

Here are the steps normally used for initializing a **ColorMap**:

```
            /* define some colors in an array of words */
UWORD colortable [] = { 0, 0xf00, 0x0f0, 0x00f }
            /* allocate space and get a pointer to it */
            /* 4 colors in this table (4 registers for Copper
             * to reload before this ViewPort is displayed */
vp.ColorMap = GetColorMap (4);
LoadRGB4( vp, ColorTable, 4 )
```

Note: The "4" in the name **LoadRGB4()** refers to the fact that each of the red, green, and blue values in a color table entry consists of four bits. It has nothing to do with the fact that this particular color table contains four entries, which is a result of the choice of DEPTH = 2 for this example.

From the section called "ViewPort Color Selection," notice that you might need to specify more colors in the color map than you think. If you use a dual-playfield display (covered later in this chapter) with a depth of 1 for each of the two playfields, this means a total of four colors (two for each playfield). However, because playfield 2 uses color registers starting from number 8 on up when in dual-playfield mode, the color map must be initialized to contain at least 10 entries. That is, it must contain entries for colors 0 and 1 (for playfield 1) and color numbers 8 and 9 (for playfield 2). Space for sprite colors must be allocated as well.

Creating the Display Instructions

Now that you have initialized the system data structures, you can request that the system prepare a set of display instructions for the Copper using these structures as input data. During the one or more blank vertical lines that precede each **ViewPort**, the Copper is busy changing the characteristics of the display hardware to match the characteristics you expect for this **ViewPort**. This may include a change in display resolution, a change in the colors to be used, or other user-defined modifications to system registers.

Here is the code that creates the display instructions:

```
MakeVPort( &v, &vp );
```

In this line of code, **&v** is the address of the **View** structure and **&vp** is the address of the first **ViewPort** structure. Using these structures, the system has enough information to build the instruction stream that defines your display.

MakeVPort() creates a special set of instructions that controls the appearance of the display. If you are using animation, the graphics animation routines create a special set of instructions to control the hardware sprites and the system color registers. In addition, the advanced user can create special instructions (called user Copper instructions) to change system operations based on the position of the video beam on the screen.

All of these special instructions must be merged together before the system can use them to produce the display you have designed. This is done by the system routine **MrgCop()** (which stands for "Merge Coprocessor Instructions"). Here is a typical call:

```
MrgCop (&v); /* merge this View's Copper instructions
              * into a single instruction list */
```

LOADING AND DISPLAYING THE VIEW

To display the **View**, you need to load it using **LoadView()** and turn on the direct memory access (DMA). A typical call is shown below.

```
LoadView( &v );
```

where **&v** is the address of the **View** structure defined in the example above.

Two macros control display DMA: **ON_DISPLAY** and **OFF_DISPLAY**. They simply turn the display DMA control bit in the DMA control register on or off. After you have loaded a new **View**, you use **ON_DISPLAY** to allow the system DMA to display it on the screen.

If you are drawing to the display area and do not want the user to see intermediate steps in the drawing, you can turn off the display. Because **OFF_DISPLAY** shuts down the display DMA and possibly speeds up other system operations, it can be used to provide additional memory cycles to the blitter or the 68000. The distribution of system DMA, however, allows four-channel sound, disk read/write, and a sixteen-color, low-resolution display (or four-color, high-resolution display) to operate at the same time with no slowdown (7.1 megahertz effective rate) in the operation of the 68000.

GRAPHICS EXAMPLE PROGRAM

The program below creates and displays a single-playfield display that is 320 pixels wide, 200 lines high, and two bit-planes deep.

```
#include "exec/types.h"
#include "graphics/gfx.h"
#include "hardware/dmabits.h"
#include "hardware/custom.h"
#include "hardware/blit.h"
#include "graphics/gfxmacros.h"
#include "graphics/copper.h"
#include "graphics/view.h"
#include "graphics/gels.h"
#include "graphics/regions.h"
#include "graphics/clip.h"
#include "exec/exec.h"
#include "graphics/text.h"
#include "graphics/gfxbase.h"

#define DEPTH 2
#define WIDTH 320
#define HEIGHT 200
#define NOT_ENOUGH_MEMORY -1000
/* construct a simple display */

struct View v;
struct ViewPort vp;
struct ColorMap *cm;        /* pointer to ColorMap structure, dynamic alloc */
struct RasInfo ri;
struct BitMap b;
struct RastPort rp;

LONG i;
SHORT j,k,n;
```

```
extern struct ColorMap *GetColorMap();
struct GfxBase *GfxBase;

struct View *oldview;          /* save pointer to old View so can restore */

                               /* black, red, green, blue */
USHORT colortable[] = { 0x000, 0xf00, 0x0f0, 0x00f };  /* my own colors */
SHORT  boxoffsets[] = { 802, 2010, 3218 };              /* where to draw boxes */

UBYTE *displaymem;
UWORD *colorpalette;

main()
{
    GfxBase = (struct GfxBase *)OpenLibrary("graphics.library",0);
    if (GfxBase == NULL) exit(1);
    oldview = GfxBase->ActiView; /* save current View to restore later */
    /* example steals screen from Intuition if Intuition is around */

    InitView(&v);          /* initialize View */
    InitVPort(&vp);        /* init ViewPort */
    v.ViewPort = &vp;      /* link View into ViewPort */

    /* init bit map (for RasInfo and RastPort) */
    InitBitMap(&b,DEPTH,WIDTH,HEIGHT);

    /* (init RasInfo) */
    ri.BitMap = &b;
    ri.RxOffset = 0;
    ri.RyOffset = 0;
    ri.Next = NULL;

    /* now specify critical characteristics */
    vp.DWidth = WIDTH;
    vp.DHeight = HEIGHT;
    vp.RasInfo = &ri;

    /* (init color table) */
    cm = GetColorMap(4);           /* 4 entries, since only 2 planes deep */
    colorpalette = (UWORD *)cm->ColorTable;
    for(i=0; i<4; i++) {
        *colorpalette++ = colortable[i];
    }
    /* copy my colors into this data structure */
    vp.ColorMap = cm;          /* link it with the ViewPort */
```

```
    /* allocate space for bitmap */
    for(i=0; i<DEPTH; i++)
    {
        b.Planes[i] = (PLANEPTR)AllocRaster(WIDTH,HEIGHT);
        if(b.Planes[i] == NULL) exit(NOT_ENOUGH_MEMORY);
    }

    MakeVPort( &v, &vp );       /* construct Copper instruction (prelim) list */
    MrgCop( &v );               /* merge preliminary lists together into a real
                                 * Copper list in the view structure. */

    for(i=0; i<2; i++)
    {
        displaymem = (UBYTE *)b.Planes[i];
        BltClear(displaymem,RASSIZE(WIDTH,HEIGHT),0)
        }
    }

    LoadView(&v);
    /* now fill some boxes so that user can see something */
    /* always draw into both planes to assure true colors */
    for(n=1; n<4; n++)          /* three boxes */
    {
        for(k=0; k<2; k++)
        {
            /* boxes will be in red, green and blue */
            displaymem = b.Planes[k] + boxoffsets[n-1];
            DrawFilledBox(n,k);
        }
    }

    Delay(50*10);               /* wait for 10 seconds */

    LoadView(oldview);          /* put back the old View  */

    FreeMemory();               /* exit gracefully */
    CloseLibrary(GfxBase);      /* since program opened library, close it */

}   /* end of main() */

/* return user- and system-allocated memory to sys manager */
FreeMemory()
{
    /* free drawing area */
    for(i=0; i<DEPTH; i++)
```

```
	{
		FreeRaster(b.Planes[i],WIDTH,HEIGHT);
	}
	/* free the color map created by GetColorMap() */
	FreeColorMap(cm);
	/* free dynamically created structures */
	FreeVPortCopLists(&vp);
	FreeCprList(v.LOFCprList);
	return(0);
}
DrawFilledBox(fillcolor,plane)
SHORT fillcolor,plane;
{
	UBYTE value;
	for(j=0; j<100; j++)
	{
		if((fillcolor & (1 << plane)) != 0)
		{
			value = 0xff;
		}
		else
		{
			value = 0;
		}
		for(i=0; i<20; i++)
		{
			*displaymem++ = value;
		}
		displaymem += (b.BytesPerRow - 20);
	}
	return(0);
}
```

Exiting Gracefully

The sample program above provides a way of exiting gracefully, returning to the memory manager all dynamically-allocated memory chunks. Notice the calls to **FreeRaster()** and **FreeColorMap()**. These calls correspond directly to the allocation calls **AllocRaster()** and **GetColorMap()** located in the body of the program. Now look at the calls within FreeMemory() to **FreeVPortCopLists()** and **FreeCprList()**. When you call **MakeVPort()**, the graphics system dynamically allocates some space to hold intermediate instructions from which a final Copper instruction list is created. When you call **MrgCop()**, these intermediate Copper lists are merged together into the final Copper list, which is then given to the hardware for interpretation. It is this list that provides the stable display on the screen, split into separate **ViewPorts** with their own colors and resolutions and so on.

When your program completes, you must see that it returns all of the memory resources that it used so that those memory areas are again available to the system for reassignment to other projects. Therefore, if you use the routines **MakeVPort()** or **MrgCop()**, you must also arrange to use **FreeCprList()** (pointing to each of those lists in the **View** structure) and **FreeVPortCopLists()** (pointing to the **ViewPort** that is about to be deallocated). If your view is interlaced, you will also have to call **FreeCprList(&v.SHFCprList)** because an interlaced view has a separate Copper list for each of the two fields displayed.

As a final caveat, notice that when you do free everything, the memory manager or other programs may immediately change the contents of the freed memory. Therefore, if the Copper is still executing an instruction stream (as a result of a previous **LoadView()**) when you free that memory, the display will go "south." You will probably want to turn off the display or provide an alternate Copper list when this one is to be deallocated.

Advanced Topics

CREATING A DUAL-PLAYFIELD DISPLAY

In dual-playfield mode, you have two separately controllable playfields. In this mode, you always define two **RasInfo** data structures. Each of these structures defines one of the playfields. There are seven different ways you can configure a dual-playfield display, because there are five different distributions of the bit-planes which the system hardware allows. Table 1-4 shows these distributions.

Table 1-4: Bit-Plane Assignment in Dual-playfield Mode

Number of Bit-planes	**Playfield 1 Depth**	**Playfield 2 Depth**
0	0	0
1	1	0
2	1	1
3	2	1
4	2	2
5	3	2
6	3	3

Recall that if you set PFBA in the **ViewPort Modes** variable to 1, you can swap playfield priority and display playfield 2 in front of playfield 1. In this way, you can get more bit-planes in the background playfield than you have in the foreground playfield. If you create a display with multiple **ViewPorts**, only for this **ViewPort** will the playfield priority be changed.

Playfield 1 is defined by the first of the two **RasInfo** structures. Playfield 2 is defined by the second of the two **RasInfo** structures.

When you call **MakeVPort()**, you use parameters as follows:

MakeVPort(&view, &viewport);

The **ViewPort Modes** variable must include the DUALPF bit. This tells the graphics system that there are two **RasInfo** structures to be used.

In summary, to create a dual-playfield display you must do the following things:

- Allocate one **View** structure
- Allocate two **BitMap** structures
- Allocate two **RasInfo** structures (linked together), each pointing to different **BitMaps**
- Allocate one **ViewPort** structure
- Set up a pointer in the **ViewPort** structure to the playfield 1 **RasInfo**

- Initialize each **BitMap** structure to describe one playfield, using one of the permissible bit-plane distributions shown in table 1-4 and allocate memory for the bit-planes themselves. Note that **BitMap** 1 and **BitMap** 2 need *not* be the same width and height.

- Initialize the **ViewPort** structure

- Set the DUALPF (and possibly the PFBA) bit in the **ViewPort Modes** variable

- Call **MakeVPort()**

- Call **MrgCop()**

For display purposes, each of the two **BitMaps** is assigned to a separate playfield display.

To draw separately into the **BitMaps**, you must also assign these **BitMaps** to two separate **RastPorts**. The section called "Initializing the RastPort" shows you how to use a **RastPort** data structure to control your drawing routines.

CREATING A DOUBLE-BUFFERED DISPLAY

To produce smooth animation or other such effects, it is occasionally necessary to double-buffer your display. To prevent the user from seeing your graphics rendering while it is in progress, you will want to draw into one memory area while actually displaying a different area.

Double-buffering consists of creating two separate display areas and two sets of pointers to those areas for a single **View**.

To create a double-buffered display, you must perform these actions:

- Allocate two **BitMap** structures

- Allocate one **RasInfo** structure

- Allocate one **ViewPort** structure

- Allocate one **View** structure

- Initialize each **BitMap** structure to describe one drawing area and allocate memory for the bit-planes themselves

- Create a pointer for each **BitMap**

- Create a pointer for the **View** long-frame Copper list (**LOFCprList**) and short-frame Copper list (**SHFCprList**) for each of two alternate display fields. The **SHFCprList** is for interlaced displays.

- Initialize the **RasInfo** structure, setting the **BitMap** pointer to point to one of the two **BitMaps** you have created

- Call **MakeVPort()**

- Call **MrgCop()**

- Call **LoadView()**

When you call **MrgCop()**, the system uses all of the information you have provided in the various data structures to create a list of instructions for the Copper to execute. This list tells the Copper how to split the display and how to specify colors for the various portions of the display. When the steps shown above have been completed, the system will have allocated memory for a long-frame (LOF) Copper list and a short-frame (SHF) Copper list and will have set pointers called **LOFCprList** and **SOFCprList** in the **View** structure. The long-frame Copper list is normally used for all non-interlaced displays, and the short-frame Copper list is used only when interlaced mode is turned on. The pointers point to the two sets of Copper instructions.

The **LOFCprList** and **SHFCprList** pointers are initialized when **MrgCop()** is called. The instruction stream referenced by these pointers includes references to the first **BitMap**.

You must now do the following:

- Save the current values in back-up pointers and set the values of **LOFCprList** and **SHFCprlist** in the **View** structure to zero. When you next perform **MrgCop()**, the system automatically allocates another memory area to hold a new list of instructions for the Copper.

- Install the pointer to the other **BitMap** structure in the **RasInfo** structure before your call to **MakeVPort()**, and then call **MakeVPort** and **MrgCop**.

Now you have created two sets of instruction streams for the Copper, one of which you have saved in a pair of pointer variables. The other has been newly created and is in the **View** structure. You can save this new set of pointers as well, swapping in the set that you want to use for display, while drawing into the **BitMap** that is not on the display. Remember that you will have to call **FreeCprList()** on both sets of Copper lists when you have finished.

HOLD-AND-MODIFY MODE

In hold-and-modify mode you can create a single-playfield display in which 4,096 different colors can be displayed simultaneously. This requires that your **ViewPort** be defined using six bit-planes and that you set the HAM bit in the **ViewPort Modes** variable.

When you draw into the **BitMap** associated with this **ViewPort**, you can choose one of four different ways of drawing into the **BitMap**. (Drawing into a **BitMap** is shown in the next section, "Drawing Routines.") If you draw using color numbers 0-15, the pixel you draw will appear in the color specified in that particular system color register. If you draw with any other color value from 16-31, the color displayed depends on the color of the pixel that is to the immediate left of this pixel on the screen. For example, hold constant the contents of the red and the green parts of the previously produced color, and take the rest of the bits of this new pixel's color register number as the new contents for the blue part of the color. Hold-and-modify means hold part and modify part of the preceding defined pixel's color.

Note that a particular hold-and-modify pixel can only change one of the three color values at a time. Thus, the effect has a limited control.

In hold-and-modify mode, you use all six bit-planes. Planes 5 and 6 are used to modify the way bits from planes 1 - 4 are treated, as follows:

- If the 6-5 bit combination from planes 6 and 5 for any given pixel is 00, normal color selection procedure is followed. Thus, the bit combinations from planes 4 - 1, in that order of significance, are used to choose one of 16 color registers (registers 0-15).

  If only five bit-planes are used, the data from the sixth plane is automatically supplied with the value as 0.

- If the 6-5 bit combination is 01, the color of the pixel immediately to the left of this pixel is duplicated and then modified. The bit combinations from planes 4 - 1 are used to replace the four "blue" bits in the pixel color without changing the value in any color register.

- If the 6-5 bit combination is 10, the color of the pixel immediately to the left of this pixel is duplicated and then modified. The bit combinations from planes 4 - 1 are used to replace the four "red" bits.

- If the 6-5 bit combination is 11, the color of the pixel immediately to the left of this pixel is duplicated and then modified. The bit combinations from planes 4 - 1 are used to replace the four "green" bits.

- At the leftmost edge of each line, hold-and-modify begins with the background color. The color choice does *not* carry over from the preceding line.

Drawing Routines

Most of the graphics drawing routines require information about how the drawing is to take place. For this reason, the graphics support routines provide a data structure called a **RastPort**, which contains information essential to the graphics drawing functions. In using most of the drawing functions, you must pass them a pointer to your **RastPort** structure. Associated with the **RastPort** is another data structure called a **BitMap**, which contains a description of the organization of the data in the drawing area.

INITIALIZING A BITMAP STRUCTURE

The **RastPort** contains information for controlling the drawing. In order to use the graphics, you also need to tell the system the memory area location where the drawing will occur. You do this by initializing a **BitMap** structure, defining the characteristics of the drawing area, as shown in the following example. This was already shown in the section called "Forming a Basic Display," but it is repeated here because it relates to drawing as well as to display routines. You need not necessarily use the same **BitMap** for both the drawing and the display.

```
struct BitMap myBitMap;
SHORT depth = 3;/* max of eight colors ... going to need three
                 * bit-planes to represent this number of colors */
SHORT width = 320;
SHORT height = 200;

InitBitMap( &myBitMap, depth, width, height);
```

INITIALIZING A RASTPORT STRUCTURE

Before you can use a **RastPort** for drawing, you must initialize it. Here is a sample initialization sequence:

```
struct RastPort myRastPort;
InitRastPort(&myRastPort);

    /* now link together the BitMap and the RastPort */
myRastPort.BitMap = &myBitMap;
```

Note that you cannot perform the link until after the **RastPort** has been initialized.

The **RastPort** data structure can be found in the include files *rastport.h* and *rastport.i*. It contains the following information:

- o Drawing pens
- o Drawing modes
- o Patterns
- o Text attributes and font information
- o Area-filling information
- o Graphics elements information for animation
- o Current pen position
- o A write mask
- o Some graphics private data
- o A pointer for user extensions

The following sections explain each of the items in the **RastPort** structure.

Drawing Pens

The Amiga has three different drawing "pens" associated with the graphics drawing routines. These are:

- o **FgPen** — the foreground or primary drawing pen. For historical reasons, it is also called the A-Pen.

- o **BgPen** — the background or secondary drawing pen. For historical reasons, it is also called the B-Pen.

- o **AOlPen** — the area outline pen. For historical reasons, it is also called the O-Pen.

A drawing pen variable in the **RastPort** contains the current value (range 0-255) for a particular color choice. This value represents a color register number whose contents are to be used in rendering a particular type of image. In essence, the bits of a "pen" determine which bit-planes are affected when a color is written into a pixel (as determined by the drawing mode and modified by the pattern variables and the write mask as described below). The drawing routines support **BitMaps** up to eight planes deep, allowing for future expansion in the hardware.

Note: The Amiga 1000 contains only 32 color registers. Any range beyond that repeats the colors in 0-31. For example, pen numbers 32-63 refer to the colors in registers 0-31.

The color in **FgPen** is used as the primary drawing color for rendering lines and areas. This pen is used when the drawing mode is JAM1 (see the next section for drawing modes). JAM1 specifies that only one color is to be "jammed" into the drawing area.

You establish the color for **FgPen** using the statement:

SetAPen(&myRastPort, newcolor);

The color in **BgPen** is used as the secondary drawing color for rendering lines and areas. If you specify that the drawing mode is JAM2 (jamming two colors) and a pattern is being drawn, the primary drawing color (**FgPen**) is used where there are 1s in the pattern. The secondary drawing color (**BgPen**) is used where there are 0s in the pattern.

You establish the drawing color for **BgPen** using the statement:

SetBPen(&myRastPort, newcolor);

The area outline pen **AOlPen** is used in two applications: area fill and flood fill. (See "Area Fill Operations" below.) In area fill, you can specify that an area, once filled, can be outlined in this **AOlPen** color. In flood fill (in one of its operating modes) you can fill until the flood-filler hits a pixel of the color specified in this pen variable.

You establish the drawing color for **AOlPen** using the statement:

SetOPen(&myRastPort, newcolor);

Drawing Modes

Four drawing modes may be specified:

JAM1 Whenever you execute a graphics drawing command, one color is jammed into the target drawing area. You use only the primary drawing pen color, and for each pixel drawn, you *replace* the color at that location with the **FgPen** color.

JAM2 Whenever you execute a graphics drawing command, two colors are jammed into the target drawing area. This mode tells the system that the pattern variables (both line pattern and area pattern—see the next section) are to be used for the drawing. Wherever there is a 1 bit in the pattern variable, the **FgPen** color replaces the color of the pixel at the drawing position. Wherever there is a 0 bit in the pattern variable, the **BgPen** color is used.

COMPLEMENT

For each 1 bit in the the pattern, the corresponding bit in the target area is complemented — that is, its state is reversed. As with all other drawing modes, the write mask can be used to protect specific bit-planes from being modified. Complement mode is often used for drawing and then erasing lines.

INVERSEVID

This is the drawing mode used primarily for text. If the drawing mode is (JAM1 | INVERSEVID), the text appears as a transparent letter surrounded by the **FgPen** color. If the drawing mode is (JAM2|INVERSEVID), the text appears as in (JAM1|INVERSEVID) except that the **BgPen** color is used to draw the text character itself. In this mode, the roles of **FgPen** and **BgPen** are effectively reversed.

You set the drawing modes using the statement:

SetDrMd(&myRastPort, newmode);

Patterns

The **RastPort** data structure provides two different pattern variables that it uses during the various drawing functions: a line pattern and an area pattern. The line pattern is 16 bits wide and is applied to all lines. When you initialize a **RastPort**, this line pattern value is set to all 1s (hex FFFF), so that solid lines are drawn. You can also set this pattern to other values to draw dotted lines if you wish. For example, you can establish a dotted line pattern with the statement:

SetDrPt(&myRastPort, 0xcccc);

where "cccc" is a bit-pattern, 1100110011001100, to be applied to all lines drawn. If you draw multiple, connected lines, the pattern cleanly connects all the points.

The area pattern is 16 bits wide and its height is some power of two. This means that you can define patterns in heights of 1, 2, 4, 8, 16, and so on. To tell the system how large a pattern you are providing, include this statement:

SetAfPt(&myRastPort, &myAreaPattern, power_of_two);

where **&myAreaPattern** is the address of the first word of the area pattern and **power_of_two** specifies how many words are in the pattern. For example:

```
USHORT myAreaPattern[ ] = {
    0xff00,
    0xff00,
    0x00ff,
    0x00ff,
    0xf0f0,
    0xf0f0,
    0x0f0f,
    0x0f0f
};
SetAfPt( &myRastPort, &myAreaPattern, 3 );
```

This example produces a pattern that is a large checkerboard above a small checkerboard. Because **power_of_two** is set to 3, the pattern is 2 to the 3rd, or 8, rows high.

Pattern Positioning

The pattern is always positioned with respect to the upper left corner of the **RastPort** drawing area (the 0,0 coordinate). If you draw two rectangles whose edges are adjacent, the pattern will be continuous across the rectangle boundaries.

Multicolored Patterns

The last example above produces a two-color pattern with one color where there are 1s and the other color where there are 0s in the pattern. A special mode allows you to develop a pattern having up to 256 colors. To create this effect, specify **power_of_two** as a negative value instead of a positive value.

The following initialization establishes an 8-color checkerboard pattern where each square in the checkerboard has a different color. The checkerboard is 2 squares wide by 4 squares high.

```
USHORT myAreaPattern[3][8] = {
    {
      0x0000,      /* plane 0 pattern */
      0x0000,
      0xffff,
      0xffff,
      0x0000,
      0x0000,
      0xffff,
      0xffff,
    },
```

```
        {
          0x0000,      /* plane 1 pattern */
          0x0000,
          0x0000,
          0x0000,
          0xffff,
          0xffff,
          0xffff,
          0xffff,
        },
        {
          0xff00,      /* plane 2 pattern */
          0xff00,
          0xff00,
          0xff00,
          0xff00,
          0xff00,
          0xff00,
          0xff00
        {
    };

    SetAfPt( &myRastPort, &myAreaPattern, -3 );

    /* when doing this, it is best to set three other parameters as follows: */
    SetAPen( &myRastPort, 255);
    SetBPen( &myRastPort, 0);
    SetDrMd( &myRastPort, JAM2);
```

If you use this multicolored pattern mode, you must provide as many planes of pattern data as there are planes in your **BitMap**.

Text Attributes

Text attributes and font information are set by calls to the font routines. These are covered separately in chapter 4, "Text."

Area-fill Information

Two structures in the **RastPort**—**AreaInfo** and **TmpRas**—define certain information for area filling operations. The **AreaInfo** pointer is initialized by a call to the routine **InitArea()**.

```
InitArea (&myRastPort, &areabuffer, count);
```

To use area fill, you must first provide a work space in memory for the system to store the list of points that define your area. You must allow a storage space of 5 bytes per vertex. To create the areas in the work space, you use the functions **AreaMove()**, **AreaDraw()**, and **AreaEnd()**.

Typically, you prepare the **RastPort** for area-filling using a sequence like the following:

```
UWORD areabuffer [250];
   /* allow up to 100 vertices in the definition of an area */
InitArea (&myRastPort, &areabuffer[0], 100);
```

The area buffer *must* start on a *word* boundary. That is why the sample declaration shows **areabuffer** as composed of unsigned words (250), rather than unsigned bytes (500). It still reserves the same amount of space, but aligns the data space correctly.

In addition to the **AreaInfo** structure in the **RastPort**, you must also provide the system with some work space to build the object whose vertices you are going to define. This requires that you initialize a **TmpRas** structure, then point to that structure for your **RastPort** to use.

Here is sample code that builds and initializes a **TmpRas**. Note that the area to which **TmpRas.RasPtr** points must be at least as large as the area (width times height) of the largest rectangular region you plan to fill. Typically, you allocate a space as large as a single bit-plane (usually 320 by 200 bits for low-resolution mode, 640 by 200 bits for high-resolution mode).

```
PLANEPTR myplane;
myplane = AllocRaster(320,200);        /* get some space */
if (myplane == 0) exit(1);             /* stop if no space */
myRastPort.TmpRas= InitTmpRas(&myTmpRas,
      myplane,RASSIZE(320,200));
```

When you use functions that dynamically allocate memory from the system, you must remember to return these memory blocks to the system before your program exits. See the description of **FreeRaster()** in the "Library Summaries" appendix.

Graphics Element Pointer

The graphics element pointer in the **RastPort** structure is called **GelsInfo**. If you are doing graphics animation using the GELS system, this pointer must refer to a properly initialized **GelsInfo** structure. See chapter 3, "Animation," for more information.

Current Pen Position

The graphics drawing routines keep the current position of the drawing pen in the variables **cp_x** and **cp_y**, for the horizontal and vertical positions, respectively. The coordinate location 0,0 is in the upper left corner of the drawing area. The x value increases proceeding to the right; the y value increases proceeding toward the bottom of the drawing area.

Write Mask

The write mask is a **RastPort** variable that determines which of the bit-planes are currently writable. For most applications, this variable contains all 1s (hex ff). This means that all bit-planes defined in the **BitMap** are affected by a graphics writing operation. You can selectively disable one or more bit-planes by simply specifying a 0 bit in that specific position in the control byte. For example:

```
myRastPort.Mask = 0xFB;     /* disable bit-plane 2 */
```

USING THE GRAPHICS DRAWING ROUTINES

This section shows you how to use the Amiga drawing routines. All of these routines work either on their own or with the windowing system and layer library. See chapter 2, "Layers," or *Intuition: The Amiga User Interface* for details about using the layer library and windows.

As you read this section, keep in mind that to use the drawing routines, you need to pass them a pointer to a **RastPort**. You can define the **RastPort** directly, as shown in the sample program segments in preceding sections, or you can get a **RastPort** from your **Window** structure using code like the following:

```
struct Window *w;
struct RastPort *usableRastPort;
      /* and then, after your Window is initialized... */
usableRastPort = w->RastPort;
```

You can also get the **RastPort** from the layer structure, if you are not using Intuition.

Drawing Individual Pixels

You can set a specific pixel to a desired color by using a statement like this:

```
int result;
result = WritePixel( &myRastPort, x, y);
```

WritePixel() uses the primary drawing pen and changes the pixel at that x,y position to the desired color if the x,y coordinate falls within the boundaries of the **RastPort**. A value of 0 is returned if the write was successful; a value of -1 is returned if x,y was outside the range of the **RastPort**.

Reading Individual Pixels

You can determine the color of a specific pixel with a statement like this:

```
int    result;
result = ReadPixel( &myRastPort, x, y);
```

ReadPixel() returns the value of the pixel color selector (from 0 to 255) at the specified x,y location. If you specify an x,y outside the range of your **RastPort**, this function returns a value of -1.

Drawing Lines

Two functions are associated with line drawing: **Move()** and **Draw()**. **Move()** simply moves the cursor to a new position. It is like picking up a drawing pen and placing it at a new location. This function is executed by the statement:

```
Move( &myRastPort, x, y);
```

Draw() draws a line from the current x,y position to a new x,y position specified in the statement itself. The drawing pen is left at the new position. This is done by the statement:

```
Draw( &myRastPort, x, y);
```

Draw() uses the pen color specified for **FgPen**. Here is a sample sequence that draws a red line from location (0,0) to (100,50). Assume that the value in color register 2 represents red.

```
SetAPen( &myRastPort, 2);        /* make primary pen red */
Move( &myRastPort, 0, 0);        /* move to new location */
Draw( &myRastPort, 100,50);      /* draw to a new location */
```

Caution: If you attempt to draw a line outside the bounds of the **BitMap**, using the basic initialized **RastPort**, you may crash the system. You must either do your own software clipping to assure that the line is in range, or use the layer library. Software clipping means that you need to determine if the line will fall outside your **BitMap** *before* you draw it.

Drawing Patterned Lines

To turn the example above into a patterned line draw, simply add the following statement:

```
SetDrPt( &myRastPort, 0xaaaa);
```

Now all lines drawn appear as dotted lines. To resume drawing solid lines, execute the statement:

```
SetDrPt( &myRastPort, -1);
```

Drawing Multiple Lines with a Single Command

You can use multiple **Draw()** statements to draw connected line figures. If the shapes are all definable as interconnected, continuous lines, you can use a simpler function, called **PolyDraw()**. **PolyDraw()** takes a set of line endpoints and draws a shape using these points. You call **PolyDraw()** with the statement:

```
PolyDraw( &myRastPort, count, arraypointer);
```

PolyDraw() reads an array of points and draws a line from the current pen position to the first, then a connecting line to each succeeding position in the array until **count** points have been drawn. This function uses the current drawing mode, pens, line pattern, and write mask specified in the target **RastPort**; for example:

```
SHORT linearray[ ] = {
    3,3,
    15,3,
    15,15,
    3,15,
    3,3
};
PolyDraw( &myRastPort, 5, &linearray[0]);
```

draws a rectangle, using the five defined pairs of x,y coordinates.

Area-fill Operations

Assuming that you have properly initialized your **RastPort** structure to include a properly initialized **AreaInfo**, you can perform area fill by using the functions described in this section.

AreaMove() tells the system to begin a new polygon, closing off any other polygon that may already be in process by connecting the end-point of the previous polygon to its starting point. **AreaMove()** is executed with the statement:

```
AreaMove( &myRastPort, x, y);
```

AreaDraw() tells the system to add a new vertex to a list that it is building. No drawing takes place when **AreaDraw()** is executed. It is executed with the statement:

```
AreaDraw( &myRastPort, x, y);
```

AreaEnd() tells the system to draw all of the defined shapes and fill them. When this function is executed, it obeys the drawing mode and uses the line pattern and area pattern specified in your **RastPort** to render the objects you have defined. Note that to fill an area, you do not have to **AreaDraw()** back to the first point before calling **AreaEnd()**. **AreaEnd()** automatically closes the polygon. **AreaEnd()** is executed with the following statement:

```
AreaEnd( &myRastPort);
```

Here is a sample program segment that includes the **AreaInfo** initialization. It draws a pair of disconnected triangles, using the currently defined **FgPen**, **BgPen**, **AOlPen**, **DrawMode**, **LinePtrn**, and **AreaPtrn**:

```
WORD areabuffer[250];
struct RastPort *rp;
```

```
struct TmpRas tmpras;
struct AreaInfo myAreaInfo;

InitArea(&myAreaInfo, areabuffer, 100);
rp->AreaInfo = &myAreaInfo;
rp->TmpRas = InitTmpRas( &tmpras, AllocRaster(320,200), RASSIZE(320,200);

/* Area routines need a temporary raster buffer at least as large as the
 * largest object to be drawn. If a single task uses multiple RastPorts,
 * it is sometimes possible to share the same TmpRas structure among
 * multiple RastPorts. Multiple tasks, however, cannot share a TmpRas,
 * as each task won't know when another task has a drawing partially
 * completed.
*/

AreaMove( rp, 0,0 );
AreaDraw( rp, 0,100);
AreaDraw( rp, 100,100);

AreaMove( rp, 50,10);
AreaDraw( rp, 50,50);
AreaDraw( rp, 100,50);

AreaEnd ( rp );
```

If you had executed the statement "SetOPen(&myRastPort, 3)" in the area-fill example, then the areas that you had defined would have been outlined in pen color 3. To turn off the outline function, you have to set the **RastPort Flags** variable back to 0 by:

```
#include "graphics/gfxmacros.h"

BNDRYOFF(&myRastPort);
```

Otherwise, every subsequent area-fill or rectangle-fill operation will use the outline pen.

> **Caution**: If you attempt to fill an area outside the bounds of the **BitMap**, using the basic initialized **RastPort**, it may crash the system. You must either do your own software clipping to assure that the area is in range, or use the layer library.

Flood-fill Operations

Flood fill is a technique for filling an arbitrary shape with a color. The Amiga flood-fill routines can use a plain color or do the fill using a combination of the drawing mode, **FgPen**, **BgPen**, and the area pattern.

There are two different modes for flood fill:

- o In *outline mode* you specify an x,y coordinate, and from that point the system searches outward in all directions for a pixel whose color is the same as that specified in the area outline pen. All horizontally or vertically adjacent pixels *not* of that color are filled with a colored pattern or plain color. The fill stops at the outline color. Outline mode is selected when the **mode** variable is a 0.

- o In *color mode* you specify an x,y coordinate, and whatever pixel color is found at that position defines the area to be filled. The system searches for all horizontally or vertically adjacent pixels whose color is the same as this one and replaces them with the colored pattern or plain color. Color mode is selected when the **mode** variable is a 1.

You use the **Flood()** routine for flood fill. The syntax for this routine follows.

Flood(rp, mode, x, y);

where

rp is a pointer to the **RastPort**

x,y is the starting coordinate in the **BitMap**

mode tells how to do the fill

The following sample program fragment creates and then flood-fills a triangular region. The overall effect is exactly the same as shown in the preceding area-fill example above, except that flood-fill is slightly slower than area-fill. Mode 0 (fill to a pixel that has the color of the outline pen) is used in the example.

```
oldAPen = myRastPort.FgPen;
SetAPen( &myRastPort, myRastPort.AOlPen);
/* using mode 0 */
/* triangular shape */
Move( &myRastPort, 0, 0);
Draw( &myRastPort, 0, 100);
Draw( &myRastPort, 100, 100);
Draw( &myRastPort, 0, 0);    /* close it */

SetAPen( &myRastPort, oldAPen);
Flood(&myRastPort, 0, 10, 50);
```

This example saves the current **FgPen** value and draws the shape in the same color as **AOlPen**. Then **FgPen** is restored to its original color so that **FgPen**, **BgPen**, **DrawMode**, and **AreaPtrn** can be used to define the fill within the outline.

Rectangle-fill Operations

The final fill function, **RectFill()**, is for filling rectangular areas. The form of this function follows:

```
RectFill( rp, xmin, ymin, xmax, ymax);
```

where

xmin and **ymin**
: represent the upper left corner of the rectangle

xmax and **ymax**
: represent the lower right corner of the rectangle

rp points to the **RastPort** that receives the filled rectangle

Rectangle-fill uses **FgPen**, **BgPen**, **AOlPen**, **DrawMode** and **AreaPtrn** to fill the area you specify. Remember that the fill can be multicolored as well as single- or two-colored.

The following three sets of statements perform exactly the same function:

```
/* area-fill a rectangular area */
SetAPen(rp,1);
SetOPen(rp,3);
AreaMove(rp,0,0);
AreaDraw(rp,0,100);
AreaDraw(rp,100,100);
AreaDraw(rp,100,0);
AreaEnd(rp);

/* flood-fill a rectangular area */
SetAPen(rp,3);
SetOPen(rp,3);
Move(rp,0,0);
Draw(rp,0,100);
Draw(rp,100,100);
Draw(rp,100,0);
Draw(rp,0,0);
SetAPen(rp,1);
Flood(rp,0,50,50);

/* rectangle-fill a rectangular area */
SetAPen(rp,1);
SetOPen(rp,3);
Rectfill(rp,0,0,100,100);
```

Not only is the **RectFill()** routine the shortest, it is also the fastest to execute.

Data Move Operations

The graphics support functions include several routines for simplifying the handling of the rectangularly organized data that you would encounter when doing raster-based graphics. These routines do the following:

- o Clear an entire segment of memory
- o Set a raster to a specific color
- o Scroll a subrectangle of a raster
- o Draw a pattern "through a stencil"
- o Extract a pattern from a bit-packed array and draw it into a raster
- o Copy rectangular regions from one bit-map to another
- o Control and utilize the hardware-based data mover, the blitter

The following sections cover these routines in detail.

Clearing a Memory Area

For memory that is accessible to the blitter (that is, internal CHIP memory), the most efficient way to clear a range of memory is to use the blitter. You use the blitter to clear a block of memory with the statement:

BltClear(memblock, bytecount, flags);

where **memblock** is a pointer to the location of the first byte to be cleared, and **bytecount** is the number of bytes to set to zero.

This command accepts the starting location and count and clears that block to zeros. For the meanings of settings of the **flags** variable, see the summary page for this routine in the "Library Summaries" appendix.

Setting a Whole Raster to a Color

You can preset a whole raster to a single color by using the function **SetRast()**. A call to this function takes the following form:

SetRast(RastPort, pen);

where

RastPort
is a pointer to the **RastPort** you wish to use

pen
is the pen value that you wish to fill that **RastPort**

Scrolling a Sub-rectangle of a Raster

You can scroll a sub-rectangle of a raster in any direction — up, down, left, right, or diagonally. To perform a scroll, you use the **ScrollRaster()** routine and specify a dx and dy (delta-x, delta-y) by which the rectangle image should be moved towards the (0,0) location.

As a result of this operation, the data within the rectangle will become physically smaller by the size of delta-x and delta-y, and the area vacated by the data when it has been cropped and moved is filled with the background color (color in **BgPen**).

Here is the syntax of the **ScrollRaster()** function:

```
ScrollRaster( rp, dx, dy, xmin, ymin, xmas, ymax );
```

where

rp is a pointer to a **RastPort**

dx, **dy**
are the distances (positive, 0, or negative) to move the rectangle

xmin, **xmax**, **ymin**, **ymax**
specify the outer bounds of the sub-rectangle

Here are some examples that scroll a sub-rectangle:

```
    /* scroll down 2 */
ScrollRaster(&myRastPort,0,2,10,10,50,50);

    /* scroll right 1 */
ScrollRaster(&myRastPort,1,0,10,10,50,50);
```

Drawing through a Stencil

The routine **BltPattern()** allows you to change only a very selective portion of a drawing area. Basically, this routine lets you define the rectangular region to be affected by this drawing operation and a mask of the same size that defines how that area will be affected.

Figure 1-17 shows an example of what you can do with **BltPattern()**. The 0 bits are represented by blank rectangles; the 1 bits by filled-in rectangles.

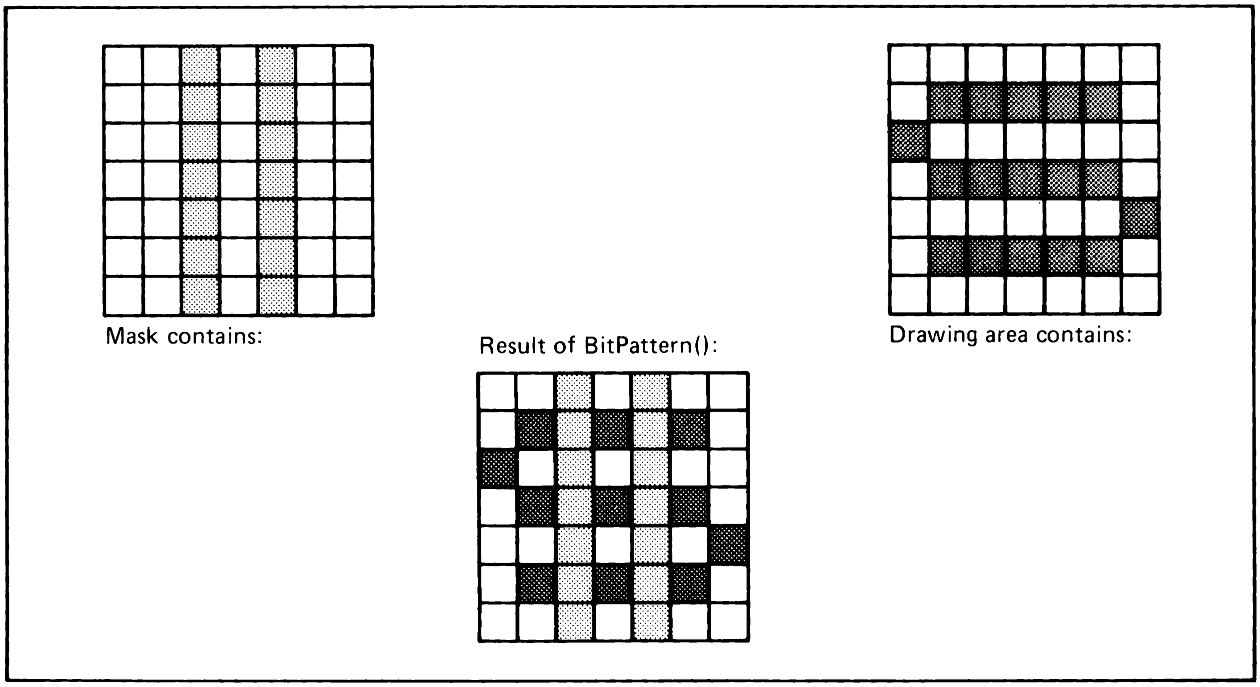

Figure 1-17: Example of Drawing Through a Stencil

In the "Result" drawing, the lighter squares show where the target drawing area has been affected. Exactly *what* goes into the drawing area where the mask has 1's is determined by your **FgPen**, **BgPen**, **DrawMode**, and **AreaPtrn**.

The variables that control this function are:

rastport a pointer to the drawing area

mask a pointer to the mask (mask layout explained below)

xl, maxx upper left corner x, and lower right corner x

yl, maxy upper left corner y, and lower right corner y

bytecnt number of bytes per row for the mask (*must* be an even number of bytes)

You call **BltPattern()** with:

BltPattern(rastport, mask, xl, yl, maxx, maxy, bytecnt)

The **mask** parameter is a rectangularly organized, contiguously stored pattern. This means that the pattern is stored in linearly increasing memory locations stored as (**maxy - yl**) rows of **bytecnt** bytes per row.

Note: These patterns must obey the same rules as **BitMaps**. This means that they must consist of an even number of bytes per row. For example, a mask such as:

```
0100001000000000
0010010000000000
0001100000000000
0010010000000000
```

is stored in memory beginning at a legal *word* address.

Extracting from a Bit-packed Array

You use the routine **BltTemplate()** to extract a rectangular area from a source area and place it into a destination area. Figure 1-18 shows an example.

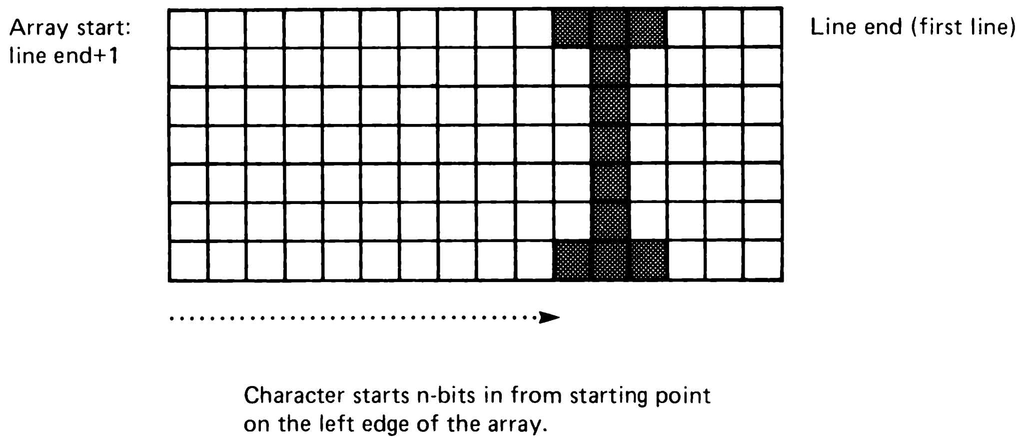

Figure 1-18: Example of Extracting from a Bit-Packed Array

If the rectangular bit array is to be represented as a rectangle within a larger, rectangularly organized bit array, the system must know how the larger array is organized. This allows the system to extract each line of the object properly. For this extraction to occur properly, you need to tell the system the modulo for the array. The modulo is the value that must be added to the address pointer so that it points to the correct word in the next line in this rectangularly organized array.

Figure 1-19 represents a single bit-plane and the smaller rectangle to be extracted. The modulo in this instance is 4, because at the end of each line, you must add 4 to the address pointer to make it point to the first word in the smaller rectangle.

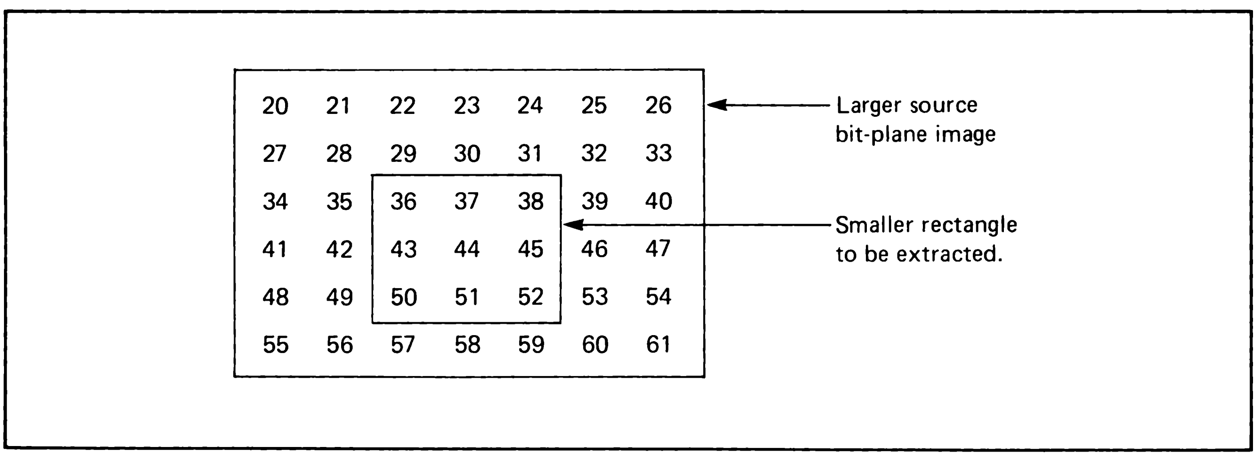

Figure 1-19: Modulo

Note that the modulo value must be an even number of bytes.

BltTemplate() takes the following arguments:

source	the source pointer for the array
srcX	source X (bit position) in the array at which the rectangle begins
srcMod	source modulo so it can find the next part of the source rectangle
destRastPort	the destination **RastPort**
destX, destY	destination x and y, showing where to put the rectangle
sizeX, sizeY	size x and y, indicating how much data to move

You call **BltTemplate()** with:

BltTemplate(source, srcX, srcMod, destRastPort, destX, destY, sizeX, sizeY);

BltTemplate() uses **FgPen**, **BgPen**, **DrawMode** and **Mask** to place the template into the destination area. This routine differs from **BltPattern()** in that only a solid color is deposited in the destination drawing area, with or without a second solid color as the background (as in the case of text). Also, the template can be arbitrarily bit-aligned and sized in x.

Copying Rectangular Areas

Two routines copy rectangular areas from one section of chip memory to another: **BltBitMap()** and **ClipBlit()**. **BltBitMap()** is the basic routine, taking **BitMaps** as part of its arguments. It allows you to define a rectangle in a source region and copy it to a destination area of the same size elsewhere in memory. This routine is often used in graphics rendering.

ClipBlit() takes most of the same arguments, but it works with the **RastPorts** and layers. Before **ClipBlit()** moves data, it looks at the area from which and to which the data is being copied (**RastPorts**, not **BitMaps**) and determines if there are overlapping areas involved. It then splits up the overall operation into a number of bit maps to move the data in the way you request.

Here is a sample call to **ClipBlit()**. This call is used in an image editor to transfer a rectangular block of data from the screen to a back-up area.

```
ClipBlit( &rastport,        /* on-screen area */
        x,y,                /* upper left corner of rectangle */
        &undorastport,      /* screen editor can undo things, has
                             * a RastPort specifically for undo */
        0,0,                /* upper left corner of destination */
        SIZEx,SIZEy         /* how big is the rectangle */
        minterm);
```

The **minterm** variable is an unsigned byte value whose leftmost 4 bits represent the action to be performed during the move. This routine uses the blitter device to move the data and can therefore logically combine or change the data as the move is made. The most common operation is a direct copy from source area to destination, which is the hex value C0.

You can determine how to set the **minterm** variable by using the logic equations shown in table 1-5.

Table 1-5: Minterm Logic Equations

Logic Term in Leftmost 4 Bits	Logic Term Included in Final Output
8	BC
4	$B\overline{C}$
2	$\overline{B}C$
1	$\overline{BC}$

Source B contains the data from the source rectangle, and source C contains the data from the destination area. If you choose bits 8 and 4 from the logic terms (C0), in the final destination area you will have data that occurs in source B only. Thus, C0 means a direct copy. The logic equation for this is:

$$BC + B\overline{C} = B(C + \overline{C}) = B$$

Logic equations may be used to decide on a number of different ways of moving the data. For your convenience, a few of the most common ones are listed in table 1-6.

Table 1-6: Some Common Logic Equations for Copying

Hex Value	Mode
30	Replace destination area with inverted source B.
50	Replace destination area with inverted version of original of destination.
60	Put B where C is not, put C where B is not (cookie cut).
80	Only put bits into destination where there is a bit in the same position for both source and destination (sieve operation).

Refer to the listing for **BltBitMap()** in the "Library Summaries" index.

Accessing the Blitter in a Multitasking Environment

To use the blitter, you must first be familiar with how its registers control its operation. This topic is covered thoroughly in the *Amiga Hardware Reference Manual* and is not repeated here.

Four routines may be used to gain access to the blitter:

- **OwnBlitter()** allows your task to obtain exclusive use of the blitter. Note, however, that the system uses the blitter extensively for disk and display operation. While your task is using the blitter, many other system processes will be locked out. Therefore, use it only for brief periods and relinquish it as quickly as possible, using **DisownBlitter()**.

- **DisownBlitter()** returns the device to shared operation.

- **QBlit()** and **QBSBlit()** let your task queue up requests for the use of the blitter on a non-exclusive basis. You share the blitter with system tasks.

You provide a data structure called a **bltnode** (blitter node). The system can use this structure to link blitter usage requests into a first-in, first-out (FIFO) queue. When your turn comes, your own blitter routine can be repeatedly called until your routine says it is finished using the blitter.

Two separate queues are formed. One queue is for the **QBlit()** routine. You use **QBlit()** when you simply want something done and you do not necessarily care when it happens. This may be the case when you are moving data in a memory area that is not currently being displayed.

The second queue is maintained for **QBSBlit()**. QBS stands for "queue-beam-synchronized" blitter operations. **QBSBlit()** forms a beam-synchronized FIFO. When the video beam gets to a predetermined position, your routine is called. Beam synchronization takes precedence over the simple FIFO. This means that if the beam sync matches, the beam-synchronous blit will be done before the non-synchronous blit in the first position in the queue. You might use **QBSBlit()** to draw into an area of memory that is currently being displayed to modify memory that has already been "passed-over" by the video beam. This avoids display flicker as an area is being updated.

The input to each routine is a pointer to a **bltnode** data structure. The required items of the data structure are:

- o A pointer to a **bltnode**
- o A pointer to a function to perform
- o A **beamsync** value (used if this is a **beamsync** blit)
- o A status flag indicating whether the blitter control should perform a "clean-up" routine when the last blit is finished
- o The address of the clean-up routine if the status flag states that it should be used

The **bltnode** data structure is contained in the include file *hardware/blit.h*. Here is a copy of that data structure, followed by details about the items you must initialize:

```
struct bltnode
{
      struct    bltnode *n;
      int       (*function)( );
      char      stat;
      short     blitsize;
      short     beamsync;
      int       (*cleanup)( );
};
```

The contents of **bltnode** are as follows:

struct bltnode *n;

This is a pointer to the next **bltnode**, which, for most applications will be zero. You should not link **bltnodes** together. This is to be performed by the system by way of a separate call to **QBlit()** or **QBSBlit()**.

int (*function)( );

This position is occupied by the address of a function that the blitter queuer will call when your turn comes up. Your routine must be formed as a subroutine, with an **RTS** at the end. Using the C-language convention, the returned value will be in D0 (C returns its value by the **return(value)** statement).

If you return a nonzero value, the system will call your routine the next time the blitter is done until you finally return 0. This is to allow you to maintain control over the blitter; for example, it allows you to handle all five bit-planes if you are blitting an object that spans that number of planes. For display purposes, if you are blitting multiple objects and then saving and restoring the background, you must be sure that all planes of the object are positioned before another object is overlaid. This is the reason for the lockup in the blitter queue; it allows all work per object to be completed before going on to the next one.

Actually, the system tests the *status codes* for a condition of EQUAL or NOTEQUAL. When the C language returns the value of 0, it sets the status codes to EQUAL. When it returns a value of -1, it sets the status codes to NOTEQUAL, so they would be compatible. Functions (*function)()) that are written for **QBlit()** and **QBSBlit()** are not normally written in C. They are usually written in assembly language, as they then can take advantage of the ability of the queue routines to pass them parameters in the system registers. The register passing conventions for these routines are as follows:

- Register A0 receives a pointer to the system hardware registers so that all hardware registers can be referenced as an offset from that address.

- Register A1 contains a pointer to the current **bltnode**. You may have queued up multiple blits, each of which perhaps uses the same blitter routine. You can access the data for this particular operation as an offset from the value in A1. A typical user of these routines will precalculate the hardware register values that are stuffed into the registers and, during the routine, simply stuff them. For example, you can create a new structure such as the following:

```
struct myblit {
      struct bltnode; /* make this new structure
                       * compatible with the bltnode
                       * by making it the first element */
      short bltcon1;  /* contents to be stuffed into
                       * blitter control register 1 */
      short fwmask,lwmask;
                      /* first and last word masks */
      short bltmdc, bltmdb, bltmda;
                      /* modulos for sources a, b,and c */
      char *bltpta, *bltptb, *bltptc;
                      /* pointer to source data for sources */
                 };
```

Other forms of data structures are certainly possible, but this should give you the general idea.

char stat;

Tells the system whether or not to execute the clean-up routine at the end. This byte should be set to CLEANUP (0x40) if cleanup is to be performed. If not, then the **bltnode cleanup** variable can be zero.

short beamsync;

The value that should be in the VBEAM counter for use during a beam-synchronous blit before the **function()** is called.

The system cooperates with you in planning when to start a blit in the routine **QBSBlit()** by not calling your routine until, for example, the video beam has already passed by the area on the screen into which you are writing. This is especially useful during single buffering of your displays. There may be time enough to write the object between scans of the video display. You will not be visibly writing while the beam is trying to scan the object. This avoids flicker (part of an old view of an object along with part of a new view of the object).

int (*cleanup)();

The address of a routine that is to be called after your last return from the **QBlit()** routine. When you finally return a zero, the queuer will call this subroutine (ends in **RTS** or **return()**) as the clean-up. Your first entry to the function may have dynamically allocated some memory or may have done something that must be undone to make for a clean exit. This routine must be specified.

User Copper Lists

The Copper coprocessor allows you to produce mid-screen changes in certain hardware registers in addition to changes that the system software already provides. For example, it is the Copper that allows the Amiga to split the viewing area into multiple draggable screens, each with its own independent set of colors.

To create your own mid-screen (or mid-Intuition-Screen) effects on the system hardware registers, you provide "user Copper lists" that can be merged into the system Copper lists.

In the **ViewPort** data structure there is a pointer named **UCopIns**. If this pointer value is non-NULL, it points to a user Copper list that you have dynamically allocated and initialized to contain your own special hardware-stuffing instructions. You allocate a user Copper list by an instruction sequence such as the following:

```
struct UCopList *cl;

cl = (struct UCopList *)
    AllocMem(sizeof(struct UCopList), MEMF_PUBLIC |
            MEMF_CHIP | MEMF_CLEAR);
```

Once this pointer to a user Copper list is available, you can use it with system macros (*graphics/gfxmacros.h*) to instruct the system what to add to its own list of things for the Copper to do within a specific **ViewPort**.

The file *graphics/gfxmacros.h* provides the following three macro functions that implement user Copper instructions.

CWAIT waits for the video beam to reach a particular horizontal and vertical position. Its format follows:

```
CWAIT(uc, v, h)
```

where

uc is the pointer to the Copper list

v is the vertical position for which to wait, specified relative to the top of the **ViewPort**. The legal range of values is from 0 to 261.

h is the horizontal position for which to wait. The legal range of values is from 0 to 223

CMOVE installs a particular value into a specified system register. Its format follows:

CMOVE(uc, reg, value)

where

uc is the pointer to the Copper list

reg is the register to be affected, specified in this form form: "custom.register" (see *hardware/custom.h*)

CEND terminates the user Copper list. Its format follows:

CEND(uc)

where **uc** is the pointer to the user Copper list.

Executing any of the user Copper list macros causes the system to dynamically allocate special data structures called intermediate Copper lists that are linked into your user Copper list (the list to which **cl** points) describing the operation. When you call the function **MakeVPort(&view, &viewport)** as shown in the section called "Forming A Basic Display," the system uses all of its intermediate Copper lists to sort and merge together the real Copper lists for the system (**LOFCprList** and **SHFCprList**).

When your program exits, you must return to the system all of the memory that you allocated or caused to be allocated. This means that you must return the intermediate Copper lists, as well as the user Copper list data structure. Here are two different methods for returning this memory to the system.

```
/* Returning memory to the system if you have NOT
 * obtained the viewport from Intuition. */

FreeVPortCopLists(&viewport);

/* Returning memory to the system if you HAVE
 * obtained the viewport from Intuition. */

CloseScreen(screen);      /* Intuition only */
```

The example program below shows the use of user Copper lists under Intuition.

```
/* User-Copper-Lists Demo Program ... changes the background color
 * in mid-screen.
 */

#define WINDOWGADGETS (WINDOWSIZING|WINDOWDRAG|
      WINDOWDEPTH|WINDOWCLOSE)
#define WWIDTH 120
#define WHEIGHT 90
#define MAXINT 0xFFFFFFFF

#include "exec/types.h"
#include "exec/memory.h"
#include <graphics/gfxmacros.h>
#include <graphics/copper.h>
#include "intuition/intuition.h"
#include <hardware/custom.h>

extern struct Window *OpenWindow();
extern struct Screen *OpenScreen();

long IntuitionBase=0;
long GfxBase=0;

/* use the 40/80 column font for this test */

struct TextAttr TestFont = {
   "topaz.font", 8, 0, 0
};

struct NewScreen ns = {
   0, 0,            /* start position */
   320, 200, 4,     /* width, height, depth */
   0, 1,            /* detail pen, block pen */
   0,               /* viewing mode */
   CUSTOMSCREEN, /* screen type */
   &TestFont,       /* font to use */
   "Test Screen", /* default title for screen */
   NULL             /* pointer to additional gadgets */
};

extern struct Custom custom;
      /* provides a way to get to the base of the custom chips */
```

```
main()
{
   struct Window *w;        /* pointer to a Window   */
   struct RastPort *rp;     /* pointer to a RastPort */
   struct ViewPort *vp;     /* pointer to a ViewPort */
   struct UCopList *cl;     /* user Copper list and a pointer to it. */
   struct Screen *screen;
   GfxBase = OpenLibrary("graphics.library", 0);
   if (GfxBase == NULL)
   {
      exit(1000);
   }
   IntuitionBase = OpenLibrary("intuition.library", 0);
   if (IntuitionBase == NULL)
   {
      CloseLibrary(GfxBase);
      exit(2000);
   }
   screen = OpenScreen(&ns);
   if(!screen)
   {
      goto cleanup;
   }
   else
   {
      vp = &screen->ViewPort;
      rp = &screen->RastPort;
   }

   /* v1.1 initialization, just use CINIT for v1.2 */

   /* In this case, although WE allocated the memory for the user Copper list,
    * the SYSTEM (Intuition) deallocates it when the custom screen is closed.
    * Therefore there is no corresponding FreeMem() in this sample program.
    */
   cl = AllocMem(sizeof(struct UCopList),MEMF_PUBLIC|MEMF_CLEAR);

   CWAIT(cl,100,0);                  /* wait till middle of screen */
   CMOVE(cl,custom.color[0],0xFFF);  /* change background color */
   CEND(cl);

   /* Programmer can affect ANY of the system registers that the Copper has access to
    * (see the Amiga Hardware Reference Manual) in this way. Simply note that the
    * system may already be using these registers in some manner and that most of
    * the system registers are either read-only or write-only, so you'll have to be
```

```
    * careful about what you are trying to affect.
    */
   vp->UCopIns = cl;

   Delay(50);      /* wait one second before changing anything */

   /* Now force a remake of the Copper list for all screens. */

   RethinkDisplay();

   Delay(100);
   CloseScreen(screen);
cleanup:
   CloseLibrary(IntuitionBase);
   CloseLibrary(GfxBase);
}

/* end of main() */
```

Advanced Graphics Examples

DUAL-PLAYFIELDS EXAMPLE

This example is almost identical to the single-playfield demonstration program earlier in this chapter. It has been adapted to show a dual-playfield display with objects drawn in both playfields. The single playfield wrote directly into the screen's memory. This example adds a **RastPort** so that rectangle-fill routines can be used.

```
#include <exec/types.h>
#include <graphics/gfx.h>
#include <graphics/gfxbase.h>
#include <hardware/dmabits.h>
#include <hardware/custom.h>
#include <graphics/gfxmacros.h>
#include <graphics/rastport.h>
#include <graphics/view.h>
#include <exec/exec.h>

#define DEPTH 2
#define WIDTH 320
#define HEIGHT 200
#define NOT_ENOUGH_MEMORY -1000
```

```
struct View v;
struct ViewPort vp;
struct ColorMap *cm; /* pointer to ColorMap structure, dynamic alloc */
struct RasInfo ri;
struct BitMap b;

/* added a second RasInfo for dual.playfield */
struct RasInfo ri2;
/* added a second BitMap for dual.playfield */
struct BitMap b2;

short i,j,k,n;
struct ColorMap *GetColorMap();
struct GfxBase *GfxBase;

        /* black, red, green, blue,
         * ignored, ignored, ignored, ignored,
         * (transparent), purple, lime green, mauve */
USHORT colortable[] = {
        0x000, 0xf00, 0x0f0, 0x00f,
        0,0,0,0,
        0,     0x495, 0x62a, 0xf9c
};
/* Nobody will see center set of 4 colors in this case because only two planes
 * and dual-playfield mode. (In dualpf mode, colors 0-7 are dedicated to
 * playfield 1, and 8-15 to playfield number 2. So since only 2 planes in each
 * playfield, colors 4-7 and 12-15 won't even get used in this example)
*/

UWORD *colorpalette;

/* added RastPorts for both bitmaps */

struct RastPort rp, rp2;
struct View *oldview; /* save and restore old View */

main()
{
        GfxBase = (struct GfxBase *)OpenLibrary("graphics.library",0);
        if (GfxBase == NULL) exit(1);

        InitView(&v);    /* initialize View */
        v.ViewPort = &vp;   /* link View into ViewPort */
        InitVPort(&vp); /* init ViewPort */
```

```
                    /* now specify critical characteristics */
    vp.DWidth = WIDTH;
    vp.DHeight = HEIGHT;
    vp.RasInfo = &ri;
    vp.Modes = DUALPF | PFBA ;  /* dual-playfield mode */

    /* init bit map (for RasInfo and RastPort) */
    InitBitMap(&b,DEPTH,WIDTH,HEIGHT);
        /* (init RasInfo) */
    ri.BitMap = &b;
    /* align upper left corners of display
     * with upper left corner of drawing area */
    ri.RxOffset = 0;
    ri.RyOffset = 0;

/* ************************************************************ */
/* changed here for dual playfields */
    InitBitMap(&b2,DEPTH,WIDTH,HEIGHT);
    ri.Next = &ri2;
    ri2.BitMap = &b2;
    ri2.RxOffset = 0;
    ri2.RyOffset = 0;
    ri2.Next = 0;
/* ************************************************************** */

                    /* (init color table) */
    cm = GetColorMap(12);    /* 12 entries, since dual playfields */
    colorpalette = cm->ColorTable;
    for(i=0; i<12; i++)
    {
        *colorpalette++ = colortable[i];
    }
                    /* copy my colors into this data structure */
    vp.ColorMap = cm;   /* link it with the ViewPort */

                    /* allocate space for BitMap */
    for(i=0; i<DEPTH; i++)
    {
      b.Planes[i] = (PLANEPTR)AllocRaster(WIDTH,HEIGHT);
      if(b.Planes[i] == NULL) exit(NOT_ENOUGH_MEMORY);
      b2.Planes[i] = (PLANEPTR)AllocRaster(WIDTH,HEIGHT);
      if(b2.Planes[i] == NULL) exit(NOT_ENOUGH_MEMORY);
    }

    /* Initialize the RastPorts and link them to the bitmaps */
```

```
InitRastPort(&rp);
InitRastPort(&rp2);
rp.BitMap = &b;
rp2.BitMap = &b2;

MakeVPort( &v, &vp );      /* construct Copper instr (prelim) list */
MrgCop( &v );              /* merge prelim lists together into a real
                            * Copper list in the View structure. */
SetRast(&rp,0);            /* simpler form of setting drawing area to 0 */
SetRast(&rp2,0);

oldview = GfxBase->ActiView; /* save current view to restore later */
/* example steals screen from Intuition if started from WBench */

LoadView(&v);

/* Now fill some boxes so that user can see something */
/* first playfield */
SetAPen(&rp,1);
RectFill(&rp,20,20,200,100);
SetAPen(&rp,2);
RectFill(&rp,40,40,220,120);
SetAPen(&rp,3);
RectFill(&rp,60,60,240,140);
/* second playfield */
SetAPen(&rp2,1);
RectFill(&rp2,50,90,245,180);
SetAPen(&rp2,2);
RectFill(&rp2,70,70,265,160);
SetAPen(&rp2,3);
RectFill(&rp2,90,10,285,148);

/* Now tear some holes in the playfield so user can see that foreground
 * area of playfield 2 (called PFB also) is transparent in any area
 * where it has a color value of 0
 */

SetAPen(&rp2,0);
RectFill(&rp2,110,15,130,175);
RectFill(&rp2,175,15,200,175);
Delay(300);         /* uses AmigaDOS function... delay 5 seconds */
LoadView(oldview);  /* Put Intuition's View back again */
WaitTOF();          /* wait for Intuition View to return */
FreeMemory();       /* and exit gracefully */
CloseLibrary(GfxBase);
```

```
}     /* end of main() */

FreeMemory()
{                  /* return user and system-allocated memory to sys manager */

      for(i=0; i<DEPTH; i++)               /* free the drawing area */
      {
         FreeRaster(b.Planes[i],WIDTH,HEIGHT);
         FreeRaster(b2.Planes[i],WIDTH,HEIGHT);
      }
      FreeColorMap(cm);                 /* free the color map */
      /* free dynamically created structures */
      FreeVPortCopLists(&vp);
      FreeCprList(v.LOFCprList);
      return(0);
}
```

HOLD-AND-MODIFY MODE EXAMPLE

This example demonstrates the Amiga's hold-and-modify mode, showing at all times a different subset of 256 of the 4,096 colors available on the Amiga. At any moment, no two squares are the same color.

```
/*****************************************************************************/
 *  Rob Peck     -- November  5, 1985
 *  Bob Pariseau -- November 10, 1985   (Rework for tutorial)
 *****************************************************************************/

#include <exec/types.h>
#include <intuition/intuition.h>
#include <intuition/intuitionbase.h>

#define  XSIZE 11            /* Color box sizes */
#define  YSIZE 6

struct   GfxBase       *GfxBase;   /* Export the library pointers */
struct   IntuitionBase *IntuitionBase;

struct   RastPort      *rp;    /* Graphics structures */
struct   ViewPort      *vp;

struct TextAttr TestFont =
{
      "topaz.font",      /* Standard system font */
```

```
     8,   0,   0
};

struct  Window        *w;   /* Intuition structures */
struct  Screen        *screen;
struct  IntuiMessage  *message;

struct NewScreen ns = {
  0, 0,       /* start position */
  320, 200, 6,    /* width, height, depth */
  0, 1,       /* detail pen, block pen */
  HAM,    /* Hold and Modify ViewMode */
  CUSTOMSCREEN, /* screen type */
  &TestFont,    /* font to use */
  " 256 different out of 4096",     /* default title for screen */
  NULL    /* pointer to additional gadgets */
};

struct NewWindow nw = {
      0, 11,              /* start position */
      320, 186,   /* width, height */
      -1, -1,             /* detail pen, block pen */
      MOUSEBUTTONS|CLOSEWINDOW, /* IDCMP flags */
      ACTIVATE|WINDOWCLOSE,   /* window flags */
      NULL,               /* pointer to first user gadget */
      NULL,               /* pointer to user checkmark */
      "colors at any given moment",    /*  window title */
      NULL,               /* pointer to screen (set below) */
      NULL,               /* pointer to superbitmap */
      0, 0, 320, 186,   /* ignored since not sizeable */
      CUSTOMSCREEN    /* type of screen desired */
};

LONG  squarecolor[16 * 16], freecolors[4096-(16*16)];
SHORT squares[16 * 16];
SHORT xpos[16], ypos[16];

char  *number[] = {
      "0", "1", "2", "3", "4", "5", "6", "7", "8", "9",
      "A", "B", "C", "D", "E", "F"
};

SHORT sStop, cStop, sequence;
BOOL  textneeded;
```

```
main()
{
  ULONG  class;
  USHORT code, i;
  BOOL   wheelmode;

  for(i=0; i<16; i++)        /* establish color square positions */
  {
    xpos[i] = (XSIZE + 4) * i + 20;
    ypos[i] = (YSIZE + 3) * i + 21;
  }

  GfxBase = (struct GfxBase *)OpenLibrary("graphics.library", 0);
  if (GfxBase == NULL) exit(100);

  IntuitionBase = (struct IntuitionBase *)OpenLibrary("intuition.library", 0);
  if (IntuitionBase == NULL)
  {
    CloseLibrary(GfxBase);
    exit(200);
  }

  screen = (struct Screen *)OpenScreen(&ns);
  if (screen == NULL)
  {
    CloseLibrary(IntuitionBase);
    CloseLibrary(GfxBase);
    exit(300);
  }

  nw.Screen = screen;        /* open window in our new screen */
  w = (struct Window *)OpenWindow(&nw);
  if (w == NULL)
  {
    CloseScreen(screen);
    CloseLibrary(IntuitionBase);
    CloseLibrary(GfxBase);
    exit(400);
  }

  vp = &screen->ViewPort;      /* Set colors in screen's VP    */
  rp = w->RPort;    /* Render into the window's RP  */

  /* Set the color registers: Black, Red, Green, Blue, White */
```

```
SetRGB4(vp, 0, 00, 00, 00);
SetRGB4(vp, 1, 15, 00, 00);
SetRGB4(vp, 2, 00, 15, 00);
SetRGB4(vp, 3, 00, 00, 15);
SetRGB4(vp, 4, 15, 15, 15);

SetBPen(rp, 0);      /* Insure clean text */
textneeded = TRUE;
wheelmode  = TRUE;    /* Start with Color Wheel display */

for (i,j) {
{  /* Process any and all messages in the queue, then update the display
    * colors once, then come back here to look at the queue again.  If you
    * see a left-mouse-button-down event, then switch display modes.  If you
    * see a Close-Window-gadget event, then clean up and exit the program.
    * NOTE:  This is a BUSY LOOP so the colors will cycle as quickly as possible.
    */

   while((message = (struct IntuiMessage *)GetMsg(w->UserPort)) != NULL)
   {
     class = message->Class;
     code  = message->Code;
     ReplyMsg(message);  /* Can't reply until done using it! */

     if(class == CLOSEWINDOW)  /* Exit the program */
     {
       CloseWindow(w);
       CloseScreen(screen);
       CloseLibrary(IntuitionBase);
       CloseLibrary(GfxBase);
       exit(0);
     }

     if(class == MOUSEBUTTONS && code == SELECTDOWN)   /* swap modes */
     {
       wheelmode = NOT wheelmode;

       SetAPen(rp, 0);    /* Clear the drawing area */
       SetDrMd(rp, JAM1);
       RectFill(rp, 3, 12, 318, 183);
       textneeded = TRUE;
     }
   }
   if(wheelmode) colorWheel();  else colorFull();
 }
```

```
}


colorFull() /* Display a randomized set of colors  */
{
  SHORT sChoice, cChoice, usesquare;
  LONG  usecolor;

  if(textneeded) /* First call since mode change? */
  {
     prompt();
     sStop = 255;      /* Top of list of squares yet to change */
     cStop = 4095 - 256;   /* Top of list of colors still needing use */

     for(usecolor=0; usecolor<256; usecolor++)   /* Initialize colors */
     {
        usesquare = usecolor;
        squares[usesquare] = usesquare;
        squarecolor[usesquare] = usecolor;
        hamBox(usecolor, xpos[usesquare % 16], ypos[usesquare / 16]);
     }

     for(usecolor=256; usecolor<4095; usecolor++)      /* Ones not yet used */
     {
        freecolors[usecolor - 256] = usecolor;
     }
  }

  /*************************************************************************
   * Randomly choose next square to change such that all squares change color
   * at least once before any square changes twice.  squares[0] through squares
   * [sStop] are the square numbers that have not yet changed in this pass.
   * RangeRand(r) is an integer function provided in "amiga.lib" that produces
   * a random result in the range 0 to (r-1) given an integer r in the range 1 to 65535.
   ************************************************************************/

   sChoice = RangeRand(sStop + 1);  /* Pick a remaining square */

   usesquare = squares[sChoice]; /* Extract square number */
   squares[sChoice] = squares[sStop];   /* Swap it with sStop slot */
   squares[sStop] = usesquare;

   if(NOT sStop--) sStop = 255;  /* Only one change per pass */

  /*************************************************************************
```

```
   * Randomly choose new color for selected square such that all colors are
   * used once before any color is used again, and such that no two squares
   * simultaneously have the same color.  freecolors[0] through freecolors[cStop]
   * are the colors that have not yet been chosen in this pass.  Note that
   * the 256 colors in use at the end of the previous pass are not available
   * for choice in this pass.
   ***********************************************************************/

   cChoice = RangeRand(cStop + 1);

   usecolor = freecolors[cChoice];
   freecolors[cChoice] = freecolors[cStop];
   freecolors[cStop] = squarecolor[usesquare];
   squarecolor[usesquare] = usecolor;

   if(NOT cStop--) cStop = 4095 - 256;

   hamBox(usecolor, xpos[usesquare % 16], ypos[usesquare / 16]);
}

colorWheel()     /* Display an ordered set of colors */
{
   SHORT  i, j;

   if(textneeded)
   {
      prompt();

      SetAPen(rp, 2);   /* Green pen for green color numbers */
      Move(rp, 260, ypos[15]+17);
      Text(rp, "Green", 5);
      for(i=0; i<16; i++)
      {
         Move(rp, xpos[i]+3, ypos[15]+17);
         Text(rp, number[i], 1);
      }

      SetAPen(rp, 3);   /* Blue pen for blue color numbers */
      Move(rp, 4, 18);
      Text(rp, "Blue", 4);
      for(i=0; i<16; i++)
      {
         Move(rp, 7, ypos[i]+6);
         Text(rp, number[i], 1);
      }
```

```
        SetAPen(rp, 1);  /* Red pen for red color numbers */
        Move(rp, 271, 100);
        Text(rp, "Red", 3);

        sequence = 0;
    }

    SetAPen(rp, 1);      /* Identify the red color in use */
    SetDrMd(rp, JAM2);
    Move(rp, 280, 115);
    Text(rp, number[sequence], 1);

    for(j=0; j<16; j++)        /* Update all of the squares */
        for(i=0; i<16; i++)
            hamBox((sequence<<8 | i<<4 | j), xpos[i], ypos[j]);

    if(++sequence == 16) sequence=0;
}

prompt()   /* Display mode changing prompt */
{
    SetDrMd(rp, JAM2);
    SetAPen(rp, 4);
    Move(rp, 23, 183);
    Text(rp, "[left mouse button = new mode]", 30);
    textneeded = FALSE;
}

/*********************************************************************
 * hamBox() -- routine to draw a colored box in Hold and Modify mode.  Draws a
 *     box of size XSIZE by YSIZE with an upper left corner at (x,y).  The
 *     desired color is achieved in 3 steps on each horizontal line of the box.
 *     First we set the red component, then the green, then the blue.  We
 *     achieve this by drawing a vertical line of Modify-Red, followed by a
 *     vertical line of Modify-Green, followed by a rectangle of Modify-Blue.
 *     Note that the resulting color for the first two vertical lines depends
 *     upon the color(s) of the pixels immediately to the left of that
 *     line.  By the time we reach the rectangle we are assured of getting
 *     (and maintaining) the desired color because we have set all 3
 *     components (R, G, and B) straight from the bit map.
 *********************************************************************/
hamBox(color, x, y)
LONG   color, x, y;
{
```

```
   SHORT  c;

   SetDrMd(rp, JAM1);        /* Establish Drawing Mode in RastPort */

   c=((color & 0xf00)>>8);/* Extract desired Red color component. */
   SetAPen(rp, c + 0x20);    /* Hold G, B from previous pixel.  Set R=n. */
   Move(rp, x, y);
   Draw(rp, x, y+YSIZE);

   x++;
   c=((color & 0xf0)>>4);  /* Extract desired Green color component. */
   SetAPen(rp, c + 0x30);    /* Hold R, B from previous pixel.  Set G=n. */
   Move(rp, x, y);
   Draw(rp, x, y+YSIZE);

   x++;
   c=(color & 0xf);          /* Extract desired Blue color component.*/
   SetAPen(rp, c + 0x10);    /* Hold R, G from previous pixel.  Set B=n. */
   RectFill(rp, x, y, x+XSIZE-2, y+YSIZE);
}
```

Chapter 2

Layers

The layers library enables you to create displays containing overlapping display elements. This chapter describes the layers library routines and how you use them in creating graphics.

Introduction

The layers library contains routines that do the following:

- Multiplex a **BitMap** among various tasks by creating "layers" in the **BitMap**

- Create separate writable **BitMap** areas, some portions of which may be in the common (perhaps on-screen) **BitMap**, and some portions in an obscured area. In two modes, called smart-refresh and superbitmap, graphics are rendered into both the obscured and the non-obscured areas.

- Move, size or depth-arrange the layers, bringing obscured segments into a non-obscured area

Tasks can create layers in a common **BitMap** and then output graphics to those layers without any knowledge that there are other tasks currently using this **BitMap**.

To see what the layers library provides, you need only look at the Intuition user interface, as used by numerous applications on the Amiga. The windows that Intuition creates are based, in part, on the underlying strata of the layers library. You can find more details about Intuition in the book titled *Intuition: The Amiga User Interface.*

If you wish, you can use the layers library directly to create your own windowing system. The layers library takes care of the difficult things, that is, the bookkeeping jobs that are needed to keep track of where to put which bits. Once a layer is created, it may be moved, sized, depth-arranged or deleted using the routines provided in this library. In performing their rendering operations, the graphics routines know how to use the layers and only draw into the correct drawing areas.

DEFINITION OF LAYERS

The internal definition of the layers resembles a set of *clipping rectangles* in that a drawing area is split into a set of rectangles. A clipping rectangle is a rectangular area into which the graphics routines will draw. Some of the rectangles are visible; some are invisible. If a rectangle is visible, the graphics can draw directly into it. If a rectangle is obscured by an overlapping layer, the graphics routine may possibly draw into some other memory area. This memory area must be at least large enough to hold the obscured rectangle so the graphics routines can, on command, expose the obscured area.

The layers library manages interactions between the various layers by using a data structure called **Layer_Info**. Each major drawing area, called a **BitMap** (which all windows share), requires one **Layer_Info** data structure.

You may choose to split the viewing area into multiple parts by providing multiple independent **ViewPorts**. If you use the layers library to subdivide each of these parts into layers (effectively providing windows within these subdivisions), you must provide one **Layer_Info** structure for each of these parts.

TYPES OF LAYERS SUPPORTED

The layers library supports four types of layers:

- *Simple Refresh*

  No back-up area is provided. Instead, when an obscured section of the layer is exposed to view, the routine using this layer is told that a "refresh" of that area is in order. This means that the program using this layer must redraw those portions of its display that are contained in the previously obscured section of the layer. All graphics rendering routines are "clipped" so that they will only draw into exposed sections of the layer.

- *Smart Refresh*

  The system provides one or more back-up areas into which the graphics routines can draw whenever a part of this layer is obscured.

- *Superbitmap*

  There is a single back-up area, which is permanently provided to store what is not in the layer. The back-up area may be larger than the area that is actually shown in the on-screen **BitMap**.

- *Backdrop*

  A backdrop layer always appears behind all other layers that you create. The current implementation of backdrop layers prevents them from being moved, sized, or depth-arranged.

Layers Library Routines

The layers library contains the routines shown below:

Purpose	Routine
Allocating a **Layer_Info** structure	**NewLayerInfo()**
Deallocating a **Layer_Info** structure	**DisposeLayerInfo()**
Intertask operations	**LockLayer(), UnLockLayer(), LockLayers(), UnlockLayers(), LockLayerInfo(), UnlockLayerInfo()**
Creating and deleting layers	**CreateUpfrontLayer(), CreateBehindLayer(), DeleteLayer()**
Moving layers	**MoveLayer()**
Sizing layers	**SizeLayer()**
Changing a viewpoint	**ScrollLayer()**
Reordering layers	**BehindLayer, UpfrontLayer()**
Determining layer position	**WhichLayer()**
Sub-layer rectangle operations	**SwapBitsRastPortClipRect()**

INITIALIZING AND DEALLOCATING LAYERS

The function **NewLayerInfo()** allocates and initializes a **Layer_Info** data structure and allocates some extra needed memory for the 1.1 release. After the call to **NewLayerInfo()**, you can use the layer operations described in the following paragraphs.

The function **DisposeLayerInfo()** deallocates a **Layer_Info** structure that was allocated with a call to **NewLayerInfo()** and frees the extra memory that was allocated.

Note: Prior to the current 1.1 release, **Layer_Info** structures were initialized with the **InitLayers()** function. For backwards compatibility, you can still use this function with newer software. For optimal performance, however, you should call **FattenLayerInfo()** to allocate the needed extra memory and **ThinLayerInfo()** to return the memory to the system free-list. Failure to deallocate memory will result in loss of that available memory.

INTERTASK OPERATIONS

This section shows the use of the routines **LockLayerInfo()**, **UnlockLayerInfo()**, **LockLayer()**, **UnlockLayer()**, **LockLayers()**, and **UnlockLayers()**.

LockLayerInfo() and UnlockLayerInfo()

You create layers by using the routines **CreateUpFrontLayer()** and **CreateBehindLayer()**. If multiple tasks are all trying to create layers on the same screen or **ViewPort**, each task will be trying to affect the same data structures while creating its layers. The **Layer_Info** data structure controls the layers. **LockLayerInfo()** ensures that the **Layer_Info** data structure remains intact and tasks can obtain this exclusive access.

LockLayerInfo() grants exclusive access to the locking task. If some other task has the **Layer_Info** locked, the call will block until the lock succeeds.

LockLayer() and Unlocklayer()

If a task is making some changes to a particular layer, such as resizing it or moving it, the task must inhibit the graphics rendering into the layer. **LockLayer()** blocks graphics output once the current graphics function has completed. The other task goes to sleep only if it attempts to draw graphics. **LockLayer()** returns exclusive access to the layer once other tasks, including graphics, are finished with this layer.

UnlockLayer() frees the locked layer for other operations.

If more than one layer must be locked, then these **LockLayer()** calls must be surrounded by **LockLayerInfo()** and **UnLockLayerInfo()**. This is to prevent deadlock situations.

LockLayers() and UnlockLayers()

Sometimes it is necessary to lock all layers at the same time. For example, under Intuition, a rubber-band box is drawn when a window is being moved or sized. To draw such a box, Intuition must stop all graphics rendering to all windows (and associated layers) so that it can draw a line using the graphics complement drawing mode. If other graphics draw over this line, it would not be possible for Intuition to erase it again, using a subsequent complement operation over the same line. Thus **LockLayers()** is used to lock all layers in a single command. **UnlockLayers()** releases the layers.

You can simulate **LockLayers()** by calling **LockLayer()** for each layer in the **LayerList**. However, in that case, you must call **LockLayerInfo()** before and **UnlockLayerInfo()** after each **LockLayer()** call.

CREATING AND DELETING LAYERS

CreateUpFrontLayer() creates a layer that is in front of all other layers. Intuition uses this function to create certain types of new windows, as well as other Intuition components.

CreateBehindLayer() creates a layer that is behind all other layers. Intuition uses this function to create a new "Backdrop" window.

Each of the routines that create layers return a pointer to a layer data structure (shown in the include file *graphics/layers.h*).

Note: When you create a layer, the system automatically creates a **RastPort** to go along with it. Because a **RastPort** is specified by the drawing routines, if you use this layer's **RastPort**, you will draw into only the area that you have designated on the screen for this layer. See also the topic called "The Layer's RastPort" below.

DeleteLayer() is used to remove a layer from the layer list. It is one of the functions used by Intuition to close a window.

For these functions, you need to perform **LockLayerInfo()** and **UnlockLayerInfo()**, because you need to access the **Layer_Info** structure itself.

MOVING LAYERS

MoveLayer() moves a layer to a new location. When you move a layer, the move command affects the list of layers that is being managed by the **Layer_Info** data structure. The system locks the **Layer_Info** for you during this operation.

SIZING LAYERS

The **SizeLayer()** command changes the size of a layer by leaving the coordinates of the upper left corner the same and modifying the coordinates of the lower right corner of the layer. The system locks the **Layer_Info** for you during this operation.

CHANGING A VIEWPOINT

ScrollLayer() is for superbitmap layers only. This command changes the portion of a superbitmap that is shown by a layer. An analogy is a window in a wall. If the homeowner does not like the view he sees from a particular window, he might either change what he sees by planting trees (that is, new graphics rendering) or he might decide to move the window to see another part of the great outdoors (changing the portion of the superbitmap shown by a layer). You must provide a superbitmap; the **ScrollLayer()** command repositions the smaller layer against the larger superbitmap, thus showing a different part of it.

Because the layer size and on-screen position do not change while this operation is taking place, it is not necessary to lock the **Layer_Info** data structure. However, it is necessary to prevent graphics-rendering operations from drawing into this layer or its associated superbitmap while **ScrollLayer()** is performing the repositioning. Thus, the system locks the layer for you while this operation is taking place.

REORDERING LAYERS

BehindLayer() and **UpfrontLayer()** are used, respectively, to move a layer behind all other layers or in front of all other layers. **BehindLayer()** also considers any backdrop layers, moving a current layer behind all others except backdrop layers. The system performs **LockLayers()** for you during this operation.

DETERMINING LAYER POSITION

If the viewing area has been separated into several layers, you may wish to find out which layer is topmost at a particular x,y coordinate. For example, Intuition does this while keeping track of the mouse position. When you move the mouse into one of the windows and click the left button, Intuition feeds the current x,y coordinate to **WhichLayer()**. In return, **WhichLayer()** tells Intuition which layer has been selected, and thus it knows with which window you wish to work.

If you wish to be sure that no task changes the sequence of layers (by using **UpfrontLayer()**, **BehindLayer()**, **CreateUpFrontLayer()**, **DeleteLayer()**, **MoveLayer()** or **SizeLayer()**) before your task can use this information, call **LockLayerInfo()** before calling **WhichLayer()**. Then, after receiving and using the information that **WhichLayer()** delivers, you can call **UnlockLayerInfo()**. In this way, you will assure that you are acting on data that was true as of the moment it was received.

SUB-LAYER RECTANGLE OPERATIONS

The **SwapBitsClipRectRastPort()** routine is for users who do not want to worry about clipping rectangles. The need for this routine goes a bit deeper than that. It is a routine that actually enables the menu operations of Intuition to function much more quickly than they would if this routine were not provided.

Consider the case where there are several windows open on an Intuition screen. If you wish to produce a menu, there are two ways to do it:

- o Create an up-front layer with **CreateUpfrontLayer()**, then render the menu in it. This could use lots of memory and require a lot of (very temporary) "slice-and-dice" operations to create all of the clipping rectangles for the existing windows and so on.

- o Use **SwapBitsClipRectRastPort()**, directly on the screen drawing area:

  - o Render the menu in a back-up area off the screen, then lock all of the on-screen layers so that no task can use graphics routines to draw over your menu area on the screen.

  - o Next, swap the on-screen bits with the off-screen bits, making the menu appear.

  - o When you finish with the menu, swap again and unlock the layers.

The second rendering method is faster and leaves the clipping rectangles and most of the rest of the window data structures untouched.

Notice that all of the layers must be locked while the menu is visible. Any task that is using any of the layers for graphics output will be halted while the menu operations are taking place. If, on the other hand, the menu is rendered as a layer, no task need be halted while the menu is up because the lower layers need not be locked. It is a tradeoff decision that you must make.

The Layer's RastPort

When you create a layer, you automatically get a **RastPort**. The pointer to the **RastPort** is contained in the layer data structure and can be retrieved typically by the statement:

```
rp = layer->rp;         /* copy the pointer from the layer structure
                         * into a local pointer for further use */
```

Using this **RastPort**, you can draw anywhere into the layer's defined rectangle. Location (0,0) is the coordinate location for the upper left corner of the rectangle, and location (**xmax, ymax**) is the lower right corner. If you try to draw to any location outside of this coordinate system, the graphics routines will clip the drawing to the inside boundaries of this area.

The type of layer you specify by the **Flags** variable determines the other facilities the layer provides. The following paragraphs describe the types of layers —simple refresh, smart refresh, superbitmap, and backdrop—and the flags you set for the type you want. Note that the three layer-type **Flags** are mutually exclusive. That is, you cannot specify more than one layer-type flag—LAYERSIMPLE, LAYERSMART, LAYERSUPER.

SIMPLE REFRESH LAYER

When you draw into the layer, any portion of the layer that is visible (not obscured) will have its drawing rendered into the common **BitMap** of the viewing area.

If another layer operation is performed that causes part of a simple refresh layer to be obscured and then exposed, you must restore the part of the drawing that your application rendered into the obscured area.

Simple refresh has two basic advantages:

- It uses no back-up area to save drawing sections that cannot be seen anyway (and therefore saves memory).

- When an application tries to restore the layer by performing a full-layer redraw, (sandwiched between a **BeginUpdate()**, **EndUpdate()** pair), only those damaged areas are redrawn, making the operation very time efficient.

Its disadvantage is that the application needs to watch to see if its layer needs refreshing. This test can be performed, typically, by a statement set such as the following:

```
refreshstatus = layer->Flags & LAYERREFRESH;
if (refreshstatus != 0) refresh(layer);
```

Note: Applications using Intuition typically get their refresh notifications as event messages passed through an Intuition Direct Communications Message Port (IDCMP).

SMART REFRESH LAYER

If any portion of the layer is hidden by another layer, the bits for that obscured portion are rendered into a back-up area. With smart refresh layers, the system handles all of the refresh requirements except when the layer is made larger. Its disadvantage is the additional memory needed to handle this automatic refresh.

SUPERBITMAP LAYER

A superbitmap layer is similar to a smart refresh layer. It too has a back-up area into which drawings are rendered for currently obscured parts of the display. However, it differs from smart refresh in that:

- o The back-up **BitMap** is user-supplied, rather than being allocated dynamically by the system.

- o The back-up **BitMap** may be larger than the area of this **BitMap** that is currently showing within the current size of this layer.

To see a larger portion of a superbitmap in the on-screen layer, you use **SizeLayer()**. To see a different portion of the superbitmap in the layer, you use **ScrollLayer()**.

When the graphics routines perform your drawing commands, part of the drawing appears in the common **BitMap** (the on-screen portion). Any drawing outside the layer itself is rendered into the superbitmap. When it is time to scroll or size the layer, the layer contents are copied into the superbitmap, the scroll or size positioning is modified, and the appropriate portions are then copied back into the layer.

BACKDROP LAYER

Any layer can be designated a backdrop layer. You can turn off the backdrop flag temporarily and allow a layer to be depth-arranged. Then by restoring the backdrop flag, you can again inhibit depth-arrangement operations.

You change the backdrop flag typically by the statements:

```
layer->Flags &= LAYERBACKDROP;      /* turn off the backdrop bit */
layer->Flags |= LAYERBACKDROP;      /* turn on the backdrop bit */
```

Using the Layers Library

The following is a step-by-step example showing how the layers library can be used in your programs. Note that the Intuition software, which is part of the system as well, manages many of these items for you. The example below can be started up under Intuition, but it requires that the Amiga be reset in order to exit the program.

The example program explains the individual parts separately, then merges the parts into a single working example. This simple example produces three rectangles on the screen: one red, one green, and one blue. Each rectangle is rendered as a rectangle-fill of one of three smart layers created for the example.

OPENING THE LAYERS LIBRARY

Like all library routines, the layers library must be opened before it can be used. This is done typically by the following code:

```
struct LayersBase *LayersBase;
    ...
LayersBase = (struct LayersBase *)OpenLibrary("layers.library",0);
if(LayersBase == NULL)
{
    exit(NO_LAYERS_LIBRARY_FOUND);
}
```

OPENING THE GRAPHICS LIBRARY

Because the example uses various graphics library functions as well as the layers library, you must also open the graphics library with the following code:

```
struct GfxBase *GfxBase;
    ...
GfxBase = (struct GfxBase *)OpenLibrary("graphics.library",0);
if(GfxBase == NULL)
{
    exit(NO_GRAPHICS_LIBRARY_FOUND);
}
```

CREATING A VIEWING WORKSPACE

You can create a viewing workspace by using the primitives **InitVPort()**, **InitView()**, **MakeVPort()**, **MrgCop()**, and **LoadView()**. See the "Graphics Example" section in chapter 1, "Graphics Primitives." You add the following statements:

```
struct Layer_Info *li;
li=NewLayerInfo();
```

This provides and initializes a **Layer_Info** data structure with which the system can keep track of layers that you create.

CREATING THE LAYERS

You can create layers in this common bit map by calling **CreateUpfrontLayer()** (or **CreateBehindLayer()**), with a sequence such as the following. The **Flags** value in this example is LAYERSMART (see *graphics/clip.h* in the "Include Files" appendix for all other flag values). This sequence requests construction of a smart refresh layer.

```
#define FLAGS LAYERSMART
struct BitMap b;
struct Layer_Info i;
struct RastPort *rp[3];   /* allocate a RastPort pointer for each layer */
struct Layer *layer[3];   /* allocate a layer pointer for each layer */

    /* Layer_Info, common BitMap, x1,y1,x2,y2,
     * flags = 0 (smart refresh), null pointer to superbitmap */
layer[0] = CreateUpfrontLayer(&li,&b,20,20,100,80,FLAGS,NULL);

layer[1] = CreateUpfrontLayer(&li,&b,30,30,110,90,FLAGS,NULL);
layer[2] = CreateUpfrontLayer(&li,&b,40,40,120,100,FLAGS,NULL);

    /* if not enough memory, can't continue the example */
if(layer[0]==NULL || layer[1]==NULL || layer[2]==NULL) exit(3);
```

GETTING THE POINTERS TO THE RASTPORTS

Each layer pointer data structure contains a pointer to the **RastPort** that it uses. Here is the assignment from the layer structure to a set of local pointers:

```
for(i=0; i<3; i++)
{
      rp[i] = layer[i]->rp;
}
```

USING THE RASTPORTS FOR DISPLAY

Here are the rectangle-fill operations that create the display:

```
for(i=0; i<3; i++)
{
     SetAPen(rp[i],i+1);
     SetDrMd(rp[i],JAM1);
     RectFill(rp[i],0,0,80,50);
}
```

If you perform an **UpfrontLayer()** or **BehindLayer()** command prior to the **Delay()** shown in the complete example below, all of the data contained in each layer is retained and correctly rendered automatically by the layers library. This is because these are all smart-refresh layers. If you change the example to use a **Flags** value of LAYERSIMPLE, and then perform **UpfrontLayer()** or **BehindLayer()**, the obscured portions of the layers, now exposed, contain only the background color. This illustrates that simple-refresh layers may have to be redrawn after layer operations are performed.

LAYERS EXAMPLE

Here is the complete example, which is a compilation of the complete example in chapter 1 and the pieces given above. Sections of the example that differ from those shown in the chapter 1 example are indicated through comments to show the additions adding the layers library demonstration.

```
/*****************************************************************************
 * This example shows how to use the layers.library. Certain functions are not
 * available in the system software prior to the release of version 1.1. Therefore,
 * this example can be compiled only if your C-disk supports version 1.1 or beyond.
 ***************************************************************************** */

#include "exec/types.h"
#include "graphics/gfx.h"
#include "hardware/dmabits.h"
#include "hardware/custom.h"
#include "hardware/blit.h"
#include "graphics/gfxmacros.h"
#include "graphics/copper.h"
#include "graphics/view.h"
#include "graphics/gels.h"
#include "graphics/regions.h"
#include "graphics/clip.h"
#include "exec/exec.h"
#include "graphics/text.h"
#include "graphics/gfxbase.h"
/* ************ added for layers support *********************** */
#include "graphics/layers.h"
#include "graphics/clip.h"
/* ************ added for layers support *********************** */

#define DEPTH 2
#define WIDTH 320
#define HEIGHT 200
#define NOT_ENOUGH_MEMORY -1000

/* construct a simple display */
#define FLAGS LAYERSMART
/* dynamically created RastPorts from the calls to CreateUpfrontLayer */
struct RastPort *rp[3];       /* RastPort for each layer */

struct ColorMap *GetColorMap();
struct GfxBase *GfxBase;

SHORT  boxoffsets[] = { 802, 2010, 3218 };
                    /* black, red, green, blue */
USHORT colortable[] = { 0x000, 0xf00, 0x0f0, 0x00f };
long LayersBase;
extern struct Layer *CreateUpfrontLayer();
extern struct Layer_Info *NewLayerInfo();
```

```
main()
{
    struct View *oldview; /* save pointer to old View so can go back to sys */
    struct View v;
    struct ViewPort vp;
    struct ColorMap *cm; /* pointer to ColorMap structure, dynamic alloc */
    struct RasInfo ri;
    struct BitMap b;
    short i,j,k,n;
    struct Layer_Info *li;
    struct Layer *layer[3];

    GfxBase = (struct GfxBase *)OpenLibrary("graphics.library",0);
    if (GfxBase == NULL) exit(1);

    LayersBase = OpenLibrary("layers.library",0);
    if(LayersBase == NULL) exit(2);

    oldview = GfxBase->ActiView;  /* save current View, go back later */
    /* example steals screen from Intuition */

    li = NewLayerInfo();        /* get a Layer_Info structure */
    if(li == NULL) exit(100);

    /* not needed if gotten by NewLayerInfo InitLayers(li);
       FattenLayerInfo(li); */

    InitView(&v);           /* initialize View */
    v.ViewPort = &vp;   /* link View into ViewPort */
    InitVPort(&vp);         /* init ViewPort */
    /* now specify critical characteristics */
    vp.DWidth = WIDTH;
    vp.DHeight = HEIGHT;
    vp.RasInfo = &ri;
                        /* init BitMap (for RasInfo and RastPort) */
    InitBitMap(&b,DEPTH,WIDTH,HEIGHT);
    ri.BitMap = &b;             /* (init RasInfo) */
    ri.RxOffset = 0; /* align upper left corners of display
                      * with upper left corner of drawing area */
    ri.RyOffset = 0;
    ri.Next = NULL;
                        /* (init color table) */
    vp.ColorMap = GetColorMap(4); /* four entries, since only two planes deep */
    colorpalette = (UBYTE *)cm->ColorTable;
                        /* copy my colors into this data structure */
```

```
LoadRGB4(vp,colortable,4);

                        /* allocate space for BitMap */
for(i=0; i<DEPTH; i++)
{
      b.Planes[i] = (PLANEPTR)AllocRaster(WIDTH,HEIGHT);
      if(b.Planes[i] == NULL) exit(NOT_ENOUGH_MEMORY);
      BltClear(b.Planes[i],RASSIZE(width,height),0);
}

MakeVPort( &v, &vp );      /* construct Copper instr (prelim) list */
MrgCop( &v );              /* merge prelim lists together into a real
                            * Copper list in the View structure. */

LoadView(&v);

/* now fill some boxes so that user can see something */

      /* Layer_Info, common BitMap, x,y,x2,y2,
       * flags = 0 (simple refresh), null pointer to superbitmap */
layer[0] = CreateUpfrontLayer(li,&b,5,5,85,65,FLAGS,NULL);
if(layer[0] == NULL) goto cleanup1;

layer[1] = CreateUpfrontLayer(li,&b,20,20,100,80,FLAGS,NULL);
if(layer[1] == NULL) goto cleanup2;

layer[2] = CreateUpfrontLayer(li,&b,45,45,125,105,FLAGS,NULL);
if(layer[2] == NULL) goto cleanup3;

for(i=0; i<3; i++)     /* layers are created, now draw to them */
{
      rp[i] = layer[i]->rp;
      SetAPen(rp[i],i+1);
      SetDrMd(rp[i],JAM1);
      RectFill(rp[i],0,0,79,59);
}
SetAPen(rp[0],0);
Move(rp[0],5,30);
Text(rp[0],"Layer 0",7);

SetAPen(rp[1],0);
Move(rp[1],5,30);
Text(rp[1],"Layer 1",7);

SetAPen(rp[2],0);
```

```
    Move(rp[2],5,30);
    Text(rp[2],"Layer 2",7);

    Delay(100);       /* two seconds before first change */
    BehindLayer(li,layer[2]);

    Delay(100);       /* another change two seconds later */

    UpfrontLayer(li,layer[0]);

    for(i=0; i<30; i++)
    {
          MoveLayer(li,layer[1],1,3);
          Delay(10);        /* wait .2 seconds (uses DOS function) */

    }

  cleanup3:
    LoadView(oldview);              /* put back the old View  */
    DeleteLayer(li,layer[2]);
  cleanup2:
    DeleteLayer(li,layer[1]);
  cleanup1:
    DeleteLayer(li,layer[0]);

    DisposeLayerInfo(li);

          /* return user and system-allocated memory to sys manager */
    for(i=0; i<DEPTH; i++)  /* free the drawing area */
       FreeRaster(b.Planes[i],WIDTH,HEIGHT);
    FreeColorMap(cm);             /* free the color map */
                            /* free dynamically created structures */
    FreeVPortCopLists(&vp);
    FreeCprList(v.LOFCprList);
    return(0);

    CloseLibrary(GfxBase);

}     /* end of main() */
```

Clipping Rectangle List

When you perform the various graphics drawing routines, you will notice that the routines draw into Intuition windows, even though the windows might be partially or totally obscured on the screen. This is because the layer library functions split the drawing area to provide lists of drawing areas that the graphics drawing can use for its operations.

In particular, the layer library functions split the windows into rectangles. You need only concern yourself with a single overall **RastPort** that contains the description of the complete area that you are managing. When either you or Intuition use the layer library, the graphics routines will be able to tell how the drawing area is split and where rendering can occur.

The set of rectangles comprising the layer is known as a clipping rectangle list (**ClipRect** structure). A clipping rectangle is a rectangular area into which the graphics routines will draw. All drawing that would fall outside of that rectangular area is clipped (not rendered).

DAMAGE LIST

For a smart-refresh window, the system automatically generates off-screen buffer spaces, essentially linked into the clipping rectangle list. Thus, parts of the display that are on the screen are rendered into the on-screen drawing area, and parts of the display that are obscured are drawn into a back-up area. When segments are exposed, the back-up area information is brought to view automatically during the routines **UpfrontLayer()** and **BehindLayer()**, as well as during **MoveLayer()**.

For a simple-refresh window however, any section of a drawing area that is not covered in the clipping rectangle list is not drawn into by the graphics routines. When obscured areas are exposed, they will not contain any graphics rendering at all. As the system creates and moves layers in front of such simple-refresh windows, the layers library keeps track of the rectangular segments that have not been drawn and are therefore not part of any automatically saved back-up areas. This list of non-drawn areas is called a **DamageList**.

REPAIRING THE DAMAGE

When you receive a REFRESH event from Intuition for a simple refresh window, you are being told that Intuition, through the layers library, has done something to change the portions of your window that are exposed to view. In other words, there is likely to be a blank space where there is supposed to be some graphics.

To update only those areas that need updating, you call **BeginUpdate()**. **BeginUpdate()** saves the pointer to the current clipping rectangles. It also installs in the layer structure a pointer to the set of **ClipRects** generated from the **DamageList**. In other words, the graphics rendering routines see only those rectangular spaces that need to be updated and refuse to draw into any other spaces within this layer. If, for example, there are only one or two tiny rectangles that need to be fixed, the graphics routines can ignore all but these spaces and repair them very quickly and efficiently. To repair the layer, you ask the graphics routines to redraw the whole layer, but the routines use the new clipping rectangle list (that is, the damage list) to speed the process.

To complete the update process call **EndUpdate()**, to restore the original **ClipRect** list.

Regions

Regions are rectangles that, when combined, can become part of a **DamageList**. The library *graphics.library* contains several support routines for regions. Among these are routines for the following operations:

Operation	Routine
Creating and deleting regions	**NewRegion(), DisposeRegion()**
Changing a region	**AndRectRegion(), OrRectRegion, XorRectRegion()**
Clearing a region	**ClearRegion()**

Basically, the region commands let you construct a custom **DamageList**, which you can use with your graphics rendering routines. With this list, you can selectively update a custom-sized, custom-shaped part of your display area without disturbing any of the other layers that might be present.

CREATING AND DELETING REGIONS

NewRegion() allocates and initializes a new data structure that may be thought of as a blank painter's easel.

If this new region is to be used as the basis for a **DamageList**, and you asked the graphics routines to draw something through this **DamageList**, nothing would be drawn as there is nothing in the region. The region that you produce can be thought of as patches of canvas. A new region has no canvas.

Because a region is dynamically created by using **NewRegion()**, the procedure **DisposeRegion()** is provided to return the memory to the system when you have finished with it. Note that not only the region structure is deallocated; so are any rectangles that have been linked into it.

CHANGING A REGION

OrRectRegion() modifies a region structure by *or*'ing a clipping rectangle into the region. This has an effect similar to adding a rectangle of canvas to the easel. If you now exercise the drawing routines, the rendering will occur in the areas where the region has been *or*'ed (canvas rectangle has been added) and will be inhibited elsewhere.

AndRectRegion() modifies a region structure by *and*'ing a clipping rectangle into the region. This has an effect similar to using the rectangle as an outline for a position on the easel. Any area of canvas that falls outside this outline is clipped and discarded.

XorRectRegion() applies the rectangle to the region in an exclusive-or mode. That is, wherever there is no canvas, canvas is applied to the easel. Wherever there is canvas present within the rectangle, a hole is created. Thus it is a combination of **OrRectRegion()** and **AndRectRegion()** in a single application.

CLEARING A REGION

While you are performing various types of selective drawing area updates, you may wish to do some of your graphics rendering with one form of region, and some with a different form of region. You can perform **ClearRegion()** to go from one form back to a fresh, empty region. Then you can begin again to compose yet another modified region for the next drawing function.

USING REGIONS

The region routines typically are used in a sequence like the following:

```
struct Region *r;
struct Rectangle *rect1, *rect2, rect3;

r = NewRegion();
OrRectRegion(rect1, r);        /* add a rectangle */
AndRectRegion(rect3, r);           /* patch a rectangle */
XorRectRegion(rect2, r);       /* weird patch */
        . . .
/* in this section of code:
 * 1. Save current pointer to DamageList for the layer you wish to affect.
 * 2. Equate the region address (r) to the DamageList pointer in the
 *    layer structure.
 * 3. Perform whatever drawing functions you wish into this layer.
 * 4. Restore the original DamageList pointer.
*/
        . . .
DisposeRegion(r);
```

The drawing will only occur in those areas of the drawing area that you have specified should be updated. Graphics rendering is often made faster this way, because not all of the area need be updated.

A typical sequence using **ClearRegion()** might be:

```
struct Region *r;
struct Rectangle *rect1, *rect2, rect3;
struct Layer_Info *li;

r = NewRegion();
OrRectRegion(rect1, r);
OrRectRegion(rect2, r);
        . . .
    (swap in as a damage list)
BeginUpdate(li);
    (draw, draw, draw something)
EndUpdate(li);
    (restore original damage list)
        . . .
ClearRegion(r);
AndRectRegion(rect3, r);
        . . .
    (swap, draw, restore)
        . . .
DisposeRegion(r);
```

SAMPLE APPLICATION FOR REGIONS

For example, assume that you are producing a display that requires a view through a fence. You can create this "slats" effect by using regions, as follows:

1. Create a new region.

2. Create several rectangles representing the open areas of the slats in the fence.

3. *Or* these into the region.

4. Save the **DamageList** pointer in the affected layer so it can be restored later.

5. Copy the region address into **DamageList** pointer.

6. Draw the scene into the entire layer using the graphics.

7. Restore the original **DamageList** pointer.

8. Dispose of the region.

Here is a sample application. It is based on the sample layers library program shown above. For brevity, the comments have been stripped out except where new material, pertinent to regions, has been inserted.

```
/* SIMPLE REGIONS EXAMPLE.... DRAW BEHIND A FENCE */
/* Certain layers.library routines are used herein that are not
 * available until Amiga C compiler version 1.1 and beyond. */

#include <exec/types.h>
#include <graphics/gfx.h>
#include <hardware/dmabits.h>
#include <hardware/custom.h>
#include <graphics/gfxmacros.h>
#include <graphics/regions.h>
#include <graphics/clip.h>
#include <graphics/text.h>
#include <hardware/blit.h>
#include <graphics/gfxbase.h>
#include <graphics/copper.h>
#include <graphics/gels.h>
#include <graphics/rastport.h>
#include <graphics/view.h>
#include <exec/exec.h>
```

```
#include <graphics/layers.h>

#define FLAGS LAYERSIMPLE
extern struct Layer *CreateUpfrontLayer();

struct GfxBase *GfxBase;

long LayersBase;

#define DEPTH 2
#define WIDTH 320
#define HEIGHT 200
#define NOT_ENOUGH_MEMORY -1000

struct ColorMap *GetColorMap();

USHORT colortable[] = { 0x000, 0xf00, 0x0f0, 0x00f };
        /* black, red, green, blue */

extern struct Layer_Info *NewLayerInfo();

main()
{
    struct View *oldview;
    struct View v;
    struct ViewPort vp;
    struct ColorMap *cm;
    struct RasInfo ri;
    struct BitMap b;
    struct RastPort *rp;        /* one RastPort for one layer */
    short i,j,k,n;
    UBYTE *displaymem;
    UWORD *colorpalette;

    struct Layer_Info *li;
    struct Layer *layer;        /* one layer pointer */

    extern struct Region *NewRegion();
    struct Region *rgn;         /* one region pointer */
    struct Rectangle rect[14];  /* some rectangle structures */
    struct Region *oldDamageList;
    SHORT x,y;

    GfxBase = (struct GfxBase *)OpenLibrary("graphics.library",0);
    if (GfxBase == NULL) exit(1);
```

```
LayersBase = OpenLibrary("layers.library",0);
if(LayersBase == NULL) exit(2);


oldview = GfxBase->ActiView;

li = NewLayerInfo();      /* v1.1 code only */
InitView(&v);
v.ViewPort = &vp;
InitVPort(&vp);
vp.DWidth = WIDTH;
vp.DHeight = HEIGHT;
vp.RasInfo = &ri;
InitBitMap(&b,DEPTH,WIDTH,HEIGHT);
ri.BitMap = &b;
ri.RxOffset = 0;
ri.RyOffset = 0;
ri.Next = NULL;
cm = GetColorMap(4);
colorpalette = (UWORD *)cm->ColorTable;
for(i=0; i<4; i++)
{
   *colorpalette++ = colortable[i];
}
vp.ColorMap = cm;
for(i=0; i<DEPTH; i++)
{
    b.Planes[i] = (PLANEPTR)AllocRaster(WIDTH,HEIGHT);
    if(b.Planes[i] == NULL) exit(NOT_ENOUGH_MEMORY);
   BltClear(b.Planes[i],RASSIZE(WIDTH,HEIGHT,0);
}

MakeVPort( &v, &vp );
MrgCop( &v );

LoadView(&v);
layer = CreateUpfrontLayer(li,&b,0,0,200,140,FLAGS,NULL);
if(layer==NULL) exit(3);

rp = layer->rp;

SetAPen(rp,3);
RectFill(rp,0,0,199,139);        /* show the layer itself */

j=10;                            /* initialize the rectangles */
```

```
for(i=0; i<10; i++)
{
    rect[i].MinX = j;
    rect[i].MaxX = j + 8;
    rect[i].MinY = 20;
    rect[i].MaxY = 120;
    j += 16;
}

rgn = NewRegion();              /* get a new region to use */
if(rgn == NULL) exit(4);

for(i=0; i<14; i++)
    OrRectRegion(rgn,&rect[i]);

oldDamageList = layer->DamageList;
layer->DamageList = rgn;

BeginUpdate(layer);

/* here insert the drawing routines to draw something behind the slats */
x = 4;  y = 10;
SetAPen(rp,0);
SetDrMd(rp,JAM1);
RectFill(rp,0,0,199,139);
SetAPen(rp,1);
SetBPen(rp,0);
SetDrMd(rp,JAM2);
for(i=0; i<14; i++)
{
   Move(rp, x, y);
   Text(rp,"Behind A Fence",14);
   x += 4;  y += 9;
}
EndUpdate(layer);
layer->DamageList = oldDamageList;
DisposeRegion(rgn);

Delay(300);

DeleteLayer(li, layer);
DisposeLayerInfo(li);

LoadView(oldview);
```

```
    /* return user and system-allocated memory to sys manager */
  for(i=0; i<DEPTH; i++)/* free the drawing area */
        FreeRaster(b.Planes[i],WIDTH,HEIGHT);
  FreeColorMap(cm);              /* free the color map */
                          /* free dynamically created structures */
  FreeVPortCopLists(&vp);
  FreeCprList(v.LOFCprList);
  return(0);

  CloseLibrary(GfxBase);

}   /* end of main() */
```

Chapter 3

Animation

Introduction

The graphics animation routines let you define images by specifying various characteristics of graphic objects, such as the following:

- Height
- Width
- Colors
- Shape
- Position in the drawing area
- How to draw the object
- How to move the object
- How the object interacts with other elements

The objects you define are called GELS (for "graphic elements"). You can draw GELS into or onto a background display of some type. The graphics animation routines operate on a list of GELS to produce a list of instructions that cause the system to draw the GELS in the manner you have specified.

PREPARING TO USE GRAPHICS ANIMATION

Because the animation routines have been designed to interact with a background display, you must first make sure that such a display is already defined.

To define a display with which the GELS can interact, you define **View**, **ViewPort**, and **RastPort** structures. For details on the construction of these structures, see chapter 1, "Graphics Primitives," and chapter 2, "Layers."

The graphics animation routines described in this chapter create additional material that is linked into the **View** structure. This material consists of additional instructions for color changes and dynamic reassignment of the hardware resources that create the display animation effects you specify.

TYPES OF ANIMATION

Using the Amiga system tools, you can perform two different kinds of image animation: sprite animation and playfield animation.

Sprite Animation

Sprites are hardware objects that you create and move independently of the playfield display. Sprites are always 16 low-resolution pixels wide and are as high as you specify. To move sprites, you must define where they are on the screen. The built-in priority circuitry determines how the sprite appears on the screen relative to the playfield elements or to other sprites.

You can manipulate sprites directly through a simple sprite set of routines or by using the graphics kernel **VSprite** routines.

Playfield Animation

Sprites are normally moved against a background. This background area is called the playfield. You may treat the playfield area as a single background or separate it into two separately controllable sections, using dual-playfield mode. See chapter 1, "Graphics Primitives," for details on how to create and control playfields.

In playfield animation, sections of the playfield are modified. You draw, erase, and redraw objects into the playfield, creating an animation effect. To move the data quickly and efficiently, the system uses one of the specialized built-in hardware devices, the *blitter*. The system uses the blitter to move the playfield objects, while it saves and restores the background. The objects controlled by the blitter are called **Bobs**, for "blitter objects."

Playfield animation is somewhat more complicated than **VSprite** animation from the point of view of system design, but not much more complicated for you as the user of the animation routines. The hardware displays the **VSprites** over the playfield automatically, and the priority overlay circuitry assures that they will be displayed in the correct order. If you are animating multiple **Bobs**, you control their *video priority* by defining the sequence in which the system draws them. The last one drawn has the highest video priority in the sense that it appears to be in front of all other **Bobs**.

A **Bob** is physically a part of the playfield. When the system displays a **Bob**, it must first save a copy of the playfield area into which the **Bob** will be drawn. Then the system can restore the playfield to its original condition when moving the **Bob** to a new location. Once the playfield areas have been saved, the system can draw the **Bob**. To move the **Bob**, the system must first restore the playfield area (thus erasing the object) before it saves the playfield at the new location and draws the **Bob** there.

Bobs offer more flexibility and many more features than **VSprites**. **Bob** animation is less restrictive but slower than **VSprite** animation. **VSprites** are superior to **Bobs** in speed of display, because **VSprites** are mostly hardware-driven and **Bobs** are part hardware and part software. **Bobs**, on the other hand, are superior to **VSprites** in that they offer almost all of the benefits of **VSprites** but suffer none of the limitations, such as size or number of colors.

Both are very powerful and useful. The requirements of your particular application determine the type of GEL to use.

THE GELS SYSTEM

The acronym GEL describes all of the graphic elements, or "objects," supplied by the Amiga ROM kernel. Both **VSprites** and **Bobs** are GELS, as are the more advanced animation elements known as **AnimComps** and **AnimObs**.

Initializing the GEL System

To initialize the graphics element animation system, you provide the system with the addresses of two data structures. The system uses these data structures to keep track of the GELS that you will later define. To perform this initialization, you call the system routine **InitGels()**, which takes the form:

InitGels(head, tail, Ginfo);

where

head
is a pointer to the **VSprite** structure to be used as the GEL list head

tail
is a pointer to the **VSprite** structure to be used as the GEL list tail

Ginfo
is a pointer to the **GelsInfo** structure to be initialized

The graphics animation system uses two "dummy" **VSprites** as place holders in the list of GELS that you will construct. The dummy **VSprites** are used as the head and tail elements in the system list of GELS. You add graphics elements to or delete them from this list.

The call to **InitGels()** forms a linked list of GELS that is empty except for these two dummy elements. When the system initializes the list with the dummy **VSprite**, it automatically gives the **VSprite** at the head the maximum possible negative y and x positions and the **VSprite** at the tail the maximum possible positive y and x positions. This assures that the two dummy elements are always the outermost elements of the list.

The y,x values are coordinates that relate to the physical position of the GEL within the drawing area. The system uses the y,x values as the basis for the placement (and later sorting) of the GELS in the list.

When you add a GEL to the list of graphics elements, the system links that GEL into the list shown above. Then the system adds any new element to the list immediately ahead of the first GEL whose y,x value is greater than or equal to that of the new GEL being added.

Types of GELS

Figure 3-1 shows how you can view the components of GELS as inter-related layers of graphics elements.

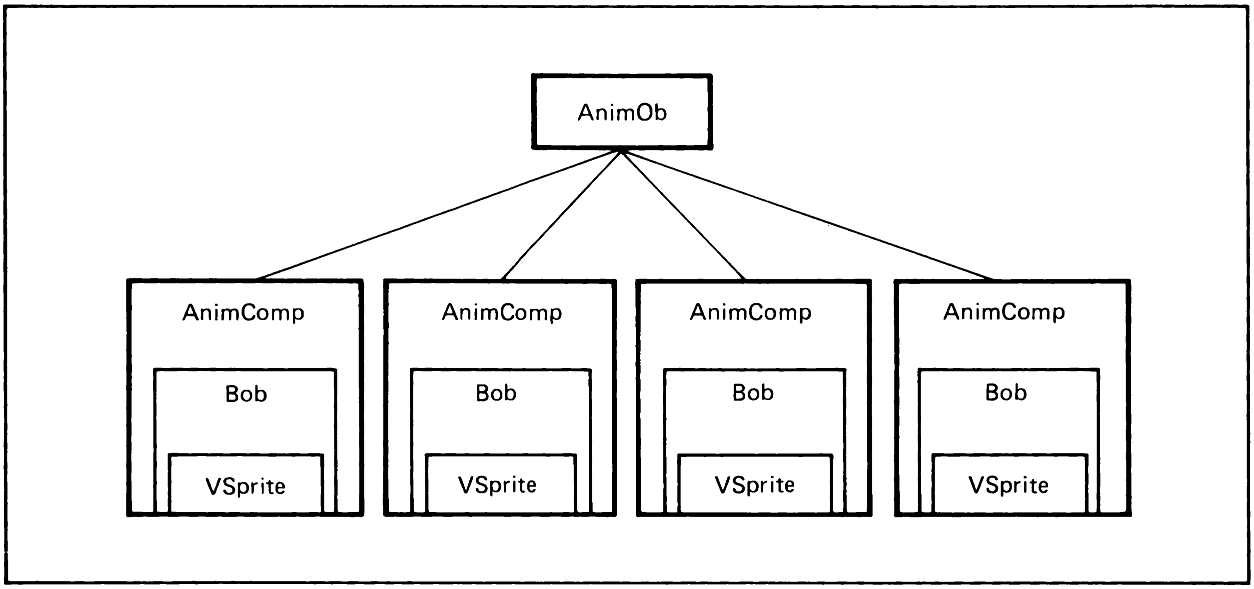

Figure 3-1: Shells of Gels

The types of GELS are listed below:

- o Simple (hardware) sprites
- o **VSprites**
- o **Bobs**
- o **AnimComps**
- o **AnimObs**

VSprites and **Bobs** are the primary software-controlled animation objects. They are part of an integrated animation system. The simple sprites, on the other hand, are separate from the animation system. It is up to you to decide which type of sprite to use. The next sections describe all of these animation components.

Simple (Hardware) Sprites

The simple sprite is a special graphics element, related to the graphics animation system only in that it vies with the **VSprites** for the use of the same underlying hardware elements, the real hardware sprites.

The Amiga hardware has the ability to handle up to eight sprite objects. Each sprite is produced by one of the eight hardware sprite DMA channels. Each sprite is 16-bits wide and arbitrarily tall. The Amiga software provides a choice about how you can use these hardware elements. You can either allocate one or more hardware sprites for your exclusive use, or you can allow all sprites to be managed by the system software and assigned as virtual sprites by the system. Using virtual sprites, it can appear as though you have an unlimited set of sprites with which to work. If you need only a few sprites, however, you may wish to use the less complex routines shown in the section called "Using Simple Sprites."

VSprites

The virtual sprite is the most elemental component. It contains a little more information than is needed to define a hardware sprite. The system temporarily assigns each **VSprite** to a hardware sprite, as needed. The information in the **VSprite** structure allows the system to maintain the more general GEL functions, such as collision detection and double-buffering. After a sprite DMA channel has displayed the last line of a sprite, the system can reuse the channel to display a different image lower on the screen. The system software takes advantage of this reusability to dynamically assign hardware sprites to carry **VSprite** images.

The **VSprite** is a data structure closely related to hardware sprites. The **VSprite** structure contains the following information:

- o Size
- o Image display data
- o Screen coordinates
- o Collision descriptors
- o A pointer to color information

Bobs

The **Bob** is the next outermost level of the GEL system. It is like an expanded hardware sprite done in software. It uses the same information defined in a **VSprite**, but adds other data that further defines this type of object. **Bobs** and **VSprites** differ in that the system draws **Bobs** into the playfield using the blitter, while it assigns **VSprites** to hardware sprites.

A **Bob** structure contains the following information:

- A pointer to a **VSprite**
- Priority descriptors
- Variables and pointers that define how and where to save the background

AnimComps

The **AnimComp** (for "animation component") is a data structure that extends the definition of a **Bob**. It allows the system to include the **Bob** as part of a total animation object. An **AnimComp** expands on the **Bob** data. **AnimComps** include the following:

- A pointer to this **AnimComp**'s **Bob**
- Links that define the sequence of animation drawings
- Information that describes the screen coordinates of the **AnimComp** with respect to the position of the **AnimOb**, described below
- Timing information for sequencing this **AnimComp** as part of the list of animation drawings
- A pointer to a user routine to execute in conjunction with this **AnimComp**

AnimObs

The **AnimOb** (for "animation object") is the primary animation object. It is a pseudo-object whose primary purpose is to link one or more **AnimComps** into a single overall object. As the **AnimOb** moves, so move its **AnimComps**. When the **Bobs** move with their **AnimComps**, the system sets the screen coordinates in the **VSprite** accordingly. **AnimObs** include the following:

- A pointer to this **AnimOb**'s first **AnimComp**

- Links to previous or succeeding **AnimObs**

- Information that describes the position of this **AnimOb** on the screen, as well as its velocity and acceleration

- Information for double-buffering this **AnimOb**, if desired

- A pointer to a user routine to execute in conjunction with this **AnimOb**

Using Simple (Hardware) Sprites

To use simple sprites, define their data structures and use the following routines:

- **ON_SPRITE** — a system macro to turn on sprite DMA

- **OFF_SPRITE** — a system macro to turn off sprite DMA

- **GetSprite()** — attempts to allocate a sprite from the virtual sprite machine for your exclusive use

- **ChangeSprite()** — modifies the sprite's appearance

- **MoveSprite()** — changes the sprite's position

- **FreeSprite()** — returns the sprite to the virtual sprite machine

These routines are described in detail in the following sections.

To use these simple sprite routines or the **VSprite** routines, you must include the SPRITE flag in the data structure for **OpenScreen()**. If you are not using Intuition, this flag must be specified in the **View** and **ViewPort** data structures before **MakeView()** is called.

CONTROLLING SPRITE DMA

You can use the graphics macros **ON_SPRITE** and **OFF_SPRITE** to control sprite DMA. **OFF_SPRITE** prevents the system from displaying any sprites, whether hardware or VSprite. **ON_SPRITE** restores the sprite data access and display. Note that the Intuition cursor is a sprite. Thus, if you use **OFF_SPRITE**, you make Intuition's cursor invisible as well.

ACCESSING A HARDWARE SPRITE

You use **GetSprite()** to gain access to a new hardware sprite. You use a call such as

status = GetSprite(sprite, number)

GetSprite() allocates a hardware sprite for your exclusive use. The virtual sprite allocator can no longer assign this sprite. Note that if you steal one sprite, you are effectively stealing two. The sprite pairs 0/1, 2/3, 4/5, and 6/7 share the same color registers. If you are stealing a hardware sprite, you steal its color registers as well. So you might as well ask for the other sprite in the pair. Table 3-1 shows the color registers assigned to each sprite pair.

Table 3-1: Sprite Color Registers

Color Registers	Sprite
16-19	0 or 1
20-23	2 or 3
24-27	4 or 5
28-31	6 or 7

You are not granted *exclusive* use of the color registers. If the **ViewPort** is 5 bit-planes deep, all 32 of the system color registers will still be used by the playfield display hardware.

Note, however, that registers 16, 20, 24, and 28 always generate the "transparent" color when selected by a sprite, regardless of which color is actually in them. Their true color will be used only if they are selected by a playfield. For further information, see the *Amiga Hardware Reference Manual.*

Also note that sprites and sprite colors are bound to the **ViewPort** in that you can reload the colors between **ViewPorts**. In other words, if a user in a **ViewPort** located in the top part of the screen allocates sprite 0 and a user in the a **ViewPort** at the bottom of the screen allocates sprite 1, these two sprites will not necessarily have the same color set, as the two **ViewPorts** can have totally independent sets of colors.

The inputs to the **GetSprite()** routine are:

sprite A pointer containing the address of a data structure called **SimpleSprite**

number The number (0-7) of the hardware sprite you wish to reserve. If **number** is -1, the system gets any sprite.

A value of 0-7 is returned in "status" if your request was granted, specifying which sprite you have allocated. A value of -1 means that this sprite is already allocated.

The structure for a simple sprite is shown below:

```
struct SimpleSprite {
     /* pointer to definition data of the hardware sprite to be displayed */
     UWORD *posctldata;
     UWORD height;    /* height of this simple sprite in rows */
     UWORD x,y;  /* current position */
     /* number (0-7) of hardware sprite associated with this simple sprite */
     UWORD num;
};
```

This data structure is found in the *graphics/sprite.h* file in the appendixes to this manual.

CHANGING THE APPEARANCE OF A SIMPLE SPRITE

The **ChangeSprite()** routine changes the appearance of a reserved sprite. It is called by the following sequence:

ChangeSprite(vp, s, newdata)

ChangeSprite() substitutes a new data content for that currently used to display a reserved hardware sprite.

The inputs to this routine are:

vp	A pointer to the **ViewPort** for this sprite or 0 if this sprite is relative only to the current **View**
s	A pointer to a **SimpleSprite** structure
newdata	A pointer to a data structure containing the new data to be used

The structure for the new data is shown below:

```
struct userspritedata
{
    /* position and control information for this sprite */
    UWORD posctl[2];
    /* two words per line of sprite height, first of the two
     * words contains msbit for color selection, second word
     * contains lsbit (colors 0,1,2,3 from allowable color
     * register selection set).  Color '0' for any sprite
     * pixel makes it transparent.
    */
    UWORD sprdata[2][height];          /* actual sprite image */

    /* initialize to 0, 0 for unattached simple spites */
    UWORD reserved[2];
};
```

MOVING A SIMPLE SPRITE

MoveSprite() repositions a reserved hardware sprite. It is called as follows:

MoveSprite(vp, sprite, x, y)

After you call this routine, the reserved sprite is moved to a new position relative to the upper left corner of the **ViewPort**.

The inputs to **MoveSprite()** are as follows:

vp A pointer to the **ViewPort** with which this sprite interacts or 0 if this sprite's position is relative only to the current **View**

sprite A pointer to a **SimpleSprite** structure

x, y Pixel position to which a sprite is to be moved. If the sprite is being moved over a high-resolution display, the system can move the sprite only in two-pixel increments. In low-resolution mode, single-pixel increments in the x direction are acceptable. For an interlaced mode display, the y direction motions are in two line increments. The same image of the sprite is placed into both even and odd fields of the interlaced display.

The upper left corner of the **ViewPort** area has coordinates (0,0). The motion of the sprite is relative to this position.

The following example demonstrates how you move a simple sprite.

```
/* This program creates and displays a 320-by-200 by 2-bit-plane
 * single-playfield display and adds one simple sprite to it.
 */

#include "exec/types.h"
#include "graphics/gfx.h"
#include "hardware/dmabits.h"
#include "hardware/custom.h"
#include "hardware/blit.h"
#include "graphics/gfxmacros.h"
#include "graphics/copper.h"
#include "graphics/view.h"
#include "graphics/gels.h"
#include "graphics/regions.h"
#include "graphics/clip.h"
#include "exec/exec.h"
#include "graphics/text.h"
#include "graphics/gfxbase.h"
#include "graphics/sprite.h"

#define DEPTH 2
#define WIDTH 320
#define HEIGHT 200
#define NOT_ENOUGH_MEMORY -1000

/* construct a simple display */

struct View view;
struct ViewPort viewport;

/* pointer to ColorMap structure, dynamically allocated */
struct ColorMap *cm;

struct RasInfo rasinfo;
struct BitMap bitmap;

SHORT xmove, ymove;

extern struct ColorMap *GetColorMap();
struct GfxBase *GfxBase;

/* save pointer to old View so can restore */
struct View *oldview;
```

```
USHORT colortable[] = {
      /* black, red, green, blue */
      0x000, 0xf00, 0x0f0, 0x00f,
      0,0,0,0,
      0,0,0,0,0,0,0,0,
      0,0,0,0,0,0,0,0,    /* sprites from here up */
      0,0,0,0,0,0,0,0
};

/* where to draw boxes */
SHORT  boxoffsets[] = {
      802, 2010, 3218
};

UWORD *colorpalette;

struct SimpleSprite sprite;

/* Last entry is "position control" for the next reuse of the hardware sprite.
 * Simple sprite machine supports only one use of a hardware sprite per video
 * frame. Any combination of binary bits from word 1 and word 2 per line
 * establishes the color for a pixel on that line.  Any nonzero pixels in lines
 * 1-3 are color "1" of the sprite, lines 4-6 are color "2", lines 7-9 are color "3".
*/
UWORD sprite_data[ ] = {
      0,0,               /* position control */
      0x0fc3, 0x0000,  /* image data line 1 */
      0x3ff3, 0x0000,  /* image data line 2 */
      0x30c3, 0x0000,  /* image data line 3 */
      0x0000, 0x3c03,  /* image data line 4 */
      0x0000, 0x3fc3,  /* image data line 5 */
      0x0000, 0x03c3,  /* image data line 6 */
      0xc033, 0xc033,  /* image data line 7 */
      0xffc0, 0xffc0,    /* image data line 8 */
      0x3f03, 0x3f03,  /* image data line 9 */

      /* NOTE this last line specifies unattached, simple sprites */
      0, 0               /* next sprite field */
};

/******************************************************************
 * FOLLOWING IS FOR INFORMATION ONLY.... the simple-sprite machine directly
 * sets these bits; the user has no need to change any of them.  Use the
 * functions ChangeSprite() and MoveSprite() to have an effect on the sprite.
 *
```

```
* position control:
*
*   first UWORD:
*     bits 15-8, start vertical value, lowest 8 bits of this value
*           contained here.
*     bits  7-0, start horizontal value, highest 8 bits of this value
*           contained here.
*
*   second UWORD:
*     bits 15-8, end (stopping) vertical value, lowest 8 bits of this
*           value contained here.
*     bit 7 = Attach-bit (used for attaching sprites to get additional
*           colors (15 instead of 3, supported by the hardware but
*           NOT supported by the simple sprite machine).
*     bits 6-4 (unused)
*     bit 2 start vertical value; bit 8 of that value.
*     bit 2 end vertical value; bit 8 of that value.
*     bit 2 start horizontal value; bit 0 of that value.
*
****************************************************************/

main()
{
      LONG i;
      SHORT j,k,n;
      SHORT spgot;
      UBYTE *displaymem;

      GfxBase = (struct GfxBase *)OpenLibrary( "graphics.library" , 0 );
      if( GfxBase == NULL ) exit(100);

      /* save current view to restore later */
      oldview = GfxBase->ActiView;

      /* example steals screen from Intuition if started from WBench */

      InitView( &view );                /* initialize View */
      InitVPort( &viewport );           /* init ViewPort */
      view.ViewPort = &viewport;        /* link View into ViewPort */

      /* init bit map (for RasInfo and RastPort) */
      InitBitMap( &bitmap, DEPTH, WIDTH, HEIGHT );

      /* init RasInfo */
      rasinfo.BitMap = &bitmap;
```

```
rasinfo.RxOffset = 0;
rasinfo.RyOffset = 0;
rasinfo.Next = NULL;

/* now specify critical characteristics */
viewport.DWidth = WIDTH;
viewport.DHeight = HEIGHT;
viewport.RasInfo = &rasinfo;

/* initialize the color map.  It has 32 entries. Sprites take up
 *the top 16 and we want to specify some sprite colors */
cm = GetColorMap( 32 );

/* no memory for color map */
if(cm == NULL) {
      FreeMemory();
      exit( 100 );
}

colorpalette = (UWORD *)cm->ColorTable;
for(i=0; i<32; i++) {
      *colorpalette++ = colortable[i];
}

/* copy my colors into this ViewPort structure */
viewport.ColorMap = cm;

/* addition for simple sprite: */
vp.Modes = SPRITES;

/* allocate space for bitmap */
for(i=0; i<DEPTH; i++) {
      bitmap.Planes[i] = (PLANEPTR) AllocRaster( WIDTH, HEIGHT );
      if( bitmap.Planes[i] == NULL ) exit( NOT_ENOUGH_MEMORY );

       /* clear the display area */
      BltClear( bitmap.Planes[i], RASSIZE(WIDTH,HEIGHT), 1 );
}

/* construct Copper instr (prelim) list */
MakeVPort( &view, &viewport );

/* merge prelim lists into a real Copper list in the view structure. */
MrgCop( &view );
LoadView( &view );
```

```
/* now fill some boxes so that user can see something */
/* always draw into both planes to assure true colors */
for(n=1; n<4; n++)      /* three boxes */
{
      for(k=0; k<2; k++)
      {
            /* boxes will be in red, green and blue */
            displaymem = bitmap.Planes[k] + boxoffsets[n-1];
            DrawFilledBox( n, k, displaymem );
      }
}

/*********************************************
 * now we are ready to play with the sprites!
 *********************************************/

/* Get the next available sprite.  We should do an error
 * check, if returns -1, then no sprites are available
*/
spgot = GetSprite( &sprite, -1 );

sprite.x = 0;           /* initialize position and size info */
sprite.y = 0;           /* matches that shown in sprite_data */
sprite.height = 9;      /* so that system knows layout of data later */

/* now put some colors into this sprite's color registers
 * to custom-control the colors this particular sprite will display.
 * NOTE: sprite pairs share color registers; i.e., sprites 0 and 1,
 * 2 and 3, 4 and 5, 6 and 7 as pairs share the same sets of color
 * registers (see the Amiga Hardware Reference manual for details).
 * The code following figures out which sprite the system gave us,
** and sets that sprite's color registers to the correct value
*/
k = ((spgot & 0x06)*2) + 16;

/* convert sprite number into the base number for its color reg set */
/* value at k treated as transparent */
SetRGB4( &viewport, k+1, 12, 3, 8 );
SetRGB4( &viewport, k+2, 13, 13, 13 );
SetRGB4( &viewport, k+3, 4, 4, 15 );

/* top of sprite is red, middle is white, bottom is blueish */
ChangeSprite(&viewport,&sprite,sprite_data);

MoveSprite(0,&sprite,30,0);
```

```
    xmove = 1;  ymove = 1;
    for( n = 0; n < 4; n++ ) {
        i=0;
        while( i++ < 185 ) {
            MoveSprite( 0, &sprite, sprite. x + xmove, sprite.y + ymove );

            /* slow it down to one move per video frame */
            WaitTOF();
        }
        ymove = -ymove;
        xmove = -xmove;
    }

    /* free this sprite so others can use it also */
    FreeSprite( spgot );


    /* restore the system to its original state */
    LoadView( oldview );
    FreeMemory();
    CloseLibrary( GfxBase );

}   /* end of main() */

/* return user and system-allocated memory to sys manager */
FreeMemory()
{
    LONG i;

    /* free drawing area */
    for( i=0; i<DEPTH; i++ ) {
        if( bitmap.Planes[i] != NULL ) {
            FreeRaster( bitmap.Planes[i], WIDTH, HEIGHT );
        }
    }
    /* free the color map created by GetColorMap() */
    if( cm != NULL ) FreeColorMap( cm );

    /* free dynamically created structures */
    FreeVPortCopLists( &viewport );
    FreeCprList( view.LOFCprList );
    return( 0 );
}

DrawFilledBox( fillcolor, plane, displaymem )
```

```
SHORT fillcolor,plane;
UBYTE *displaymem;
{
    UBYTE value;
    LONG j;

    for(j=0; j<100; j++) {
        if((fillcolor & (1 << plane)) != 0) {
            value = 0xff;
        } else {
            value = 0;
        }
        for(i=0; i<20; i++) {
            *displaymem++ = value;
        }
        displaymem += (bitmap.BytesPerRow - 20);
    }
    return(0);
}
```

RELINQUISHING A SIMPLE SPRITE

The **FreeSprite()** routine returns an allocated sprite to the virtual sprite machine. The virtual sprite machine can now reuse this sprite to allocate virtual sprites. The syntax of this routine is

FreeSprite(num)

where **num** is the number (0-7) of the sprite you want to return.

Note: You *must* free sprites after you have allocated them using **GetSprite()**. If you do not free them and your task ends, the system will have no way of reallocating those sprites until the system is rebooted.

Using VSprites

This section tells how to define a **VSprite**. It describes how to:

- Specify the size of the **VSprite** object

- Select its colors
- Form its image
- Specify its position within the drawing area
- Add it to the list of GELS
- Control it after you add it to the list

The system software also provides a way to detect collisions between individual **VSprites** and other on-screen objects. Collision detection applies to both **VSprites** and to **Bobs**. It appears as a separate topic under "Topics Common to Both VSprites and Bobs."

SPECIFYING THE SIZE OF A VSPRITE

The first step in defining a **VSprite** is telling its dimensions to the system. A **VSprite** is always 16 pixels wide and may be any number of lines high. Each pixel is the same size as a pixel in low-resolution mode (320 pixels across a horizontal line) of the graphics display. To specify how many lines make up the **VSprite** image, you use the **VSprite** structure **Height** variable.

If your **VSprite** is 12 lines high and the name of your **VSprite** structure is myVSprite, then you can set the height value with the following statement:

```
myVSprite.Height = 12;
```

Each line of a **VSprite** requires two data words to specify the color content of each pixel. This means that the data area containing the **VSprite** image is 12 x 2, or 24, words long.

See the next section for details on how bits of these data words select the color of the **VSprite** pixels.

SPECIFYING THE COLORS OF A VSPRITE

Because **VSprites** are so closely related to the hardware sprites, the choice of colors for **VSprites** is limited in the same way. Specifically, each pixel of a **VSprite** can be any one of three different colors or it may be transparent. However, the system software provides a great deal of versatility in the choice of colors for the virtual sprites. Each virtual sprite may have its own set of three unique colors.

When the system assigns a hardware sprite to carry the **VSprite**'s image, it assigns that **VSprite**'s color set to the hardware sprite that will produce that image. To define which set of three colors to use for this **VSprite**, you initialize the **VSprite** structure pointer named **SprColors**. **SprColors** points to the first data item of three sequentially-stored 16-bit values. The system then jams these values into the selected hardware sprite's color registers when it is being used to display this **VSprite**.

Every time you direct the system to redraw the **VSprites**, the GEL system reevaluates the current on-screen position of each **VSprite** and decides which hardware sprite will carry this **VSprite**'s image for this rendering. It creates a customized Copper instruction sequence including both the repositioning of hardware sprites and the reloading of sprite color registers for various screen positions. Thus, during a move sequence, a **VSprite** may be represented by one or many different real hardware sprites, depending on its current position relative to other **VSprites**.

For example, if your set of colors is defined by the statement:

```
WORD spriteColors = { 0x00F, 0x0F0, 0xF00 };
```

and if your **VSprite** is named myVSprite, to set the **VSprite** colors you would use the following statement:

```
myVSprite.SprColors = &spriteColors;
```

How you specify the **VSprite** colors may affect how many **VSprites** you can show on the screen at any one time. For further information, see "How VSprites are Assigned."

SPECIFYING THE SHAPE OF A VSPRITE

To define the appearance of a **VSprite**, initialize the **VSprite** structure pointer called **ImageData** to point to the first word of the image data. A **VSprite** image is defined exactly as the image of a real hardware sprite. It takes two sequential 16-bit data words to define each line of a **VSprite**.

To select colors for the pixels of a **VSprite**, examine the combination of the data bits in corresponding locations in each of the two data words that define each line. The first of each pair of data words supplies the low-order bit of the color selector for that pixel; the second word of the pair supplies the high-order bit.

For example:

mem	0101111111111111
mem + 1	0011111111111111

Reading from left to right, the combinations of these two sequential memory data words form the binary values of 00, 01, 10, 11, and so on. These binary values select colors as follows.

00 - selects **VSprite** color of "transparent"
01 - selects the first of three **VSprite** colors you have defined
10 - selects the second **VSprite** color
11 - selects the third **VSprite** color

In those areas where the combination of bits yields a value of 00, the **VSprite** is transparent. Any object whose priority is lower than that of the **VSprite** will show through in transparent sections of the **VSprite**. Thus, you might form a full three-color image, with some transparent areas, from a data set like the following sample:

VSprite Data

mem	1111111111111111	Defines top line -
mem + 1	1111111111111111	contains only color 3
mem + 2	0011111111111100	Defines second line -
mem + 3	0011000000001100	contains colors 1 and 3 and some transparency
mem + 4	0000110000110000	Defines third line -
mem + 5	0000111111110000	contains colors 2 and 3 and some transparency
mem + 6	0000001001000000	Defines fourth line -
mem + 7	0000001111000000	contains colors 2 and 3 and some transparency
mem + 8	0000000110000000	Defines last line -
mem + 9	0000000110000000	contains color 3 and some transparency

The **VSprite** Height for this sample image is 5.

SprColors must point to the set of three colors that are to be used to display this **VSprite**, and **ImageData** must point to the location ("mem" in the example) that contains the first word of the **VSprite** definition.

SPECIFYING VSPRITE POSITION

To control the position of a **VSprite**, you use the y and x variables within the **VSprite** structure. You specify the position of the upper left corner of a **VSprite** relative to the upper left corner of the drawing area where you wish the **VSprite** to appear. Assign a value of 0,0 for y,x to make the **VSprite** appear with its upper left corner against the upper left corner of the drawing area. You can use values of y and x to move the **VSprite** entirely off the screen, if you wish.

You resolve the vertical positioning for **VSprites** in terms of the non-interlaced mode of the display. When you position a **VSprite** so that its y value is within the visible area of the screen, you can select any one of 200 possible positions down the screen at which its topmost edge can be placed.

You resolve the horizontal positioning for **VSprites** in terms of the low-resolution mode of the screen display. When you position a **VSprite** so that its x value is within the visible area of the screen, you can select any one of 320 possible positions across the screen at which its left-most edge can be placed. Note that if you are using **VSprites** under Intuition and within a screen, they will be positioned relative to the upper left-hand corner of the screen.

USING VSPRITE FLAGS

Now that you have defined the **VSprite**'s size, colors, shape, and position, you may want to know where to add information to the data structures or where to check about the progress of the system routines. The following sections describe the functions of the **VSprite** flags, the variables that let you do some of these activities.

The **VSprite** data structure contains a variable named **Flags** that has information about its data and about the progress of the system routines. The following sections describe the uses of the VSPRITE, VSOVERFLOW, and GELGONE flags. You can use these flags to perform these tasks:

VSPRITE	Indicate whether the system should treat the structure as a **VSprite** or part of a **Bob**.
VSOVERFLOW	Check on the **VSprites** the system cannot display. (This is a read-only system variable.)
GELGONE	Find out if the system has moved a GEL outside the clipping region of the drawing area. (This is a read-only system variable.)

VSPRITE Flag

To tell the GEL routines to treat this **VSprite** structure as a VSprite instead of a **Bob**, set the VSPRITE flag to 1. This affects the interpretation of the data layout and the use of various system variables. If you set the VSPRITE flag bit to zero, the GEL routines treat this **VSprite** structure as though it defined a **Bob** instead of a **VSprite**.

Note: Under Intuition, **VSprites** work only in screens, not in windows. **Bobs** work in both screens and in windows. Thus, if you wish to use **VSprites** and **Bobs** together, you can only do so by writing directly to the **RastPort** of a screen.

VSOVERFLOW Flag

If you have currently defined more **VSprites** at the same horizontal line than the system can possibly assign to the real hardware sprites, then the **VSprites** that the system cannot display have their VSOVERFLOW flag set. This means that it is possible that one or more **VSprites** will not appear on the display for this pass of producing the GELS.

GELGONE Flag

When the GELGONE flag is set to 1, you know that the system has moved a GEL (**VSprite** or a **Bob**) entirely outside of the clipping region of the drawing area. You can assume that the system will fully or at least partially draw any objects within the clipping region. Because the system will not draw this object that is outside the clipping area, you may wish to use **RemVSprite()** to delete the **VSprite** from the GEL list in order to speed up processing of the rest of the list. Of course, **VSprites** that you remove from the list are no longer managed or checked by the system.

ADDING A VSPRITE

To control **VSprites**, you first describe them using the **VSprite** structure variables mentioned above. Next you tell the system (by adding the **VSprites** to the GEL list) which **VSprites** to handle. This section tells you how to add a **VSprite** to the GEL list.

To add a **VSprite** to the system GEL list, call the system routine **AddVSprite()**, and specify the address of the **VSprite** structure that controls this **VSprite** as well as the **RastPort** with which it is associated.

A typical system call for this purpose follows:

```
struct VSprite myVSprite;
     ...
     ...
AddVSprite( &myVSprite, &rastport );
```

REMOVING A VSPRITE

To remove a **VSprite** from the list of controlled objects, use the system routine **RemVSprite()**. This function takes the following form:

```
RemVSprite( VS );
```

where **VS** is a pointer to the **VSprite** structure to be removed from the GEL list

GETTING THE VSPRITE LIST IN ORDER

When the system has displayed the last line of a **VSprite**, it reassigns the hardware sprite to another **VSprite** located at a lower position, farther left on the screen. The system allocates hardware sprites in the order in which it encounters the **VSprites** in the list. Therefore, you must sort the list of **VSprites** before the system can assign the use of the hardware sprites correctly.

When you first enter **VSprites** into the list using **AddVSprite()**, the system uses the y,x coordinates to place the **VSprites** into the correct position in the list. If you change the y,x coordinates after they are in the list, you must reorder the list before the system can use it to produce the display.

You use the routine **SortGList()** (for "sort the GEL list") to get them in the correct order before asking the system to display them. This sorting step is essential! You call this function as follows:

```
SortGList( RPort );
```

where **RPort** is a pointer to the **RastPort** structure containing the **GelsInfo**

Note that there may be a GEL list in more than one **RastPort**. You must sort all of them.

DISPLAYING THE VSPRITES

The next few sections explain how to display the **VSprites**. You use the following system routines:

- o **ON_DISPLAY** — to turn on the playfield display
- o **ON_SPRITE** — to turn on the **VSprites** display
- o **DrawGList()** — to draw the elements into the current **RastPort**
- o **MrgCop()** — to install the **VSprites** into the display
- o **LoadView()** — to ask the system to display the new **View**
- o **WaitTOF()** — to synchronize the routines with the display

Turning on the Display

Before you can view a display on the screen, you must enable the system direct memory access for both the hardware sprites and the playfield display. To enable the display of both playfield and **VSprites**, use the system macro calls:

```
ON_DISPLAY;
ON_SPRITE;
```

Drawing the Graphics Elements

The system routine called **DrawGList()** looks through the list of controlled GELS. It prepares necessary instructions and memory areas to display the data according to your requirements. You call this routine as follows:

```
DrawGList( RPort, VPort );
```

where

RPort
is a pointer to the **RastPort**

VPort
is a pointer to the **View**

Because the system links **VSprites** to a **View**, the use of a **RastPort** is not significant for them. However, you can use **DrawGList()** for **Bobs** as well as **VSprites**, so it is required that you pass the pointer to the **RastPort** to the routine. **DrawGList()** actually draws **Bobs** into that **RastPort** when you execute the instructions.

Once **DrawGList()** has prepared the necessary instructions and memory areas to display the data, you will need to install the **VSprites** into the display with **MrgCop()**.

Merging VSprite Instructions

Recall that the call to **DrawGList()** did not actually draw the **VSprites**. It simply provided a new set of instructions that the system uses to assign the **VSprite** images to real hardware sprites, based on their positions. The **View** structure already has a set of instructions that specifies how to construct the display area. It includes pointers to the set of **VSprite** instructions that was made by the call to **DrawGList()**. To install the current **VSprites** into the display area, you call the routine **MrgCop()** to merge together all of the display-type instructions in the **View** structure. You call this routine as follows:

MrgCop(View);

where **View** is a pointer to the **View** structure whose Copper instructions are to be merged

DrawGList() handles **Bobs** as wells as **VSprites**. Therefore, the call to **DrawGList()**, although it did not really draw the VSprite images yet, *does* draw the **Bobs** into the selected **RastPort**.

Loading the New View

Now that the display instructions include the definition of the **VSprites**, you can ask the system to prepare to display this newly configured **View**. You do this with the following system routine:

LoadView(view);

where **view** is a pointer to the **View** that contains the pointer to the Copper instruction list

The Copper instruction lists are double-buffered, so this instruction does not actually take effect until the next display field occurs. This avoids the possibility of some routine trying to update the Copper instruction list while the Copper is trying to use it to create the display.

Synchronizing with the Display

To synchronize your routines with the display, you use a call to the system routine **WaitTOF()**. Although your routines may possibly be capable of generating more than 60 complete display fields per second, the system itself is limited to 60 displays per second. Therefore, after generating a complete display, you may wish to wait until that display is ready to be shown on the screen before starting to generate the next one. **WaitTOF()** holds your task until the vertical-blanking interval (blank area at the top of the screen) has begun. At that time, the system has retrieved the current Copper instruction list and is ready to allow generation of a new list.

The call to the vertical-blanking synchronization routine takes the following form:

WaitTOF();

Now that you have learned how to add and display **VSprites**, you may want want to change some of their characteristics, as shown in the following section.

Changing VSprites

Once the **VSprite** has been added to the GEL list and is in the display, you can change some of its characteristics with the following operations:

- o Pointing to a new **VSprite** image (change the **ImageData** pointer)
- o Pointing to a new **VSprite** color set (change the **SprColors** pointer)
- o Defining a new **VSprite** position (change the y,x values)

VSPRITE OPERATIONS SUMMARY

This section provides a summary of the **VSprite** operations in their proper sequence:

- o Define a **View** structure that you can later merge with the **VSprite** instructions.
- o Initialize the GEL system (call **InitGels()**). This only needs to be done once.
- o Define the VSprite:
    - \- Define height.

- Define on-screen position.
- Define where to find **ImageData** data.
- Define where to find **SprColors** to use.
- Define **VSprite** structure flags to show that this is a **VSprite**.

o Add the **VSprite** to the GEL list.

o Change the **VSprite** appearance by doing the following:

- Changing the pointer to **ImageData**.
- Changing its height.

o Change the **VSprite** colors by changing the pointer to **SprColors**.

o Move the **VSprite** by defining a new y,x position.

o Display the **VSprite** with this sequence of routines:

- **ON_DISPLAY**;
- **ON_SPRITE**;
- **SortGList()**
- **DrawGList()**
- **MrgCop()**
- **LoadView()**

Once you have mastered the basics of handling **VSprites**, you may want to study the next two sections to find out how to reserve hardware sprites for use outside the **VSprite** system and how to assign the **VSprites**.

VSPRITE ADVANCED TOPICS

This section describes advanced topics pertaining to **VSprites**. It contains details about reserving hardware sprites for use outside of the **VSprite** system, information about how **VSprites** are assigned, and more information about **VSprite** colors.

Reserving Hardware Sprites

To prevent the **VSprite** system from using specific hardware sprites, you can write into the variable named **sprRsrvd** in the **GelsInfo** structure. The pointer to the **GelsInfo** structure is contained in the **RastPort** structure. If the contents of this 8-bit value is zero, then all of the hardware sprites may be used by the **VSprite** system. If any of the bits is a 1, the sprite corresponding to that bit will not be utilized by **VSprites**. Note that this increases the likelihood of a **VSprite** VSOVERFLOW. See the next section, "How VSprites are Assigned," for further details on this topic.

Hardware sprites are reserved as shown below.

This sprite is reserved:	7 6 5 4 3 2 1 0
If this **sprRsrvd** bit is a 1:	7 6 5 4 3 2 1 0

You normally assign hardware sprites in pairs, as suggested by the following example. Suppose you want to reserve sprites 0 and 1. Your program would typically include the following kinds of statements:

```
struct RastPort myRastPort;   /* the View structure is defined */
    ...
    ...
myRastPort->GelsInfo->sprRsrvd = 0x03;   /* reserve 0 and 1 */
```

If you reserve a hardware sprite for your own use, the system is unable to use that hardware sprite when it makes a **VSprite** assignment. In addition, because pairs of hardware sprites share color register sets, reserving one hardware sprite effectively eliminates two.

If you are using the simple sprite system to allocate sprites, you can look in the **GfxBase** structure to see which sprites are already in use.

Note: If Intuition is running, sprite 0 is already reserved for use as the pointer.

The reserved sprite status is accessible as

currentreserved = GfxBase->SpriteReserved

The next section presents a few trouble-shooting techniques for **VSprite** assignment.

How VSprites Are Assigned

Each **VSprite** can display three possible colors plus transparent. To define colors for **VSprites**, you use the **SprColors** pointer. **SprColors** points to the first of three word quantities, representing the three possible pixel colors for that virtual sprite.

Although the **VSprites** are handled by the automatic routines, the system *may* run out of sprites. If you ask that the software display more than four **VSprites** on a single horizontal scan line, it is possible that one or more sprites may disappear until the conflict is resolved.

Here is the reason that the **VSprite** routines might have problems, and some suggestions on how to avoid them. There are 8 *real* sprite DMA channels. Sprites 0 and 1 share color registers 17-19; sprites 2 and 3 share registers 21-23; sprites 4 and 5 share registers 25-27; and sprites 6 and 7 share registers 29-31.

When the **VSprite** routines use the sorted list of **VSprite** elements, they build a Copper instruction list that decides when to reuse a sprite DMA channel. They also build a Copper instruction stream that stuffs the color register set for the sprite selected at that time on the screen to represent this **VSprite** image.

This process consists of the following steps:

1. Use real sprite 0 to represent the first virtual sprite. Load that virtual sprite's colors into the three color registers for sprite 0 (registers 17, 18, 19).

2. Now look at the rest of the virtual sprites the user wishes to display on this same horizontal line.

3. If the **VSprite** color pointers are all different from the pointer found in the sprite 0 pointer, it will not be possible to use the real sprite 1 DMA channel for display on this line because it shares the real sprite 0 colors.

4. Conversely, if one of the other virtual sprites to appear on this line shares the same virtual color pointer, the **VSprite** routines can use sprite DMA channel 1 to represent that second virtual sprite.

5. The **VSprite** routines continue to map virtual sprites against the real sprites until either of the following events occurs:

   o All virtual sprites are assigned.

   o The system runs out of real sprites that it can use.

The system will run out of real sprites to use if you ask the virtual sprite system to display more than four sprites having different pointers to their color table on the same horizontal line. During the time that there is a conflict, one or more of your virtual sprites will disappear.

You can avoid these problems by taking the following precautions:

o Minimize the number of **VSprites** you wish to appear on a single horizontal line.

o If colors for some virtual sprites are the same, make sure that the pointer for each of the **VSprite** structures for these virtual sprites points to the same memory location, rather than to a duplicate set of colors elsewhere in memory.

If You Do Not Specify VSprite Colors

To pick the set of colors to use, you specify the pointer named **SprColors**. If you specify a 0 value for **SprColors**, that **VSprite** does *not* generate a color-change instruction stream for the Copper when the system displays it. Instead, the **VSprite** appears drawn in the color set that is currently written into the color registers for the hardware sprite currently selected to display this **VSprite**.

Table 3-2 shows how the hardware sprites use the color registers to select their possible range of colors:

Table 3-2: Hardware Sprite Color Registers

Hardware Sprite	**Color Registers**
0 and 1	17 - 19
2 and 3	21 - 23
4 and 5	25 - 27
6 and 7	29 - 31

During one screen display, the system may use hardware sprite number 1 to display a **VSprite**. In this case, the **VSprite** selects its three available colors from color register numbers 17-19. On another screen display, the system may select hardware sprite number 7 to display the same

VSprite. In this case, the hardware sprite uses color registers 29-31.

Therefore, if you make the **SprColors** pointer a 0, specifying that color does not matter, the system may display your **VSprite** in any one of a set of four different possible color groupings as indicated in the table above.

How VSprite and Playfield Colors Interact

The **VSprites** use system color registers 16 through 31 to hold the **VSprite** color selections. There are only 32 color registers in the system. The highest 16 color registers (16-31) are shared with the playfield color selections. If you are working in 32-color low-resolution mode, the system makes the first 16 color selections for the playfield pixels from color registers 0-15 and then makes the remaining color selections from color registers 16-31.

If you are using the **VSprite** system and specifying the colors (using **SprColors**) for each **VSprite**, the contents of color registers 16-31 will change constantly as the video display beam progresses down the screen. The Copper instructions change the registers to display the correct set of colors for your **VSprites** depending on their positions. If you have any part of a 32-color playfield display drawn in any of the colors shown in table 3-2, those colors will appear to flicker and change as your **VSprites** move.

This problem also affects 32-color **Bobs** because **Bobs** are actually drawn as part of the playfield display. Anything that affects the playfield affects the **Bobs** as well.

You can avoid this flickering and changing of colors by taking the following precautions:

- o Use no more than 16 colors in the playfield display whenever you use **VSprites**; or
- o If you are using a 32-color playfield display, do not use any colors other than 0-15, 16, 20, 24, and 28. The remaining color numbers are used by the **VSprite** system; or
- o Specify the **VSprite SprColors** pointer as a value of 0. This avoids changing the contents of any of the hardware sprite color registers, but may cause the **VSprites** to change colors depending on their positions relative to each other, as described in the previous section.

The first two alternatives are the easiest to implement.

Using Bobs

Because **Bobs** and **VSprites** are both graphics objects handled by the GEL system, they share many of the same data requirements. **VSprites** and **Bobs** differ primarily in that **Bobs** are drawn into the playfield using the blitter, while **VSprites** are assigned to hardware sprites.

The following sections describe how to define a **Bob**, including how to specify its size, select its colors, form its image, and specify its on-screen position.

Because a **Bob** is a more complex object than a VSprite, you must also define various other items, such as the color depth of the **Bob**, how to handle the drawing of the **Bob**, and certain other variables that the GEL system requires when **Bobs** are used.

LINKING A BOB TO A VSPRITE STRUCTURE

To fully define a **Bob**, you define two different structures: a **VSprite** structure and a **Bob** structure. The graphics animation system has been designed as a set of interrelated elements, each of which builds on the information provided by the underlying structure to create additional versatility. The common elements—such as height, collision-handling information, position in the drawing area, and pointers to the data definition—are part of the **VSprite** structure. The added features—such as drawing sequence, data about saving and restoring the background, and other features not common to **VSprites**—are part of the **Bob** structure instead.

The **VSprite** and **Bob** structures must point to one another, so that the system knows where all of the appropriate variables are defined. For example, suppose your program defines two structures that are to define a **Bob** named "myBob" as follows:

```
struct Bob myBob;
struct VSprite myVSprite;
```

You must create a link between the two structures with a set of program statements such as:

```
myBob.BobVSprite = &myVSprite;
myVSprite.VSBob = &myBob;
```

Now the system can go back and forth between the two structures to obtain the various elements as needed to define the **Bob**.

SPECIFYING THE SIZE OF A BOB

Whereas a **VSprite** was limited to 16 pixels of width, a **Bob** can be any size you wish to define. To specify the size of a **Bob**, you use not only the **Height** but also the **Width** variable. You specify these variables in a **VSprite** structure associated with the **Bob**. Specify the width as the number of 16-bit words it takes to fully contain the object.

As an example, suppose the **Bob** is 24 pixels wide and 20 lines tall. You use statements such as the following to specify the size:

```
myVSprite.Height = 20; /* 20 lines tall */
myVSprite.Width  = 2;  /* 2 words = 24 pixels wide, rounded
                        * up to the next multiple of 16 pixels. */
```

Because **Bobs** are drawn into the playfield background, the pixels of the **Bob** are the same size as the background pixels. With hardware sprites, the pixels are of a fixed size (low-resolution pixels).

SPECIFYING THE COLORS OF A BOB

Because a **Bob** is drawn into the playfield area, it can have as many colors as the playfield area itself. Typically a five-bit-plane, low-resolution mode display allows you to select playfield pixels (and therefore, **Bob** pixels) from any of 32 active colors out of a system palette of 4,096 different color choices. The set of colors you select for the playfield area is the set of colors the system uses to display the **Bobs**.

For **Bobs**, the system ignores the **SprColors** variable in the **VSprite** structure. You use the **Depth** variable in the **VSprite** structure to define how much data is provided to define the **Bob**. This variable also defines how many different colors you can choose for each of the pixels of a **Bob**.

The **Depth** variable specifies how many bit-plane images the system must retrieve from the **Bob** image data area to make up the **Bob**. These are called bit-plane images as the system will write each image into a different bit-plane. The combination of bits in identical y,x positions in each bit-plane determines the color of the pixel at that position.

For example, if you specify only one plane, then the bits of that image let you select only two different colors: one color for each bit that is a 0, a second color for each bit that is a 1. Likewise, if there are 5 images stored sequentially and you specify a depth of 5, each image contributes one bit for each position in the image to the color number selector, allowing up to 32 different choices of color for each **Bob** pixel.

You specify depth using a statement such as the following:

```
myVSprite.Depth = 5;  /* allow 32 colors; requires that a
                       * 5-bit-plane image be present in data area. */
```

SPECIFYING THE SHAPE OF A BOB

The organization of a **Bob** in memory is different from that of a **VSprite** because of the way the system retrieves data to draw **Bobs**. To define a **Bob**, you must still initialize the **ImageData** pointer to point to the first word of the image definition; however, the layout of the data is different for **Bobs** than for **VSprites**.

The sample image below shows the same image defined as a **VSprite** in the "Using VSprites" section above. The data, however, is stored in a way typical of a **Bob**.

If a shape is 2 bits "deep" and is a triangular shape, you would lay it out in memory as follows:

```
        <first bit-plane data>
mem         1111111111111111
mem + 1     0011000000001100
mem + 2     0000111111110000
mem + 3     0000001111000000
mem + 4     0000000110000000
        <second bit-plane data>
mem + 5     1111111111111111
mem + 6     0011111111111100
mem + 7     0000110000110000
mem + 8     0000001111000000
mem + 9     0000000110000000
        <<third bit-plane data>
                 ...
        <<fourth bit-plane data>
                 ...
        <<fifth bit-plane data>
```

To state the width of the **Bob** image, you use 16-bit words. The **Width** value is the number of words that fully contain the image. For example, you store a 29-bit wide image in 32 bits (2 data words of 16 bits each) for each line of its data.

You still specify the number of lines with the **Height** variable in the **VSprite** data structure. However, you treat **Height** somewhat differently for a **Bob** than for a **VSprite**. Specifically, for a **VSprite**, two adjacent data words that always occur together define the colors of each **VSprite** pixel. For a **Bob**, the **Height** variable defines how many adjacent data words it takes to define one complete bit-plane image. That is, for a **Bob** the number of adjacent data words in each bit-plane image definition is given by the following formula: **Height** x **Width**.

The **Depth** variable defines how many adjacent (end-to-end) images there are in the data area to define the shape of the **Bob**. See the example at the end of the "PlaneOnOff" section below.

OTHER ITEMS INFLUENCING BOB COLORS

Three other variables in the **VSprite** structure affect the color of **Bob** pixels: **PlanePick**, **ImageShadow**, and **PlaneOnoff**.

PlanePick

Assume that you have defined a playfield composed of five bit-planes. The variable **PlanePick** in the **VSprite** structure lets you specify which of the bit-planes are to be affected when the system draws the **Bob**. **PlanePick** binary values affect the bit-planes according to the following pattern:

Draw **Bob** into this bit-plane:	5 4 3 2 1 0
If this **PlanePick** bit is a 1:	5 4 3 2 1 0

For example, if **PlanePick** has a binary value of:

0 0 0 1 1

then the system draws the first bit-plane image of the **Bob** into bit-plane 0 and the second image into bit-plane 1.

Suppose that you still want to define an image of only 2 bit-planes, but wish to draw the **Bob** into bit-planes 1 and 4 instead of 0 and 1. Simply choose a **PlanePick** value of:

1 0 0 1 0

This value means "write first image into plane 1, second image into plane 4."

ImageShadow

The variable named **ImageShadow** is a pointer to a memory area that you have reserved for holding the shadow mask of a **Bob**. A shadow mask is the logical *or* combination of all 1-bits of a **Bob** image. There is a variable in the **VSprite** structure called **CollMask** (pointer to a collision mask, covered under "Topics Common to Both VSprites and Bobs") for which you reserve some memory space. The **ImageShadow** and **CollMask** pointers usually, but not necessarily, point to the same data.

Figure 3-2 shows an example of a shadow mask with only the 1 bits.

```
If this is the image in:                       Then its Image Shadow is:

          Plane 1        Plane 2

1 1 1 1 1 1 1 1 1 1 1 1 1                      1 1 1 1 1 1 1 1 1 1 1 1 1
  1                   1                          1                   1
    1               1      1 1 1                   1     1 1 1     1
      1           1          1                       1     1     1
        1       1                                      1       1
          1   1                                          1   1
            1                                              1
```

Figure 3-2: An Image and Its ImageShadow

The system uses the shadow mask along with the variable **PlaneOnOff**, discussed in the next section. Because **ImageShadow** in the **Bob** structure is a pointer to a data area containing the sprite shadow, you must provide space that the the system can use for this purpose. You must then initialize the pointer to the first location within the data area that you have set aside. You can calculate the minimum size of this area as follows:

shadow size = Height * Width

So, for example, an object 5 lines high by 32 bits wide (**VSprite** *or* **Bob**) requires a sprite shadow storage area of at least 5 x 2, or ten 16-bit locations. The example in the "PlaneOnOff" section below shows how to reserve the memory for the sprite shadow and how to tell the system where to find it.

PlaneOnOff

The variable named **PlaneOnOff** tells the system what to do with the playfields that are not "picked" (affected) by **PlanePick**. The binary bit positions for **PlaneOnOff** are the same as those for **PlanePick** (lowest bit position specifies the lowest-numbered bit-plane). However, their meaning differs. For every plane position *not* selected by **PlanePick**, parts of the non-selected plane are filled with the value shown in the corresponding position of **PlaneOnOff**. The parts that are filled are the positions where there is a 1-bit present in the sprite's image shadow.

This provides a great deal of versatility. You can use a two-plane **VSprite** image as the source for many **Bob** images. Yet, because of the color combinations each contains, it may seem that there are several different images present.

For example, assume that the data shown in the **Bob** layout above defines a two-bit-plane Bob image that selects its colors from color registers 0, 1, 4, and 5. To initialize the **Bob** and **VSprite** structures, you need to provide the following types of statements:

```
/* data definition from example layout */
WORD BobData[]= {
     0xFFFF, 0x300C, 0x0FF0, 0x03C0, 0x0180,
     0xFFFF, 0x3FFC, 0x0C30, 0x03C0, 0x0180
};

/* reserve space for the collision mask for this Bob */
WORD BobCollision[10];

myVSprite.Width = 1;  /* sample image is 16 pixels wide (1 word) */
myVSprite.Height = 5; /* takes 5 lines to define each image of the Bob */
myVSprite.Depth = 2;  /* only two bit-plane images are defined in BobData */

/* show the system where it can find the data image of the Bob */
myVSprite.ImageData = BobData;

/* binary = 00101, means draw into only bit-planes 0 and 2 */
myVSprite.PlanePick = 0x05;

/* binary = 00000, means for planes not picked, that is, 1, 3, and 4,
 *fill those planes with 0's wherever there is a 1 in the sprite shadow mask
*/
myVSprite.PlaneOnOff = 0x00;

/* where to put collision mask */
myVSprite.CollMask = BobCollision;
```

```
/* tell the system where it can assemble a sprite shadow */
/* point to same area as CollMask */
myBob.ImageShadow = BobCollision;

/* create the sprite collision mask for this Bob's VSprite structure */
InitMasks( &myVSprite );
```

Whenever the system draws this **Bob**, it fills any position where there is a 1 in the sprite shadow with a 0 for any plane not selected by **PlanePick**. Therefore, the only binary combinations the **Bob** pixels can form are as shown below. Because of **PlanePick**, 1s can appear only at these two locations: 0 0 1 0 1. So the color choices are limited to the following:

Color Selected	Binary Combination
color 0	0 0 0 0 0
color 1	0 0 0 0 1
color 4	0 0 1 0 0
color 5	0 0 1 0 1

These color choices fulfill the requirements specified for the example.

To select the position of a **Bob**, specify the y and x variables in the **VSprite** structure associated with the **Bob**. For example:

```
myVSprite.Y = 100;
myVSprite.X = 100;
```

BOB PRIORITIES

This section describes the two choices you have for system priorities between **Bobs**. You can ignore the priority issue and let the system decide which **Bob** has the highest priority, or you can specify the drawing order yourself. When you specify the drawing order, you control which **Bob** the system draws *last*, and therefore, which one appears in front of other **Bobs**.

Letting the System Decide Priorities

If you want the system to decide, you set the **Before** and **After** pointers in the **Bob** data structure to zero. In this case, the system draws the **Bobs** in their y,x positional order on the screen. In other words, the system draws whichever object is on the screen and is currently the highest within the drawing area (lowest y coordinate value). If two objects have the same y coordinate, the object that has the lowest x coordinate value is drawn first.

The **Bob** drawn first has the lowest priority. The **Bob** drawn last has the highest priority because later objects overlap the objects drawn earlier.

As you use the animation system to move objects past each other on the screen, you will notice that sometimes the objects switch priorities as they pass each other. For example, suppose you want the system to establish the priorities of the **Bobs**, and there are two **Bobs** defined in the system — myBob2 and myBob3. You set the **Before** and **After** pointers as follows:

```
myBob2.Before = 0;
myBob2.After  = 0;
myBob3.Before = 0;
myBob3.After  = 0;
```

Specifying the Drawing Order

If you wish to specify the priorities, simply specify the pointers as follows. **Before** points to the **Bob** that this **Bob** should be drawn before, and **After** points to the **Bob** that this **Bob** should be drawn after. This guarantees that **Bob** objects retain their relative priorities.

For example, suppose you want to assure that myBob3 always appears in front of myBob2. You must initialize the **Before** and **After** pointers so that the system will always draw myBob3 last; that is, after myBob2.

```
myBob2.Before = &myBob3;    /* draw Bob2 before drawing Bob3 */
myBob2.After  = 0;          /* draw Bob2 after no other Bob */
myBob3.After = &myBob2;     /* draw Bob3 after drawing Bob2 */
myBob3.Before = 0;          /* draw Bob3 before no other Bob */
                            /* draw nothing in particular after this Bob */
```

If you decide to specify the **Before** and **After** pointers for any one **Bob** in a group, then you must also at least set the **Before** and **After** pointers to zero for *all* of the rest of the **Bobs** in that group.

For example, if there are ten **Bobs** and you only care that the system draws numbers 4, 6, and 9 in that sequence, you must properly fill in the **Before** and **After** pointers for these three **Bobs**. If you do not care in which order the system draws the other seven **Bobs**, you need only initialize their **Before** and **After** pointers to a value of 0 to assure correct treatment by the system.

You must properly point *all* **Before** and **After** pointers of a group to each other because the **Bob** that is the upper-leftmost becomes the first the system considers for drawing. The system follows the **Before** pointers until it finds one having a zero value, and draws that **Bob** first. It then draws other **Bobs** in the sequence you have specified.

In the example code sequence above, the comment "draw nothing in particular after this Bob" simply means that once the drawing sequence for this set of **Bobs** has been performed, the system still proceeds to find and draw all other **Bobs** currently linked into the GEL list. To continue the drawing operation, the system simply goes on searching the list for the next **Bob** whose **Before** pointer is 0.

Specifying Priority between Bobs and VSprites

See "Topics Common to Both VSprites and Bobs" below for details.

SAVING THE PLAYFIELD DISPLAY

Once the system has drawn the **Bobs**, they become part of the playfield segment of the display. The image of a **Bob** overlays part of the background area. To move a **Bob** from one place to another, you must tell the system to save the background before it draws the **Bob** and to restore the background to its original condition when it moves the **Bob**.

A variable called **sprFlag** in the **VSprite** structure contains a flag called SAVEBACK. To cause the system to save and restore the background for that **Bob**, set the SAVEBACK flag to 1.

In addition to the **sprFlag** variable, you must also tell the system where it can put this saved background area. For this, you use the **SaveBuffer** variable. For example, if the **Bob** is 48 pixels wide and 20 lines high, and the system is drawing it into a playfield of five bit-planes, you must allocate space for storing the following:

$$(48 \text{ pixels}/16 \text{ pixels per word}) * (20 \text{ lines}) * (5 \text{ bit-planes}) = 300 \text{ words}$$

To allocate this space, use the graphics function **AllocRaster()**. When you use **AllocRaster()** for this purpose, you can specify the area size in bits, so it may well be the most convenient way to reserve the space you need. For example:

```
myBob.SaveBuffer = AllocRaster(48,20 * 5);
    /* save space to store 48 bits times 20 words times 5 bit-planes */
```

Note that the **AllocRaster()** function rounds the width value up to the next integer multiple of 16 bits.

USING BOB FLAGS

The following sections describe the **Bob** flags. Some of these are in the **VSprite** structure associated with the **Bob**; others are in the **Bob** structure itself. The description of each flag tells the structure in which the flag is located.

VSPRITE Flag

If you are using the **VSprite** structure to describe a **Bob**, set VSPRITE to zero.

The VSPRITE flag is located in the **VSprite** structure.

SAVEBACK Flag

If you want the GEL routines to save the background before the **Bob** is drawn and to restore the background after the **Bob** is removed, set the SAVEBACK (for "save the background") flag in the **VSprite** structure to 1.

If you set this flag, you must have allocated the buffer named **SaveBuffer**.

OVERLAY Flag

If the system should use the sprite shadow mask when it draws the **Bob** into the background, set the OVERLAY flag in the **VSprite** structure to 1. If this flag is set, it means that the background original colors show through in any section where there are 0 bits in the sprite shadow mask. Essentially, then, those 0 bits define areas of the **Bob** that are "transparent."

If you set the OVERLAY bit to a value of 0, the system uses the *entire rectangle* of words that define the **Bob** image and uses its contents to *replace* the playfield area at the specified y,x coordinates.

If you set this flag, you must have allocated space for and initialized the **ImageShadow** shadow mask. See the section above called "Sprite Shadow Mask" for details on the shadow mask.

GELGONE Flag

The system sets this flag in the **VSprite** structure to indicate when the **Bob** has been moved to y,x coordinates entirely outside of the "clipping region."

When an object crosses over certain specified boundaries in the drawing area, the system does not draw all of the object into the background but "clips" (truncates) it to those limits. At the time of this writing, the variables named **topmost**, **bottommost**, **leftmost**, and **rightmost** define the minimum and maximum y,x coordinates of this clipping region.

When the system sets the GELGONE flag to a 1, you know that the object has passed entirely beyond those limits and that the system will not draw any part of the object into the drawing area. On the basis of that information, you may decide that the object need no longer be part of the GEL list and may decide to remove it to speed up the consideration of other objects.

SAVEBOB Flag

To tell the system not to erase the old image of the **Bob** when the **Bob** is moved, set the SAVEBOB flag in the **Bob** structure to 1. This lets you use the **Bob** like a paintbrush if you wish. It has the opposite effect of SAVEBACK.

Note: It takes longer to preserve and restore the raster image than simply to draw a new **Bob** image wherever required.

BOBISCOMP Flag

If this **Bob** is part of an **AnimComp**, set the BOBISCOMP flag in the **Bob** structure to 1. If the flag is a 1, you must also initialize the pointer named **BobComp**. Otherwise, the system ignores the pointer, and it may be left alone. See "Animation Structures and Controls" for a discussion of **AnimComps**.

BWAITING Flag

When a **Bob** is waiting to be drawn, the system sets the BWAITING flag in the **Bob** structure to 1. This occurs only if the system has found a **Before** pointer in this **Bob**'s structure that points to another **Bob**. Thus, the system flag BWAITING provides current draw-status to the system. Currently, the system clears this flag on return from each call to **DrawGList()**.

BDRAWN Flag

The BDRAWN system status flag in the **Bob** structure tells the system that this **Bob** has already been drawn. Therefore, in the process of examining the various **Before** and **After** flags, the drawing routines may determine the drawing sequence. Currently, the system clears this flag on return from each call to **DrawGList()**.

BOBSAWAY Flag

To initiate the removal of a **Bob** during the next call to **DrawGList()**, set BOBSAWAY to 1. Either you or the system may set this **Bob** structure system flag. The system restores the background where it has last drawn the **Bob**. The system will unlink the **Bob** from the system GEL list the next time **DrawGList()** is called unless you are using double-buffering. In that case, the **Bob** will not be unlinked and completely removed until two calls to **DrawGList()** have occurred and the **Bob** has been removed from both buffers.

BOBNIX Flag

When a **Bob** has been completely removed, the system sets the BOBNIX flag to 1 on return from **DrawGList()**. In other words, when the background area has been fully restored and the **Bob** has been removed from the GEL list, this flag in the removed **Bob** is set to a 1. BOBNIX is significant when you use double-buffering, because once you ask that a **Bob** be removed, the system must remove it from the active drawing buffer and from the display buffer. Once BOBNIX has been set for a double-buffered **Bob**, it has been removed from both buffers and you are free to reuse it or deallocate it.

This flag is in the **Bob** structure.

SAVEPRESERVE Flag

The SAVEPRESERVE flag is a double-buffer version of the SAVEBACK flag. If you are using double-buffering and wish to save and restore the background, you set SAVEBACK to 1. SAVEPRESERVE is used by the system to indicate whether the Bob in the "other" buffer has been restored; it is for system use only.

ADDING A BOB

To add a **Bob** to the system GEL list (the same list you created for **VSprites** using **InitGels()**), you use the **AddBob()** routine. It is advisable that you initialize the different variables you plan to use within the **Bob** structure before you ask that the system add this **Bob** to the list.

For example:

```
struct GelsInfo myGelsInfo;
struct VSprite dummySpriteA, dummySpriteB;
struct Bob myBob;

/* done ONCE, for this GelsInfo */
InitGels( &dummySpriteA, &dummySpriteB, &myGelsInfo );

/* here initialize the Bob variables */
AddBob( &myBob, &rastport );
```

REMOVING A BOB

Two methods may be used to remove a **Bob**. This section describes the system routine for each method.

The first method uses the **RemBob()** routine. You call this routine as follows:

```
RemBob ( &myBob, &rastport );
```

RemBob() causes the system to remove the **Bob** during the next call to **DrawGList()** (or two calls to **DrawGList()** if the system is double-buffered). **RemBob()** asks the system to remove the **Bob** "at its next convenience."

The second method uses the **RemIBob()** routine. For example:

```
RemIBob ( &myBob, &rastport, &viewport );
```

RemIBob() tells the system "remove this **Bob** immediately!" It causes the system to erase the **Bob** from the drawing area and causes the immediate erasure of any other **Bob** that had been drawn subsequent to this one. The system then unlinks the **Bob** from the system GEL list. To redraw the **Bobs** that were drawn on top of the one just removed, you must make another call to **DrawGList()**.

GETTING THE LIST OF BOBS IN ORDER

Like the list of **VSprites**, the list of GELS must be in the proper y,x sorted order from top of screen to bottom and from left to right. The system uses the position information to decide drawing sequences if you have not specified otherwise by using the **Before** and **After** pointers. You must therefore assure that the GEL list is sorted before you ask the system to display the **Bobs**.

To sort the GEL list, you call **SortGList()**. For example:

```
SortGList( &rastport );
```

DISPLAYING BOBS

This section provides the typical sequence of operations for drawing the **Bobs** on the screen. It is very similar to that shown for **VSprites**, as both **Bobs** and **VSprites** are GELS and are part of the same list of controlled objects.

Specifically, the system automatically synchronizes the drawing routines to the display beam and may not require that the display be turned off during the update. If large **Bobs** or many **Bobs** are created, you may be interested in double-buffering. See the section called "Double-Buffering" in this chapter for details.

When you call **DrawGList()**, the system *actually draws* any **Bobs** on this list into the area you have specified. The system saves the backgrounds if you have provided for the save and then performs the drawing sequence in the order you requested. To initiate this drawing, call **DrawGList()**. For example:

```
struct RastPort *rp;
struct ViewPort *vp;
    ...
DrawGList(rp, vp);     /* draw the elements */
```

CHANGING BOBS

You can change the following characteristics of **Bobs**:

- To change their appearance, change the pointer to the **ImageData** in the associated **VSprite** structure. Note that the change in the **ImageData** pointer also requires a change in the **ImageShadow** or a recalculation of the object mask, using **InitMasks()**.

- To change their color choices, change their **PlanePick** and/or **PlaneOnOff** values; also change the depth parameters if the sprite image has multiple planes defined.

- To change the location in the drawing area, change the y,x values in the associated **VSprite** structure.

- To change the object priorities, change the drawing sequence by altering the **Before** and **After** flags in the **Bob** structures.

- To change the **Bob** into a paintbrush, set the SAVEBOB flag to a 1 in the **Bob** structure.

Note: Neither these nor other changes actually happen until you call **SortGList()** and then **DrawGList()**.

DOUBLE-BUFFERING

Double-buffering is the technique of supplying two different memory areas in which the drawing routines may create images. The system displays one memory space while you are drawing into the other area. This assures that you never see any display fields on the screen that consist partly of old material and partly of new material.

The system animation routines use an extension that you establish to the **Bob** structure. Also, if you do not care to use double-buffering, you need not tie up precious memory resources for unneeded variable storage space.

To find whether a **Bob** is to be double-buffered, the system examines the pointer named **DBuffer** in the **Bob** structure. If this pointer has a value of 0, the system does not use double-buffering for this **Bob**.

Note: If you do *not* wish to use double-buffering, you must initialize the **DBuffer** pointer to zero. For example:

```
myBob.DBuffer = 0;     /* do this if this Bob is NOT double-buffered */
```

The next section discusses several other variables that you must describe if you want to use double-buffering. *Note*: if any of the **Bobs** are double-buffered, then *all* of them must be double-buffered.

Variables Used in Double-Buffering

To use double-buffering for a given **Bob**, you must provide a data packet for the system to store some of the variables it needs to handle double-buffering. This data packet is a structure named **DBufPacket** that consists of the following variables:

BufY, BufX
: System variables that let the system keep track of where the object was located "last screen" (as compared to the **Bob** structure variables called **oldY** and **oldX** that tell where the object was two screens ago). **BufY** and **BufX** provide for correct restoration of the background within the currently active drawing buffer.

BufPath
: System variable related to the drawing order used to draw this **Bob** into the background. **BufPath** assures that the system restores the backgrounds in the correct sequence; it relates to the system variables **DrawPath** and **ClearPath** (found in this **Bob**'s **VSprite** structure).

BufBuffer
: You must set this field to point to a buffer as big as this Bob's **SaveBuffer** to allocate separate space for buffering the background on which you are drawing the **Bob**. This buffer is used to store the background for later restoration when the system moves the object.

The next section shows how to pull all these variables together to make a double-buffered **Bob**.

Creating a Double-Buffered Bob

To create a double-buffered **Bob**, you must initialize all of the normal **Bob** variables and pointers and execute a code sequence similar to the following:

```
struct DBufPacket myDBufPacket;

/* allocate a DBufPacket for myBob */
  ...
  ...
/* same size as previous example in "Saving the Playfield Display" */
myDBufPacket.BufBuffer = AllocRaster( 48, 20 * 5 );

/* tell Bob about its double buff status */
myBob.DBuffer = myDBufPacket;
```

BOB OPERATIONS SUMMARY

The following steps are involved in defining, moving, and displaying a **Bob**:

- o Define a **RastPort** structure for the drawing routine to use.
- o Initialize the GEL system (call **InitGels()**) for this **RastPort**. You only need to do this once.
- o Create and link a **Bob** and a **VSprite** structure.
- o Define the following **Bob** parameters:
  - Height
  - Width
  - Depth
  - Position
  - Where to find **ImageData** data
  - Which planes to pick for writing this **Bob**
  - How to treat the planes not picked
  - **VSprite** structure flags to show that this is a **Bob**
  - Space for the sprite shadow
  - Pointer to a **DBufPacket** if you want to use double-buffering (otherwise, make this pointer a NULL (0) value)
- o Call **InitMasks()** to create the sprite shadow.
- o Add the **Bob** to the GEL list.
- o Change the **Bob** appearance by
  - Changing the pointer to **ImageData**
  - Changing its height, width or depth

- o Change the **Bob** colors by

    - Changing the playfield color set

    - Changing **PlanePick** and **PlaneOnOff**

- o Move the **Bob** by defining a new y,x position.

- o Display the **Bob** by calling:

    - **SortGList();**

    - **DrawGList();**

Now that you've mastered the basics of handling **VSprites** and **Bobs**, you may want to find out about some of the interactions between the two and how to cope with these interactions. Or, you may want to skip these advanced topics and read about software collisions, clipping, and adding new features in "VSprite and Bob Topics" below.

BOB ADVANCED TOPICS

How Bob Colors Are Controlled

Bobs do not use the **SprColor** pointer. To determine the color of a **Bob**, you use the existing colors in the 32-entry color table. The lower 16 of the 32 possible color selections (registers 0-15) are always dedicated to playfield color selections, providing 16 unique colors for the **Bobs**, since they are playfield objects.

However, the playfields and the **VSprites** share the upper 16 of the 32 color entries (registers 16-31). If you are using five bit-planes to display the **Bobs**, any **Bob** with a pixel whose color value exceeds 15 may change color if the virtual sprites are running at the same time.

Note: This also applies to *any* static part of the display area (the playfield), whether a **Bob** or simply part of the background display, for which a five- or six-bit-plane image is used if the color number for a specific pixel exceeds the value of 15.

To explain further, the virtual sprite routines, notably **SortGList()** and **DrawGList()**, work together to decide which real sprite will be used at any point on the screen. **DrawGList()** makes up a Copper instruction list to change the contents of the upper 16 color registers, perhaps several times within a single display field. Therefore, depending on where a **Bob** image is on the screen relative to a virtual sprite, and depending on its color content, a **Bob** may take on different colors (perhaps even within only a part of its body).

To minimize color interactions between **Bobs** and virtual sprites, take the appropriate precautions:

- o Limit the background to four or fewer bit-planes and thus limit the **Bob** color choices to 16 or fewer.

- o Use five bit-planes, but specify **Bob** colors or background colors from the colors 0 through 15 or 16, 20, 24, or 28 only. Colors 16, 20, 24, and 28 are used neither by real sprites nor by virtual sprites and are treated as transparent areas. Therefore, if you use only these colors for **Bobs**, the simultaneous use of virtual sprites will not affect the **Bob** or background colors.

- o Use **sprRsrvd** to "fence-off" certain sprite pairs, so you can also use their colors for **Bobs**.

Topics Common to Both VSprites and Bobs

DETECTING GEL COLLISIONS

To detect collisions between graphics elements, you use the **DoCollision()** routine. **DoCollision()** determines if there are any pixels of one graphics element currently touching those of another graphics element or if any of the graphics elements have passed outside of specified screen boundaries.

Whenever there is a collision, the system performs one of 16 possible collision routines. The addresses of the collision routines are kept in a table called the collision handler table. **DoCollision()** examines the **HitMask** and **MeMask** of each of the **VSprite** structures in the GEL list and determines if there is a collision between any two GELS. It then calls the collision-handler routine at the table position corresponding to the bits in the **HitMask** and **MeMask**, as outlined below.

Note: The current form of these routines does *not* use the built-in *hardware* collision detection. You may, if you wish, reserve one or more sprites for your own use and move them using your own routines. When specific sprites have been reserved for your own use, you may choose to use the hardware collision detection to sense collisions between your own objects and other on-screen elements. See the *Amiga Hardware Reference Manual* for information about hardware collision detection.

Default Kinds of Collisions

Two kinds of software collisions are handled by the collision routines: boundary hits and GEL-to-GEL hits.

You can set up routines to handle as many as 16 different kinds of collisions using the **VSprite** structure **MeMask** and **HitMask**. When you call a collision routine, you give it certain kinds of information about the colliding elements, as described in the next two sections.

Boundary Hits

During the operation of the **DoCollision()** routines, if you have enabled boundary collisions for a GEL and that GEL crosses a boundary, the system calls the boundary-hit routine you have defined. Note that the system calls the routine once for each GEL that has gone outside of the boundary.

The system will call your routine with the following two arguments:

- A pointer to the **VSprite** structure of the GEL that hit the boundary

- A flag word containing one to four bits set, representing top, bottom, left and right boundaries, telling you which one or more boundaries it has hit or exceeded. To test these, use the names TOPHIT, BOTTOMHIT, LEFTHIT, and RIGHTHIT.

GEL-to-GEL Collisions

If, instead of a GEL-to-boundary collision, **DoCollision()** senses a GEL-to-GEL collision, the system calls your collision routine with the following two parameters. They will be different from those in the GEL-to-boundary collision.

- Address of the **VSprite** structure that defines the uppermost (or leftmost if y coordinates are identical) object of a colliding pair

- Address of the **VSprite** structure that defines the lowermost (or rightmost if y coordinates are identical) object of a colliding pair

Handling Multiple Collisions

When multiple elements collide within the same display field, the following set of sequential calls to the collision routines occurs:

- o The system issues each call in a sorted order for GELs starting at the upper left-hand corner of the screen and proceeding to the right and down the screen.
- o For any two colliding graphics elements, the system issues only one call to the collision routine for this pair. The system bases the collision call on the object that is the highest and leftmost of the pair on the screen.

Preparing for Collision Detection

Before you can use the system to detect collisions between GELS, you must initialize the table of collision-detection routines. This table points to the actual routines that you will use for the various collision types you have defined. Also, you must prepare certain variables and pointers within the **VSprite** structure: **BorderLine**, **CollMask**, **HitMask**, and **MeMask**.

Building a Table of Collision Routines

To add to or change the table entries for the collision routines, call the **SetCollision()** routine. The syntax for this routine follows:

SetCollision(num, routine, Ginfo)

where

num
: is the collision vector number

routine
: is a pointer to the user collision routine

GInfo
: is a pointer to a **GelsInfo** structure

When the **View** structure is first initialized, the system sets all of the values of the collision routine pointers to zero. You must initialize those table entries so that they correspond to the **HitMask** and **MeMask** bits that you have set. Only those table entries can cause the system to call the collision routines.

You must also allocate a table, pointed to by **GelsInfo**, for vectors. The table needs to be only as large as the number of bits for which you wish to provide collision processing. For example:

```
VOID myCollisionRoutine( GELM, GELN ) /* sample collision routine */
struct VSprite *GELM;
struct VSprite *GELN;
{
    printf("GEL at %lx has hit GEL at %lx", (long)GELM, (long)GELN);
}

    /* sample initialization */
    ReadyGels(gelsinfo, rastport);/* use exec_support function */
    SetCollision( 15, myCollisionRoutine, &gelsinfo );
```

Collision Mask

The variable named **CollMask** is a pointer to a memory area that you have reserved for holding the collision mask of a GEL. A collision mask is usually the same as the shadow mask of the GEL, formed from a *logical-or* combination of all 1 bits in all planes of the image. Figure 3-3 shows an example collision mask.

```
If this is the image in:                        Then its CollMask is:

          Plane 1        Plane 2

1 1 1 1 1 1 1 1 1 1 1 1 1                       1 1 1 1 1 1 1 1 1 1 1 1 1
  1                   1                           1                   1
    1               1      1 1 1                    1     1 1 1     1
      1           1          1                        1     1     1
        1       1                                       1       1
          1   1                                           1   1
            1                                               1
```

Figure 3-3: A Collision Mask

You normally use this collision mask to control drawing of the object and to define essentially the positions where there is an image bit present. After you have defined the collision mask through the routine **InitMasks()**, you may specify that the system is to store both the shadow mask and the collision mask in the same location.

For example, here are typical program statements to reserve an area for the sprite shadow, initialize the pointer correctly, and then specify that the system uses the same mask for collisions (this example assumes a two-word-wide, four-line-high image):

```
/* reserve 8 16-bit locations for sprite
 * shadow to be stored into by the system.
*/
WORD myShadowData[8];
     /* and point to it */
myVSprite.ImageShadow = myShadowData;
     /* collision mask is same as shadow */
myVSprite.CollMask  = myShadowData;
```

As an alternative, for certain game-oriented applications, you may design certain objects with sensitive regions and non-sensitive regions. Suppose you have an object, such as a spaceship, with an outer layer that is to be non-sensitive and an inner core that is to register collisions for the overall object. You would define your shadow mask with 1 bits in the appropriate positions to define the desired sensitive area. An example using this type of image is shown in figure 3-4.

```
If the current CollMask is:          Perhaps you only want to
                                     have a sensitive area which
                                     has this shape:

1 1 1 1 1 1 1 1 1 1 1 1 1
  1                   1
    1     1 1 1     1              1     1 1 1     1
      1     1     1                  1     1     1
        1       1                      1       1
          1   1
            1
```

Figure 3-4: Shadow Mask for a Sensitive Area

BorderLine Image

For fast collision detection, the system uses the pointer named **BorderLine**. **BorderLine** specifies the location of the horizontal *logical-or* combination of all of the bits of the object. It may be compared to taking the whole object and squashing it down into one single horizontal line. Here is a sample of an object and its **BorderLine** image:

OBJECT

001100001100
000110011000
000011110000
000110011000
001100001100

BORDERLINE IMAGE

001111111100

The borderline image establishes a single set of words (represented by the collision mask) that have 1 bits at the outermost edges of the object. Using this squashed image, the system can quickly determine if the image is touching the left or rightmost boundary of the drawing area.

To establish the borderline data, you make a system call to **InitMasks()**. Before calling **InitMasks()**, you provide the system with a place to store the image it creates. The size of the data area you reserve must be at least as large as the image is wide.

In other words, if it takes three 16-bit words to hold the width of a GEL, then you must reserve three words for the borderline image. For example:

```
/* reserve some space for the border image to be stored for this Bob */
WORD myBorderLineData[3];

/* tell the system where to put the BorderLine image it will form */
myVSprite.BorderLine = myBorderLineData;
```

Note: Both **Bobs** and **VSprites** participate in the software collision detection.

The next section tells how to turn on the software collision detection independently for each GEL.

Software Collision-Detect Control Variables

You can enable or disable software collision detection for each GEL independently. In addition, any time the system senses a collision, you can specify which of 16 possible collision routines you wish to have automatically executed. The **HitMask** and **MeMask** variables in the **VSprite** structure let you specify the relationships between different GELS.

By specifying the bits in these masks, you can control how and when the system senses collisions between objects. The collision testing routine, in addition to sensing an overlap between objects, also uses these masks to determine which routine(s) (if any) the system will call when a collision occurs.

When the system determines a collision, it *and*s the **HitMask** of the upper-leftmost object in the colliding pair with the **MeMask** of the lower-rightmost object of the pair. The bits that are 1s after the *and* operation choose which of the 16 possible collision routines to perform.

- If the collision is with the boundary, bit 0 is a 1 and the system calls the collision handling routine number 0. You assign bit 0 to the condition called "boundary hit." The system uses the flag called BORDERHIT to indicate that an object has landed on or moved beyond the outermost bounds of the drawing area (the edge of the clipping region).

- If you set any one of the other bits (1 to 15), then the system calls the collision handling routine corresponding to the set bit.

If more than one bit is set in both masks, the system calls the vector corresponding to the rightmost bit.

Using HitMask and MeMask

This section provides an example of the use of the **HitMask** and **MeMask** to define a new form of collision detection.

Suppose there are two classes of objects that you wish to control on the screen: ENEMYTANK and MYMISSILE. Objects of class ENEMYTANK should be able to pass across one another without registering any collisions. Objects of class MYMISSILE should also be able to pass across one another without collisions. However, when MYMISSILE collides with ENEMYTANK or ENEMYTANK collides with MYMISSILE, the system should process a collision routine.

Choose a pair of collision detect bits not yet assigned within **MeMask**, one to represent ENEMYTANK, the other to represent MYMISSILE. You will use the same two bits in the corresponding **HitMask**.

	MeMask	HitMask	
Bit #	2 1	2 1	
GEL #1	0 1	1 0	ENEMYTANK
GEL #2	0 1	1 0	ENEMYTANK
GEL #3	1 0	0 1	MYMISSILE

In the example, bit 1 represents ENEMYTANK objects. In the **MeMask**, bit 1 is a 1 for GEL #1 and says "I am an ENEMYTANK." Bit 2 is a zero says this object is *not* a MYMISSILE object.

In bit 1 of the **HitMask** of GEL #1, the 0 bit there says, "I will not register collisions with other ENEMYTANK objects." However, the 1 bit in bit 2 says, "I *will* register collisions with MYMISSILE objects."

Thus when a call to **DoCollision()** occurs, for any objects that appear to be colliding, the system *ands* the **MeMask** of one object with the **HitMask** of the other object. If there are non-zero bits present, the system will call one (or more) of your collision routines.

In this example, suppose that the system senses a collision between ENEMYTANK #1 and ENEMYTANK #2. Suppose also that ENEMYTANK #1 is the top/leftmost object of the pair. Here is the way that the collision testing routine performs the test to see if the system will call any collision-handling routines:

Bit #	2	1
ENEMYTANK #1 MeMask	0	1
ENEMYTANK #2 HitMask	1	0
Result of *and*	0	0

Therefore, the system does not call a collision routine.

Suppose that **DoCollision()** finds an overlap between ENEMYTANK #1 and MYMISSILE, and MYMISSILE is the top/leftmost of the pair:

Bit #	2	1
MYMISSILE #1 MeMask	1	0
ENEMYTANK #2 HitMask	1	0
Result of *and*	1	0

Therefore, the system calls the collision routine at position 2 in the table of collision-handling routines.

BOB/VSPRITE COLLISION BOUNDARIES WITHIN A RASTPORT

To specify a region within the **RastPort** (drawing area) that the system will use to define the outermost limits of the GEL boundaries, you use the following variables: **topmost**, **bottommost**, **leftmost**, and **rightmost**. The **DoCollision()** routine tests these boundaries when determining collisions within this **RastPort**.

Here is a typical program segment that assigns the variables correctly. It assumes that you already have a **RastPort** structure named myRastPort.

```
myRastPort->GelsInfo->topmost = 50;
myRastPort->GelsInfo->bottommost = 100;
myRastPort->GelsInfo->leftmost = 80;
myRastPort->GelsInfo->rightmost = 240;
```

The current release of the system software makes use of the clipping-rectangle feature of the **RastPorts** to create clipping to the **RastPort**'s limits. However, you may base the "boundary collision" limits for this **RastPort** on the variables shown here.

ADDING NEW FEATURES TO BOB/VSPRITE DATA STRUCTURES

This section describes how to expand the size and scope of the **VSprite** or **Bob** data structures. In the definition for the **VSprite** and the **Bob** structures, there is an item called **UserExt** at the end of the structure. If you want to add something to these structures (specifically, a user extension), you simply specify that the **UserExt** variable is composed of a specific type.

Why would you want to add things to the structure? When the **DoCollision()** routine passes control to your collision-processing function, you may wish to change some variable associated with the GEL. The example below places speed and acceleration figures with each GEL. When you perform the collision routine, it exchanges these values between the two colliding objects. The system uses additional routines during the no-collision times to calculate the new positions for the objects.

You could define a structure similar to the following:

```
struct myInfo {
      short xvelocity;
      short yvelocity;
      short xaccel;
      short yaccel;
};
```

that you want to have associated with each of the GELS. These variables are, for example, *your* user extensions.

You would also provide the following line:

For **VSprites**:
```
#define VUserStuff struct myInfo
```

For **Bobs**:
```
#define BUserStuff struct myInfo
```

For **AnimObs**:
```
#define AUserStuff struct myInfo
```

When the system is compiling the *graphics/gels.h* file with your program, the compiler substitutes "struct myInfo" everywhere that **UserExt** is used in the header. The structure is thereby customized to include the items you wish to associate with it.

Note: The header files include the following UserStuff variables for **VSprites**, **Bobs**, and **AnimObs**:

VSprites:	**VUserStuff**
Bobs:	**BUserStuff**
AnimObs:	**AUserStuff**

Animation Structures and Controls

This section outlines the system animation support for **Bobs** only. In the section called "Bob Priorities" you learned how to control the priorities of **Bobs** with respect to one another by specifying the drawing sequence. The following sections explain how to link objects and how to specify an animation completely by linking different views of objects into a sequence.

To perform animation, an artist produces a series of drawings. Each drawing differs from the preceding one so that when they are sequenced, the object appears to move naturally. An animation in the Amiga consists of a linked list of the components of the animation object and each component as a linked list of the different drawings in its sequence.

To perform the actual animation, you make a call to a system routine called **Animate()**. When you call **Animate()**, the software follows all of your animation instructions and "moves" the objects accordingly. When you next call **DrawGList()**, the system draws all objects in the position caused by your calls to **Animate()**. Essentially, **Animate()** simply manipulates a set of instructions in a set of object lists. Only when the system draws the objects are your instructions displayed visually.

Remember, the system draws the currently sorted objects from its GELS list.

CHARACTERISTICS OF THE ANIMATION SYSTEM

The animation system lets you define a series of **Bobs**, which it then links into an overall object. The combined object consists of one or more **Bobs** that comprise the overall object and additional **Bobs** that comprise alternate appearances (animation sequences) for the various component parts.

You specify the following:

- o The initial appearance of an overall object by defining **Bobs** as its components
- o Alternate views of various components by defining additional **Bobs**
- o The drawing precedence for the initial appearance of the object among the **Bobs** that comprise the initial appearance

The animation system does the following:

- o Moves all linked objects simultaneously

- Maintains inter-object prioritization

- Sequences alternate views to provide animation through user-specified timing variables

KEEPING TRACK OF GRAPHIC OBJECTS

The section called "Getting the List of Bobs in Order" described how the system maintains a list of **Bobs** to draw on the screen according to your instructions. The animation system selectively adds items to and removes items from this list of screen objects during the **Animate()** routine. The next time you call **DrawGList()**, the system will draw the current **Bobs** in the list into the selected **RastPort**.

CLASSES OF ANIMATION OBJECTS

You have two classes of animation objects to consider: **AnimObs** and **AnimComps**. The **AnimOb** is the primary animation object. It is this object whose position you are specifying with respect to the coordinates of the drawing area. Actually, an **AnimOb** itself contains no imagery. It is merely the top-level data structure that organizes the components that it manages and that specifies a position relative to which everything else is drawn. The **AnimComp**, on the other hand, is an animation component — for example, an arm, leg, or head — of an animation object. The animation object consist of animation components that you specify.

To define an **AnimOb**, you specify several characteristics of the primary animation object, including the following:

- The initial position of this object

- Its velocity and acceleration in the X and Y directions

- How many calls to **DrawGList()** you have made while this object has been active

- A pointer to a special animation routine related to this object (if desired)

- A pointer to the first of its animation components

- Your own extensions to this structure, if desired

POSITIONS OF ANIMATION OBJECTS

The next two sections tell how to specify the initial position of an **AnimOb** and its **AnimComp**.

Position of an AnimOb

To specify a registration point within the drawing area (the **RastPort**) for all components, you use the variables **AnX** and **AnY** in the **AnimOb** structure. Figure 3-5 illustrates that each component has its own offset from the object's registration point.

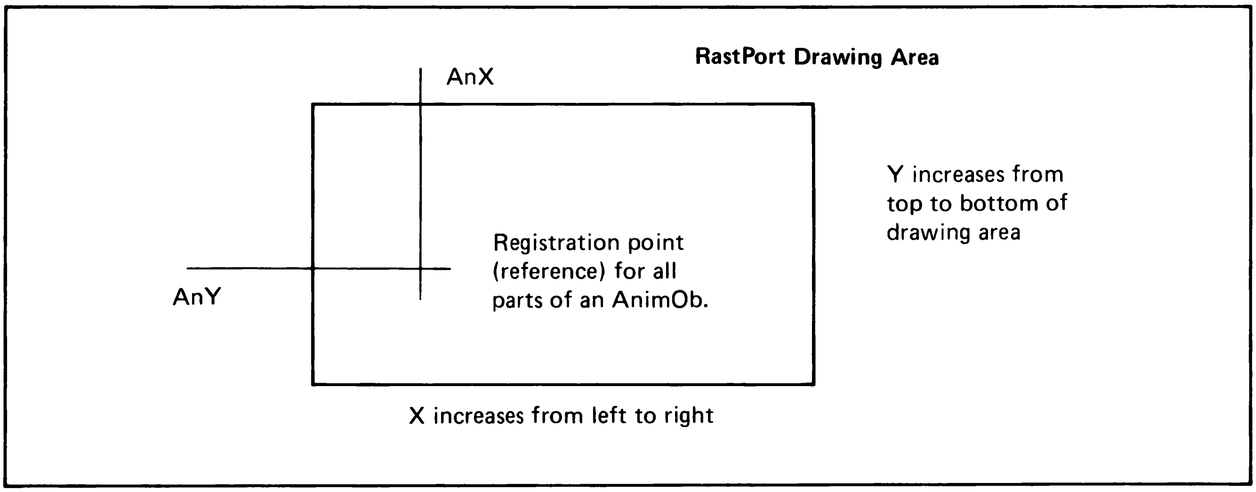

Figure 3-5: Specifying an AnimOb Position

Position of an AnimComp

To specify where the component is to be located *relative to the position of the registration point,* you use variables in the **AnimComp** structure. When you move the animation object, all of the component parts of this animation object move with it, as illustrated in figure 3-6.

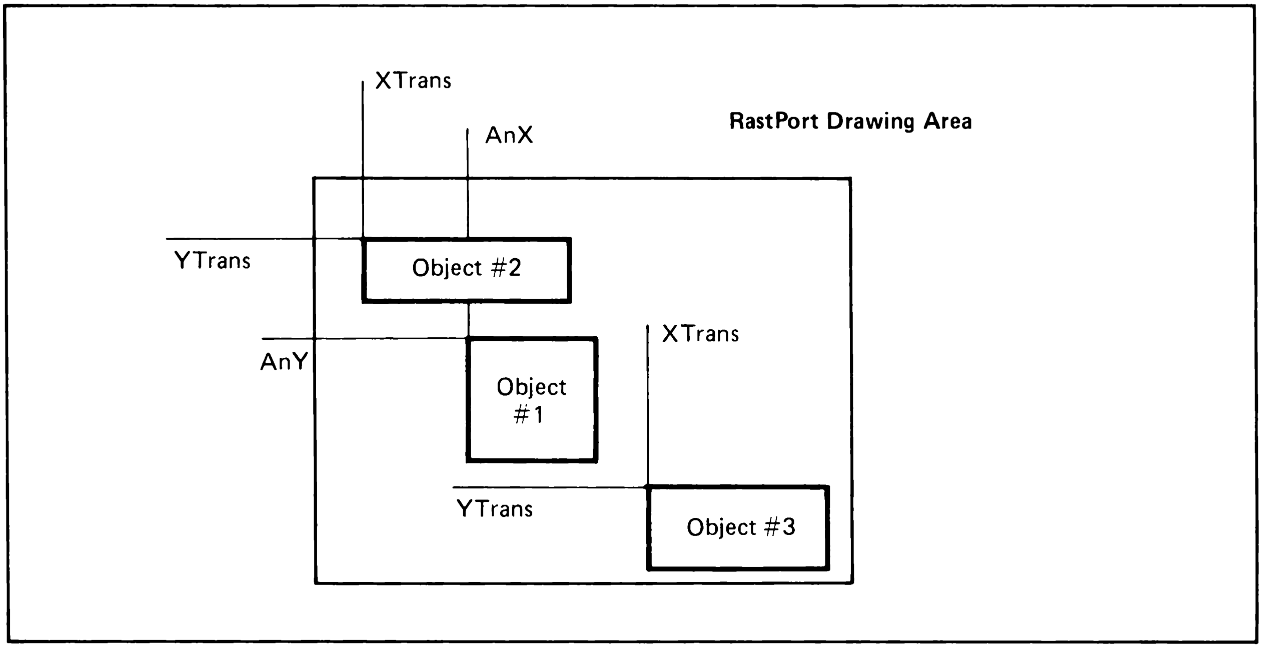

Figure 3-6: Specifying an AnimComp Position

To specify the relative placement of a component with respect to the registration point of the **AnimOb**, you assign the values of **XTrans** and **YTrans** in the **AnimComp** structure. These values can be positive (as shown for object #3), negative (as shown for object #2), or zero (as shown for component #1) in figure 3-6 above.

Now that the system knows the position of the objects and components you wish to animate, you can tell the system how to animate them. The following sections describe the animation choices provided for you by the system.

ANIMATION TYPES

The system software allows two forms of animation: sequenced drawing and motion control.

Sequenced Drawing

In sequenced drawing, an artist produces a sequence of views of an object, where each view is a modification of a preceding view. To produce apparent motion of the object, the artist draws each new view of an object at a position somewhat farther from a common reference point than the preceding view.

If an animation is to be continuous, based on a repeating sequence, then the last drawing in the series should allow the first drawing in the series to be the next in line, creating a continuity of motion. Figure 3-7 shows four out of a sequence of drawings that could use this technique for animation. (The other intermediate steps are not shown.)

As you will notice, each of the drawings, reading from right to left, is a little closer to its registration point (the reference point). The upper level of the figure shows the figures individually. The lower level shows the figures overlaid, demonstrating that smooth motion would be possible. To the left of the overlaid figures is a second set, drawn in gray, representing the reinitialization of the sequence of drawings, beginning with number one.

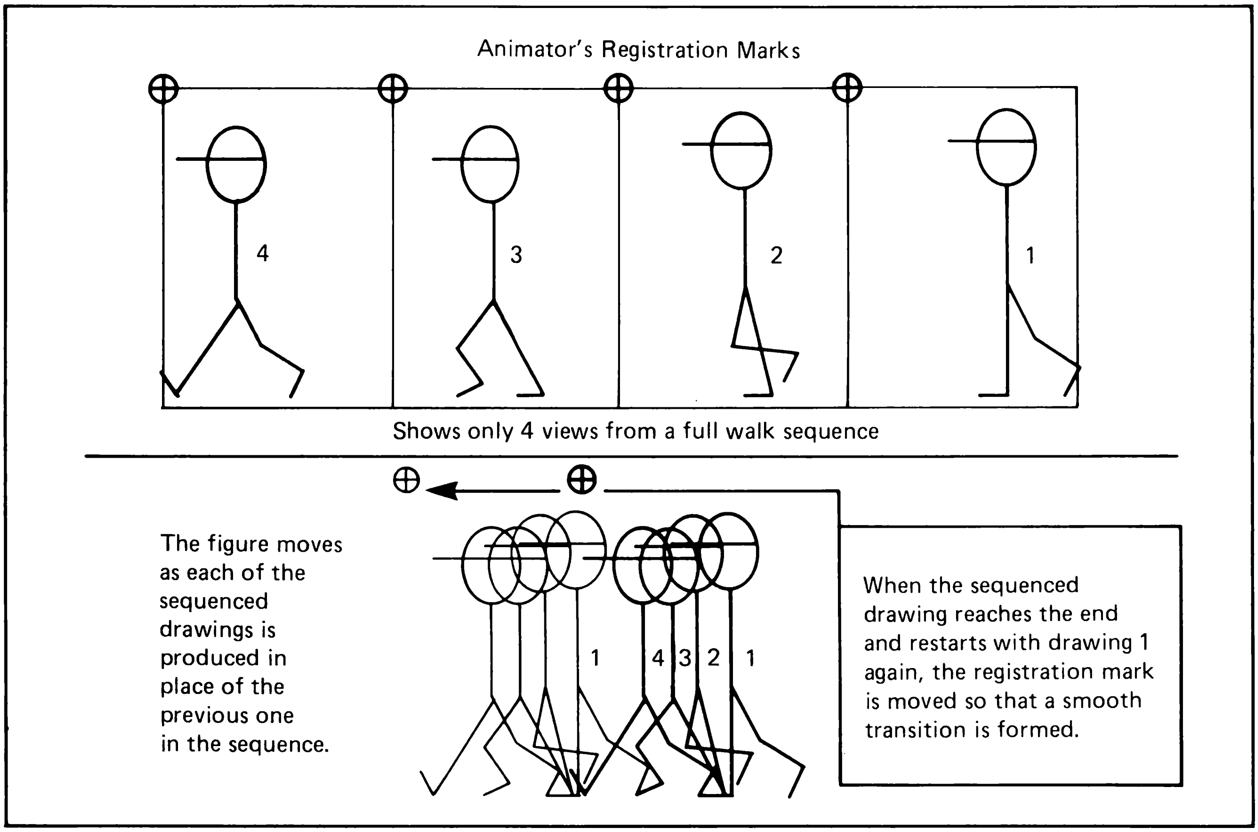

Figure 3-7: A Sequenced Drawing

Sequenced animation often consists of a closed "ring" of drawings. When the last drawing of the sequence has been completed, the first drawing in the sequence is repeated again, becoming the first in the next part of the animation, offset by a specific position in space.

To specify sequenced drawing, use the variables called **compFlags** in the **AnimComp** structure, and **RingXTrans** and **RingYTrans** in the **AnimOb** structure.

To move the registration mark to a new location, you set the RINGTRIGGER bit for a component in its **compFlags** variable. The system software adds the values of **RingXTrans** and **RingYTrans** found in the **AnimOb** structure to the values of **AnX** and **AnY** of the head object (the registration mark), thereby moving the reference point to the new location. The next time you execute **DrawGList()**, the drawing sequence starts over again at the new location, mating properly with the final drawing of the sequence at the old registration mark.

You usually set RINGTRIGGER in only one of the animation components in a sequence; however, you can choose to use this flag and the translation variables in any way you wish.

Motion Control

In the second form of animation, you can specify objects that have independently controllable velocities and accelerations in the X and Y directions. Components can still sequence. Furthermore, you can use ring and velocity simultaneously if you wish.

The variables that control this motion are located in the **AnimOb** structure and are called:

- **YVel, XVel**— the velocities in the y and x directions
- **YAccel, XAccel**— the accelerations in the y and x directions

Velocities and accelerations can be either positive or negative.

The system treats the velocity numbers as though they are fixed-point binary fractions, with the decimal point fixed at position 6 in the word. That is:

```
vvvvvvvvvv.ffffff
```

where v stands for actual values that you add to the x or y (**AnX**, **AnY**) positions of the object for each call to **Animate()**, and f stands for the fractional part. By using a fractional part, you can specify the speed of an object in increments as precise as 1/64th of an interval.

In other words, if you set the value of **XVel** at 0x0001, it will take 64 calls to the **Animate()** routine before the system will modify the object's x coordinate position by a step of one. The system requires a value of 0x0040 to move the object one step per call to **Animate()**.

Each call you make to **Animate()** simply adds the value of **XAccel** to the current value of **XVel**, and **YAccel** to the current value of **YVel**, modifying these values accordingly.

Using Sequenced Drawing and Motion Control

If you are using sequenced drawing, you will probably set the velocity and acceleration variables to zero. This allows you to produce the animation exactly in the form in which the artist has designed it in the first place.

Consider an example of a person walking. As each foot falls, with sequenced drawing, it is positioned on the ground exactly as originally drawn. If you include a velocity value, then the person's foot will not be stationary with respect to the ground, and the person appears to "skate" rather than walk. If you set the velocity and acceleration variables at zero, you can avoid this problem.

INITIALIZING THE ANIMATION SYSTEM

To initialize the system, you must define a pointer to an **AnimOb**. The system uses this pointer to keep track of all of the real **AnimObs** that you create. The following typical code sequence accomplishes this:

```
struct AnimOb *animKey;
    -
    -
animKey = NULL;
```

Note: Before you can use the animation system, you must call the routine **InitGels()**. Therefore, you must initialize the GEL system as well as the animation system. See the "Initializing the GEL System" section for details on **InitGels()**, the Bob-control system that eventually displays the objects that you manipulate.

SPECIFYING THE ANIMATION OBJECTS

To add animation objects to the controlled object list, you use the routine **AddAnimOb()**. Figure 3-8 shows how to build a list of controlled objects using this routine. The **animKey** always points to the object most recently added to the list.

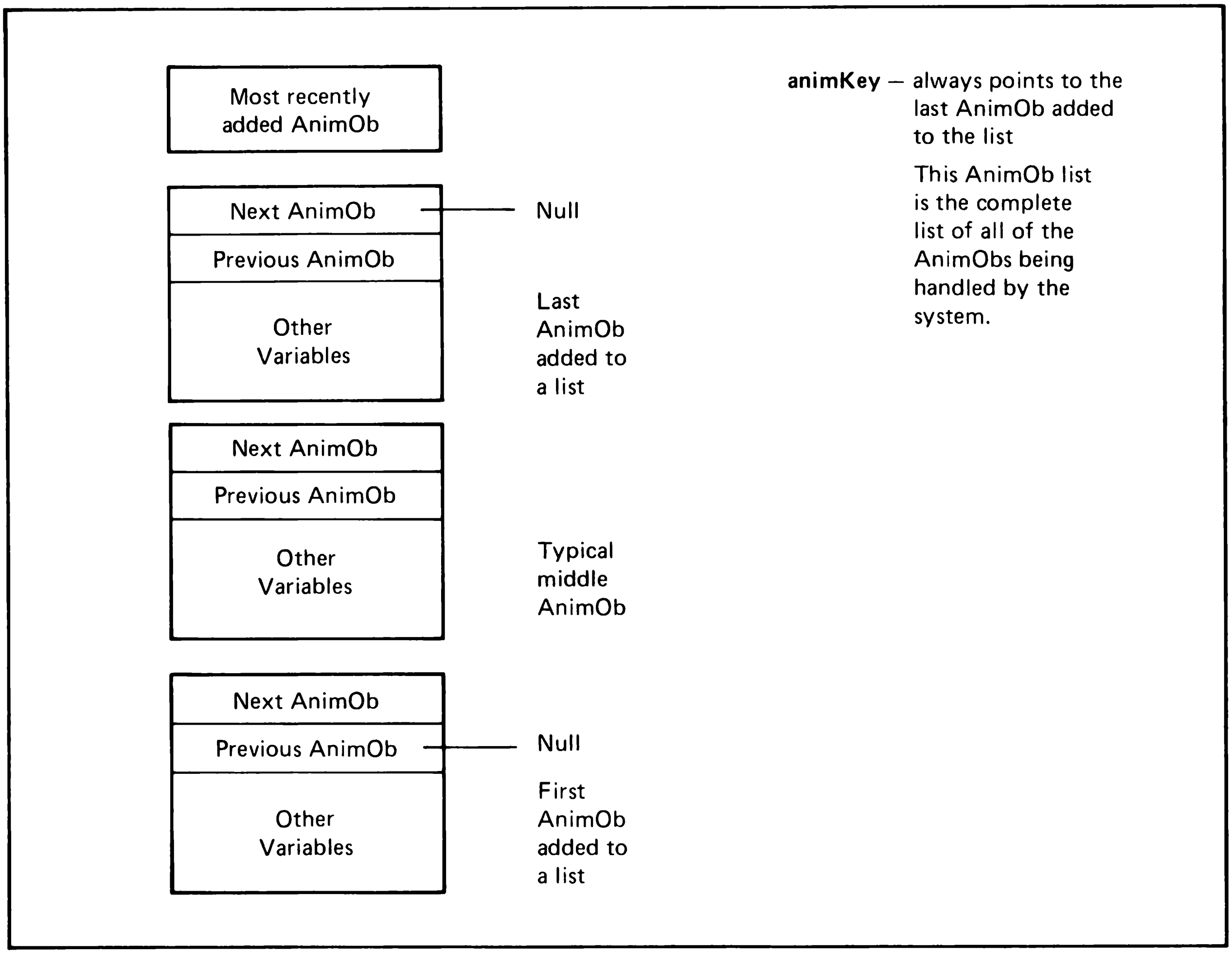

Figure 3-8: Linking AnimObs into a List

Next, you tell the system about the components that make up the object.

SPECIFYING ANIMATION COMPONENTS

As previously stated, each animation object consists of one or more individual component parts. The parts may be, for example, the body of an object, its arms, its legs, and so on. Not only does the system animator move parts from place to place, but it also offers different views of each of the parts. To specify the relationships between the individual parts and views of those parts, you initialize various pointers within the **AnimComp** structure.

You use the pointers called **PrevSeq** and **NextSeq** to build a doubly-linked list of a set of animation components used for sequenced drawing, as outlined above. In all cases, when you specify **AnimComps**, you must initialize these pointers to build the sequence that you wish the system to follow for drawing the various views of this component. The "Animation Sequencing" section below shows how the system uses these pointers.

To link the components together into a whole object, use the pointers called **PrevComp** and **NextComp**. When you build an animation object, you must initialize the **PrevComp** and **NextComp** pointers *for only the initial view of the animation object.* Whenever the animation system senses that one of the animation objects has "timed out" and switched to a new sequence of that component, the system automatically adjusts the **PrevComp** and **NextComp** pointers so that it retains the complete animation object.

Figure 3-9 shows an animation object built of several components. The **AnimOb** points to the head component. Notice that the "head" component may be any one of the components of the object. A pointer in the structure of the head component, in turn, points to the next one, and so on (building the initial view of the object).

To point around the ring for each of the component sequenced views (although the objects do not necessarily have to form a ring), you initialize the sequence pointers **NextSeq** and **PrevSeq**. The animation system ignores the **PrevComp** and **NextComp** pointers for each of the *non-current* components.

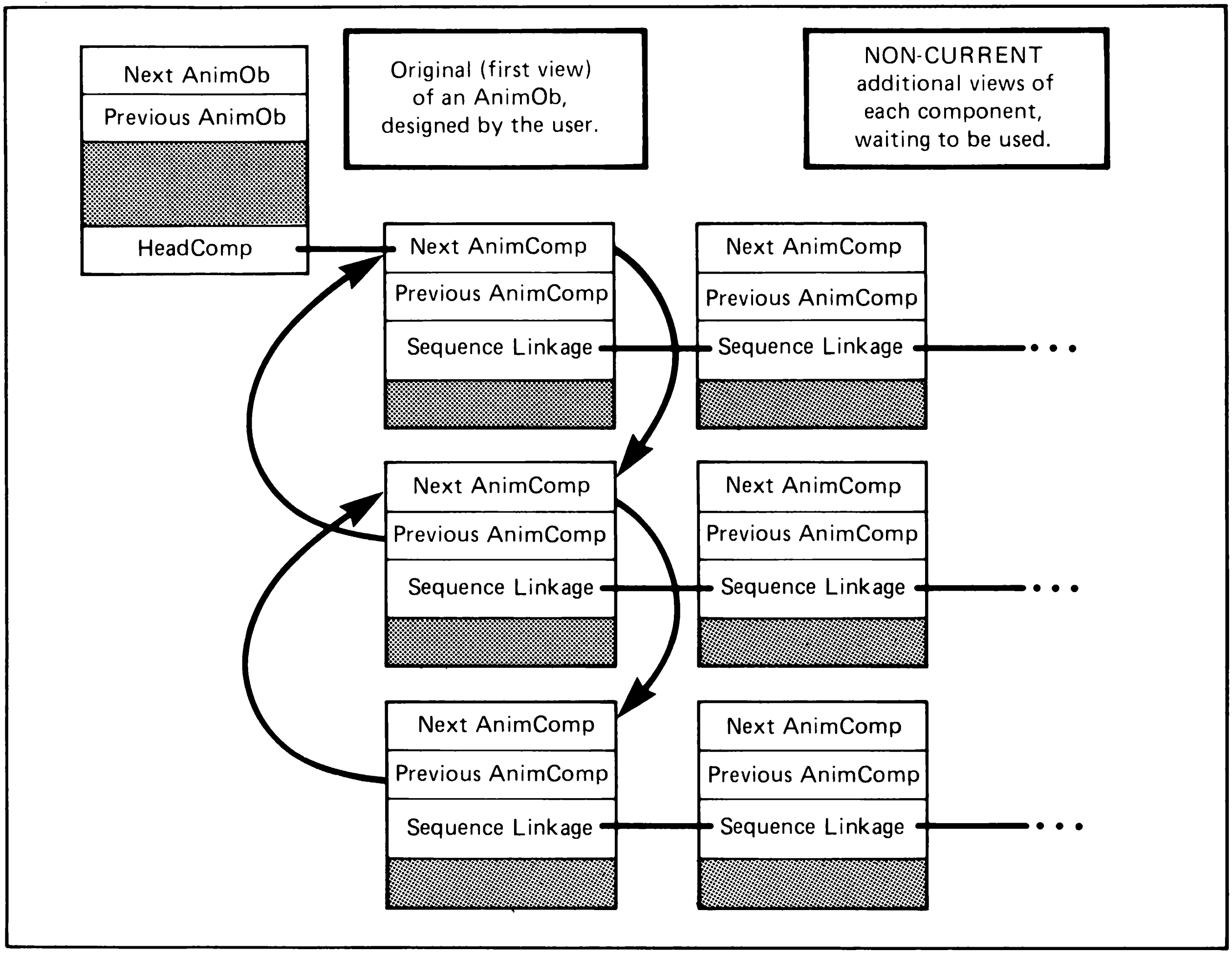

Figure 3-9: Linking AnimComps To Form an AnimOb

DRAWING PRECEDENCE

The sequence in which you link the components in a list to define the object itself is immaterial. The system simply uses this list of components to define the overall object. To specify the drawing precedence for the objects in an animation object, you use the **Before** and **After** pointers in the **Bob** structure *for the initial sequence of the animation object.*

If you refer to the description of adding **Bobs** in the section called "Adding a Bob," you will see that when you add **Bobs** to the system, the **Before** and **After** pointers control the drawing sequence and thereby the precedence of the objects. Once you have added the **Bobs** to the system with **AddBob()**, you must assign a fixed set of pointers to establish the correct drawing order.

Animation components may have several views, each of which points to a **Bob** structure. However, only one of those views is actually "active" for that component at any one time, making up part of the overall animation object. The animation system adjusts the **Before** and **After** pointers of the **Bob** structure for each of the current views to maintain the sequence of drawing for each of the components the same as that you have defined for the initial view. Adjustments take place in the sequencing any time any one of the animation components "times out" and shows a new sequence. Therefore, if you are defining **Bobs** as part of the animation system, you need only initialize the **Before** and **After** pointers within the **Bob** structure for the initial sequence of each of the components.

You may wish to define multiple animation objects. To assure that one complete *object* always has priority over another object, you can use the initial sequence linkage to control this as well. You use the **Bob Before** and **After** pointers to link together the last **AnimComp**'s **Bob** of one **AnimOb** to the first **AnimComp**'s **Bob** of the next **AnimOb**. The system maintains the drawing order during calls to **Animate()** from that time onward.

You may modify the drawing order during part of the animation (such as to make one object pass in front of another during one display sequence, then pass behind it on the next sequence). You can perform this kind of activity, if you wish, during an AnimORoutine or AnimCRoutine. See the section called "Your Own Animation Routine Calls" for details.

ANIMATION SEQUENCING

To perform sequenced drawing, you must define the sequence in which you wish the drawings to be made. For each of the animation components, there is a set of pointers that allows you to define the exact sequence in which the drawings should appear.

After a period of time that you have specified, which is separately controllable for each component, the system software automatically switches from the current drawing in the sequence to the next one. For this purpose, you provide three pieces of information in the **AnimComp** structure: pointers to the previous and next drawings in the sequence that you have defined, a user flag variable called **Flags**, and a **TimeSet** variable.

After the specified time interval for each of the sequenced drawings, the system software switches to show the next drawing specified in the sequence. The next section shows how you specify the time.

Figure 3-10 illustrates how the system uses the "next sequential image" pointer to step from one image to the next at the specified time.

If you set the RINGTRIGGER bit in the **Flags** variable, the system adjusts the reference point for the sequenced drawing. See the "Sequenced Drawing" section above for details.

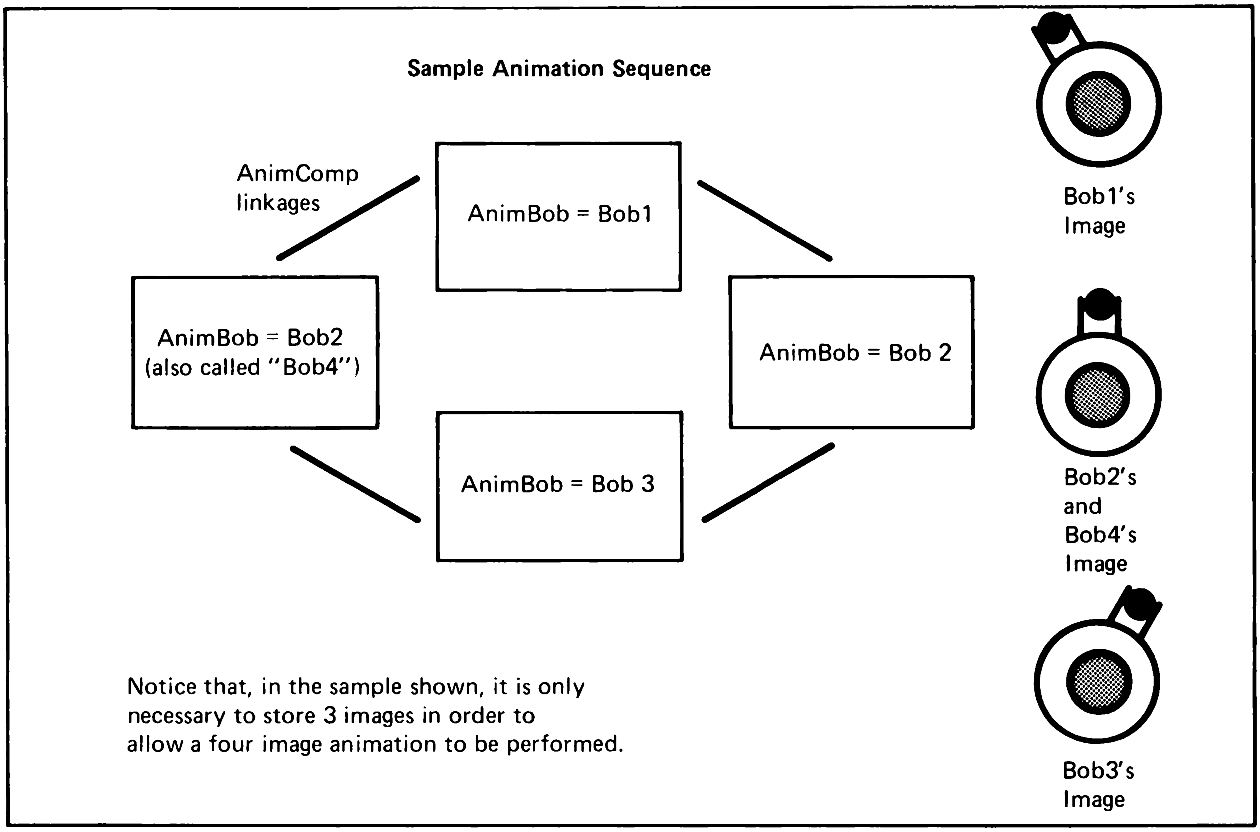

Figure 3-10: Linking AnimComps for Sequenced Drawing

SPECIFYING TIME FOR EACH IMAGE

When you have defined all of your animation objects and components, you call the **Animate()** routine. To manipulate the objects, you set the variable called **Timer** in the **AnimComp** structure and you set a corresponding variable called **TimeSet** (also in the **AnimComp** structure).

When the system selects the animation component, the system copies the value currently in **TimeSet** into the variable named **Timer**. If **Timer** has a nonzero value when you call **Animate()**, then the current view of the animation component remains the active view for as many calls to **Animate()** as you specify with the value in **Timer**. When the **Timer** value counts down to zero, the system makes the next sequential view active. If you set the value in **TimeSet** to zero, **Timer** remains zero. **Timer** never triggers from a non-zero state and, therefore, does *not* cause any change in the view.

When the system activates a new sequence component, it checks that component's **compFlags** to see if the RINGTRIGGER flag bit is set. If so, the system performs ring processing, which means that it adds the values **RingYTrans** and **RingXTrans** to **AnY** and **AnX** respectively. See the section called "Animation Types" for details.

Now let's see how this process works in an actual animation. Let's say that you are animating the figure of a man. As he walks across the screen, he swings his arm back and forth at a fixed rate. Assume that you have three drawings of the arm: swung forward, at a center position, and swung back. To animate the arm, you may follow these steps:

1. Define four **Bobs**: the first for the forward swing, the second for the center, the third for the back swing, and the fourth centered again.

2. Define four **AnimComps**, one for each of these **Bobs**. To link them together in a sequence (forward, center, back, center), use the **PrevSeq** and **NextSeq** pointers.

3. Link *one* of the **AnimComps** in this sequence to the **AnimComp** that defines the body of the man, using the **AnimComp**, **PrevComp**, and **NextComp** pointers.

4. Set the **Timer** variable for *each* sequenced **AnimComp** to a value appropriate for him to hold that pose. For example, three calls to **Animate()** for forward and back, and two calls for each of the two centered positions of his arm might be appropriate values.

5. Set the value of **XTrans** and **YTrans** for *each* **AnimComp** to position the arm properly with respect to the rest of the body for each sequence of the arm swing.

6. Continue the arm sequence by setting the RINGTRIGGER bit in the flags variable of the last sequence, thereby triggering a return to the first view when the timer of the last view times out.

Now, each time you call **Animate()**, the animation system checks all of the **Timer** variables, as well as calling your AnimCRoutines and AnimORoutines. When each of the **Timer** variables becomes a zero, the next sequenced view of the **AnimComp** replaces the current sequence. When an **AnimComp** becomes "current," the value in its **TimeSet** variable is copied into its **Timer** variable.

This also means that you have told the system two things: first, to remove the **Bob** of the current sequence from the system **Bob** list the next time you call **DrawGList()**; and second, to use the **Bob** representing the new sequence in its place. The system automatically copies the **Bob** **Before** and **After** pointers from the current sequence into the new sequence **AnimComp**'s **Bob** to assure that the object is still drawn in the same order, maintaining its priority relative to other objects in the drawing area.

YOUR OWN ANIMATION ROUTINE CALLS

The **AnimOb** and **AnimComp** structures include pointers to your own routines that you want the system to call. If you want a routine to be called, you must specify the address of the routine in this variable. If no routine is to be called, you must set this variable to zero. No values are passed to these routines, except a pointer to its **AnimOb** or **AnimComp**, respectively. However, because you set each AnimORoutine (the **AnimOb** routine) and AnimCRoutine (the **AnimComp** routine), you can use the extensions to the **AnimOb** or **Bob** or **VSprite** structures to hold the variables you need for your own routines.

Suppose you are creating the following animation:

- A man is walking a dog down a street. There is a fireplug at one side of the screen. Let's say you wish to change the appearance of the fireplug if the dog approaches too closely. You would, therefore, design an AnimORoutine to do a proximity check on the dog.

- To allow the fireplug to have different appearances, you might provide three individual views. One is normal, one is an intermediate view (comparable to the center arm-swing mentioned earlier), and the final view is a "strength pose," saying "back off dog!"

- You may set the **TimeSet** and **Timer** variables for the "normal" appearance for the fireplug at zero. This means that it should never change from this appearance no matter how many calls to **Animate()** occur, as defined above. (If it is already zero, it will not decrement; therefore, it can never go from non-zero to zero).

- You may set the **TimeSet** variable for the intermediate view to 1 (stay in the intermediate pose for only one call to **Animate()**). In addition, you may set the **TimeSet** variable for the strength pose to 10 (stay strong for ten calls to **Animate()**).

- For each call to **Animate()**, the AnimORoutine for the fireplug checks how close the dog has approached. If it is within a certain range, the AnimORoutine changes the **Timer** variable for the normal fireplug pose to a 1.

- The next call to **Animate()** finds a value of 1 in the **Timer** variable and decrements it. This makes a value of 0, forcing a change to the next sequence (the intermediate pose). The system will remove the normal pose **Bobs** from the system **Bob** list it is to draw, and the next call to **DrawGList()** will therefore draw the intermediate pose instead.

- The next call to **Animate()** finds a value of 1 in the **Timer** variable for the intermediate pose and decrements it, causing a change to the strength pose. The fireplug remains in the strength pose for ten calls to **Animate()**, returning through the intermediate pose for one call, then to the normal pose again.

- Now that the **Timer** value has become zero again, the fireplug returns to the original state, staying in its normal pose until the dog again approaches within range.

MOVING THE OBJECTS

When you have defined all of the structures and have established all of the links, you can call the **Animate()** routine to move the objects. **Animate()** adjusts the positions of the objects as described above, and calls the various subroutines (AnimCRoutines and AnimORoutines) that you have specified.

After the system has completed the **Animate()** routine, as the screen objects have been moved, their order in the graphics objects list may possibly be incorrect. Therefore, as always, before ordering the system to redraw the objects, you must sort them first.

If you perform **DoCollision()** when the system has newly positioned the objects after your call to **Animate()**, your collision routines may also have an effect on the ultimate position of the objects. Therefore, you should again call **SortGList()** to assure that the system correctly orders the objects before you call **DrawGList()**, as illustrated in the following typical call sequence:

```
/* ... setup of graphics elements and objects */

Animate( key, rp );      /* "move" objects per instructions */
SortGList( rp );         /* put them in order */
DoCollision( rp );       /* software collision detect/action */
SortGList( rp );         /* put them back into right order */
DrawGList( vp, rp );     /* draw into current RastPort */
```

Complete Example Program

The following program produces a single-buffered display with two **Bobs** and two **Vsprites**.

```
/* SAMPLE PROGRAM THAT USES GELTOOLS TO PRODUCE A DOUBLE BUFFERED DISPLAY
 * SCREEN CONTAINING TWO BOBS AND TWO VSPRITES
 *
 * Author:  David Lucas
 */


/* Leave this structure definition at the top. Look at gels.h. */
struct vInfo {
        short vx,vy;            /* This VSprites velocity. */
        short id;
};
#define VUserStuff struct vInfo


/* Things to notice:

        Default value in sprite/playfield priority register has all
        hardware sprites having a higher priority than either of the
        two playfields.   Areas containing color 0 of both the bob and
        vsprite are shown as transparent (see hole in center of each).

        You can specify bob drawing order by using the before and after
        pointers, thereby always maintaining an apparent precedence of
        one bob over another.  Re Vsprites.... because they are assigned
        sequentially from top of screen to bottom, in sprite numerical
        order (0, 1, 2, 3 etc), and because the lowest numbered hardware
        sprite has the highest video precedence, the sprite that is
        closest to the top of the screen always appears in front of the
        sprite beneath it.

        Without double-buffering, there would be flicker on the part
        of the bobs.  Double buffering consists of writing into an area
        that is not being displayed.  Some of the flicker could have been
        alleviated by waiting for the video beam to reach top-of-frame
        before doing the drawing, but when the bobs are near the top,
        it makes it all the more difficult to draw without apparent
        flicker in that case.  Also note that multitasking will
        occasionally upset even this plan in that it can delay the
        drawing operation until the beam is in the area that is being drawn.

 */
```

```
/******************************************************************************
 * A sprite and a bob on a screen.
 */

#include "intuall.h"

#define SBMWIDTH 320    /* My screen size constants. */
#define SBMHEIGHT 200
#define SBMDEPTH 4

#define RBMWIDTH 330    /* My rastport size constants. */
#define RBMHEIGHT 210
#define RBMDEPTH SBMDEPTH

#define VSPRITEWIDTH 1  /* My VSprite constants. */
#define VSPRITEHEIGHT 12
#define VSPRITEDEPTH 2
#define NSPRITES 2

#define BOBWIDTH 62     /* My Bob constants. */
#define BOBHEIGHT 31
#define BOBDEPTH 4
#define NBOBS 2

struct IntuitionBase *IntuitionBase = NULL;
struct GfxBase *GfxBase = NULL;

struct IntuiMessage *MyIntuiMessage = NULL;

struct TextAttr TestFont = {     /* Needed for opening screen. */
        (STRPTR)"topaz.font", TOPAZ_EIGHTY, 0, 0
};

/* DBL BUF */
struct BitMap *MyBitMapPtrs[2] = {NULL, NULL};
WORD ToggleFrame = 0;

struct GelsInfo GInfo;          /* For all Gels. */

struct VSprite *VSprites[NSPRITES];
WORDBITS VSpriteImage[] = {
/* Plane 0, Plane 1 */
        0xFFFF, 0xFFFF, /* Line 1, first. */
        0xFFFF, 0xC003,
        0xFFFF, 0xC003,
        0xF00F, 0xCFF3,
        0xF00F, 0xCFF3,
        0xF00F, 0xCC33,
        0xF00F, 0xCC33,
        0xF00F, 0xCFF3,
        0xF00F, 0xCFF3,
        0xFFFF, 0xC003,
        0xFFFF, 0xC003,
        0xFFFF, 0xFFFF, /* Line 12, last. */
};
```

```
USHORT *VSpriteImage_chip = 0;

/* These are the colors that will be used for my VSprites. Note I really do mean
 * colors, not color register numbers. High to low, starting at bit 12 and going
 * down to LSB, there are four bits each of red, green and blue. Please read the
 * sprite section of the hardware manual. The gels system will put them into the
 * proper color registers when they are displayed. Reminder: Sprites can only
 * use color registers in sets of 3...
 *   17,18,19 = sprite 0 and 1,
 *   21,22,23 = sprite 2 and 3,
 *   25,26,27 = sprite 4 and 5,
 *   29,30,31 = sprite 6 and 7.
 * Please read the section on how VSprites are assigned in the RKM.
 */
WORD MyVSpriteColors[] = {
        0x0f00, /* Full red. */
        0x00f0, /* Full green. */
        0x000f  /* Full blue. */
};

struct Bob *Bobs[NBOBS];
short BobImage[] = {
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC, /* Plane 0, line 1. */
        0xC000, 0x0000, 0x0000, 0x000C,
        0xCFFF, 0xFFFF, 0xFFFF, 0xFFCC,
        0xCC00, 0x0000, 0x0000, 0x00CC,
        0xCCFF, 0xFFFF, 0xFFFF, 0xFCCC,
        0xCCC0, 0x0000, 0x0000, 0x0CCC,
        0xCCCF, 0xFFFF, 0xFFFF, 0xCCCC,
        0xCCCC, 0x0000, 0x0000, 0xCCCC,
        0xCCCC, 0xFFFF, 0xFFFC, 0xCCCC,
        0xCCCC, 0xC000, 0x000C, 0xCCCC,
        0xCCCC, 0xCFFF, 0xFFCC, 0xCCCC,
        0xCCCC, 0xCC00, 0x00CC, 0xCCCC,
        0xCCCC, 0xCCFF, 0xFCCC, 0xCCCC,
        0xCCCC, 0xCCC0, 0x0CCC, 0xCCCC,
        0xCCCC, 0xCCCF, 0xCCCC, 0xCCCC,
        0xCCCC, 0xCCCC, 0xCCCC, 0xCCCC,
        0xCCCC, 0xCCCF, 0xCCCC, 0xCCCC,
        0xCCCC, 0xCCC0, 0x0CCC, 0xCCCC,
        0xCCCC, 0xCCFF, 0xFCCC, 0xCCCC,
        0xCCCC, 0xCC00, 0x00CC, 0xCCCC,
        0xCCCC, 0xCFFF, 0xFFCC, 0xCCCC,
        0xCCCC, 0xC000, 0x000C, 0xCCCC,
        0xCCCC, 0xFFFF, 0xFFFC, 0xCCCC,
        0xCCCC, 0x0000, 0x0000, 0xCCCC,
        0xCCCF, 0xFFFF, 0xFFFF, 0xCCCC,
        0xCCC0, 0x0000, 0x0000, 0x0CCC,
        0xCCFF, 0xFFFF, 0xFFFF, 0xFCCC,
        0xCC00, 0x0000, 0x0000, 0x00CC,
        0xCFFF, 0xFFFF, 0xFFFF, 0xFFCC,
        0xC000, 0x0000, 0x0000, 0x000C,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC, /* Plane 0, line 31. */

        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC, /* Plane 1, line 1. */
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xF000, 0x0000, 0x0000, 0x003C,
        0xF000, 0x0000, 0x0000, 0x003C,
        0xF0FF, 0xFFFF, 0xFFFF, 0xFC3C,
        0xF0FF, 0xFFFF, 0xFFFF, 0xFC3C,
        0xF0F0, 0x0000, 0x0000, 0x3C3C,
        0xF0F0, 0x0000, 0x0000, 0x3C3C,
        0xF0F0, 0xFFFF, 0xFFFC, 0x3C3C,
        0xF0F0, 0xFFFF, 0xFFFC, 0x3C3C,
        0xF0F0, 0xF000, 0x003C, 0x3C3C,
        0xF0F0, 0xF000, 0x003C, 0x3C3C,
        0xF0F0, 0xF0FF, 0xFC3C, 0x3C3C,
        0xF0F0, 0xF0FF, 0xFC3C, 0x3C3C,
        0xF0F0, 0xF0F0, 0x3C3C, 0x3C3C,
        0xF0F0, 0xF0F0, 0x3C3C, 0x3C3C,
        0xF0F0, 0xF0F0, 0x3C3C, 0x3C3C,
        0xF0F0, 0xF0FF, 0xFC3C, 0x3C3C,
        0xF0F0, 0xF0FF, 0xFC3C, 0x3C3C,
        0xF0F0, 0xF000, 0x003C, 0x3C3C,
        0xF0F0, 0xF000, 0x003C, 0x3C3C,
        0xF0F0, 0xFFFF, 0xFFFC, 0x3C3C,
        0xF0F0, 0xFFFF, 0xFFFC, 0x3C3C,
        0xF0F0, 0x0000, 0x0000, 0x3C3C,
        0xF0F0, 0x0000, 0x0000, 0x3C3C,
        0xF0FF, 0xFFFF, 0xFFFF, 0xFC3C,
        0xF0FF, 0xFFFF, 0xFFFF, 0xFC3C,
        0xF000, 0x0000, 0x0000, 0x003C,
        0xF000, 0x0000, 0x0000, 0x003C,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC, /* Plane 1, line 31. */

        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC, /* Plane 2, line 1. */
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFF00, 0x0000, 0x0000, 0x03FC,
        0xFF00, 0x0000, 0x0000, 0x03FC,
        0xFF00, 0x0000, 0x0000, 0x03FC,
        0xFF00, 0x0000, 0x0000, 0x03FC,
        0xFF00, 0xFFFF, 0xFFFC, 0x03FC,
        0xFF00, 0xFFFF, 0xFFFC, 0x03FC,
        0xFF00, 0xFFFF, 0xFFFC, 0x03FC,
        0xFF00, 0xFFFF, 0xFFFC, 0x03FC,
        0xFF00, 0xFF00, 0x03FC, 0x03FC,
        0xFF00, 0xFF00, 0x03FC, 0x03FC,
        0xFF00, 0xFF00, 0x03FC, 0x03FC,
        0xFF00, 0xFF00, 0x03FC, 0x03FC,
        0xFF00, 0xFF00, 0x03FC, 0x03FC,
        0xFF00, 0xFF00, 0x03FC, 0x03FC,
        0xFF00, 0xFF00, 0x03FC, 0x03FC,
        0xFF00, 0xFFFF, 0xFFFC, 0x03FC,
        0xFF00, 0xFFFF, 0xFFFC, 0x03FC,
        0xFF00, 0xFFFF, 0xFFFC, 0x03FC,
        0xFF00, 0xFFFF, 0xFFFC, 0x03FC,
        0xFF00, 0x0000, 0x0000, 0x03FC,
        0xFF00, 0x0000, 0x0000, 0x03FC,
        0xFF00, 0x0000, 0x0000, 0x03FC,
```

```
        0xFF00, 0x0000, 0x0000, 0x03FC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC, /* Plane 2, line 31. */

        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC, /* Plane 3, line 1. */
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0x0000, 0x0003, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC,
        0xFFFF, 0xFFFF, 0xFFFF, 0xFFFC  /* Plane 3, line 31. */
};
USHORT *BobImage_chip = 0;

/* These are for my custom screen. */
struct Screen *screen = NULL;
struct NewScreen ns = {
    0, 0,                   /* Start position. */
    SBMWIDTH, SBMHEIGHT, SBMDEPTH,       /* Width, height, depth. */
    0, 0,                   /* Default detail pen, block pen. */
    NULL,                   /* Viewing mode. */
    CUSTOMSCREEN | CUSTOMBITMAP,         /* Screen type. DBL BUF */
    &TestFont,              /* Font to use. */
    NULL,                   /* No default title. */
    NULL,                   /* No pointer to additional gadgets. */
    NULL                    /* No pointer to CustomBitMap. */
};

/* These are for my window. */
struct Window *window = NULL;

struct NewWindow nw = {
    0, 0,                   /* Start position. */
    SBMWIDTH, SBMHEIGHT,    /* Width, height. */
    0, 0,                   /* Detail pen, block pen. */
    CLOSEWINDOW,            /* IDCMP flags. */
    WINDOWCLOSE | BORDERLESS,            /* Flags. */
    NULL,                   /* No pointer to FirstGadget. */
    NULL,                   /* No pointer to first CheckMark. */
    NULL,                   /* No default Title. */
    NULL,                   /* No pointer to Screen. */
    NULL,                   /* No pointer to BitMap. */
    0, 0,                   /* MinWidth, MinHeight (not used). */
    SBMWIDTH, SBMHEIGHT,    /* MaxWidth, MaxHeight (not used). */
    CUSTOMSCREEN            /* Screen type. */
};

/***************************************************************************
 * This will be called if a sprite collision with the border is detected.
 */

borderPatrol(s, b)
struct VSprite *s;
int b;
{
    register struct vInfo *info;

    info = &s->VUserExt;
    if (b & (TOPHIT | BOTTOMHIT))        /* Top/Bottom hit, change direction. */
        info->vy = -(info->vy);
    if (b & (LEFTHIT | RIGHTHIT))        /* Left/Right hit, change direction. */
        info->vx = -(info->vx);

}

/***************************************************************************
 * Fun Starts.
 */

main()
{
    SHORT i, j;

    /* Open libraries that will be used directly. */
    if ((IntuitionBase = (struct IntuitionBase *)
            OpenLibrary("intuition.library", LIBRARY_VERSION)) == 0) {
#ifdef DEBUG
        kprintf("Main: Can't open Intuition.\n");
#endif
        MyCleanup();
        Exit(-1);
    }

    if ((GfxBase = (struct GfxBase *)
            OpenLibrary("graphics.library", LIBRARY_VERSION)) == 0) {
#ifdef DEBUG
        kprintf("Main: Can't open Graphics.\n");
```

```
#endif
        MyCleanup();
        Exit(-1);
    }

/****************************************************************************
 * DBL BUF
 */
    for(j=0; j<2; j++) {
        if ((MyBitMapPtrs[j] = (struct BitMap *)
                AllocMem(sizeof(struct BitMap), MEMF_CHIP)) == 0) {
#ifdef DEBUG
            kprintf("Main: Can't allocate BitMap.\n");
#endif
            MyCleanup();
            Exit(-1);
        }
        InitBitMap(MyBitMapPtrs[j], RBMDEPTH, RBMWIDTH, RBMHEIGHT);
        for(i=0; i<RBMDEPTH; i++) {
            if ((MyBitMapPtrs[j]->Planes[i] = (PLANEPTR)AllocRaster(RBMWIDTH,
                    RBMHEIGHT)) == 0) {
#ifdef DEBUG
                kprintf("Main: Can't allocate BitMaps' Planes.\n");
#endif
                MyCleanup();
                Exit(-1);
            }
            BltClear(MyBitMapPtrs[j]->Planes[i], (RBMWIDTH / 8) * RBMHEIGHT, 1);
        }
    }
    ns.CustomBitMap = MyBitMapPtrs[0]; /* !! */
    screen->RastPort.Flags = DBUFFER;

    /* Open My Very Own Screen. */
    if ((screen = (struct Screen *)OpenScreen(&ns)) == 0) {
#ifdef DEBUG
        kprintf("Main: Can't open Screen.\n");
#endif
        MyCleanup();
        Exit(-1);
    }

    /* Now get that flashing title bar off the display. DBL BUF */
/*
    screen->ViewPort.RasInfo->RxOffset = 5;
    screen->ViewPort.RasInfo->RyOffset = 5;
*/

    /* Set screens' colors (Could've used LoadRGB4()). */
    SetRGB4(&screen->ViewPort, 00, 00, 00, 00);
    SetRGB4(&screen->ViewPort, 01, 15, 00, 00);
    SetRGB4(&screen->ViewPort, 02, 00, 15, 00);
    SetRGB4(&screen->ViewPort, 03, 00, 00, 15);
    SetRGB4(&screen->ViewPort, 04, 15, 15, 00);
    SetRGB4(&screen->ViewPort, 05, 15, 00, 15);
    SetRGB4(&screen->ViewPort, 06, 08, 15, 15);

    SetRGB4(&screen->ViewPort, 07, 15, 11, 00);
    SetRGB4(&screen->ViewPort, 08, 05, 13, 00);
    SetRGB4(&screen->ViewPort, 09, 14, 03, 00);
    SetRGB4(&screen->ViewPort, 10, 15, 02, 14);
    SetRGB4(&screen->ViewPort, 11, 15, 13, 11);
    SetRGB4(&screen->ViewPort, 12, 12, 09, 08);
    SetRGB4(&screen->ViewPort, 13, 11, 11, 11);
    SetRGB4(&screen->ViewPort, 14, 07, 13, 15);
    SetRGB4(&screen->ViewPort, 15, 15, 15, 15);

    nw.Screen = screen;

    if ((window = (struct Window *)OpenWindow(&nw)) == 0) {
#ifdef DEBUG
        kprintf("Main: Can't open Window.\n");
#endif
        MyCleanup();
        Exit(-1);
    }

    /****************************************************************************
     * Now that the screen envirionment is set up, It's time to set up the
     * gels system.
     */

    /* ReadyGels is in GelTools(). */
    if (ReadyGels(&GInfo, &screen->RastPort) != 0) {
#ifdef DEBUG
        kprintf("Main: ReadyGels failed.\n");
#endif
        MyCleanup();
        Exit(-1);
    }

    SetCollision(0, borderPatrol, &GInfo);

    /* Copy Images to chip memory. */
    if (!InitImages()) {
#ifdef DEBUG
        kprintf("Main: InitImages() failed.\n");
#endif
        MyCleanup();
        Exit(-1);
    }

    /****************************************************************************
     * System is set up, now set up each Gel.
     */

    /* First use the routines in geltools to get the sprite. */
    for(i = 0; i < NSPRITES; i++) {
        if ((VSprites[i] = (struct VSprite *)MakeVSprite(VSPRITEHEIGHT,
                VSpriteImage_chip, &MyVSpriteColors[0], i*6, (i*8)+10,
                VSPRITEWIDTH, VSPRITEDEPTH, VSPRITE)) == 0) {
#ifdef DEBUG
            kprintf("Main: MakeVSprite failed.\n");
```

```
#endif
            MyCleanup();
            Exit(-1);
        }

        VSprites[i]->VUserExt.vx = 1;
        VSprites[i]->VUserExt.vy = 1;
        VSprites[i]->VUserExt.id = i;

        AddVSprite(VSprites[i], &screen->RastPort);
    }

    /* First use the routines in geltools to get the bob. */
    for(i = 0; i < NBOBS; i++) {
        if ((Bobs[i] = (struct Bob *)MakeBob(BOBWIDTH, BOBHEIGHT, BOBDEPTH,
              BobImage_chip, 0x0F, 0x00, (i*6), (i*8)+10,
              SAVEBACK | OVERLAY)) == 0) {
#ifdef DEBUG
            kprintf("Main: MakeBob failed.\n");
#endif
            MyCleanup();
            Exit(-1);
        }

        Bobs[i]->BobVSprite->VUserExt.vx = 1;
        Bobs[i]->BobVSprite->VUserExt.vy = 1;
        Bobs[i]->BobVSprite->VUserExt.id = i;

        /* DBL BUF */
        if ((Bobs[i]->DBuffer = (struct DBufPacket *)AllocMem (sizeof(struct
              DBufPacket), MEMF_CHIP)) == 0) {
#ifdef DEBUG
            kprintf("Main: Can't allocate double buffers' packet for a bob.\n");
#endif
            MyCleanup();
            Exit(-1);
        }
        if ((Bobs[i]->DBuffer->BufBuffer = (WORD *)AllocMem (sizeof(SHORT) *
              ((BOBWIDTH+15)/16) * BOBHEIGHT * BOBDEPTH, MEMF_CHIP)) == 0) {
#ifdef DEBUG
            kprintf("Main: Can't allocate double buffer for a bob.\n");
#endif
            MyCleanup();
            Exit(-1);
        }
        AddBob(Bobs[i], &screen->RastPort);

        /* The following relies on the fact that AddBob sets the before
         * and after pointers to 0, so the first before and last after.
         * are left alone.
         * Earlier bob has higher priority, thus this bob'll be drawn
         * AFTER that one, thus this bob will appear on top of all earlier
         * ones. One could set the bobs to be drawn in any order by rearranging
         * these pointers.
         */
        if (i > 0) {
            Bobs[i]->After = Bobs[i-1];
            Bobs[i]->After->Before = Bobs[i];
        }
    } /* End of for. */

    /***************************************************************************
     * Hey, wow, everything opened, and allocated, and initialized! Whew.
     */
    for (;;) {
        DrawGels();

        while (MyIntuiMessage = (struct IntuiMessage *)
              GetMsg(window->UserPort))
            switch (MyIntuiMessage->Class) {
                case CLOSEWINDOW:
                    ReplyMsg(MyIntuiMessage);
                    MyCleanup();
                    Exit(TRUE);
                    break;
                default:
                    ReplyMsg(MyIntuiMessage);
                    break;
            }
    }
}

/***************************************************************************
 * DrawGels part of loop.
 */

DrawGels()
{
    register struct VSprite *pSprite;

    /* Move everything in the sprite list. This includes Bobs. */
    pSprite = GInfo.gelHead->NextVSprite;
    while (pSprite != GInfo.gelTail) {
        pSprite->X += pSprite->VUserExt.vx;
        pSprite->Y += pSprite->VUserExt.vy;
        pSprite = pSprite->NextVSprite;
    }

    SortGList(&screen->RastPort);         /* Put the list in order. */
    DoCollision(&screen->RastPort);       /* Collision routines may called now. */
    DrawGList(&screen->RastPort,&screen->ViewPort);      /* Draw 'em. */
    screen->ViewPort.RasInfo->BitMap = MyBitMapPtrs[ToggleFrame];   /* DBL BUF */
    WaitTOF();                            /* When the beam hits the top... */
    MakeScreen(screen);                   /* Tell intuition to do it's stuff. */
    RethinkDisplay();                     /* Does a MrgCop & LoadView. */
    ToggleFrame ^=1;                                               /* DBL BUF */
    screen->RastPort.BitMap = MyBitMapPtrs[ToggleFrame];           /* DBL BUF */
}

/***************************************************************************
 * This will be called in case of error, or when main is done.
 */
```

```
MyCleanup()
{
    short i, j;

    for (i=0; i < NBOBS; i++) {
        if (Bobs[i] != NULL) {
            DeleteGel(Bobs[i]->BobVSprite);
        }
    }

    for (i=0; i < NSPRITES; i++) {
        if (VSprites[i] != NULL) {
            DeleteGel(VSprites[i]);
        }
    }
    PurgeGels(&GInfo);
    FreeImages();
    if (window != NULL)
        CloseWindow(window);
    if (screen != NULL)
        CloseScreen(screen);

    /* DBL BUF */
    for(j=0; j<2; j++) {
        if (MyBitMapPtrs[j] != NULL) {
            for(i=0; i<RBMDEPTH; i++) {
            if (MyBitMapPtrs[j]->Planes[i] != 0)
                FreeRaster(MyBitMapPtrs[j]->Planes[i], RBMWIDTH, RBMHEIGHT);
            }
            FreeMem(MyBitMapPtrs[j], sizeof(struct BitMap));
        }
    }

    if (GfxBase != NULL)
        CloseLibrary(GfxBase);
    if (IntuitionBase != NULL)
        CloseLibrary(IntuitionBase);
}

InitImages()
{
    extern USHORT *VSpriteImage_chip;
    extern USHORT *BobImage_chip;
    int i;

    if ((VSpriteImage_chip = (USHORT *)
            AllocMem(sizeof(VSpriteImage), MEMF_CHIP)) == 0) {
#ifdef DEBUG
        kprintf("InitImages: No Memory for VSpriteImage.\n");
#endif
        return(FALSE);
    }
    if ((BobImage_chip = (USHORT *)
            AllocMem(sizeof(BobImage), MEMF_CHIP)) == 0) {
#ifdef DEBUG
        kprintf("InitImages: No Memory for BobImage.\n");
#endif
        return(FALSE);
    }
    for(i=0; i<24; i++)
        VSpriteImage_chip[i] = VSpriteImage[i];
    for(i=0; i<496; i++)
        BobImage_chip[i] = BobImage[i];
    return(TRUE);
}

FreeImages()
{
    extern USHORT *VSpriteImage_chip;
    extern USHORT *BobImage_chip;

    if (VSpriteImage_chip != 0)
            FreeMem(VSpriteImage_chip, sizeof(VSpriteImage));
    if (BobImage_chip != 0)
            FreeMem(BobImage_chip, sizeof(BobImage));
}
```

```
/*** intuall.h *************************************************************
 *
 *  intuall.h, general includer for intuition
 *
 *  Confidential Information: Commodore-Amiga, Inc.
 *  Copyright (c) Commodore-Amiga, Inc.
 *
 *                                    Modification History
 *      date        author :          Comments
 *      ------      ------            -------------------------------------
 *      1-30-85     -=RJ=-            created this file!
 *
 ****************************************************************************/

#include <exec/types.h>
#include <exec/nodes.h>
#include <exec/lists.h>
/* #include <exec/interrupts.h> */
#include <exec/memory.h>
#include <exec/ports.h>
#include <exec/tasks.h>
#include <exec/libraries.h>
#include <exec/devices.h>
#include <exec/io.h>
#include <exec/devices.h>

#include <devices/console.h>
#include <devices/timer.h>
#include <devices/keymap.h>
#include <devices/inputevent.h>

#define Msg IOStdReq            /* temporary kluge for dosextens.h */

#include <libraries/dos.h>
#include <libraries/dosextens.h>


#include <graphics/gfx.h>       /* ALWAYS INCLUDE GFX.H before other includes */
#include <graphics/regions.h>   /* new as of 7/9/85 */
#include <hardware/blit.h>

#define blitNode bltnode        /* temporary kludge for gels.h */

#include <graphics/collide.h>
#include <graphics/copper.h>
#include <graphics/display.h>
#include <hardware/dmabits.h>
#include <graphics/gels.h>
#include <graphics/clip.h>
#include <graphics/rastport.h>
#include <graphics/view.h>
#include <graphics/gfxbase.h>
#include <graphics/text.h>
/* #include <hardware/intbits.h> */




#include <hardware/custom.h>
#include <graphics/gfxmacros.h>
#include <graphics/layers.h>
#include <intuition/intuition.h>        /* changed so I can get gadget addr */
#include <devices/gameport.h>
```

```c
/* ======================================================================

GELTOOLS.C -

        A FILE CONTAINING USEFUL SETUP TOOLS FOR THE ANIMATION SYSTEM


        author:  Rob Peck, incorporating valuable comments and changes from
                 Barry Whitebook and David Lucas.

====================================================================== */

#include <exec/types.h>
#include <exec/memory.h>
#include <graphics/gfx.h>       /* ALWAYS INCLUDE GFX.H before other includes */
#include <graphics/gels.h>
#include <graphics/clip.h>
#include <graphics/rastport.h>
#include <graphics/view.h>
#include <graphics/gfxbase.h>
```

```c
/******************************************************************************
 * This file is a collection of tools which are used with the vsprite and
 * bob software.  It contains the following:
 *
 * ReadyGels( *gelsinfo, *rastport );
 * PurgeGels( *gelsinfo );
 *
 * struct VSprite *MakeVSprite(lineheight,*image,*colorset,x,y,
 *       wordwidth,imagedepth,flags);
 * DeleteVSprite( &VSprite );
 *
 * struct Bob *MakeBob(bitwidth,lineheight,imagedepth,*image,
 *             planePick,planeOnOff,x,y)
 * DeleteBob( &Bob );
 *
 * ReadyGels sets up the defaults of the gel system by initializing the
 * GelsInfo structure you provide.  First it allocates room for and
 * links in lastcolor and nextline. It then uses information in your
 * RastPort structure to establish boundary collision defaults at
 * the outer edges of the raster.  It then links together the GelsInfo
 * and the RastPort which you provide. Next it allocates space for two
 * dummy virtual sprite structures, calls InitGels and SetCollision.
 ! You must already have run LoadView before ReadyGels is called.
 *
 * PurgeGels deallocates all memory which ReadyGels and NewGelList have
 * allocated.  The system will crash if you have not used these
 * routines to allocate the space (you cant deallocate something
 * which you havent allocated in the first place).
 *
 * MakeVSprite allocates enough space for and inits a normal vsprite.
 * DeleteVSprite deallocates the memory it used.
 *
 * MakeBob initializes a standard bob and allocates as much memory as is needed
 * for a normal bob and its vsprite structure, links them together.
 * To find the associated vsprite, look at the back-pointer (see the
 * routine doc itself).
 * DeleteBob deallocates the memory it used.
 *
 * Written by Rob Peck, with thanks to Barry Whitebrook and David Lucas.
 *
 ******************************************************************************/
```

```
void border_dummy()
{
  return;
}

/* Caller passes a pointer to his GelsInfo structure which he wants to init,
 * along with a pointer to his IVPArgs.  Default init places the topmost
 * bottommost etc at the outermost boundaries of callers rastport parameters.
 * Caller can change all this stuff after this routine returns.
 */

extern struct RastPort *myRast;

struct VSprite *SpriteHead = NULL;
struct VSprite *SpriteTail = NULL;

/***************************************************************************
 * This routine cannot be run until the first LoadView(&view) has been
 * executed.  InitGels works with an already active View, so LoadView
 * must have been run first.
 */

ReadyGels(g, r)
struct RastPort *r;
struct GelsInfo *g;
{
   /* Allocate head and tail of list. */
   if ((SpriteHead = (struct VSprite *)AllocMem(sizeof
         (struct VSprite), MEMF_PUBLIC | MEMF_CLEAR)) == 0) {
#ifdef DEBUG
      kprintf("ReadyGels: No memory for sprite head.\n");
#endif
      return(-1);
   }

   if ((SpriteTail = (struct VSprite *)AllocMem(sizeof
         (struct VSprite), MEMF_PUBLIC | MEMF_CLEAR)) == 0) {
#ifdef DEBUG
      kprintf("ReadyGels: No memory for sprite tail.\n");
#endif
      return(-1);
   }

  /* By setting all bits here, it means that there are NO
   * reserved sprites.  The system can freely use all of the
   * hardware sprites for its own purposes.  The caller will not be
   * trying to independently use any hardware sprites!
   */
   g->sprRsrvd = -1;

  /* The nextline array is used to hold system information about
   * "at which line number on the screen is this hardware sprite
   * again going to become available to be given a new vsprite to
   * display".
   */




   if ((g->nextLine = (WORD *)AllocMem(sizeof(WORD) * 8,
         MEMF_PUBLIC | MEMF_CLEAR)) == NULL) {
#ifdef DEBUG
      kprintf("ReadyGels: No memory for nextline.\n");
#endif
      return(-1);
   }

  /* In the lastcolor pointer array, the system will store
   * a pointer to the color definitions most recently used
   * by the system. .... as a reminder, virtual sprites can
   * be assigned to any of the real hardware sprites which
   * may be available at the time.  The vsprite colors will
   * be written into the hardware sprite register set for
   * the hardware sprite to which that vsprite is assigned.
   * This pointer array contains one pointer to the last
   * set of three colors (from the vsprite structure *sprColors)
   * for each hardware sprite.
   *
   * As the system is scanning to determine which hardware
   * sprite should next be used to represent a vsprite, it
   * checks the contents of this array.  If a hardware sprite
   * is available and already has been assigned this set of
   * colors, no color assignment is needed, and therefore
   * no color change instructions will be generated for the
   * copper list.
   *
   * If all vsprites use a different set of sprColors, (pointers
   * to sprColors are different for all vsprites), then there
   * is a limit of 4 vsprites on a horizontal line.  If, on
   * the other hand, you define, lets say 8 vsprites, with
   * 1 and 2 having the same sprColors, 3 and 4 the same as
   * each other, 5 and 6 the same as each other, and 7 and 8
   * also having the same vsprite colors, then you will be
   * able to have all 8 vsprites on the same horizontal line.
   *
   * In this case, you will be able to put all 8 vsprites on
   * the same horizontal line.  The reason this helps is that
   * the system hardware shares the color registers between pairs
   * of hardware sprites.  The system thus has enough resources
   * to assign all vsprites to hardware sprites in that there
   * are 4 color-sets for 8 vsprites, exactly matching the
   * hardware maximum capabilities.
   *
   * Note that lastcolor will not be used for bobs. Just sprites.
   */
   if ((g->lastColor = (WORD **)AllocMem(sizeof(LONG) * 8,
         MEMF_PUBLIC | MEMF_CLEAR)) == NULL) {
#ifdef DEBUG
      kprintf("ReadyGels: No memory for lastcolor.\n");
#endif
      return(-1);
   }

  /* This is a table of pointers to the routines which should
   * be performed when DoCollision senses a collision.  This
```

```
   * declaration may not be necessary for a basic vsprite with
   * no collision detection implemented, but then it makes for
   * a complete example.
   */
   if ((g->collHandler = (struct collTable *)AllocMem(sizeof(struct
        collTable), MEMF_PUBLIC | MEMF_CLEAR)) == NULL) {
#ifdef DEBUG
      kprintf("ReadyGels: No memory for collHandler.\n");
#endif
      return(-1);
   }

  /* When any part of the object touches or passes across
   * this boundary, it will cause the boundary collision
   * routine to be called.  This is at smash[0] in the
   * collision handler table and is called only if
   * DoCollision is called.
   */
   g->leftmost = 0;
   g->rightmost = r->BitMap->BytesPerRow * 8 - 1;
   g->topmost = 0;
   g->bottommost = r->BitMap->Rows - 1;

   r->GelsInfo = g;  /* Link together the two structures */

   InitGels(SpriteHead, SpriteTail, g );

  /* Pointers initialized to the dummy sprites which will be
   * used by the system to keep track of the animation system.
   */
   SetCollision(0, border_dummy, g);
   WaitTOF();
   return(0);
}

/***************************************************************************
 * Use this to get rid of the gels stuff when it is not needed any more.
 * You must have allocated the gels info stuff (use the ReadyGels routine).
 */

PurgeGels(g)
struct GelsInfo *g;
{
   if (g->collHandler != NULL)
      FreeMem(g->collHandler, sizeof(struct collTable));
   if (g->lastColor != NULL)
      FreeMem(g->lastColor, sizeof(LONG) * 8);
   if (g->nextLine != NULL)
      FreeMem(g->nextLine, sizeof(WORD) * 8);
   if (g->gelHead != NULL)
      FreeMem(g->gelHead, sizeof(struct VSprite));
   if (g->gelTail != NULL)
      FreeMem(g->gelTail, sizeof(struct VSprite));
}

/***************************************************************************

 * Because MakeVSprite is called by MakeBob, MakeVSprite only creates the
 * VSprite,it doesn't add it to the system list. The calling routine must
 * do an AddVSprite after it is created.
 */

struct VSprite *MakeVSprite(lineheight, image, colorset, x, y,
                            wordwidth, imagedepth, flags)
SHORT lineheight;       /* How tall is this vsprite? */
WORD *image;            /* Where is the vsprite image data, should be
                           twice as many words as the value of lineheight */
WORD *colorset;         /* Where is the set of three words which describes
                           the colors that this vsprite can take on? */
SHORT x, y;             /* What is its initial onscreen position? */
SHORT wordwidth, imagedepth, flags;
{
   struct VSprite *v;   /* Make a pointer to the vsprite structure which
                           this routine dynamically allocates */

   if ((v = (struct VSprite *)AllocMem(sizeof(struct VSprite),
         MEMF_PUBLIC | MEMF_CLEAR)) == 0) {
#ifdef DEBUG
      printf("MakeVSprite: Couldn't allocate VSprite.\n");
#endif
      return(0);
   }

   v->Flags = flags;    /* Is this a vsprite, not a bob? */

   v->Y = y;            /* Establish initial position relative to */
   v->X = x;            /* the Display coordinates. */

   v->Height = lineheight;      /* The Caller says how high it is. */
   v->Width = wordwidth;        /* A vsprite is always 1 word (16 bits) wide. */

  /* There are two kinds of depth... the depth of the image itself, and the
   * depth of the playfield into which it will be drawn. The image depth
   * says how much data space will be needed to store an image if it's
   * dynamically allocated. The playfield depth establishes how much space
   * will be needed to save and restore the background when a bob is drawn.
   * A vsprite is always 2 planes deep, but if it's being used to make a
   * bob, it may be deeper...
   */

   v->Depth = imagedepth;

  /* Assume that the caller at least has a default boundary collision
   * routine.... bit 1 of this mask is reserved for boundary collision
   * detect during DoCollision(). The only collisions reported will be
   * with the borders. The caller can change all this later.
   */

   v->MeMask = 1;
   v->HitMask = 1;

   v->ImageData = image;        /* Caller says where to find the image. */
```

```
  /* Show system where to find a mask which is a squished down version
   * of the vsprite (allows for fast horizontal border collision detect).
   */

   if ((v->BorderLine = (WORD *)AllocMem((sizeof(WORD)*wordwidth),
         MEMF_PUBLIC | MEMF_CLEAR)) == 0) {
#ifdef DEBUG
      kprintf("MakeVSprite: Couldn't allocate BorderLine.\n");
#endif
      return(0);
   }

  /* Show system where to find the mask which contains a 1 bit for any
   * position in the object in any plane where there is a 1 bit (all planes
   * OR'ed together).
   */

   if ((v->CollMask = (WORD *)AllocMem(sizeof(WORD)*lineheight*wordwidth,
         MEMF_CHIP | MEMF_CLEAR)) == 0) {
#ifdef DEBUG
      kprintf("MakeVSprite: Couldn't allocate CollMask.\n");
#endif
      return(0);
   }

  /* This isn't used for a Bob, just a VSprite. It's where the
   * Caller says where to find the VSprites colors.
   */
   v->SprColors = colorset;

   /* These aren't used for a VSprite, and MakeBob'll do set up for Bob. */
   v->PlanePick = 0x00;
   v->PlaneOnOff = 0x00;

   InitMasks(v);         /* Create the collMask and borderLine */
   return(v);
}

struct Bob *MakeBob(bitwidth,lineheight,imagedepth,image,
      planePick,planeOnOff, x,y, flags)
SHORT bitwidth,lineheight,imagedepth,planePick,planeOnOff,x,y,flags;
WORD *image;
{
   struct Bob *b;
   struct VSprite *v;
   SHORT wordwidth;

   wordwidth = (bitwidth+15)/16;

  /* Create a vsprite for this bob, it will need to be deallocated
   * later (freed) when this bob gets deleted.
   * Note: No color set for bobs.
   */
   if ((v = MakeVSprite(lineheight, image, NULL, x, y, wordwidth,
         imagedepth, flags)) == 0) {
#ifdef DEBUG
      kprintf("MakeBob: MakeVSprite failed.\n");
#endif
      return(0);
   }

   /* Caller selects which bit planes into which the image is drawn. */
   v->PlanePick = planePick;

   /* What happens to the bit planes into which the image is not drawn. */
   v->PlaneOnOff = planeOnOff;

   if ((b = (struct Bob *)AllocMem(sizeof(struct Bob),
         MEMF_PUBLIC | MEMF_CLEAR)) == 0) {
#ifdef DEBUG
      kprintf("MakeBob: Couldn't allocate bob.\n");
#endif
      return(0);
   }

   v->VSBob = b; /* Link together the bob and its vsprite structures */

   b->Flags = 0; /* Not part of an animation (BOBISCOMP) and don't keep the
                    image present after bob is removed (SAVEBOB) */

  /* Tell where to save background. Must have enough space for as many
   * bitplanes deep as the display into which everything is being drawn.
   */

   if ((b->SaveBuffer = (WORD *)AllocMem(sizeof(SHORT) * wordwidth
         * lineheight * imagedepth, MEMF_CHIP | MEMF_CLEAR)) == 0) {
#ifdef DEBUG
      kprintf("MakeBob: Couldn't allocate save buffer.\n");
#endif
      return(0);
   }

   b->ImageShadow = v->CollMask;

  /* Interbob priorities are set such that the earliest defined bobs have
   * the lowest priority, last bob defined is on top.
   */

   b->Before = NULL;     /* Let the caller worry about priority later. */
   b->After = NULL;

   b->BobVSprite = v;

  /* InitMasks does not preset the imageShadow ... caller may elect to use
   * the collMask or to create his own version of a shadow, although it
   * is usually the same.
   */

   b->BobComp = NULL;    /* this is not part of an animation */
   b->DBuffer = NULL;    /* this is not double buffered */

  /* Return a pointer to this newly created bob for additional caller
```

```
    * interaction or for AddBob(b);
    */
    return(b);
}

/* Deallocate memory which has been allocated by the routines Makexxx. */
/* Assumes images and imageshadow deallocated elsewhere. */
DeleteGel(v)
struct VSprite *v;
{
    if (v != NULL) {
        if (v->VSBob != NULL) {
            if (v->VSBob->SaveBuffer != NULL) {
                FreeMem(v->VSBob->SaveBuffer, sizeof(SHORT) * v->Width
                        * v->Height * v->Depth);
            }
            if (v->VSBob->DBuffer != NULL) {
                if (v->VSBob->DBuffer->BufBuffer != 0) {
                    FreeMem(v->VSBob->DBuffer->BufBuffer,
                            sizeof(SHORT) * v->Width * v->Height * v->Depth);
                }
                FreeMem(v->VSBob->DBuffer, sizeof(struct DBufPacket));
            }
            FreeMem( v->VSBob, sizeof(struct Bob));
        }
        if (v->CollMask != NULL) {
            FreeMem(v->CollMask, sizeof(WORD) * v->Height * v->Width);
        }
        if (v->BorderLine != NULL) {
            FreeMem(v->BorderLine, sizeof(WORD) * v->Width);
        }
        FreeMem(v, sizeof(struct VSprite));
    }
}
```

Chapter 4

Text

Introduction

Text on the Amiga is simply another graphics primitive. Because of this, you can easily intermix text and graphics on the same screen. Typically, a 320-by-200 graphics screen can contain 40-column, 25-line text using a text font defined in an 8-by-8 matrix. The same type of font can be used to display 80-column text if the screen resolution is extended to 640 by 200. Window borders and other graphics embellishments may reduce the actual available area.

The text support routines use the **RastPort** structure to hold the variables that control the text drawing process. Therefore, any changes you make to **RastPort** variables affect both the drawing routines and the text routines.

In addition to the basic fonts provided in the ROMs, you can link your own font into the system, and ask that it be used along with the other system fonts.

This chapter shows you how to:

- Print text into a drawing area
- Specify the character color
- Specify which font to use
- Access disk-based fonts
- Link in a new font
- Define a new font
- Define a disk-based font

Printing Text into a Drawing Area

The placement of text in the drawing area depends on several variables. Among these are the current position for drawing operations, the font width and height, and the placement of the font baseline within that height.

CURSOR POSITION

Text position and drawing position use the same variables in the **RastPort** structure—**cp_y** and **cp_x**, the current vertical and horizontal pen position. The text character begins at this point. You use the graphics call **Move(&rastPort, x, y)** to establish the **cp_y** and **cp_x** position.

BASELINE OF THE TEXT

The **cp_y** position of the drawing pen specifies the position of the baseline of the text. In other words, all text printed into a **RastPort** using a single "write string" command is positioned relative to this **cp_y** as the text baseline. Figure 4-1 shows some sample text that includes a character that has 1 dot below the baseline and a maximum of 7 dots above and including the baseline.

For clarity, blank squares and shaded squares, rather than 0s and 1s, are used for the figure.

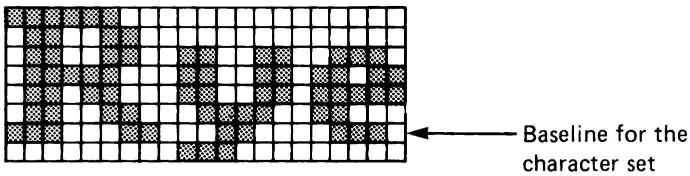

Figure 4-1: Text Baseline

The figure shows that for this font, the baseline value is 6. The baseline value is the number of lines from the top of the character to the baseline.

When the text routines output a character to a **RastPort**, the leftmost edge of the character position is specified by the **cp_x** (current horizontal position) variable.

After all characters have been written to the **RastPort**, the variable **cp_y** is unchanged. The value of **cp_x** will be changed by the number of horizontal positions that were needed to write all characters of the specified text. Both fixed-width and proportionally spaced character sets are accommodated.

The default fonts in the system are all designed to be above and below the baseline, where the baseline position is at line 6 of the character font. This means that you must specify a **cp_y** value of at least 6 when you request that text be printed to a **RastPort** in order to assure that you stay within the memory bounds of the **RastPort** itself. Location (0,0) specifies the upper left-hand corner of the memory space that is dedicated to the **RastPort**. Because all text will be written above and below the baseline, you must start at a proper position or the routines will write into non-**RastPort** memory.

You should not request that the text routines write beyond the outer bounds of the **RastPort** memory, either horizontally or vertically. Text written outside the **RastPort** bounds may be clipped if the **RastPort** supports clipping (most do). Clipping means that the system will display only that portion of the text that is written into the boundaries of the **RastPort**.

SIZE OF THE FONT

Font design is covered later in this chapter. For now, simply note that the width and height of the font affect how many characters you may print on a line. The position of the baseline affects where you print a line.

PRINTING THE TEXT

You may print text into a **RastPort** by using the **Text()** routine. A typical call to this routine is:

Text(&rastPort, string, count)

where

&rastPort	is a pointer that describes where the text is to be output
string	is the address of the string output
count	is the string length

SAMPLE PRINT ROUTINE

Here is an example showing a string to be written to a **RastPort**. This example assumes that you have already prepared a **RastPort** into which the text can be rendered.

```
    /* sample routine to print a single line of text to the screen. */
struct RastPort *rp;
test( )
{
SetAPen( rp, 1);     /* use color number 1 to draw the text */
Move( rp, 0, 40);    /* start down a few lines from the top */
Text( rp, "This is test text", 17 );
return();
}
```

Selecting the Font

Character fonts each have a name. Two default character fonts are provided in the ROMs. One font produces either 40- or 80-column text (depending on the use of a 320 or 640 horizontal resolution, respectively). The other font produces either 32- or 64-column text. The names and specifications of these default fonts are are shown in table 4-1.

Table 4-1: Default Character Fonts

Font Type	Height	Name
40/80	8	topaz.font
32/64	9	topaz.font

To specify which font the system should use, you call the system routine **OpenFont()** or **OpenDiskFont()**, followed by **SetFont()**. A typical call to these routines follows.

```
font=OpenFont(textattr);
font=OpenDiskFont(textattr);
SetFont( font, rp )
```

where

font
is a pointer to a **TextFont** data structure, returned by either **OpenFont()** or **OpenDiskFont()**.

textattr
is a structure located in the include file *graphics/text.h*. It contains a pointer to a null-terminated string that specifies the name of the font, font height, font style bits, and font preference bits.

rp is the address of the **RastPort** that is to use that font until told to use a different one.

The call to **OpenFont()** or **OpenDiskFont()** says "give me a font with these characteristics." The system attempts to fulfill your request by providing the font whose characteristics best match your request. The table above shows that both of the system fonts have the name "topaz.font." In the system font selections, the height of the characters distinguishes between them. If **OpenFont()** cannot be satisfied, it returns a 0.

Note: In chapter 1, "Graphics Primitives," you saw that the routine **InitRastPort()** initializes certain variables to default values. This routine automatically sets the default to topaz.font with the correct width according to Preferences.

The example below shows how a new font is selected. This example prints two lines of text to the screen, each line of text in a different font. It assumes that a **RastPort** is already set up elsewhere.

```
#include "graphics/text.h"

test( )
{
struct TextAttr f;
     /* provide a font structure to build on for font change */
struct TextFont *font;
f.ta_Name = "topaz.font";
     /* set font name into font descriptor struct */
     /* initial font default is "topaz.font" */
f.ta_YSize = 8;
     /* define font size */
f.ta_Style = 0;
     /* define font style */
f.ta_Flags = 0;
     /* define font preferences */
font=OpenFont(&f);
if (font !=0) {
     SetFont( rp, font);
          /* ask system to find & set one like this */
     Move( rp, 0, 40);
     Text( rp, "topaz.font, 8 dots high", 23 );
     CloseFont(font);
     }
f.ta_Ysize=9;
font=OpenFont(&f);
if (font != 0) {
     SetFont(rp,font);
     Move( rp, 0, 48);
          /* start a few lines down from the top */
     Text( rp, "topaz.font, 9 dots high", 23);
     CloseFont(font);
     {
return(0);
}
```

Selecting the Text Color

You can select which color to use for the text you print by using the graphics calls **SetAPen()** and **SetBPen()** and by selecting the drawing mode in your **RastPort** structure. The combination of those values determines exactly how the text will be printed.

Selecting a Drawing Mode

The **DrawMode** variable of a **RastPort** determines how the text will be combined with the graphics in the destination area.

Note: The **DrawMode** selections are *values*, not bits. You can select from any *one* of the following drawing modes.

If **DrawMode** is JAM1, it means that the text will be drawn in the color of **FgPen** (the foreground, or primary, drawing pen). Wherever there is a 1-bit in the text pattern, the **FgPen** color will overwrite the data present at the text position in the **RastPort**. This is called overstrike mode.

If **DrawMode** is JAM2, it means that the **FgPen** color will be used for the text, and the **BgPen** color (the background or secondary drawing color pen) will be used as the background color for the text. The rectangle of data bits that defines the text-character completely overlays the destination area in your **RastPort**. Where there is a 1 bit in the character pattern definition, the **FgPen** color is used. Where there is a 0 bit in the pattern, the **BgPen** color is used. This mode draws text with a colored background.

If **DrawMode** is COMPLEMENT, it means that wherever the text character is drawn, a position occupied by a 1 bit causes bits in the destination **RastPort** to be changed as follows (see also figure 4-2):

- o If a text-character 1 bit is to be written over a destination area 0 bit, it changes the destination area to a 1 bit.

- o If a text-character 1 bit is to be written over a destination area 1 bit, the result of combining the source and destination is a 0 bit. In other words, whatever the current state of a destination area bit, a 1 bit in the source changes it to the opposite state.

- o Zero bits in the text character definition have no effect on the destination area.

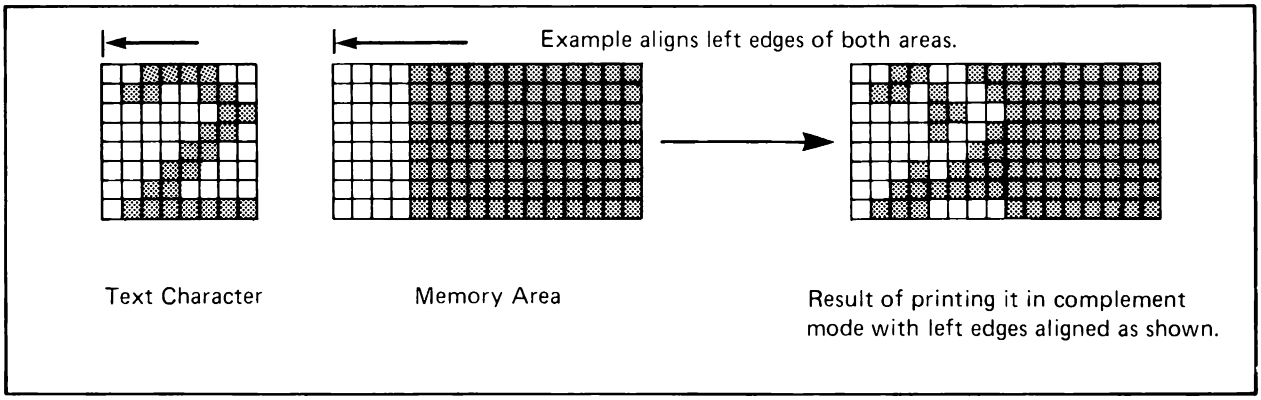

Figure 4-2: Complement Mode

If you set the INVERSVID flag to a 1, it will change all 1 bits to 0 bits and vice versa in a text or other **RastPort** writing operation before writing them into the destination area. If the drawing mode at that time is JAM2, then the pattern colors will be reversed as well. If **DrawMode** is INVERSVID, you can produce inverse video characters.

Here is an example showing each of the three modes of text that you can produce. Again it assumes that your **RastPort** has been set up elsewhere.

```
    /* sample routine to print four lines of text to
     * the screen, each line in a different mode */
test( )
{
SetAPen( rp, 2);           /* use color 2 as primary drawing color */
SetBPen( rp, 3);           /* use color 3 as secondary drawing color */
Move( rp, 0, 6);           /* move the drawing position near upper left */
SetDrMd( rp, JAM1 );       /* Jam 1 color into target raster */
Text( rp, "This is JAM1 mode", 17 );
Move( rp, 0, 46);          /* move the drawing position for next line */
SetDrMd( rp, JAM2 );       /* Jam 2 colors into target raster */
Text( rp, "This is JAM2 mode", 17 );
Move( rp, 0, 86);          /* move the drawing position for next line */
    /* use exclusive-or (COMPLEMENT) to write */
SetDrMd( rp, COMPLEMENT );
Text( rp, "This is COMPLEMENT mode", 23 );
Move( rp, 0, 126 );
SetDrMd(rp,JAM1+INVERSEVID);
Text( rp, "INVERSE", 7 );
return;
}
```

Effects of Specifying Font Style

When you call **OpenFont()**, specifying certain style characteristics, the system searches the loaded fonts to find the closest match to the font you requested. If the remainder of the characteristics match what you have requested, but the style does not match, the text routines **AskSoftStyle()** and **SetSoftStyle()** create a font styled as you have requested by modifying the existing font (that is, modifying a normal font to italic or bold by modifying its characters.) Because many fonts do not lend themselves to such modifications, it is always preferred that the font of the specific style be loaded for use. The system always tries to find the exact specified font before attempting to modify another to fit your request.

If there is a font present in the system that matches your **OpenFont()** request both in name and size, but not in style, (as determined by looking at the font style field), you may use **SetSoftStyle()** to generate the selected style algorithmically as follows:

NORMAL

The font is used exactly as defined.

UNDERLINED

An underline is generated one pixel below the baseline position.

ITALIC

The character is given a slant to the right, starting from the bottom line, and shifting subsequent upward line positions to the right one bit position for every second count up from the bottom of the character.

EXTENDED

This attribute cannot be set with **SetSoftStyle()**. See "Font Style" below.

If you use a font that has the various style characteristics built in, rather than generated, the internal spacing and kerning tables tell the system how to leave the proper amount of space between characters if you are simply printing them one at a time.

If you ask **Text()** to output the characters individually, **Text()** calculates character positioning and width based on the *normal* width and inter-character spacing that it finds in the font descriptor. After printing one or more characters, it automatically positions the drawing pen (**cp_x**) at the position it believes to be correct for the next output character. This may cause adjacent characters to overlap when printed individually.

There is a solution to this problem. If you are using generated style for a font, you must take care to build your output strings of characters before calling **Text()** to output them. **Text()** can handle character strings, correctly generating the desired style with correct inter-character spacing.

To increase inter-character spacing, you can set a field called **rp_TxSpacing** in the **RastPort**. The spacing is specified in pixels.

Adding a New Font to the System

The ROM Exec code maintains a list of the text fonts that are currently linked into the system. To add another font, you must open a disk font using the diskfont library or define the font. You must also reserve some memory where the font can be loaded, move the font definition into that memory area, and link the font name and location into the system font list.

Using a Disk Font

To use an existing disk font, you must open the diskfont library and open a disk font. Here are the program fragments you need to open the library. This gives you access to whatever routines the diskfont library contains:

```
struct Library *DiskfontBase;

DiskfontBase = (struct Library *)
          OpenLibrary("diskfont.library",0);
```

Before trying to use the diskfont routines, you should check that the **OpenLibrary()** call returned a value other than NULL.

Here is the program fragment you need to actually load a disk-based font. It assumes that you already know the name of the font you want to load.

```
struct TextFont *font;
struct TextAttr myTextAttr;

font = OpenDiskFont(&myTextAttr);
```

Finding Out Which Fonts Are Available

The function **AvailFonts()** fills in a memory area designated by you to hold a list of all of the fonts available in the entire system. **AvailFonts()** searches the AmigaDOS directory path currently assigned to FONTS: and locates all available fonts. If you haven't issued a DOS ASSIGN command to change the FONTS: directory path, the system will search the *sys:fonts* directory.

The test program "whichfont.c" at the end of this chapter provides a list of the fonts you can use and shows you how to find the appropriate items to put into the text attribute data structure for the call to **OpenDiskFont()**.

Contents of a Font Directory

In a font directory, you will usually find two names for each font type. A typical pair of entries in the fonts directory is as follows:

```
sapphire.font
sapphire(dir)
```

The file named *sapphire.font* does not contain the actual font. It contains the description of the contents of that font family. The contents are described by a **FontContentsHeader** and one or more **FontContents** data structure entries. The **FontContentsHeader** structure is defined in *libraries/diskfont.h* as:

```
struct FontContentsHeader {
   UWORD  fch_FileID;      /* FCH_ID */
   UWORD  fch_NumEntries;      /* the number of FontContents elements */
         /* FontContents (1 or more) follow here */
   };
```

where

fch_FileID
is simply a numeric identifier for this file type. The value is 0xf00.

fch_NumEntries
says how many entries of type **FontContents** follows this header.

The **FontContents** structure is defined as follows:

```
struct FontContents {
    char     fc_FileName[MAXFONTPATH];
    UWORD    fc_YSize;
    UBYTE    fc_Style;
    UBYTE    fc_Flags;
    };
```

where

fc_FileName
is the pathname that AmigaDOS must follow to find the actual diskfont descriptive header, along with the **TextFont** data structure of which this font is composed. Once AmigaDOS reaches the path named in FONTS:, it finds the filename by the path shown in this entry in **FontContents**.

fc_YSize, **fc_Style**, and **fc_Flags**
correspond to their equivalents in the **TextAttr** data structure (**ta_YSize**, **ta_Style**, and **ta_Flags**).

As an example, a typical entry in sapphire.font is:

"sapphire/14",	a null-terminated string, padded out with zeros for a length of MAXFONTPATH bytes,
14,	the value for fc_YSize,
00,	the value for fc_Style,
60 (hex)	the value for fc_Flags.

This entry indicates that the actual **DiskFontHeader** for the font to be loaded is in path FONTS:sapphire/14. This means that the sapphire subdirectory in the fonts directory must have a file named *14* in order to allow this font to be loaded.

The Disk Font

A disk font is constructed as a loadable, executable module. In this manner, AmigaDOS can be used to perform **LoadSegment()** and **UnloadSegment()** on it. AmigaDOS can therefore allocate memory for the font, and return the memory when the font is unloaded. The contents of the **DiskFont** are described in the include-file *libraries/diskfont.h.* The most significant item in this structure, the embedded **TextFont** structure, is described below in the topic "Defining a Font."

Defining a Font

To define a font, you must specify its characteristics using the **TextFont** structure. The **TextFont** structure is specified in the include file named *graphics/text.h.* The following topics show the meaning of the items in a **TextFont** structure. Following the structure description is an example showing a four-character font, which is defined using this structure and can be linked into the system using **AddFont()**.

THE TEXT NODE

The first item in the **TextFont** structure is a **listNode** by which the system can link this font structure into the system **TextFonts** list. You specify the name of the font using the name pointer field of the font **listNode**.

For example:

```
struct TextFont suitFont;
     /* name chosen for sample font here */
suitFont.textNode.ln_name = "suits.font";
```

FONT HEIGHT

You specify the height in the **ySize** variable. All characters of the font must be defined using this number of lines of data even if they do not require that many lines to contain all font data. Variable-height fonts are not supported.

For example:

```
suitFont.ySize = 8; /* all characters are 8 lines high */
```

FONT STYLE

You can specify the style of the font by specifying certain bits as 1s in the **TextFont Style** variable. The value of **Style** is determined by the sum of the style bits, defined as:

NORMAL (value = 0),	The text font is used exactly as defined.
UNDERLINED (value = 1),	The font is underlined.
BOLD (value = 2),	The font is bold.
ITALIC (value = 4),	The font is italic.
EXTENDED (value = 8),	The font is stretched out (width).

In the font structure, these bits indicate style attributes as intrinsically a part of the font; that is, the font already has them and you can never take them away.

FONT PREFERENCES

This variable provides additional information that tells the font routines how to create or access the characters. The Preferences variable is composed of the sum of the preference bits, defined as follows:

FPB_ROMFONT (value = 0)

The font is located in ROM. If you are making up your own font, this variable will not be zero unless you are burning new system ROMs yourself.

FPB_REVPATH (value = 2)

The font is designed to be rendered from right to left (for example, Hebrew).

FPB_PROPORTIONAL (value = 32)

The characters in the font are not guaranteed to be **xSize** wide (see "Font Width" below). Each character has its own width and positioning in the character space. The bit-packing of the characters is of great importance, as described below. The variables **modulo**, **charloc**, and **charspace** define how the characters are defined and bit-packed.

FONT WIDTH

The **xSize** variable specifies the nominal width of the font. For example:

```
suitFont.tf_XSize = 14; /* specify 14 bits width */
```

FONT ACCESSORS

If you have added a font to the system list, it is possible that more than one task will be accessing a character font. A variable in the font structure keeps track of how many accessors this font currently has. Whenever you call **OpenFont()** or **OpenDiskFont()**, this variable is incremented for the font and decremented by **CloseFont()**. The font accessor value should never be reduced below zero. This accessor count should be initialized to zero *before* you first link a new font into the system, but it is managed by the system after the link is performed.

If you wish to remove a font from the system to free the memory that it is currently using, you must ensure that the number of accessors is zero before ordering its removal.

CHARACTERS REPRESENTED BY THIS FONT

It is possible to create a font consisting of 0 to 255 characters. Some fonts can be exceedingly large because of their design and the size of the characters. For this reason, the text system allows the design and loading of fonts that may consist of only a few of the characters. The variables **tf_loChar** and **tf_hiChar** specify the numerical values for the characters represented in this font. As an example, one font could contain only the capital letters. A second font could contain the small letters, and a third could contain the punctuation marks and numerals. Depending on the size of the font itself, you may arrange to subdivide the font even further.

In the example that is being built for this chapter, a font consisting of four playing card suits is being constructed. This font might consist of only four items, one for each of the playing suits. For example:

```
suitFont.tf_LoChar = 160;
     /* value to use for first character chosen at whim */

suitFont.tf_HiChar = 163;
     /* 160 to 163 range says that there are 4 characters
      * represented in this font */
```

As part of the character data, in addition to defining the included character numbers, you must also define a character representation to be used as the image of a character number requested but not defined in this font. This character is placed at the end of the font definition.

For this example, any character number outside the range of 160-163 inclusive would print this "not in this font" character.

THE CHARACTER DATA

The font structure includes a pointer to the character set data along with descriptions of the how the data is packed into an array. The variables used are defined in *graphics/text.h*; their usage is as follows:

tf_CharData

This is a pointer to the memory location at which the font data begins. This is the bit-packed array of character information.

tf_Modulo

This is the row modulo for the font. The font is organized with the top line of the first character bit adjacent to the top line of the second character and so on.

For example, if the bit-packed character set needs 10 words of 16 bits each to hold the top line of all of the characters in the set, then the value of the modulo will be 20 (bytes). Twenty is the number which must be added to the pointer into the character matrix to go from the first line to the second line of a specific character.

tf_CharLoc

This is a pointer to an array of paired values. The values are the bit offset into the bit-packed character array for this character, and the size of the character in bits. Expressed in C language, this array of values can be expressed as:

```
struct charDef = {
    WORD charOffset;
    WORD charBitWidth;
    }
```

In the program definition, the array to which **charLoc** points can be expressed as:

```
struct charDef suitDef[5];
      /* define an array of four sets of character and one "not a
       * character" bit-packed placement and width information */
```

For all proportional fonts, there must be one set of descriptors for each character defined in the character set.

tf_CharSpace

This is a pointer to an array of words of proportional spacing information. This is the width of each character rectangle, in other words, how many bits width are used to contain the edge-to-edge width of this character's bit definition.

For example, a narrow character may still be stored within a wide space (see figure 4-3).

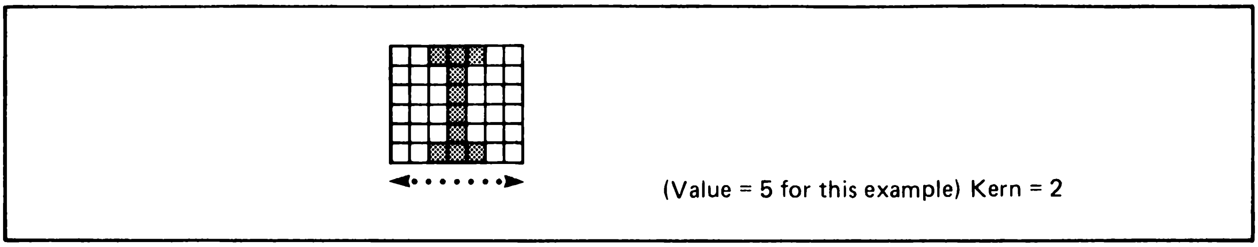

Figure 4-3: CharSpace Figure

If this pointer is null, use the nominal width for each character (**xSize**).

tf_CharKern
This is a pointer to an array of words of character kerning data. Kerning is the offset from the character pointer to the start of the bit data (see figure 4-4). If this pointer is null, kerning is zero.

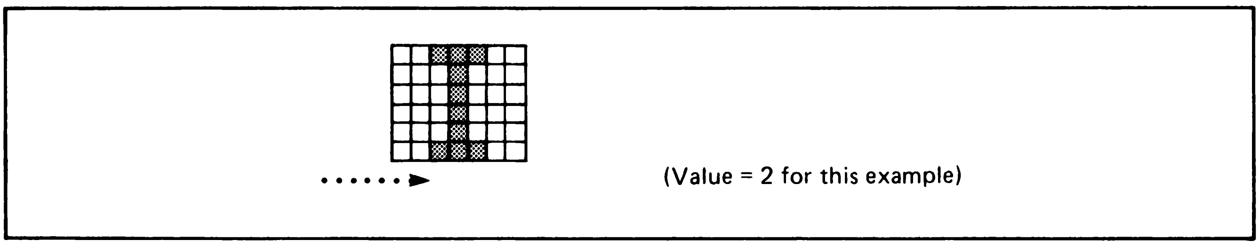

Figure 4-4: CharKern Figure

A COMPLETE SAMPLE FONT

The sample font below pulls together all of the pieces from the above sections. It defines a font whose contents are the four suits from a set of playing cards: clubs, hearts, spades and diamonds.

The suits are defined as proportionally spaced to provide a complete example, even though each suit could as easily have been defined in a 14-wide-by-8-high matrix. There is an open-centered square, which is used if you ask for a character not defined in this font.

```
* A complete sample font.  To test this font, the following must be done:
*
* 1.  In the AmigaDOS SYS:fonts directory, install a file named
*     test.font, containing 264 bytes.
*
*     The first two bytes must contain the value hex 0f00, the identifier
*     for a font header.
*
*     The next word (2 bytes), should contain the value 0001, which is
*     the number of FontContents elements.  There will be only one
*     font in the directory that this font description covers.
*
*     Follow this header material with the ASCII value for 'test/8';
*     the next 250 bytes should be set to zero. This represents the
*     pathname for AmigaDOS to follow from the directory SYS:fonts to
*     reach this test font.  'test' is the directory it should go to and
*     '8' is the font file itself, as assembled and linked below.
*
*     The next two bytes (as one word) contain the font YSize; in this
*     case, 0008.
*
*     The next byte contains the font Flags, in this case 00.
*
*     The last byte contains the font characteristics, in this case hex 60.
*     This says it is a disk-based font (bit 1 set) and the font has been
*     removed (bit 7 set), saying that the font is not currently resident.
*
*     Summary (all in hex) of test.font file:
*
*     0f00 0001 test/8 ........ 0008 00   60
*     word word 256-bytes...... word byte byte
*
* 2.  Create a directory named 'test' in SYS:fonts.
*
*     Copy the file created by assembling and linking the test font
*     below into a file named '8' in subdirectory SYS:fonts/test.
*
*     Use the font under the Notepad program or any other.  It defines ASCII
*     characters 'a' 'b' 'c' and 'd' only.  All other characters print an
*     "unknown character," a rectangle.
*
*------ Included Files ---------------------------------------------

INCLUDE     "exec/types.i"
INCLUDE     "exec/nodes.i"
```

```
INCLUDE     "libraries/diskfont.i"

            MOVEQ   #0,D0           ;provide an easy exit in case somebody
                                    ;tries to RUN this file instead of loading it.
            RTS
            DC.L    0               ; ln_Succ
            DC.L    0               ; ln_Pred
            DC.B    NT_FONT         ; ln_Type
            DC.B    0               ; ln_Pri
            DC.L    fontName        ; ln_Name
            DC.W    DFH_ID          ; FileID
            DC.W    1               ; Revision
            DC.L    0               ; Segment
fontName:
            DS.B    MAXFONTNAME     ; Name
font:
            DC.L    0               ; ln_Succ
            DC.L    0               ; ln_Pred
            DC.B    NT_FONT         ; ln_Type
            DC.B    0               ; ln_Pri
            DC.L    fontName        ; ln_Name
            DC.L    0               ; mn_ReplyPort
            DC.W    fontEnd-font    ; mn_Length
            DC.W    8               ; tf_YSize
            DC.B    0               ; tf_Style
            DC.B    FPF_DESIGNED+FPF_PROPORTIONAL       ; tf_Flags
            DC.W    14              ; tf_XSize
            DC.W    6               ; tf_Baseline

* baseline must be no greater than YSize-1, otherwise algorithmically-
* generated style (italic particularly) can corrupt system memory.

            DC.W    1               ; tf_BoldSmear
            DC.W    0               ; tf_Accessors
            DC.B    97              ; tf_LoChar
            DC.B    100             ; tf_HiChar
            DC.L    fontData        ; tf_CharData
            DC.W    8               ; tf_Modulo, no of bytes to add to
                                    ; data pointer to go from one row of
                                    ; a character to the next row of it.
            DC.L    fontLoc         ; tf_CharLoc, bit position in the
                                    ; font data at which the character
                                    ; begins.
            DC.L    fontSpace       ; tf_CharSpace
            DC.L    fontKern        ; tf_CharKern
```

```
**********************************************************
* These are the suits characters that this font data defines. ASCII lower-case
* a,b,c,d.  The font descriptor says that there are 4 characters described here.
* The fifth character in the table is the character to be output when there is
* no character in this character set that matches the ASCII value requested.
*
*
* 97            98            99         100           256
*<            ><            ><        ><            ><              >
*  @@@   @@@        @            @           @@@        @@@@@@@@@@@@
* @@@@@ @@@@@     @@@@@         @@@         @@@@@       @@        @@
*  @@@@@@@@@    @@@@@@@@@      @@@@@     @@   @   @@    @@        @@
*   @@@@@@@    @@@@@@@@@@@    @@@@@@@    @@@@@@@@@@@    @@        @@
*    @@@@@      @@@ @ @@@      @@@@@     @@   @   @@    @@        @@
*     @@@         @             @@@           @         @@        @@
*      @        @@@@@            @          @@@@@       @@@@@@@@@@@@
*
******************************************************************

fontData:
            DC.W    $071C0,$08040,$070FF,$0F000
            DC.W    $0FBE3,$0E0E0,$0F8C0,$03000
            DC.W    $07FCF,$0F9F3,$026C0,$03000
            DC.W    $03F9F,$0FFFF,$0FFC0,$03000
            DC.W    $01F0E,$0B9F3,$026C0,$03000
            DC.W    $00E00,$080E0,$020C0,$03000
            DC.W    $00403,$0E040,$0F8FF,$0F000
            DC.W    $00000,$00000,$00000,$00000
            DC.W    $00000,$00000,$00000,$00000

* font data is bit-packed edge to edge to save space; that's what the
* fontLoc is all about.

fontLoc:
            DC.L    $00000000B,$0000B000B,$000160007,$0001D000B
            DC.L    $00028000C

* Each pair of words specifies how the characters are bit-packed.  For
* example, the first character starts at bit position 0000, and is 000B
* (11) bits wide.  The second character starts at bit position 000B and
* is 000B bits wide, and so on.  Tells font handler how to unpack the
* bits from the array.

fontSpace:
            DC.W  000012,000012,000008,000012,000013
```

```
 * fontSpace array: Use a space this wide to contain this character
 * when it is printed.

fontKern:
                DC.W    000001,000001,000001,000001,000001
fontEnd:
                END
```

Sample Program

The following sample program asks **AvailFonts()** to make a list of the fonts that are available, then opens a separate window and prints a description of the various attributes that can be applied to the fonts, in the font itself. Notice that not all fonts accept all attributes (garnet9 for example, will not underline). If you run this program, note also that not all fonts are as easily readable in the various bold and italicized modes. This rendering is done in a fixed manner by software and the fonts were not necessarily designed to accept it. It is always best to have a font that has been designed with a bold or italic characteristic built in rather than trying to italicize and embolden an existing plain font.

```
/* "whichfont.c" */

#define AFTABLESIZE 2000

#include "exec/types.h"
#include "exec/io.h"
#include "exec/memory.h"

#include "graphics/gfx.h"
#include "hardware/dmabits.h"
#include "hardware/custom.h"
#include "hardware/blit.h"
#include "graphics/gfxmacros.h"
#include "graphics/copper.h"
#include "graphics/view.h"
#include "graphics/gels.h"
#include "graphics/regions.h"
#include "graphics/clip.h"
#include "exec/exec.h"
#include "graphics/text.h"
#include "graphics/gfxbase.h"
#include "devices/keymap.h"
#include "libraries/dos.h"
#include "graphics/text.h"
```

```
#include "libraries/diskfont.h"
#include "intuition/intuition.h"

struct AvailFonts *af;
struct AvailFontsHeader *afh;
extern int AvailFonts();

struct TextFont *tf;
struct TextAttr ta;

ULONG DosBase;
ULONG DiskfontBase;
ULONG IntuitionBase;
ULONG GfxBase;

struct NewWindow nw = {
        10, 10,             /* starting position (left,top) */
        620,40,             /* width, height */
        -1,-1,              /* detailpen, blockpen */
        0,                  /* flags for IDCMP */
        WINDOWDEPTH|WINDOWSIZING|WINDOWDRAG|SIMPLE_REFRESH|
            ACTIVATE|GIMMEZEROZERO,       /* window gadget flags */
        0,                      /* pointer to 1st user gadget */
        NULL,                   /* pointer to user check */
        "Text Font Test",       /* title */
        NULL,                   /* pointer to window screen */
        NULL,                   /* pointer to super bitmap */
        100,45,                 /* min width, height */
        640,200,                /* max width, height */
        WBENCHSCREEN};

struct Window *w;
struct RastPort *rp;

SHORT text_styles[ ] = { FS_NORMAL, FSF_UNDERLINED, FSF_ITALIC, FSF_BOLD,
                FSF_ITALIC | FSF_BOLD, FSF_BOLD | FSF_UNDERLINED,
                FSF_ITALIC | FSF_BOLD | FSF_UNDERLINED };

char *text[ ] = { " Normal Text", " Underlined", " Italicized", " Bold",
            " Bold Italics", " Bold Underlined",
            " Bold Italic Underlined" };
char textlength[ ] = { 12, 11, 11, 5, 13, 16, 23 };

char *pointsize[] = { " 0"," 1"," 2"," 3"," 4"," 5"," 6"," 7"," 8"," 9",
            "10","11","12","13","14","15","16","17","18","19",
```

```
            "20","21","22","23","24","25","26","27","28","29",
            "30","31"};

char fontname[40];
char dummy[100];        /* provided for string length calculation */
char outst[100];        /* build something to give to Text, see note in the
                                  * program body about algorithmically generated styles */
main()
{
      UBYTE fonttypes;
      int j,k,m;
      SHORT afsize;
      SHORT style;
      SHORT sEnd;   /* numerical position of end of string terminator,
                     * and coincidentally the length of the string. */

      if( (DosBase = OpenLibrary("dos.library", 0)) == NULL) exit(-1);
      if((DiskfontBase=OpenLibrary("diskfont.library",0))==NULL) exit(-4);
      if((IntuitionBase=OpenLibrary("intuition.library",0))==NULL) exit(-2);
      if((GfxBase=OpenLibrary("graphics.library",0))==NULL) exit(-3);

      tf=NULL; /* no font currently selected */
      afsize = AFTABLESIZE;   /* show how large a buffer is available */
      fonttypes = 0xff;             /* show us all font types */

      afh = (struct AvailFontsHeader *) AllocMem(afsize, MEMF_CLEAR);
      if(afh == NULL) exit(-5);

      printf("\nSearching for Fonts\n");
      AvailFonts(afh, afsize, fonttypes);

      af = (struct AvailFonts *) &afh[1];      /* bypass header to get to the
                                                * first of the availfonts */

      for (j = 0; j < afh->afh_NumEntries; j++)
      {
      if((af->af_Attr.ta_Flags & FPF_REMOVED) ||
        (af->af_Attr.ta_Flags & FPF_REVPATH) ||
              ((af->af_Type&AFF_MEMORY)&&
                (af->af_Attr.ta_Flags&FPF_DISKFONT)))
                ;      /* do nothing if font is removed, or if font
                        * designed to be rendered rt->left (simple
                        * example writes left to right) or if font
                        * both on disk and in ram, don't list it twice. */
```

```
    /* AvailFonts performs an AddFont to the system list; if run twice, you
     * get two entries, one of "af_Type 1" saying that the font is memory-
     * resident, and the other of "af_Type 2" saying the font is disk-based.
     * The third part of the if-statement lets you tell them apart if you
     * are scanning the list for unique elements; it says "if it's in
     * memory and it is from disk, then don't list it because you'll find
     * another entry in the table that says it is not in memory, but is on
     * disk." (Another task might have been using the font as well, creating
     * the same effect.)
     */

    else
      {
         printf("\nFont name found was: %ls",af->af_Attr.ta_Name);
         printf("  and its point size is: %ld",af->af_Attr.ta_YSize);
         /* Style parameter is in af->af_Attr.ta_Style,
          * Flags parameter is in af->af_Attr.ta_Flags.
          */
      }
    af++;
    }
    /* now that we've listed the fonts, let's look at them */

    w = (struct Window *)OpenWindow(&nw);
    rp = w->RPort;

  for(m=0; m<2; m++)   /* do normal video, then inverse video */
   {

    af = (struct AvailFonts *)&afh[1]; /* reset value of af to original */
    SetAPen(rp,1);

    if(m == 0)SetDrMd(rp,JAM1);
    else SetDrMd(rp,JAM1+INVERSVID);

    /* now print a line that says what font and what style it is */

    for (j=0; j < afh->afh_NumEntries; j++)
    {
    CStringAppend(&fontname[0],af->af_Attr.ta_Name);
                /* copy name into build-name area */
                /* already has ".font" onto end of it */

    ta.ta_Name = &fontname[0];
    ta.ta_YSize = af->af_Attr.ta_YSize;   /* ask for this size */
```

```
ta.ta_Style = af->af_Attr.ta_Style;    /* ask for designed style */
ta.ta_Flags = FPF_ROMFONT|FPF_DISKFONT|
      FPF_PROPORTIONAL|FPF_DESIGNED;
      /* accept it from anywhere it exists */
style = ta.ta_Style;

if(!((af->af_Attr.ta_Flags & FPF_REMOVED) ||
   (af->af_Attr.ta_Flags & FPF_REVPATH) ||
   ((af->af_Type&AFF_MEMORY)&&
   (af->af_Attr.ta_Flags&FPF_DISKFONT))))

   /* this is an IF-NOT, the reverse of the earlier if-test on
    * these same parameters
    */
   {
      tf = (struct TextFont *) OpenDiskFont(&ta);

      if (tf != 0)
      {
      SetFont(w->RPort, tf);
      for(k=0; k<7; k++)
         {
         style = text_styles[k];
          SetSoftStyle(w->RPort,style,255);
         SetRast(rp,0);/* erase any previous text */
         Move(rp,10,20);     /* move down a bit from the top */
         sEnd = CStringAppend(&outst[0],af->af_Attr.ta_Name);
         sEnd = sEnd + CStringAppend(&outst[sEnd],"  ");
         sEnd = sEnd + CStringAppend(&outst[sEnd],
                        pointsize[af->af_Attr.ta_YSize]);
         sEnd = sEnd + CStringAppend(&outst[sEnd]," Points, ");
         CStringAppend(&outst[sEnd],text[k]);
         Text(rp,&outst[0],CStringAppend(&dummy[0],&outst[0]));

      /* Have to build the string before sending it out to text IF
       * ALGORITHMICALLY GENERATING THE STYLE since the kerning and
       * spacing tables are based on the vanilla text, and not the
       * algorithmically generated style. If you send characters out
       * individually, it is possible that the enclosing rectangle of
       * a later character will chop off the trailing edge of a
       * preceding character.
      */
```

```
/*****************************************************************************
 * This alternate method, when in INVERSVID, exhibits the problem described above.
 *
 * Text(rp,af->af_Attr.ta_Name,STRLEN(af->af_Attr.ta_Name));
 * Text(rp,"  ",2);
 * Text(rp,pointsize[af->af_Attr.ta_YSize],2);
 * Text(rp," Points, ",9);
 *
 * Text(rp,text[k],textlength[k]);
 ****************************************************************************

                Delay(40);     /* use the DOS time delay function
                                * specifies 60ths of a second */
                }
            CloseFont(tf); /* close the old one */

        /* NOTE:  Even though you close a font, it doesn't get unloaded from
         * memory unless a font with a different name is specified for loading.
         * In this case, any font that has been closed (except the topaz set)
         * can have its memory area freed, and that font will no longer be
         * accessible.  If you close a font to go to a different point size, it
         * will NOT cause a disk access.
        */

            } /* end of if-tf-ne-0 */
          }   /* end of if-(in memory but from disk) */
        af++;
        }     /* Do next font now */
    }         /* end of for-loop, controlled by m */

        FreeMem(afh,AFTABLESIZE);
        CloseWindow(w);
        CloseLibrary(IntuitionBase);
        CloseLibrary(DosBase);
        CloseLibrary(DiskfontBase);
        CloseLibrary(GfxBase);
}

/* copy a string and return the number of characters added to a string.
 * Effectively returns the length of the string if not adding anything */
```

```
int CStringAppend(dest, source)
char *dest;
char *source;
{
   int i=0;
   char *s = source;
   char *d = dest;
   while (( i <79 )&&( *d = *s )) { d++; s++; i++; }
      /* if a NULL found in source, end the copy, but the NULL itself gets
       * copied over to the destination. If no NULL, then 79 characters get
       * copied, then a terminating NULL is added */
   if(i < 79) return(i);
   else {*d = 0; return(i);   }
      /* value returned is the position of the terminating NULL to
       * allow other strings to be appended simply using the next
       * append command in sequence */
}
```

PART II

Chapter 5

Audio Device

Introduction

The Amiga has four hardware audio channels—two of the channels produce audio output from the left audio connector and two from the right. These channels can be used in many ways. You can combine a right and a left channel for stereo sound, use a single channel, or play a different sound through each of the four channels.

The audio software is implemented as a standard Amiga input/output device with commands that allocate audio channels and control the sound output.

Some of the audio device commands isolate the programmer from idiosyncrasies of the special-chip hardware. You can also produce sound on the Amiga by directly accessing the hardware registers. For certain types of sound synthesis, this is more CPU-efficient. Some of the audio commands make most sound synthesis easier. Other commands enable your program to co-reside with other programs using the multitasking environment to produce sound at the same time. Programs can co-reside because the audio device handles allocation of audio channels and arbitrates among programs competing for the same resources.

Most personal computers that produce sound have hardware designed for one *specific* synthesis technique. The Amiga uses a very general method of digital sound synthesis that is quite similar to the method used in digital hi-fi components and state-of-the-art keyboard and drum synthesizers, with one significant difference. The Amiga has a tightly-coupled 68000 microprocessor capable of generating and modifying the digital data while the sound is playing. How much of the CPU you can afford to use for sound synthesis depends on your application.

For programs that can afford the memory, playing sampled sounds gives you a simple and very CPU-efficient method of sound synthesis. When a sound is sampled, the amplitude of the waveform that represents a sound is measured (sampled) by an analog-to-digital converter at a fixed interval (period) in time. This results in a table of numbers. When the sound is played back by the Amiga, the table is fed by a DMA channel into one of the four digital-to-analog converters in the custom chips. The digital-to-analog converter converts the samples into voltages that can be played through amplifiers and loudspeakers, reproducing the sound.

On the Amiga you can create sound data in many other ways. For instance, you can use trigonometric functions in your programs to create the more traditional sounds—sine waves, square waves, or triangle waves—by using tables that describe their shapes. Then you can combine these waves for richer sound effects by adding the tables together. Once the data is entered, you can modify it with techniques described in the section called "Audio Functions and Commands."

For information about the limitations of the audio hardware and suggestions for improving system efficiency and sound quality, refer to the *Amiga Hardware Reference Manual.*

The following works are recommended for information about computer sound generation in general:

- *Musical Applications of Microprocessors*, by Hal Chamberlain (Hayden, 1980)

- *Foundations of Computer Music*, by Curtis Roads and John Strawn (Cambridge: MIT Press, 1985)

- *Digital Audio Signal Processing*, by John Strawn (Los Altos, California: William Kaufmann, Inc., 1985)

Definitions

Terms used in the following discussions may be unfamiliar. Some of the more important terms are defined below.

Amplitude
: The height of a waveform, which corresponds to the amount of voltage or current in the electronic circuit.

Amplitude modulation
: A means of producing special audio effects by using one channel to alter the amplitude of another.

Buffer
: An area of continuous memory, typically used for storing blocks of data.

Channel
: One "unit" of the audio device.

Cycle
: One repetition of a waveform.

Frequency
: The number of times per second a waveform repeats.

Frequency modulation
: A means of producing special audio effects by using one channel to affect the period of the waveform produced by another channel.

Period
: The time elapsed between the output of successive sound samples, in units of system clock ticks.

Precedence
: Priority of the user of a sound channel.

Sample
: Byte of audio data, one of the fixed-interval points on the waveform.

Volume

The decibel level of sound coming from an audio channel.

Waveform

Graph that shows a model of how the amplitude of a sound varies over time—usually over one cycle.

Audio Functions and Commands

The first part of this section gives some general information about audio functions and commands. Following the general information there is a brief description of each command. For complete specifications, see the command and function reference section and the header files *devices/audio.i* and *devices/audio.h* in the "Include Files" appendix.

AUDIO AS A DEVICE

The audio device has much in common with the other I/O devices, so general information about device I/O is not repeated here. Before reading further, you should become familiar with the general description of device I/O in the *Amiga ROM Kernel Reference Manual: Exec.*

Audio device commands use an extended **IORequest** block instead of the standard **IORequest** block. When using an audio command, refer to the *devices/audio.i* and *devices/audio.h* files for the extended fields.

SCOPE OF COMMANDS

All audio commands (except for CMD_WRITE, ADCMD_WAITCYCLE, and CMD_READ) can operate on multiple channels. CMD_WRITE, ADCMD_WAITCYCLE, and CMD_READ operate on only one channel. You tell the audio device driver which channels you want a command to act upon by setting the least significant four bits of the **io_unit** field of the **IORequest** block. You specify a 1 in the position of the channel you want to affect and a 0 in all other positions. For instance, you specify 5 (0101) to use channels 0 and 2.

Certain of the audio device commands are actually higher-level functions in that they execute more than one audio device command with a single call. For example, the **OpenDevice()** function, when used for the audio device, can perform an ADCMD_ALLOCATE command so that you can start writing data immediately. The **CloseDevice()** function can perform a ADCMD_FREE command to relinquish the channel(s) so you can exit immediately after closing the audio device.

ALLOCATION AND ARBITRATION

You request the use of one or more audio channels by performing the ADCMD_ALLOCATE command. If possible, ADCMD_ALLOCATE obtains the channels for you. When you request a channel, you specify a precedence number from -128 (the lowest precedence) to 127 (the highest). If a channel you want is being used and you have specified a higher precedence than the current user, ADCMD_ALLOCATE will "steal" the channel from the other user. Later on, if your precedence is lower than that of another user who is performing an allocation, the channel may be stolen from you. If, after allocating a channel with the appropriate precedence, you raise the precedence to the maximum precedence with the ADCMD_SETPREC command, then no other allocation call can steal a channel from you. When you have finished with a channel, you must relinquish it with the ADCMD_FREE command to make it available for other users.

Table 5-1 shows suggested precedence values.

Table 5-1: Suggested Precedences for Channel Allocation

Predecence	**Type of Sound**
127	*Unstoppable.* Sounds first allocated at lower precedence, then set to this highest level.
90 - 100	*Emergencies.* Alert, urgent situation that requires immediate action.
80 - 90	*Annunciators.* Attention, bell (CTRL-G).
75	*Speech.* Synthesized or recorded speech (narrator.device).
50 - 70	*Sonic cues.* Sounds that provide information that is not provided by graphics. Only the beginning of each sound (enough to recognize it) should be at this level; the rest should be set to sound effects level.
-50 - 50	*Music program.* Musical notes in music-oriented program. The higher levels should be used for the attack portions of each note. Notes should separately allocate channels at the start and free them at the end.
-70 - 0	*Sound effects.* Sounds used in conjunction with graphics. More important sounds should use higher levels.
-100 - -80	*Background.* Theme music and restartable background sounds.
-128	*Silence.* Lowest level (freeing the channel completely is preferred).

When you first perform a channel allocation request, the audio device provides you with an "allocation key" that is unique to the granting of your current allocation request. The allocation key is also copied in the **ioa_AllocKey** field of your I/O control block and is used by all audio commands. Later, as you queue output requests to the audio device, the device can compare the allocation key in your request block to the key currently assigned for that channel (or channels). If the channel is stolen from you by another channel user that has a higher precedence, the copy of the key maintained by the audio channel is changed. If you attempt to perform a command on a channel that has been stolen from you, an AUDIO_NOALLOCATION error is returned and the bit in the **io_unit** field corresponding to the stolen channel is cleared so you know which channel was stolen.

There is no specific separate "audio resource." Instead, the audio device, with its allocation key management, arbitrates the use of the physical audio resources.

PERFORMING AUDIO COMMANDS

To perform an audio command, sometimes you must use the system function **BeginIO()** rather than **SendIO()** or **DoIO()**. This is because the latter two functions clear the device-specific bits in the **io_Flags** field of the **IORequest** (bits 4 thru 7). Some of the audio commands use these bits to select options. If you use **SendIO()** or **DoIO()**, the flags will be set to 0 (FALSE), which may not be desirable.

COMMAND TYPES

Commands and functions for audio use can be divided into three categories: system functions, allocation/arbitration commands, and hardware control commands. There are also three audio device flags.

The system functions are

- **OpenDevice()**
- **CloseDevice()**
- **BeginIO()**
- **AbortIO()**

The allocation/arbitration commands are

- ADCMD_ALLOCATE
- ADCMD_FREE
- ADCMD_SETPREC
- ADCMD_LOCK

The hardware control commands are

- CMD_WRITE
- ADCMD_FINISH
- ADCMD_PERVOL
- CMD_FLUSH
- CMD_RESET
- ADCMD_WAITCYCLE
- CMD_STOP
- CMD_START
- CMD_READ

The following paragraphs describe each function and command.

SYSTEM FUNCTIONS

These are standard Amiga device functions. They are used for communication with the device.

OpenDevice()

The audio device adds to the normal operation of this function. When you open the audio device with a nonzero **ioa_Length** field, **OpenDevice()** will attempt to allocate channels based on allocation mask just as if you had called the ADCMD_ALLOCATE command. This allocation is done with the ADIOF_NOWAIT flag set, so ADCMD_ALLOCATE will return immediately if it fails. If you are opening the device and are not ready to have a channel allocated to you just then, set the **ioa_Length** field to zero.

CloseDevice()

When used with the audio device, **CloseDevice()** performs an ADCMD_FREE command on any channels selected by the **io_Unit** field. If you have different allocation keys for the channels you are using, you cannot use this function to close all of them at once. Instead, you will have to issue one ADCMD_FREE command for each unique allocation that you are using. After issuing the ADCMD_FREE command(s), you can call **CloseDevice()**.

BeginIO()

Audio use of this function differs from normal use only in that it takes a pointer to an **IOAudio** structure as its only argument.

AbortIO()

This function can be used to cancel requests for ADCMD_ALLOCATE, ADCMD_LOCK, CMD_WRITE, or ADCMD_WAITCYCLE. When used with the audio device, **AbortIO()** always succeeds.

ALLOCATION/ARBITRATION COMMANDS

These commands allow the audio channels to be shared among different tasks and programs. None of these commands can be called from interrupt code.

ADCMD_ALLOCATE

This command gives access to channels. You perform this command with a pointer to a data array that describes the channels you want to allocate. For example, if you want a pair of stereo channels and you have no preference about which of the left and right channels the system will choose for the allocation, you can pass the command a pointer to an array containing 3, 5, 10, and 12. Channels 0 and 3 output sound on the left side, and channels 1 and 2 on the right side. Table 5-2 shows how this array corresponds to all the possible combinations of a right and a left channel.

Table 5-2: Possible Channel Combinations

Channel 3 left	Channel 2 right	Channel 1 right	Channel 0 left	Decimal Value of Allocation Mask
0	0	1	1	3
0	1	0	1	5
1	0	1	0	10
1	1	0	0	12

How ADCMD_ALLOCATE Operates. The ADCMD_ALLOCATE command tries the first combination, 3, to see if channels 0 and 1 are not being used. If they are available, the 3 is copied into the **io_unit** field and you get an allocation key for these channels. You copy the key into other I/O blocks for the other commands you may want to perform using these channels. When finished with the channels, you perform the ADCMD_FREE command. If channels 0 and 1 are being used, ADCMD_ALLOCATE tries the other combinations in turn. If all the combinations are in use, ADCMD_ALLOCATE checks the precedence number of the users of the channels and finds the combination that requires it to steal the channel or channels of the lowest precedence. If all the combinations require stealing a channel or channels of equal or higher precedence, the I/O request ADCMD_ALLOCATE fails. Precedence is in the **ln_Pri** field of the **io_Message** in the **IORequest** block you pass to ADCMD_ALLOCATE; it has a value from -128 to 127.

The ADIOF_NOWAIT Flag. If you need to produce a sound right now and otherwise you don't want to allocate, set the ADIOF_NOWAIT flag to 1. This will cause the command to return an IOERR_ALLOCFAILED error if it cannot allocate any of the channels. If you are producing a non-urgent sound and you can wait, set the ADIOF_NOWAIT flag to 0. Then, the **IORequest** block returns only when you gets the allocation. If ADIOF_NOWAIT is set to 0, the audio device will continue to retry the allocation request whenever channels are freed until it is successful. If the program decides to cancel the request, **AbortIO()** can be used.

ADCMD_ALLOCATE Examples. The following are some more examples of how to tell ADCMD_ALLOCATE your channel preferences. If you want any channel, but want to try to get a left channel first, use an array containing 1, 8, 2, and 4:

```
0001
1000
0010
0100
```

If you want only a left channel, use 1 and 8 (channels 0 and 3):

0001
1000

For a right channel, use 2 and 4 (channels 1 and 2):

0010
0100

To produce special effects, such as hardware-controlled amplitude and frequency modulation, you may need to allocate channels that can be "attached" to each other. The following allocation map specifies the allowable combinations. (For further information about amplitude and frequency modulation, see the *Amiga Hardware Reference Manual.*)

0011	3
0110	6
1100	12

If you want all the channels, use the following allocation map:

1111	15

If you want to allocate a channel and keep it for a sound that can be interrupted and restarted, allocate it at a certain precedence. If it gets stolen, allocate it again with the ADIOF_NOWAIT flag set to 0. When the channel is relinquished, you will get it again.

The Allocation Key. If you want to perform multi-channel commands, all the channels must have the same key since the **IORequest** block has only one allocation key field. The channels must all have that same key even when they were not allocated simultaneously. If you want to use a key you already have, you can pass in that key in the allocation key field and ADCMD_ALLOCATE can allocate other channels with that existing key. The ADCMD_ALLOCATE command returns a new and unique key only if you pass in a zero in the allocation key field.

ADCMD_FREE

ADCMD_FREE is the opposite of ADCMD_ALLOCATE. When you perform ADCMD_FREE on a channel, it does a CMD_RESET command on the hardware and "unlocks" the channel. It also checks to see if there are other pending allocation requests. You do not need to perform ADCMD_FREE on channels stolen from you.

ADCMD_SETPREC

This command changes the precedence of an allocated channel. As an example of the use of ADCMD_SETPREC, assume that you are making sound of a chime that takes a long time to decay. It is important that user hears the chime but not so important that he hears it decay all the way. You could lower precedence after the initial attack portion of the sound to let another program steal the channel. You can also set the precedence to maximum (127) if you cannot have the channel(s) stolen from you.

ADCMD_LOCK

The ADCMD_LOCK command performs the "steal verify" function. When a user is attempting to steal a channel or channels, ADCMD_LOCK gives you a chance to clean up before the channel is stolen. You perform a ADCMD_LOCK command right after the ADCMD_ALLOCATE command. ADCMD_LOCK does not return until a higher-priority user attempts to steal the channel(s) or you perform an ADCMD_FREE command. If someone is attempting to steal, you must finish up and ADCMD_FREE the channel as quickly as possible.

ADCMD_LOCK is necessary only if you want to store directly to the hardware registers instead of using the device commands. If your channel is stolen, you are not notified unless the ADCMD_LOCK command is present, and this could cause problems for the user who has stolen the channel and is now using it. ADCMD_LOCK sets a switch that is not cleared until you perform an ADCMD_FREE command on the channel. Canceling an ADCMD_LOCK request with **AbortIO()** will not free the channel.

The following outline describes how ADCMD_LOCK works when a channel is stolen and when it is not stolen.

1. User A allocates a channel.

2. User A locks the channel.

If User B allocates the channel with a higher precedence:

3. User B's ADCMD_ALLOCATE command is suspended (regardless of the setting of the ADIOF_NOWAIT flag).

4. User A's ADCMD_LOCK command is replied to with an error (ADIOERR_CHANNELSTOLEN).

5. User A does whatever is needed to finish up when a channel is stolen.

6. User A frees the channel with ADCMD_FREE.

7. User B's ADCMD_ALLOCATE command is replied to. Now user B has the channel.

If the channel is not allocated by another user:

3. User A finishes the sound.

4. User A performs the ADCMD_FREE command.

5. User A's ADCMD_LOCK command is replied.

Never make the freeing of a channel (if the channel is stolen) dependent on allocating another channel. This may cause a deadlock. To keep a channel and never let it be stolen, set precedence to maximum (127). Do not use a lock for this purpose.

HARDWARE CONTROL COMMANDS

The following commands change hardware registers and affect the actual sound output.

CMD_WRITE

This is a single-channel command and is the main command for making sounds. You pass the following to CMD_WRITE:

- A pointer to the waveform to be played (must start on a word boundary and must be in memory accessible by the custom chips, MEMF_CHIP)

- The length of the waveform in bytes (must be an even number)

- A count of how many times you want to play the waveform

If the count is 0, CMD_WRITE will play the waveform from beginning to end, then repeat the waveform continuously until something aborts it.

If you want period and volume to be set at the start of the sound, you set the WRITE command's ADIOF_PERVOL flag. If you do not do this, the previous volume and period for that channel will be used. This is one of the flags that would be cleared by **DoIO()** and **SendIO()**. The **ioa_WriteMsg** field in the **IORequest** block is an extra message field that can be replied at the start of the CMD_WRITE. This second message is used only to tell you when the CMD_WRITE command *starts* processing, and it is used only when the ADIOF_WRITEMESSAGE flag is set to 1.

If a CMD_STOP has been performed, the CMD_WRITE requests are queued up.

The CMD_WRITE command does not make its own copy of the waveform, so any modification of the waveform before the CMD_WRITE command is finished may affect the sound. This is sometimes desirable for special effects.

To splice together two waveforms without clicks or pops, you must send a separate, second CMD_WRITE command while the first is still in progress. This technique is used in double-buffering, which is described below.

Double-buffering. By using two waveform buffers and two CMD_WRITE requests you can compute a waveform continuously. This is called double-buffering. The following describes how you use double-buffering.

1. Compute a waveform in memory buffer A.

2. Issue CMD_WRITE command A with **io_Data** pointing to buffer A.

3. Continue the waveform in memory buffer B.

4. Issue CMD_WRITE command B with **io_Data** pointing to Buffer B.

5. Wait for CMD_WRITE command A to finish.

6. Continue the waveform in memory buffer A.

7. Issue CMD_WRITE command A with **io_Data** pointing to Buffer A.

8. Wait for CMD_WRITE command B to finish.

9. Loop back to step 3 until the waveform is finished.

10. At the end, remember to wait until both CMD_WRITE command A and CMD_WRITE command B are finished.

ADCMD_FINISH

The ADCMD_FINISH command aborts (calls **AbortIO()**) the current write request on a channel or channels. This is useful if you have something playing, such as a long buffer or some repetitions of a buffer, and you want to stop it.

ADCMD_FINISH has a flag you can set (ADIOF_SYNCCYCLE) that allows the waveform to finish the current cycle before aborting it. This is useful for splicing together sounds at zero crossings or some other place in the waveform where the amplitude at the end of one waveform matches the amplitude at the beginning of the next. Zero crossings are positions within the waveform at which the amplitude is zero. Splicing at zero crossings gives you fewer clicks and pops when the audio channel is turned off or the volume is changed.

ADCMD_PERVOL

ADCMD_PERVOL lets you change the volume and period of a CMD_WRITE that is in progress. The change can take place immediately or you can set the ADIOF_SYNCCYCLE flag to have the change occur at the end of the cycle. This is useful to produce vibratos, glissandos, tremolos, and volume envelopes in music or to change the volume of a sound.

CMD_FLUSH

CMD_FLUSH aborts (calls **AbortIO()**) all CMD_WRITEs and all ADCMD_WAITCYCLEs that are queued up for the channel or channels. It does not abort ADCMD_LOCKs (only ADCMD_FREE clears locks).

CMD_RESET

CMD_RESET restores all the audio hardware registers. It clears the attach bits, restores the audio interrupt vectors if the programmer has changed them, and performs the CMD_FLUSH command to cancel all requests to the channels. CMD_RESET also unstops channels that have had a CMD_STOP performed on them. CMD_RESET does not unlock channels that have been locked by ADCMD_LOCK.

ADCMD_WAITCYCLE

This is a single-channel command. ADCMD_WAITCYCLE is replied to when the current cycle has completed, that is, after the current CMD_WRITE command has reached the end of the current waveform it is playing. If there is no CMD_WRITE in progress, it returns immediately.

CMD_STOP

This command stops the current write cycle immediately. If there are no CMD_WRITEs in progress, it sets a flag so any future CMD_WRITEs are queued up and do not begin processing (playing).

CMD_START

CMD_START undoes the CMD_STOP command. Any cycles that were stopped by the CMD_STOP command are actually lost because of the impossibility of determining exactly where the DMA ceased. If the CMD_WRITE command was playing two cycles and the first one was playing when CMD_STOP was issued, the first one is lost and the second one will be played.

This command is also useful when you are playing the same wave form with the same period out of multiple channels. If the channels are stopped, when the CMD_WRITE commands are issued, CMD_START exactly synchronizes them, avoiding cancellation and distortion. When channels are allocated, they are effectively started by the CMD_START command.

CMD_READ

CMD_READ is a single-channel command. Its only function is to return a pointer to the current CMD_WRITE command. It enables you to determine which request is being processed.

Example Programs

STEREO SOUND EXAMPLE

This program demonstrates allocating a stereo pair of channels using the allocation/arbitration commands. For simplicity, it uses no hardware control commands and writes directly to the hardware registers. To prevent another task from stealing the channels before writing to the registers, it locks the channels.

```
/*****************************************************
 *
 * Stereo Sound Example
 *
 * Sam Dicker
 * 3 December 1985
 * (created: 17 October 1985)
 *
 *****************************************************/

/* If you are using the Amiga C compiler, turn off stack-checking
* in phase 2, e.g., "lc2 -v filename.q."
 */

#include "exec/types.h"
#include "exec/memory.h"
#include "hardware/custom.h"
#include "hardware/dmabits.h"
#include "libraries/dos.h"
#include "devices/audio.h"

/* audio channel assignment */
#define LEFT0B          0
#define RIGHT0B         1
#define RIGHT1B         2
#define LEFT1B          3
#define LEFT0F          1
#define RIGHT0F         2
#define RIGHT1F         4
#define LEFT1F          8

/* used by example sound */
#define WAVELENGTH      2
#define CLOCK           3579545
#define LEFTFREQ        50.0
#define RIGHTFREQ       50.1
#define MAXVOLUME       64
#define SOUNDPREC       -40

extern struct MsgPort *CreatePort();
extern struct AudChannel aud[];
extern UWORD dmacon;

/* four possible stereo pairs */
UBYTE allocationMap[] = {
```

```
    LEFT0F | RIGHT0F,
    LEFT0F | RIGHT1F,
    LEFT1F | RIGHT0F,
    LEFT1F | RIGHT1F
};

struct IOAudio *allocIOB = 0;   /* used by cleanUp to determine
                                 * what needs to be 'cleaned up' */
struct IOAudio *lockIOB = 0;
struct Device *device = 0;
struct MsgPort *port = 0;
BYTE *squareWaveData = 0;


main()
{
    UBYTE channels;
    struct AudChannel *leftRegs, *rightRegs;

    /* allocate I/O blocks from chip public memory and initialize to zero */

    if (((allocIOB = (struct IOAudio *)AllocMem(sizeof(struct IOAudio),
            MEMF_PUBLIC | MEMF_CLEAR)) == 0) ||
            ((lockIOB = (struct IOAudio *)AllocMem(sizeof(struct IOAudio),
            MEMF_PUBLIC | MEMF_CLEAR)) == 0))
        cleanUp("Out of memory");

    /* open the audio device */

    if (OpenDevice(AUDIONAME, 0, allocIOB, 0) != 0)
        cleanUp("Cannot open audio device");
    device = allocIOB->ioa_Request.io_Device;

    /* initialize I/O block for channel allocation */

    allocIOB->ioa_Request.io_Message.mn_Node.ln_Pri = SOUNDPREC;
    if ((port = CreatePort("sound example", 0)) == 0)
        cleanUp("Cannot create message port");
    allocIOB->ioa_Request.io_Message.mn_ReplyPort = port;
    allocIOB->ioa_Request.io_Command = ADCMD_ALLOCATE;

    /* if no channel is available immediately, abandon allocation */
    allocIOB->ioa_Request.io_Flags = ADIOF_NOWAIT;
    allocIOB->ioa_Data = allocationMap;
    allocIOB->ioa_Length = sizeof(allocationMap);
```

```
/* allocate channels now. Alternatively, ADCMD_ALLOCATE could have been
 * preformed when audio was first OpenDevice'd by setting up ioa_Data and
 * ioa_Length before OpenDevice'ing */

BeginIO(allocIOB);
if (WaitIO(allocIOB))
   cleanUp("Channel allocation failed");

/* initialize I/O block for to lock channels */

lockIOB->ioa_Request.io_Message.mn_ReplyPort = port;
lockIOB->ioa_Request.io_Device = device;

/* one lock command to lock both channels */
lockIOB->ioa_Request.io_Unit = allocIOB->ioa_Request.io_Unit;
lockIOB->ioa_Request.io_Command = ADCMD_LOCK;
lockIOB->ioa_AllocKey = allocIOB->ioa_AllocKey;

/* lock the channels */
SendIO(lockIOB);

/* if lock returned there is an error */
if (CheckIO(lockIOB))

   /* the channel must have been stolen */
   cleanUp("Channel stolen");

/* compute the hardware register addresses */

channels = (ULONG)(allocIOB->ioa_Request.io_Unit);
leftRegs = (channels & LEFT0F) ? &aud[LEFT0B] : &aud[LEFT1B];
rightRegs = (channels & RIGHT0F) ? &aud[RIGHT0B] : &aud[RIGHT1B];

/* allocate waveform memory from chip-addressable ram. AllocMem always
 * allocates memory on a word boundary which is necessary for audio
 * waveform data */

if ((squareWaveData = (BYTE *)AllocMem(WAVELENGTH, MEMF_CHIP)) == 0)
   cleanUp("Out of memory");

/* a two cycle square wave (how complex!) */

squareWaveData[0] = 127;
squareWaveData[1] = -127;
```

```
    /* these registers are described in detail in the Amiga Hardware Manual */

    /* write-only hardware registers must be loaded separately.
     * <reg1> = <reg2> = <data>  may not work with some compilers */
    leftRegs->ac_ptr = (UWORD *)squareWaveData;
    rightRegs->ac_ptr = (UWORD *)squareWaveData;
    leftRegs->ac_len = WAVELENGTH / 2;
    rightRegs->ac_len = WAVELENGTH / 2;

    /* a slightly different frequency is used in each channel to make the
     * sound a bit more interesting */

    leftRegs->ac_per = CLOCK / LEFTFREQ / WAVELENGTH;
    rightRegs->ac_per = CLOCK / RIGHTFREQ / WAVELENGTH;

    leftRegs->ac_vol = MAXVOLUME;
    rightRegs->ac_vol = MAXVOLUME;
    dmacon = DMAF_SETCLR | channels << DMAB_AUD0;

    /* play sound until the user press CTRL-C or lock is replied*/

    puts("Press CTRL-C to stop");
    putchar(0);
    while(Wait(SIGBREAKF_CTRL_C | 1 << port->mp_SigBit) != SIGBREAKF_CTRL_C)

        /* each time the port signals, check if lock is replied
         * (a signal is not guaranteed to be valid) */

        if (CheckIO(lockIOB)) {
            puts("Channel stolen");
            break;
        }

    /* free any allocated audio channels. In this instance explicitly
     * performing the ADCMD_FREE command is unnecessary. CloseDevice'ing
     * with allocIOB performs it and frees the channels automatically */

    allocIOB->ioa_Request.io_Command = ADCMD_FREE;
    DoIO(allocIOB);

    /* free up resources and exit */
    cleanUp("");
}
```

```
/* print an error message and free allocated resources */

cleanUp(message)
TEXT *message;
{
   puts(message);
   if (squareWaveData != 0)
      FreeMem(squareWaveData, WAVELENGTH);
   if (port != 0)
      DeletePort(port);
   if (device != 0)
      CloseDevice(allocIOB);
   if (lockIOB != 0)
      FreeMem(lockIOB, sizeof(struct IOAudio));
   if (allocIOB != 0)
      FreeMem(allocIOB, sizeof(struct IOAudio));
   exit();
}
```

DOUBLE-BUFFERED SOUND SYNTHESIS EXAMPLE

This program demonstrates double-buffered writing to an audio channel using the hardware control commands. This technique can be used to synthesize sound in "real-time." This program uses the mouse as a simple input device; to keep the example simple, the program directly reads the mouse register.

Real-time synthesis code should always be written in the fastest assembly language possible (unlike this example) and should try to precompute as much data as possible. In this example, a sine wave look-up table is precomputed. Then, while the sound is being played, the table is scanned at a rate dependent on a variable (frequency) and the scanned values are copied into temporary buffers. This frequency variable is modified by mouse movement, effectively making the mouse a pitch control. In a "real" program, because pitch is the only parameter being controlled, it would be much more efficient to modify the "period" and play one fixed sine-wave waveform buffer (or one waveform for each octave).

Two temporary buffers are used. One must be computed and sent to the audio device before the other one has finished playing. Otherwise, the audio device turns off the sound, making a pop. This program runs in software interrupts to make sure that it gets adequate processor time to avoid this problem.

```
/*****************************************************
 *
 * Double-Buffered Sound Synthesis Example
 *
 * Sam Dicker
 * 3 December 1985 (created:  8 October 1985)
 *
 *****************************************************/

/* If you are using the Amiga C compiler, turn off stack-checking
* in phase 2, e.g., "lc2 -v filename.q."
 */
#include "exec/types.h"
#include "exec/memory.h"
#include "exec/interrupts.h"
#include "exec/errors.h"
#include "hardware/custom.h"
#include "libraries/dos.h"
#include "devices/audio.h"

#define BUFFERSIZE       250
#define SINETABLEPOWER2  10
#define SINETABLESIZE    (1 << SINETABLEPOWER2)
#define SINETABLESTEP    (2 * 3.141593 / SINETABLESIZE)

/* mouse register addresses */
#define XMOUSEREG     (*((BYTE *)&joy0dat + 1))
#define YMOUSEREG     (-(*(BYTE *)&joy0dat))

extern struct MsgPort *CreatePort();
extern struct Library *OpenLibrary();
extern struct Task *FindTask();
extern UWORD joy0dat;

/* channel allocation map */
UBYTE allocationMap[ ] = { 1, 8, 2, 4 };

struct Library *MathBase = 0;   /* used by cleanUp to determine
                                 * what needs to be 'cleaned up' */
struct MsgPort *allocPort = 0;
struct IOAudio *allocIOB = 0;
struct Device *device = 0;
struct Interrupt *interrupt = 0;
struct MsgPort *soundPort = 0;
BYTE *buffer[2] = { 0 };
```

```
struct IOAudio *soundIOB[2] = { 0 };

int newBuffer();
UBYTE sineTable[SINETABLESIZE];
ULONG angle = 0;
ULONG frequency = 0x2000000;
BYTE lastYMouse;

main()
{
   int i;
   FLOAT sine = 0.0;
   FLOAT cosine = 1.0;

   /* open the math library */

   if ((MathBase = OpenLibrary("mathffp.library", 0)) == 0)
      cleanUp("Cannot open math library");

   /* generate the sine lookup table */

   for (i = 0; i < SINETABLESIZE; ++i) {

      /* generate table values between -128 and 127 */
      sineTable[i] = 127 * sine + 0.5;

      /* compute the next point in the table. The table could have been
       * computed by calling the 'sin' function for each point, but this
       * method is a little faster where great accuracy is not required */
      sine += SINETABLESTEP * (cosine -= SINETABLESTEP * sine);
   }

   /* read the starting mouse count */
   lastYMouse = YMOUSEREG;

   /* initialize I/O block to allocate a channel when the audio device is OpenDevice'd */

   if ((allocPort = CreatePort("sound example", 0)) == 0)
      cleanUp("Cannot create reply port");
   if ((allocIOB = (struct IOAudio *)AllocMem(sizeof(struct IOAudio),
         MEMF_PUBLIC | MEMF_CLEAR)) == 0)
      cleanUp("Out of memory");

   /* allocation precedence */
   allocIOB->ioa_Request.io_Message.mn_Node.ln_Pri = -40;
```

```
allocIOB->ioa_Request.io_Message.mn_ReplyPort = allocPort;

/* allocate from any channel */
allocIOB->ioa_Data = allocationMap;
allocIOB->ioa_Length = sizeof(allocationMap);

/* open the audio device with channel allocation and check for errors */

switch (OpenDevice(AUDIONAME, 0, allocIOB, 0)) {
case IOERR_OPENFAIL:
   cleanUp("Cannot open audio device");
case ADIOERR_ALLOCFAILED:
   cleanUp("Cannot allocate audio channel");
}
device = allocIOB->ioa_Request.io_Device;

/* initialize the software interrupt structure */

if ((interrupt = (struct Interrupt *)AllocMem(sizeof(struct Interrupt),
      MEMF_CLEAR | MEMF_PUBLIC)) == 0)
   cleanUp("Out of memory");
interrupt->is_Code = (VOID (*)())newBuffer;

/* initialize the reply port for CMD_WRITE's to generate software interrupts */

if ((soundPort = (struct MsgPort *)AllocMem(sizeof(struct MsgPort),
      MEMF_CLEAR | MEMF_PUBLIC)) == 0)
   cleanUp("Out of memory");
soundPort->mp_Flags = PA_SOFTINT;
soundPort->mp_SigTask = (struct Task *)interrupt;
soundPort->mp_Node.ln_Type = NT_MSGPORT;
NewList(&soundPort->mp_MsgList);

/* initialize both I/O blocks for the CMD_WRITES */

for (i = 0; i < 2; ++i) {

   /* allocate waveform memory from chip addressable ram.  AllocMem
    * always allocates memory on a word boundary which is necessary
    * for audio waveform data */
   if ((buffer[i] = (BYTE *)AllocMem(BUFFERSIZE, MEMF_CHIP))
         == 0)
      cleanUp("Out of memory");

   if ((soundIOB[i] = (struct IOAudio *)AllocMem(sizeof(struct IOAudio),
```

```
            MEMF_PUBLIC | MEMF_CLEAR)) == 0)
         cleanUp("Out of memory");
      soundIOB[i]->ioa_Request.io_Message.mn_ReplyPort = soundPort;
      soundIOB[i]->ioa_Request.io_Device = device;
      soundIOB[i]->ioa_Request.io_Unit = allocIOB->ioa_Request.io_Unit;
      soundIOB[i]->ioa_Request.io_Command = CMD_WRITE;

      /* load the volume and period registers */
      soundIOB[i]->ioa_Request.io_Flags = ADIOF_PERVOL;

      soundIOB[i]->ioa_AllocKey = allocIOB->ioa_AllocKey;
      soundIOB[i]->ioa_Data = buffer[i];
      soundIOB[i]->ioa_Length = BUFFERSIZE;

      /* some arbitrary period and volume */

      soundIOB[i]->ioa_Period = 200;
      soundIOB[i]->ioa_Volume = 64;

      /* play one cycle of each buffer, then reply */
      soundIOB[i]->ioa_Cycles = 1;

      /* this really "primes the pump" by causing the reply port
       * to generate a software interrupt and write the first buffers */
      ReplyMsg(soundIOB[i]);
   }

   /* wait for CTRL-C to stop the program */

   puts("Press CTRL-C to stop");
   putchar(0);
   Wait(SIGBREAKF_CTRL_C);

   /* free up resources and exit */
   cleanUp("");
}

/* print an error message and free allocated resources */

cleanUp(message)
TEXT *message;
{
   int i;

   puts(message);
```

```
    if (device != 0)

        /* CloseDevice'ing with 'allocIOB' preforms an ADCMD_FREE on any
         * channel allocated with 'allocIOB's ioa_AllocKey.  ADCMD_FREE
         * performs a CMD_RESET, which performs a CMD_FLUSH, which AbortIO's
         * any CMD_WRITES to those channels */
        CloseDevice(allocIOB);

    for (i = 0; i < 2; ++i) {
        if (soundIOB[i])
            FreeMem(soundIOB[i], sizeof(struct IOAudio));
        if (buffer[i])
            FreeMem(buffer[i], BUFFERSIZE);
    }
    if (soundPort)
        FreeMem(soundPort, sizeof(struct MsgPort));
    if (interrupt)
        FreeMem(interrupt, sizeof(struct Interrupt));
    if (allocIOB)
        FreeMem(allocIOB, sizeof(struct IOAudio));
    if (allocPort)
        DeletePort(allocPort, sizeof(struct MsgPort));
    if (MathBase)
        CloseLibrary(MathBase);
    exit();
}

/* software interrupt server code */

newBuffer()
{
    int i;
    struct IOAudio *ioa;
    BYTE *buffer;
    BYTE mouseChange, curYMouse;
    ULONG newFreq;

    /* get I/O block from reply port */
    ioa = (struct IOAudio *)GetMsg(soundPort);

    /* check if there really was an I/O block on the port and if there are no
     * errors.  An error would indicate either the channel was aborted from
     * being stolen (IOERR_ABORTED), it was stolen before the write was
     * performed and had the wrong allocation key (ADIOF_NOALLOCATION), or it
     * was aborted by being CloseDevice'd. In any case, if there is an error do
```

```
 * not send the next write. The program will just wait around silently */

if (ioa && ioa->ioa_Request.io_Error == 0) {

    /* determine how far the mouse has moved */

    curYMouse = YMOUSEREG;
    mouseChange = curYMouse - lastYMouse;
    lastYMouse = curYMouse;

    /* modify the frequency proportionally */
    newFreq = frequency + mouseChange * (frequency >> 6);

    /* limit the frequency range */
    if (newFreq > 0x800000 && newFreq < 0x40000000)
        frequency = newFreq;

    /* scan the table and copy each new sample into the audio waveform buffer */

    for (i = 0, buffer = ioa->ioa_Data; i < BUFFERSIZE; ++i)
        *buffer++ = sineTable[(angle += frequency) >>
                (32 - SINETABLEPOWER2)];

    /* send the write I/O block */
    BeginIO(ioa);
  }
}
```

Chapter 6

Timer Device

Introduction

The Amiga timer device provides a general time-delay capability. It can signal you when *at least* a certain amount of time has passed. Because the Amiga is a multitasking system, the timer device cannot guarantee that exactly the specified amount of time has elapsed.

To use a timer device you open up a channel of communication to the device and send the device a message saying how much time should elapse. At the end of that time, the device returns a message to you stating that the time has elapsed.

Timer Device Units

There are two units in the timer device. One uses the vertical blank interrupt for its "tick" and is called UNIT_VBLANK. The other uses a programmable timer in the 8520 CIA chip and is called UNIT_MICROHZ. These are the names you use when calling **OpenDevice()**. The examples at the end of the chapter demonstrate how you call **OpenDevice()**.

The VBLANK timer unit is very stable and has a precision comparable to the vertical blanking time, that is, +/- 16.67 milliseconds. When you make a timing request, such as "signal me in 21 seconds," the reply will come in 21 +/- .017 seconds. This timer has very low overhead and should be used for all long duration requests.

The MICROHZ timer unit uses the built-in precision hardware timers to create the timing interval you request. It accepts the same type of command—"signal me in so many seconds and microseconds." The microhertz timer has the advantage of greater resolution than the vertical blank timer, but it has less accuracy over comparable periods of time. The microhertz timer also has much more system overhead. It is primarily useful for short burst timing for which critical accuracy is not required.

Specifying the Time Request

Both timer units have identical external interfaces. Time is specified via a **timeval** structure.

```
struct timeval {
    ULONG tv_secs;
    ULONG tv_micro;
};
```

The time specified is measured from the time the request is posted. For example, you must post a timer request for 30 minutes, rather than for a specific time such as 10:30 p.m. The **micro** field is the number of microseconds in the request. Logically, seconds and microseconds are concatenated by the driver. The number of microseconds must be "normalized;" it should be a value less than one million.

The primary means of specifying a requested time is via a **timeRequest** structure. A time request consists of an **IORequest** structure followed by a **timeval** structure, as shown below.

```
struct timeRequest {
   struct IORequest tr_node;
   struct timeval tr_time;
};
```

Note that the timer driver does not use a "standard extension" **IORequest** block. It only uses the base **IORequest** structure. When the specified amount of time has elapsed, the driver will send the **IORequest** back via **ReplyMsg()** (the same as all other drivers). This means that you must fill in the **ReplyPort** pointer of the **IORequest** structure if you wish to be signaled.

When you submit a timer request, the driver destroys the values you have provided in the **timeval** structure. This means that you must reinitialize the time specification before reposting the **IORequest**.

Multiple requests may be posted to the timer driver. For example, you can make three time requests in a row to the timer, specifying:

Signal me in 20 seconds (request 1)
Signal me in 30 seconds (request 2)
Signal me in 10 seconds (request 3)

As the timer queues these requests, it changes the time values and sorts the timer requests to service each request at the requested interval, resulting effectively in the following order:

(request 3) in now+10 seconds
(request 1) 10 seconds after request 3 is satisfied
(request 2) 10 seconds after request 1 is satisfied

A sample timer program is given at the end of this chapter.

Opening a Timer Device

To gain access to a timer unit, you must first open that unit. This is done by using the system command **OpenDevice()**. A typical C-language call is shown below:

```
struct timereq timer_request_block
error = OpenDevice(TIMERNAME,unit_number,timer_request_block,0);
```

The parameters shown above are as follows:

TIMERNAME
This is a define for the null-terminated string, currently "timer.device."

unit_number
This indicates which timer unit you wish to use, either UNIT_VBLANK or UNIT_MICROHZ as defined in "Timer Device Units" above.

timer_request_block
This is the address of an **IORequest** data structure that will be used later to communicate with the device. The **OpenDevice()** command will fill in the unit and device fields of this data structure.

Adding a Time Request

You add a timer request to the device by passing a correctly initialized I/O request to the timer. The code fragment below demonstrates a sample request:

```
set_timer(seconds,microseconds)
ULONG seconds, microseconds;
{
    timermsg->io_Command = TR_ADDREQUEST;
    timermsg->tr_time.tv_secs = seconds;
    timermsg->tr_time.tv_micro = microseconds;
    DoIO(timermsg);
}
```

Note: Using **DoIO()** here puts your task to sleep until the time request has been satisfied (see the sample program at the end of the chapter).

If you wish to send out multiple time requests, you have to create multiple request blocks (referenced here as "timermsgs") and then use **SendIO()** to transmit each to the timer.

Closing a Timer

After you have finished using a timer device, you should close it:

```
CloseDevice(timermsg);
```

Additional Timer Functions and Commands

There are two additional timer commands (accessed as standard device commands, using an **IORequest** block as shown above) and three additional functions (accessed as though they were library functions).

The additional timer commands are as follows:

- TR_GETSYSTIME — get the system time
- TR_SETSYSTIME — set the system time

The additional timer library-like functions are:

- **SubTime(Dest, Source)** — subtract one time request from another
- **AddTime(Dest, Source)** — add one time request to another
- result = **CmpTime(Dest, Source)** — compare the time in two time requests

SYSTEM TIME

The "system timer" is unrelated to the system time as it appears in the **DateStamp** command of AmigaDOS. It is provided simply for the convenience of the developer and is utilized by Intuition.

The command TR_SETSYSTIME sets the system's idea of what time it is. The system starts out at time "zero" so it is safe to set it forward to the "real" time. However, care should be taken when setting the time backwards. System time is specified as being monotonically increasing.

The time is incremented by a special power supply signal that occurs at the external line frequency. This signal is very stable over time, but it can vary by several percent over short periods of time. System time is stable to within a few seconds a day. In addition, system time is changed every time someone asks what time it is using TR_GETSYSTIME. This way the return value of the system time is unique and unrepeating. This allows system time to be used as a unique identifier.

Note: The timer device sets system time to zero at boot time. AmigaDOS will set the system time when it reads in the boot disk, if it has not already been set by someone else (more exactly, if the time is less than 86,400 seconds [one day]). AmigaDOS sets the time to the last modification time of the boot disk. The time device does not interpret system time to any physical value. AmigaDOS treats system time relative to midnight, 1 January 1978.

Here is a program that can be used to inquire the system time. Instead of using the Exec support function **CreateStdIO()** for the request block, the block is initialized "correctly" for use as a **timeval** request block. The command is executed by the timer device and, on return, the caller can find the data in his request block.

```
/* getsystime.c - get system time */

#include "exec/types.h"
#include "exec/lists.h"
#include "exec/nodes.h"
#include "exec/ports.h"
#include "exec/io.h"
#include "exec/devices.h"
#include "devices/timer.h"

#define msgblock tr.tr_node.io_Message
struct timerequest tr;

main()
{
    int error;
    error = OpenDevice(TIMERNAME,UNIT_MICROHZ,&tr,0);
    msgblock.mn_Node.ln_Type = NT_MESSAGE;
    msgblock.mn_Node.ln_Pri = 0;
    msgblock.mn_Node.ln_Name = NULL;
    msgblock.mn_ReplyPort = NULL;

    tr.tr_node.io_Command = TR_GETSYSTIME;
    DoIO(&tr);

    printf("\nSystem Time is:\n");
    printf  ("Seconds Microseconds\n");
    printf  ("%10ld %10ld\n",tr.tr_time.tv_secs, tr.tr_time.tv_micro);
    CloseDevice(&tr);

}          /* end of main */
```

USING THE TIME ARITHMETIC ROUTINES

As indicated above, the time arithmetic routines are accessed in the timer device structure as though it were a routine library. To use them, you create an **IORequest** block and open the timer. In the **IORequest** block is a pointer to the device's base address. This address is needed to access each routine as an offset—for example, **_LVOAddTime**, **_LVOSubTime**, **_LVOCmpTime**—from that base address. (See the "Device Summaries" appendix for these commands.)

There are C-language interface routines in *amiga.lib* that perform this interface task for you. They are accessed through a variable called **TimerBase**. You prepare this variable by the following method (this is only a partial example):

```
struct timeval time1, time2, time3;
SHORT result;

struct Device *TimerBase;     /* declare the interface variable */

TimerBase = timermsg->Device;

/* now that TimerBase is initialized, it is permissible to call
 * the time-comparison or time-arithmetic routines */

time1.tv_secs = 3;  time1.tv_micro = 0;         /* 3.0 seconds */
time2.tv_secs = 2;  time2.tv_micro = 500000;    /* 2.5 seconds */
time3.tv_secs = 1;  time2.tv_micro = 900000;    /* 1.9 seconds */

/* result of this example is +1 ... first parameter has
 * greater time value than second parameter
 */
result = CmpTime( &time1, &time2 );

/* add to time1 the values in time2 */
AddTime( &time1, &time2);
/* subtract values in time3 from the value currently in time1.
 * Results in time1. */
SubTime( &time1, &time3);
```

WHY USE TIME ARITHMETIC?

As mentioned earlier in this section, because of the multitasking capability of the Amiga, the timer device can provide timings that are at least as long as the specified amount of time. If you need more precision than this, using the system timer along with the time arithmetic routines can at least, in the long run, let you synchronize your software with this precision timer after a selected period of time.

Say, for example, that you select timer intervals so that you get 161 signals within each 3-minute span. Therefore, the **timeval** you would have selected would be 180/161, which comes out to 1 second and 118,012 microseconds per interval. Considering the time it takes to set up a call to **set_timer** and delays due to task-switching (especially if the system is very busy) it is possible that after 161 timing intervals, you may be somewhat beyond the 3-minute time. Here is a method you can use to keep in sync with system time:

1. Begin.

2. Read system time; save it.

3. Perform your loop however many times in your selected interval.

4. Read system time again, and compare it to the old value you saved. (For this example, it will be more or less than 3 minutes as a total time elapsed.)

5. Calculate a new value for the time interval (**timeval**); that is, one that (if precise) would put you exactly in sync with system time the next time around. **Timeval** will be a lower value if the loops took too long, and a higher value if the loops didn't take long enough.

6. Repeat the cycle.

Over the long run, then, your average number of operations within a specified period of time can become precisely what you have designed.

Sample Timer Program

Here is an example program showing how to use a timer device.

```
/* Simple Timer Example Program:
 *
 * Includes dynamic allocation of data structures needed to communicate
 * with the timer device as well as the actual device I/O
 */

#include "exec/types.h"
#include "exec/nodes.h"
#include "exec/lists.h"
#include "exec/memory.h"
#include "exec/interrupts.h"
#include "exec/ports.h"
#include "exec/libraries.h"
#include "exec/tasks.h"
#include "exec/io.h"
#include "exec/devices.h"
#include "devices/timer.h"

APTR TimerBase;          /* to get at the time comparison functions */

/* manifest constants -- "never will change" */
#define    SECSPERMIN  (60)
#define    SECSPERHOUR      (60*60)
#define    SECSPERDAY  (60*60*24)

extern struct timerequest *CreateTimer();

main()
{
     /* save what system thinks is the time.... we'll advance it temporarily */
     LONG seconds;
     struct timerequest *tr;
     struct timeval oldtimeval;
     struct timeval mytimeval;
     struct timeval currentval;

     printf("0imer test0);

     /* sleep for two seconds */
     currentval.tv_secs = 2;
     currentval.tv_micro = 0;
     TimeDelay( &currentval, UNIT_VBLANK );
     printf( "After 2 seconds delay0 );
```

```
/* sleep for four seconds */
currentval.tv_secs = 4;
currentval.tv_micro = 0;
TimeDelay( &currentval, UNIT_VBLANK );
printf( "After 4 seconds delay0 );

/* sleep for 500,000 micro-seconds = 1/2 second */
currentval.tv_secs = 0;
currentval.tv_micro = 500000;
TimeDelay( &currentval, UNIT_MICROHZ );
printf( "After 1/2 second delay0 );

printf( "0 );

(void) Execute( "date", 0, 0 );

printf( "0 );

GetSysTime( &oldtimeval );
printf( "Current system time is %ld current seconds0,
      oldtimeval.tv_secs );

printf("Setting a new system time0);

seconds = 1000 * SECSPERDAY + oldtimeval.tv_secs;

SetNewTime( seconds );
/* (if user executes the AmigaDOS DATE command now, he will
 * see that the time has advanced something over 1000 days */

printf( "0 );
(void) Execute( "date", 0, 0 );

printf( "0 );

/* added the microseconds part to show that time keeps
 * increasing even though you ask many times in a row */
GetSysTime( &mytimeval );
printf( "Original system time is %ld.%06ld0,
      mytimeval.tv_secs, mytimeval.tv_micro );

GetSysTime( &mytimeval );
printf( "First system time is %ld.%06ld0,
      mytimeval.tv_secs, mytimeval.tv_micro );
```

```
    GetSysTime( &mytimeval );
    printf( "Second system time is %ld.%06ld0,
        mytimeval.tv_secs, mytimeval.tv_micro );

    printf( "Resetting to former time0 );
    SetNewTime( oldtimeval.tv_secs );

    GetSysTime( &mytimeval );
    printf( "Current system time is %ld.%06ld0,
        mytimeval.tv_secs, mytimeval.tv_micro );

    /* just shows how to set up for using the timer functions, does not
     * demonstrate * the functions themselves. (TimerBase must have a
     * legal value before AddTime, SubTime or CmpTime are performed. */
    tr = CreateTimer( UNIT_MICROHZ );
    TimerBase = (APTR)tr->tr_node.io_Device;

    /* and how to clean up afterwards */
    TimerBase = (APTR)(-1);
    DeleteTimer( tr );

}

extern struct MsgPort *CreatePort();
extern struct IORequest *CreateExtIO();

struct timerequest *
CreateTimer( unit )
ULONG unit;
{
    /* return a pointer to a time request. If any problem, return NULL */

    int error;

    struct MsgPort *timerport;
    struct timerequest *timermsg;

     timerport = CreatePort( 0, 0 );
     if( timerport == NULL )
     {
         return( NULL );
     }

     timermsg = (struct timerequest *)
       CreateExtIO( timerport, sizeof( struct timerequest ) );
```

```
	if( timermsg == NULL ) {
		return( NULL );
	}

	error = OpenDevice( TIMERNAME, unit, timermsg, 0 );
	if( error != 0 )
	{
		DeleteTimer( timermsg );
		return( NULL );
	}

	return( timermsg );
}

/* more precise timer than AmigaDOS Delay() */
TimeDelay( tv, unit )
struct timeval *tv;
int unit;
{
	struct timerequest *tr;

	/* get a pointer to an initialized timer request block */
	tr = CreateTimer( unit );

	/* any nonzero return says timedelay routine didn't work. */
	if( tr == NULL ) return( -1 );

	WaitForTimer( tr, tv );

	/* deallocate temporary structures */
	DeleteTimer( tr );
	return( 0 );
}

int
WaitForTimer( tr, tv )
struct timerequest *tr;
struct timeval *tv;
{
	tr->tr_node.io_Command = TR_ADDREQUEST; /* add a new timer request */

	/* structure assignment */
	tr->tr_time = *tv;

	/* post request to the timer -- will go to sleep till done */
```

```
	DoIO( tr );
}

int
SetNewTime( secs )
LONG secs;	/* seconds since 1 Jan 78 */
{
	struct timerequest *tr;

	tr = CreateTimer( UNIT_MICROHZ );

	/* non zero return says error */
	if( tr == 0 ) return( -1 );

	tr->tr_node.io_Command = TR_SETSYSTIME;
	tr->tr_time.tv_secs = secs;
	tr->tr_time.tv_micro = 0;
	DoIO( tr );

	DeleteTimer(tr);
	return(0);
}

int
GetSysTime(tv)
struct timeval *tv;
{
	struct timerequest *tr;

	tr = CreateTimer( UNIT_MICROHZ );

	/* non zero return says error */
	if( tr == 0 ) return( -1 );

	tr->tr_node.io_Command = TR_GETSYSTIME;
	DoIO( tr );

	/* structure assignment */
	*tv = tr->tr_time;

	DeleteTimer( tr );
	return( 0 );

}
```

```
int
DeleteTimer( tr )
struct timerequest *tr;
{
    struct MsgPort *tp;

    if( tr != 0 )
    {
        tp = tr->tr_node.io_Message.mn_ReplyPort;
        if(tp != 0) {
            DeletePort(tp);
        }

        CloseDevice( tr );
        DeleteExtIO( tr, sizeof(struct timerequest) );
    }
}
```

Chapter 7

Trackdisk Device

Introduction

The Amiga trackdisk device directly drives the disk, controls the disk motors, reads raw data from the tracks, and writes raw data to the tracks. Normally, you use the AmigaDOS functions to write or read data from the disk. The trackdisk driver is the lowest-level software access to the disk data and is used by AmigaDOS to get its job done. The trackdisk device supports the usual commands such as CMD_WRITE and CMD_READ. In addition, it supports an extended form of these commands to allow additional control over the disk driver.

The trackdisk device can queue up command sequences so that your task can do something else while it is waiting for a particular disk activity to occur. If several sequenced write commands are queued to a disk, a task assumes that all such writes are going to the same disk. The trackdisk driver itself can stop a command sequence if it senses that the disk has been changed, returning all subsequent **IORequest** blocks to the caller with an error ("disk changed").

When the trackdisk device is requested to provide status information for commands such as TD_REMOVE or TD_CHANGENUM, the value is returned in the **io_Actual** field of the **IORequest**.

The Amiga Floppy Disk

The Amiga floppy disk consists of NUMHEADS (2) heads, NUMCYLS (80) cylinders, and NUMSECS (11) sectors per cylinder. Each sector has TD_SECTOR (512) usable data bytes plus TD_LABELSIZE (16) of sector label area. This gives useful space of 880K bytes plus 28K bytes of label area per floppy disk.

Although the disk is logically divided up into sectors, all I/O to the disk is implemented as an entire track. This allows access to the drive with no interleaving and increases the useful storage capacity by about 20 percent. Normally, a read of a sector will only have to copy the data from the track buffer. If the track buffer contains another track's data, then the buffer will first be written back to the disk (if it is "dirty") and the new track will be read in. All track boundaries are transparent to the user. The driver ensures that the correct track is brought into memory.

The performance of the disk is greatly enhanced if you make effective use of the track buffer. The performance of sequential reads will be up to an order of magnitude greater than reads scattered across the disk.

The disk driver uses the blitter to encode and decode the data to and from the track buffer. Because the blitter can access only chip memory (memory that is accessible to the special-purpose chips and within the lowest 512K bytes of the system, known as MEMF_CHIP to the memory allocator **AllocMem()**), all buffers submitted to the disk must be in chip memory. In addition, only full-sector writes on sector boundaries are supported. Note also that the user's buffer must be word-aligned.

The disk driver is based upon a standard driver structure. It has the following restrictions:

- o All reads and writes must use an **io_Length** that is an integer multiple of TD_SECTOR bytes (the sector size in bytes).

- The offset field must be an integer multiple of TD_SECTOR.

- The data pointer must be word-aligned.

- The data pointer must be in MEMF_CHIP memory. This is because the disk driver uses the blitter to fill the data buffer.

- Only the 3 1/2-inch disk format is supported by the trackdisk driver. The 5 1/4-inch format is supported by the IBM PC emulation software.

Trackdisk Driver Commands

The trackdisk driver allows the following system interface functions and commands. In addition to the usual device commands, the trackdisk driver has a set of extended commands.

The system interface functions are

OpenDevice()	Obtain exclusive use of a particular disk unit
CloseDevice()	Release the unit to another task
Expunge()	Remove the device from the device list
BeginIO()	Dispatch a device command; queue commands
AbortIO()	Abort a device command

The device-specific commands are

CMD_READ	Read one or more sectors
CMD_WRITE	Write one or more sectors
CMD_UPDATE	Write out a track buffer
CMD_CLEAR	Mark a track buffer as invalid
TD_MOTOR	Turn the motor on or off
TD_SEEK	Move the head to a specific track
TD_FORMAT	Initialize one or more tracks
TD_REMOVE	Establish a software interrupt procedure for disk removal
TD_CHANGENUM	Discover the current disk-change number
TD_CHANGESTATE	See if there is a disk present in a drive
TD_PROTSTATUS	See if a disk is write-protected

In addition to the device-specific commands listed above, the trackdisk driver has a number of extended commands. These commands are similar to their normal counterparts but have additional features: they allow you to control whether a command will be executed if the disk has been changed, and they allow you to read or write to the sector label portion of a sector.

Extended commands take a slightly larger I/O request block, which contains information that is needed only by the extended command and that is ignored by the standard form of that command. The extra information takes the form of two extra longwords at the end of the data structure. These commands are performed only if the change count is less than or equal to the one in the **iotd_Count** field of the command's I/O request block. The extended commands are listed below:

ETD_READ	Read one or more sectors
ETD_WRITE	Write one or more sectors
ETD_MOTOR	Turn the motor on or off
ETD_UPDATE	Write out a track buffer
ETD_CLEAR	Mark a track buffer as invalid
ETD_SEEK	Move the head to a specific track

Creating an I/O Request

The trackdisk device, like other devices, requires that you create an I/O request message that you pass to the device for processing. The message contains the command and several other items of control information.

Here is a program fragment that can be used to create the message block that you use for trackdisk communications. In the fragment, the routine **CreateStdIO()** is called to return a pointer to a message block. This is acceptable for the standard form of the commands. If you wish to use the extended form of the command, you will need an extended form of the request block. In place of **CreateStdIO()**, you can use the routine **CreateExtIO()**, a listing of which appears in the appendixes of the *Amiga ROM Kernel Reference Manual: Exec.*

```
struct IOStdReq *diskreq;     /* I/O request block pointer
                               * for non-extended commands */
struct IOExtTD *diskextreq; /* I/O request block pointer
                               * for extended commands */
struct Port *diskreqPort;     /* a port at which to receive replies */

diskreqPort = CreatePort("diskreq.port",0);
if(diskreqPort == 0) exit(100);          /* error in CreatePort() */
diskreq = CreateStdIO(diskreqPort);
if(diskreq == 0) { DeletePort(diskreqPort); exit(200); } /* error in CreateStdIO()
diskextreq = CreateExtIO(diskreqPort,sizeof(struct IOExtTD));
if(diskextreq == 0) { DeletePort(diskreqPort); exit(300) };
```

The routine **CreatePort()** is part of *amiga.lib*. It returns a pointer to a **Port** structure that can be used to receive replies from the trackdisk driver.

The routine **CreateStdIO()** is also in *amiga.lib*. It returns a pointer to an **IOStdReq** block that becomes the message you pass to the trackdisk driver to tell it the command to perform.

The data structure **IOExtTD** takes the form:

```
struct IOExtTD {
    struct IOStdReq iotd_Req;
    ULONG  iotd_Count;
    ULONG  iotd_SecLabel;
};
```

where

IOStdReq
: is a standard **IORequest** block that contains fields used to transmit the standard commands (explained below).

iotd_Count
: helps keep old I/O requests from being performed when the diskette has been changed. All extended commands treat as an error any case where the disk change counter is greater than **iotd_Count**. Any I/O request found with an **iotd_Count** less than the current change counter value will be returned with a characteristic error (TDERR_DiskChange) in the **io_Error** field of the I/O request block. This allows stale I/O requests to be returned to the user after a disk has been changed. The current disk-change counter value can be obtained by TD_CHANGENUM.

If the user wants extended disk I/O but does not care about disk removal, then **iotd_Count** may be set to the maximum unsigned long integer value (0xFFFFFFFF).

iotd_SecLabel
: allows access to the sector identification section of the sector header.

Each sector has 16 bytes of descriptive data space available to it; the disk driver does not interpret this data. If **iotd_SecLabel** is null, then this descriptive data is ignored. If it is not null, then **iotd_SecLabel** should point to a series of 16-byte chunks (one for each sector that is to be read or written). These chunks will be written out to the sector's label region on a write or filled with the sector's label area on a read. If a CMD_WRITE (the standard write call) is done, then the sector label area is left unchanged.

Opening a Trackdisk Device

To gain access to a disk unit, you must first open the unit by using the system command **OpenDevice()**. A typical C-language call is shown below:

error = OpenDevice(TD_NAME,unit_number,disk_request_block,flags);

where:

TD_NAME
is a define for the null-terminated string, currently "trackdisk.device."

unit_number
is the disk unit you wish to use (defined below).

disk_request_block
is the address of an **IORequest** data structure that will later be used to communicate with the device. The **OpenDevice()** command will fill in the unit and device fields of this data structure.

flags
tell how the I/O is to be accomplished. For an **OpenDevice()** command, this field is normally set to zero.

The **unit_number** can be any value from 0 to 3. Unit 0 is the built-in 3 1/2-inch disk. Units 1 through 3 represent additional 3 1/2-inch disks that may be daisy-chained from the external disk unit connector on the back of the Amiga. The first unit (plugged directly into the Amiga) is unit 1. The second unit (plugged into unit 1), is designated as unit 2. The end-unit, farthest electrically from the Amiga, is unit 3.

The following are some common errors that may be returned from an **OpenDevice()** call.

Device in use
Some other task has already been granted exclusive use of this device.

Bad unit number
Either you have specified a unit number outside the range of 0-3 or you do not have a unit connected in the specified position.

Bad device type
You may be trying to use a 5 1/4-inch drive with the trackdisk driver. This is not supported.

Sending a Command to the Device

You send a command to this device by initializing the appropriate fields of your **IOStdReq** or **IOExtTD** and then using **SendIO()**, **DoIO()**, or **BeginIO()** to transmit the command to the device. Here is an example:

```
MotorOn()
{
    diskreq->io_Length = 1;             /* 1 says turn it on */
    diskreq->io_Command = TD_MOTOR;
    DoIO(diskreq);                      /* task sleep till command done */
    return(0);
}
```

Terminating Access to the Device

As with all exclusive-access devices, you *must* close the trackdisk device when you have finished using it. Otherwise, the system will be unable to allocate the device to any other task until the system is rebooted.

Device-specific Commands

The device-specific commands that are supported are explained below.

ETD_READ AND CMD_READ

ETD_READ obeys all of the trackdisk driver restrictions noted above. ETD_READ transfers data from the track buffer to the user's buffer, if and only if the disk has not been changed. If the desired sector is already in the track buffer, no disk activity is initiated. If the desired sector is not in the buffer, the track containing that sector is automatically read in. If the data in the current track buffer has been modified, it is written out to the disk before the new track is read. CMD_READ does not check if the disk has been changed before executing this command.

TRACKDISKNAME

TRACKDISKREQUEST (NO)

ETD_WRITE AND CMD_WRITE

ETD_WRITE obeys all of the trackdisk driver restrictions noted above. ETD_WRITE transfers data from the user's buffer to track buffer if and only if the disk has not been changed. If the track that contains this sector is already in the track buffer, no disk activity is initiated. If the desired sector is not in the buffer, the track containing that sector is automatically read in. If the data in the current track buffer has been modified, it is written out to the disk before the new track is read in for modification. CMD_WRITE does not check for disk change before performing the command.

ETD_UPDATE AND CMD_UPDATE

The Amiga trackdisk driver does not write data sectors unless it is necessary (you request that a different track be used) or until the user requests that an update be performed. This improves system speed by caching disk operations. The update commands ensure that any buffered data is flushed out to the disk. If the track buffer has not been changed since the track was read in, the update commands do nothing. In addition, ETD_UPDATE can make sure that the disk was not changed before it writes the buffer. This prevents writing the buffered data onto a different diskette.

ETD_CLEAR AND CMD_CLEAR

ETD_CLEAR marks the track buffer as invalid, forcing a reread of the disk on the next operation. ETD_UPDATE or CMD_UPDATE would be used to force data out to the disk before turning the motor off. ETD_CLEAR or CMD_CLEAR is usually used after the disk has been removed, to prevent caching of data to the new diskette. ETD_CLEAR or CMD_CLEAR will not do an update, nor will an update command do a clear. CMD_CLEAR does not check for disk change.

ETD_MOTOR AND TD_MOTOR

TD_MOTOR is called with a standard **IORequest** block. The **io_Length** field contains the requested state of the motor. A 1 will turn the motor on; a 0 will turn it off. The old state of the motor is returned in **io_Actual**. If **io_Actual** is zero, then the motor was off. Any other value implies that the motor was on. If the motor is just being turned on, the driver will delay the proper amount of time to allow the drive to come up to speed. Normally, turning the drive on is not necessary—the driver does this automatically if it receives a request when the motor is off. However, turning the motor off is the user's responsibility. In addition, the standard instructions to the user are that it is safe to remove a diskette if and only if the motor is off (that is, if the disk light is off).

TD_FORMAT

TD_FORMAT is used to write data to a track that either has not yet been formated or has had a hard error on a standard write command. TD_FORMAT completely ignores all data currently on a track and does not check for disk change before performing the command. TD_FORMAT is called with a standard **IORequest**. The **io_Data** field must point to at least one track worth of data. The **io_Offset** field must be track aligned, and the **io_Length** field must be in units of track length (that is, NUMSECS*TD_SECTOR). The driver will format the requested tracks, filling each sector with the contents of the **io_Data** field. You should do a read pass to verify the data. The command TD_FORMAT does not check whether the disk has been changed before the command is performed.

If you have a hard write error during a normal write, you may find it necessary to use the TD_FORMAT command to reformat the track as part of your error recovery process.

TD_REMOVE

TD_REMOVE is called with a standard **IORequest**. The **APTR io_Data** field points to a software interrupt structure. The driver will post this software interrupt whenever a disk is inserted or removed. To find out the current state of the disk, TD_CHANGENUM and TD_CHANGESTATE should be used. If TD_REMOVE is called with a null **io_Data** argument, then disk removal interrupts are suspended.

Status Commands

The commands that return status on the current disk in the unit are TD_CHANGENUM, TD_CHANGESTATE, and TD_PROTSTATUS.

TD_CHANGENUM

TD_CHANGENUM returns the current value of the disk-change counter (as used by the extended commands—see below). The disk change counter is incremented each time the disk is inserted or removed.

TD_CHANGESTATE

TD_CHANGESTATE returns zero if a disk is currently in the drive, and nonzero if the drive has no disk.

TD_PROTSTATUS

TD_PROTSTATUS returns nonzero if the current diskette is write-protected. All these routines return their values in **io_Actual**. These routines are safe to call from an interrupt routine (such as the software interrupt specified in TD_REMOVE). However, care should be taken when calling these routines from an interrupt. You should never **Wait()** for them to complete while in interrupt processing—it is never legal to go to sleep on the interrupt stack.

Commands for Diagnostics and Repair

Currently only one command, TD_SEEK, is provided for internal diagnostics and for disk repair.

TD_SEEK is called with a standard **IORequest**. The **io_Offset** field should be set to the (byte) offset to which the seek is to occur. TD_SEEK will not verify its position until the next read. That is, TD_SEEK only moves the heads; it does not actually read any data and it does not check to see if the disk has been changed.

Trackdisk Driver Errors

Table 7-1 is a list of error codes that can be returned by the trackdisk driver. When an error occurs, these error numbers will be returned in the **io_Error** field of your **IORequest** block.

Table 7-1: Trackdisk Driver Error Codes

Error Name	Error Number	Meaning
TDERR_NotSpecified	20	Error could not be determined
TDERR_NoSecHdr	21	Could not find sector header
TDERR_BadSecPreamble	22	Error in sector preamble
TDERR_BadSecID	23	Error in sector identifier
TDERR_BadHdrSum	24	Header field has bad checksum
TDERR_BadSecSum	25	Sector data field has bad checksum
TDERR_TooFewSecs	26	Incorrect number of sectors on track
TDERR_BadSecHdr	27	Unable to read sector header
TDERR_WriteProt	28	Disk is write-protected
TDERR_DiskChanged	29	Disk has been changed or is not currently present
TDERR_SeekError	30	While verifying seek position, found seek error
TDERR_NoMem	31	Not enough memory to do this operation
TDERR_BadUnitNum	32	Bad unit number (unit # not attached)
TDERR_BadDriveType	33	Bad drive type (not an Amiga 3 1/2 inch disk)
TDERR_DriveInUse	34	Drive already in use (only one task exclusive)
TDERR_PostReset	35	User hit reset; awaiting doom

Example Program

The following sample program exercises a few of the trackdisk driver commands.

```
#include "exec/types.h"
#include "exec/nodes.h"
#include "exec/lists.h"
#include "exec/memory.h"
#include "exec/interrupts.h"
#include "exec/ports.h"
#include "exec/libraries.h"
#include "exec/io.h"
#include "exec/tasks.h"
#include "exec/execbase.h"
#include "exec/devices.h"
```

```
#include "devices/trackdisk.h"

#define TD_READ CMD_READ
#define BLOCKSIZE TD_SECTOR

SHORT error;
struct MsgPort *diskport;
struct IOExtTD *diskreq;
BYTE diskbuffer[BLOCKSIZE];
BYTE *diskdata;
SHORT testval;

extern struct MsgPort *CreatePort();
extern struct IORequest *CreateExtIO();

ULONG diskChangeCount;

ReadCylSec(cyl, sec, hd)
SHORT cyl, sec, hd;
{
        LONG offset;

        diskreq->iotd_Req.io_Length = BLOCKSIZE;
        diskreq->iotd_Req.io_Data = (APTR)diskbuffer;
                /* show where to put the data when read */
        diskreq->iotd_Req.io_Command = ETD_READ;
                /* check that disk not changed before reading */
        diskreq->iotd_Count = diskChangeCount;

        /* convert from cylinder, head, sector to byte-offset value to get
         * right one (as dos and everyone else sees it)...*/

        /* driver reads one CYLINDER at a time (head does not move for
         * 22 sequential sector reads, or better put, head does not move for
         * 2 sequential full track reads.)
         */

        offset = TD_SECTOR * (sec + NUMSECS * hd + NUMSECS * NUMHEADS * cyl);
        diskreq->iotd_Req.io_Offset = offset;
        DoIO(diskreq);
        return(0);
}


MotorOn()
{
        /* TURN ON DISK MOTOR ... old motor state is returned in io_Actual */
        diskreq->iotd_Req.io_Length = 1;
        /* this says motor is to be turned on */
        diskreq->iotd_Req.io_Command = TD_MOTOR;
        /* do something with the motor */
        DoIO(diskreq);
        printf("\nOld motor state was: %ld",diskreq->iotd_Req.io_Actual);
```

```
	printf("\nio_Error value was: %ld",diskreq->iotd_Req.io_Error);
	return(0);
}

MotorOff()
{
	printf("\n\nNow turn it off");
	diskreq->iotd_Req.io_Length = 0;
	/* says that motor is to be turned on */
	diskreq->iotd_Req.io_Command = TD_MOTOR;
	/* do something with the motor */
	DoIO(diskreq);
	printf("\nOld motor state was: %ld",diskreq->iotd_Req.io_Actual);
	printf("\nio_Error value was: %ld",diskreq->iotd_Req.io_Error);
	return(0);
}

SeekFullRange(howmany)
SHORT howmany;
{
int i;
for(i=0; i<howmany; i++)
	{
		diskreq->iotd_Req.io_Offset =
			((NUMCYLS -1)*NUMSECS*NUMHEADS -1 ) * 512;
		/* seek to cylinder 79, head 1 */
		diskreq->iotd_Req.io_Command = TD_SEEK;
		DoIO(diskreq);
		if(diskreq->iotd_Req.io_Error != 0)
			printf("\nSeek Cycle Number %ld, Error = %ld",
						i, diskreq->iotd_Req.io_Error);
		diskreq->iotd_Req.io_Offset = 0;
			/* seek to cylinder 0, head 0 */
		diskreq->iotd_Req.io_Command = TD_SEEK;
		DoIO(diskreq);
		if(diskreq->iotd_Req.io_Error != 0)
			printf("\nSeek Cycle Number %ld, Error = %ld",
						i, diskreq->iotd_Req.io_Error);
		printf("\nCompleted a seek");
	}
	return(0);
}


main()
{
	SHORT cylinder,head,sector;

	diskdata = &diskbuffer[0];
		/* point to first location in disk buffer */
	diskport = CreatePort(0,0);
	if(diskport == 0) exit(100);	/* error in createport */
	diskreq = (struct IOExtTD *)CreateExtIO(diskport, sizeof(struct IOExtTD));
```

```
        /* make an io request block for communicating with the disk */
    if(diskreq == 0) { DeletePort(diskport); exit(200); }

      error = OpenDevice(TD_NAME,0,diskreq,0);
            /* open the device for access, unit 0 is builtin drive */
      printf("\nError value returned by OpenDevice was: %lx", error);

      /* now get the disk change value */
      diskreq->iotd_Req.io_Command = TD_CHANGENUM;
      DoIO(diskreq);
      diskChangeCount = diskreq->iotd_Req.io_Actual;
      printf("\nChange number for disk is currently %ld",diskChangeCount);

      MotorOn();
      SeekFullRange(10);
      for(cylinder=0; cylinder<80; cylinder++)      /* tracks to test */
        {
        for(head=0; head<2; head++)                 /* number of heads to test */
      for(sector=0; sector<11; sector++)            /* sectors to test */
            {
            ReadCylSec(cylinder, sector, head);
            if(diskreq->iotd_Req.io_Error != 0)
              printf("\nError At Cyl=%ld, Sc=%ld, Hd=%ld, Error=%ld",
                        cylinder,sector,head,
                        diskreq->iotd_Req.io_Error);
            }
         printf("\nCompleted reading Cylinder=%ld",cylinder);
         }
      MotorOff();
      CloseDevice(diskreq);

    DeleteExtIO(diskreq, sizeof(struct IOExtTD));
    DeletePort(diskport);
}   /* end of main */
```

Chapter 8

Console Device

This chapter describes how you do console (keyboard and screen) input and output on the Amiga. The console device acts like an enhanced ASCII terminal. It obeys many of the standard ANSI sequences as well as additional special sequences unique to the Amiga.

Introduction

Console I/O is tied closely to the Amiga Intuition interface; a console must be tied to a window that is already opened. From the **Window** data structure, the console device determines how many characters it can display on a line and how many lines of text it can display in a window without clipping at any edge.

You can open the console device many times, if you wish. The result of each open call is a new console unit. AmigaDOS and Intuition see to it that only one window is currently active and its console, if any, is the only one (with a few exceptions) that receives notification of input events, such as keystrokes. Later in this chapter you will see that other Intuition events can be sensed by the console device as well.

Note: For this entire chapter the characters "<CSI>" represent the *control sequence introducer*. For output you may use either the two-character sequence "<Esc>[" or the one-byte value $9B (hex). For input you will receive $9B's.

System Functions

The various system functions—such as **DoIO()**, **SendIO()**, **AbortIO()**, **CheckIO()**, and so on—operate normally. The only caveats are that CMD_WRITE may cause the caller to wait internally, even with **SendIO()**, and a task waiting on response from a console is at the user's whim. If a user never reselects that window, and the console response provides the only wake-up call, that task may well sleep indefinitely.

Console I/O

The console device may be thought of as a kind of terminal. You send character streams to the console device; you also receive them from the console device. These streams may be characters or special sequences.

GENERAL CONSOLE SCREEN OUTPUT

Console character screen output (as compared to console command sequence transmission) outputs all standard printable characters (character values hex 20 thru 7E and A0 thru FF) normally. Many control characters such as BACKSPACE and RETURN are translated into their exact ANSI equivalent actions. The line-feed character is a bit different, in that it can be translated into a new-line character. The net effect is that the cursor moves to the first column of the next line whenever a <LF> is displayed. This code is set via the mode control sequences discussed under "Control Sequences for Screen Output."

CONSOLE KEYBOARD INPUT

If you read from the console device, the keyboard inputs are preprocessed for you and you will get ASCII characters, such as "B." Most normal text-gathering programs will read from the console device in this manner. Special programs, such as word processors and music keyboard programs, will use raw input. Keys are converted via the keymap associated with the unit.

The sections below deal with the following topics:

- Setting up for console I/O (creating an I/O request structure)
- Writing to the console to control its behavior
- Reading from the console
- Closing down a console device

Creating an I/O Request

This section shows you how to set up for console I/O. Console I/O, like that used with other devices, requires that you create an I/O request message that you pass to the console device for processing. The message contains the command as well as a data area. In the data area, for a write, there will be a pointer to the stream of information you wish to write to the console. For a read, this data pointer shows where the console is to copy the data it has for you. There is also a length field that says how many characters (maximum) are to be copied either from or to the console device.

Here is a program fragment that can be used to create the message block that you use for console communications.

For *writing* to the console:

```
struct IOStdReq *consoleWriteMsg;       /* I/O request block pointer */
struct Port *consoleWritePort;          /* a port at which to receive replies*/

consoleWritePort = CreatePort("mycon.write",0);
if(consoleWritePort == 0) exit(100);    /* error in createport */
consoleWriteMsg = CreateStdIO(consoleWritePort);
if(consoleWriteMsg == 0) exit(200);     /* error in createstdio */
```

For *reading* from the console:

```
struct IOStdReq *consoleReadMsg;        /* I/O request block pointer */
struct Port *consoleReadPort;           /* a port at which to receive replies */

consoleReadPort = CreatePort("mycon.read",0);
if(consoleReadPort == 0) exit(300);    /* error in createport */
consoleReadMsg = CreateStdIO(consoleReadPort);
if(consoleReadMsg == 0) exit(400);     /* error in createstdio */
```

These fragments show two messages and ports being set up. You would use this set-up if you want to have a read command continuously queued up while using a separate message with its associated port to send control command sequences to the console. In addition, if you want to queue up multiple commands to the console, you may wish to create multiple messages (but probably just one port for receiving replied messages from the device).

Opening a Console Device

For other devices, you normally use **OpenDevice()** to pass an uninitialized **IORequest** block to the device. For a console device, a slightly different method is used. You must have initialized two fields in the request block; namely, the data pointer and the length field. Here is a subroutine that can be used to open a console device (attach it to an existing window). It assumes that intuition.library is already open, a window has also been opened, and this new console is to be attached to the open window.

```
/* this function returns a value of 0 if the console
 * device opened correctly and a nonzero value
 * (the error returned from OpenDevice) if there was an error.
*/

OpenConsole(writerequest,readrequest,window)
    struct IOStdReq *writerequest;
    struct IOStdReq *readrequest;
    struct Window *window;
    {
        int error;
        writerequest->io_Data = (APTR) window;
        writerequest->io_Length = sizeof(*window);
        error = OpenDevice("console.device", 0, writerequest, 0);
        readrequest->io_Device = writerequest->io_Device;
        readrequest->io_Unit   = writerequest->io_Unit;
            /* clone required parts of the request */
        return(error);
    }
```

Notice that this routine opens the console using one I/O request (write), then copies the write request values into the read request. This assures that both input and output go to the same console device.

SENDING A CHARACTER STREAM TO THE CONSOLE DEVICE

To perform console I/O, you fill in fields of the console I/O standard request and pass this block to the console device using one of the normal I/O functions. When the console device has completed the action, the device returns the message block to the port you have designated within the message itself. The function **CreateStdIO()** initializes the message to contain the address of the **ReplyPort**.

The following subroutines use the **IOStdReq** created above. Note that the **IOStdReq** itself contains a pointer to the unit with which it is communicating. Thus, a single function can be used to communicate with multiple consoles.

```
/* output a single character to a specified console */

ConPutChar(request,character)
struct IOStdReq *request;
char character;
{
     request->io_Command = CMD_WRITE;
     request->io_Data = &character;
     request->io_Length = 1;
     DoIO(request);
     return;
}

/* output a stream of known length to a console */

ConWrite(request,string,length)
struct IOStdReq *request;
char *string;
int length;
{
     request->io_Command = CMD_WRITE;
     request->io_Data = string;
     request->io_Length = length;
     DoIO(request);
     return;
}

/* output a NULL-terminated string of characters to a console */

ConPutStr(request,string)
struct IOStdReq *request;
char *string;
{
request->io_Command = CMD_WRITE;
request->io_Data = string;
request->io_Length = -1;     /* tells console to end when it sees a
                              * terminating zero on the string. */
DoIO(request);
     return;
}
```

Control Sequences for Screen Output

Table 8-1 lists the functions that the console device supports, along with the character stream that you must send to the console to produce the effect. Where the function table indicates multiple characters, it is more efficient to use the **ConWrite()** function rather than **ConPutChar()** because it avoids the overhead of transferring the message block multiple times. The table below uses the second form of <CSI>, that is, the hex value 9B, to minimize the number of characters to be transmitted to produce a function.

In table 8-1, if an item is enclosed in square brackets, it is optional and may be omitted. For example, for INSERT [N] CHARACTERS the value for N or M is shown as optional. The console device responds to such optional items by treating the value of N as if it is not specified. The value of N or M is always a decimal number, having one or more ASCII digits to express its value.

Table 8-1: Console Control Sequences

Command	**Sequence of Characters (in Hexadecimal Form)**
BACKSPACE (move left one column)	08
LINE FEED (move down one text line as specified by the mode function below)	0A
VERTICAL TAB (move up one text line)	0B
FORM FEED (clear the console's screen)	0C
CARRIAGE RETURN (move to first column)	0D
SHIFT IN (undo SHIFT OUT)	0E
SHIFT OUT (set MSB of each character before displaying)	0F
ESC (escape; can be part of the control sequence introducer)	1B
CSI (control sequence introducer)	
RESET TO INITIAL STATE	1B 63
INSERT [N] CHARACTERS (Inserts one or more spaces, shifting the remainder of the line to the right.)	9B [N] 40
CURSOR UP [N] CHARACTER POSITIONS (default = 1)	9B [N] 41
CURSOR DOWN [N] CHARACTER POSITIONS (default = 1)	9B [N] 42

CURSOR FORWARD [N] CHARACTER POSITIONS (default = 1)	9B [N] 43
CURSOR BACKWARD [N] CHARACTER POSITIONS (default = 1)	9B [N] 44
CURSOR NEXT LINE [N] (to column 1)	9B [N] 45
CURSOR PRECEDING LINE [N] (to column 1)	9B [N] 46
MOVE CURSOR TO ROW; COLUMN where N is row, M is column, and semicolon (hex 3B) must be present as a separator, or if row is left out, so the console device can tell that the number after the semicolon actually represents the column number.	9B [N] [3B N] 48
ERASE TO END OF DISPLAY	9B 4A
ERASE TO END OF LINE	9B 4B
INSERT LINE (above the line containing the cursor)	9B 4C
DELETE LINE (remove current line, move all lines up one position to fill gap, blank bottom line)	9B 4D
DELETE CHARACTER [N] (that cursor is sitting on and to the right if [N] is specified)	9B [N] 50
SCROLL UP [N] LINES (Remove line(s) from top of screen, move all other lines up, blanks [N] bottom lines)	9B [N] 53
SCROLL DOWN [N] LINES (Remove line(s) from bottom of screen, move all other lines down, blanks [N] top lines)	9B [N] 54
SET MODE (cause LINEFEED to respond as RETURN-LINEFEED)	9B 32 30 68
RESET MODE (cause LINEFEED to respond only as LINEFEED)	9B 32 30 6C
DEVICE STATUS REPORT (cause console to insert into your read-stream a CURSOR POSITION REPORT; see "Reading from the Console" for more information)	9B 36 6E
SELECT GRAPHIC RENDITION <style>;<fg>;<bg>6D (select text style foreground color, background color) (See the note below.)	See note below.

Note: For SELECT GRAPHIC RENDITION, any number of parameters, in any order, are valid. They are separated by semicolons. The parameters follow:

<style> =

0	Plain text
1	Bold-face
3	Italic
4	Underscore
7	Inverse-video

<fg> =

30 - 37	Selecting system colors 0-7 for foreground. Transmitted as two ASCII characters.

<bg> =

40 - 47	selecting system colors 0-7 for background. Transmitted as two ASCII characters.

For example, to select bold face, with color 3 as foreground and color 0 as background, send the sequence:

```
9B 31 3B 33 33 3B 34 30 6D
```

representing the ASCII sequence:

"<CSI>1;33;40m"

where <CSI> is the control sequence introducer, here used as the single-character value 9B hex.

The sequences in table 8-2 are not ANSI standard sequences; they are private Amiga sequences.

In these command descriptions, length, width, and offset are comprised of one or more ASCII digits, defining a decimal value.

Table 8-2: Amiga Console-control Sequences

Command	Sequence of Characters (in Hexadecimal Form)
SET PAGE LENGTH (in character raster lines, causes console to recalculate, using current font, how many text lines will fit on the page.	9B <length> 74
SET LINE LENGTH (in character positions, using current font, how many characters should be placed on each line).	9B <width> 75
SET LEFT OFFSET (in raster columns, how far from the left of the window should the text begin).	9B <offset> 78
SET TOP OFFSET (in raster lines, how far from the top of the window's **RastPort** should the topmost line of the character begin).	9B <offset> 79
SET RAW EVENTS—see the separate topic "Selecting Raw Input Events" below for more details.	
RESET RAW EVENTS—see "Selecting Raw Input Events" below.	
SET CURSOR RENDITION - make the cursor visible or invisible:	
Invisible:	9B 30 20 70
Visible:	9B 20 70
WINDOW STATUS REQUEST - ask the console device to tell you the current bounds of the window, in upper and lower row and column character positions. (User may have resized or repositioned it.) See "Window Bounds Report" below.	9B 30 20 71

Note: The console device normally handles the SET PAGE LENGTH, SET LINE LENGTH, SET LEFT OFFSET, and SET TOP OFFSET functions automatically. To allow it to do so again after setting your own values, you can send the function without a parameter.

Examples

Move cursor right by 1:

Character string equivalents: <CSI>C or <CSI>1C
Numeric (hex) equivalents: 9B 43 9B 31 43

Move cursor right by 20:

Character string equivalent: <CSI>20C
Numeric (hex) equivalent: 9B 32 30 43

Move cursor to upper left corner (home):

Character string equivalents:
<CSI>H or
<CSI>1;1H or
<CSI>;1H or
<CSI>1;H

Numeric (hex) equivalents:
9B 48
9B 31 3B 31 48
9B 3B 31 48
9B 31 3B 48

Move cursor to the fourth column of the first line of the window:

Character string equivalents:
<CSI>1;4H or
<CSI>;4H

Numeric (hex) equivalents:
9B 31 3B 34 48
9B 3B 34 48

Clear the screen:

Character string equivalents:

<FF> or CTRL-L	{clear screen character} or
<CSI>H<CSI>J	{home and clear to end of screen} or

Numeric (hex) equivalents:

0C
9B 48 9B 4A

READING FROM THE CONSOLE

Reading input from the console device returns an ANSI 3.64 standard byte stream. This stream may contain normal characters and/or RAW input event information. You may also request other RAW input events using the SET RAW EVENTS and RESET RAW EVENTS control sequences discussed below. See "Selection of Raw Input Events."

The following subroutines are useful for setting up for console reads. Only a single-character-at-a-time version is shown here.

Note: This example does not illustrate the fact that a request for more than one character can be satisfied by only one, thus requiring you to look at **io_Actual**.

```
/* queue up a read request to a console, show where to put the character when ready
 * to be returned. Most efficient if this is called right after console is opened */

QueueRead(request,whereto)
struct IOStdReq *request;
char *whereto;
{
    request->io_Command = CMD_READ;
    request->io_Data = whereto;
    request->io_Length = 1;
    SendIO(request);
    return;
}

/* see if there is a character to read. If none, don't wait,
 * come back with a value of -1 */
int
ConMayGetChar(consolePort,request,whereto)
struct Port *consolePort;
```

```
struct IOStdReq *request;
char *whereto;
{
    register temp;

    if ( GetMsg(consolePort) == NULL ) return(-1);
    temp = *whereto;
    QueueRead(request,whereto);
    return(temp);
}

/* go and get a character; put the task to sleep if
 * there isn't one present */

UBYTE
ConGetChar(consolePort,request,whereto)
struct IOStdReq *request;
struct Port *consolePort;
char *whereto;
{
    register temp;
    while((GetMsg(consolePort) == NULL)) WaitPort(consolePort);
    temp = *whereto;    /* get the character */
    QueueRead(request,whereto);
    return(temp);
}
```

INFORMATION ABOUT THE READ-STREAM

For the most part, keys whose keycaps are labeled with ANSI standard characters will ordinarily be translated into their ASCII-equivalent character by the console device through the use of its keymap. A separate section in this chapter has been dedicated to the method used to establish a keymap and the internal organization of the keymap.

For keys other than those with normal ASCII equivalents, an escape sequence is generated and inserted into your input stream. For example, in the default state (no raw input events selected) the function and arrow keys will cause the sequences shown in table 8-3 to be inserted in the input stream.

Table 8-3: Special Key Report Sequences

Key	Unshifted Sends	Shifted Sends	
F1	<CSI>0~	<CSI>10~	
F2	<CSI>1~	<CSI>11~	
F3	<CSI>2~	<CSI>12~	
F4	<CSI>3~	<CSI>13~	
F5	<CSI>4~	<CSI>14~	
F6	<CSI>5~	<CSI>15~	
F7	<CSI>6~	<CSI>16~	
F8	<CSI>7~	<CSI>17~	
F9	<CSI>8~	<CSI>18~	
F10	<CSI>9~	<CSI>19~	
HELP	<CSI>?~	<CSI>?~	(same)
Arrow keys:			
Up	<CSI>A	<CSI>T	
Down	<CSI>B	<CSI>S	
Left	<CSI>D	<CSI> A	(notice the space
Right	<CSI>C	<CSI> @	after <CSI>)

CURSOR POSITION REPORT

If you have sent the DEVICE STATUS REPORT command sequence, the console device returns a cursor position report into your input stream. It takes the form:

<CSI><row>;<column>R

For example, if the cursor is at column 40 and row 12, here are the ASCII values you receive in a stream:

9B 34 30 3B 31 32 52

WINDOW BOUNDS REPORT

A user may have either moved or resized the window to which your console is bound. By issuing a WINDOW STATUS REPORT to the console, you can read the current position and size in the input stream. This window bounds report takes the following form:

<CSI>1;1;<bottom margin>;<right margin>r

Note that the top and left margins are always 11 for the Amiga. The bottom and right margins give you the window row and column dimensions as well. For a window that holds 20 lines with 60 characters per line, you will receive the following in the input stream:

9B 31 3B 31 3B 32 30 3B 36 30 20 72

SELECTING RAW INPUT EVENTS

If the keyboard information—including "cooked" keystrokes—does not give you enough information about input events, you can request additional information from the console driver.

The command to SET RAW EVENTS is formatted as:

"<CSI>[event-types-separated-by-semicolons]{"

If, for example, you need to know when each key is pressed and released you would request "RAW keyboard input." This is done by writing "<CSI>1{" to the console. In a single SET RAW EVENTS request, you can ask the console to set up for multiple event types at one time. You must send multiple numeric parameters, separating them by semicolons (;). For example, to ask for gadget pressed, gadget released, and close gadget events, write "<CSI>7;8;11{" (all as ASCII characters, without the quotes).

You can reset, that is, delete from reporting, one or more of the raw input event types by using the RESET RAW EVENTS command, in the same manner as the SET RAW EVENTS was used to establish them in the first place. This command stream is formatted as:

<CSI>[event-types-separated-by-semicolons]}

So, for example, you could reset all of the events set in the above example by transmitting the command sequence: "<CSI>7;8;11}." Table 8-4 is a list of the valid raw input event types.

Table 8-4: Raw Input Event Types

Request Number	Description	
0	No-op	Used internally
1	RAW keyboard input	Intuition swallows all except the select button
2	RAW mouse input	
3	Event	Sent whenever your window is made active
4	Pointer position	
5	(unused)	
6	Timer	
7	Gadget pressed	
8	Gadget released	
9	Requester activity	
10	Menu numbers	
11	Close Gadget	
12	Window resized	
13	Window refreshed	
14	Preferences changed	
15	Disk removed	
16	Disk inserted	

Complex Input Event Reports

If you select any of these events you will start to get information about the events in the following form:

<CSI><class>;<subclass>;<keycode>;<qualifiers>;<x>;<y>;
<seconds>;<microseconds>|

where

<CSI>
is a one-byte field. It is the "control sequence introducer", 9B in hex.

<class>
is the RAW input event type, from the above table.

<subclass>
is usually 0. If the mouse is moved to the right controller, this would be 1.

<keycode>
indicates which key number was pressed (see figure 8-1 and table 8-6). This field can also be used for mouse information.

<qualifiers>
indicates the state of the keyboard and system. The qualifiers are defined as shown in table 8-5.

Table 8-5: Input Event Qualifiers

Bit	Mask	Key	
0	0001	Left shift	
1	0002	Right shift	
2	0004	Caps Lock	Associated keycode is special; see below.
3	0008	Ctrl	
4	0010	Left Alt	
5	0020	Right Alt	
6	0040	Left Amiga key pressed	
7	0080	Right Amiga key pressed	
8	0100	Numeric pad	
9	0200	Repeat	
10	0400	Interrupt	Not currently used.
11	0800	Multi-broadcast	This window (active one) or all windows.
12	1000	Left mouse button	
13	2000	Right mouse button	
14	4000	Middle mouse button	(Not available on standard mouse)
15	8000	Relative mouse	Indicates mouse coordinates are relative, not absolute.

The Caps Lock key is handled in a special manner. It generates a keycode only when it is pressed, not when it is released. However, the up/down bit (80 hex) is still used and reported. If pressing the Caps Lock key causes the LED to light, keycode 62 (Caps Lock pressed) is sent. If pressing the Caps Lock key extinguishes the LED, keycode 190 (Caps Lock released) is sent. In effect, the keyboard reports this key as held down until it is struck again.

The <x> and <y> fields are filled by some classes with an Intuition address: x<<16+y.

The <seconds> and <microseconds> fields contain the system time stamp taken at the time the event occurred. These values are stored as long-words by the system.

With RAW keyboard input selected, keys will no longer return a simple one-character "A" to "Z" but will instead return raw keycode reports of the form:

<CSI>1;0;<keycode>;<qualifiers>;0;0;<seconds>;<microseconds>|

For example, if the user pressed and released the "B" key with the left Shift and right Amiga keys also pressed, you might receive the following data:

<CSI>1;0;35;129;0;0;23987;99|
<CSI>1;0;163;129;0;0;24003;18|

The <keycode> field is an ASCII decimal value representing the key pressed or released. Adding 128 to the pressed key code will result in the released keycode. Figure 4-1 lets you convert quickly from a key to its keycode. The tables let you convert quickly from a keycode to a key.

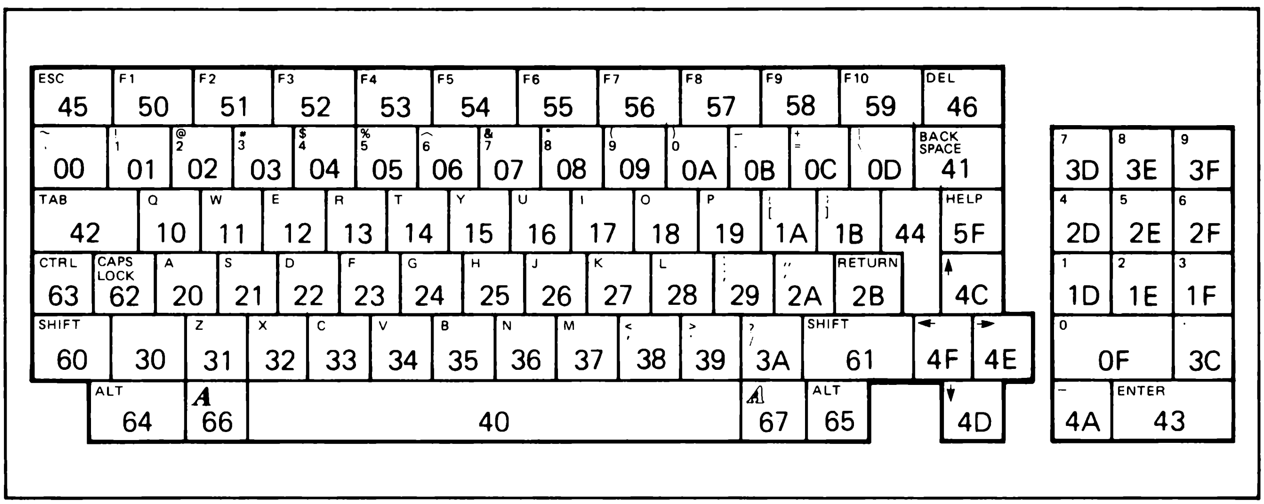

Figure 8-1: The Amiga Keyboard, Showing Keycodes in Hex

The default values given correspond to the values the console device will return when these keys are pressed and the keycaps as shipped with the standard American keyboard.

Table 8-6: System Default Console Key Mapping

Raw Key Number	Keycap Legend	Unshifted Default Value	Shifted Default Value
00	‘ ~	‘ (Accent grave)	~ (tilde)
01	1 !	1	!
02	2 @	2	@
03	3 #	3	#
04	4 $	4	$
05	5 %	5	%
06	6 ^	6	^
07	7 &	7	&
08	8 *	8	*
09	9 (	9	(
0A	0)	0	)
0B	- _	- (Hyphen)	_ (Underscore)
0C	= +	=	+
0D	\ |	\	|
0E		(undefined)	
0F	0	0	0 (Numeric pad)
10	Q	q	Q
11	W	w	W
12	E	e	E
13	R	r	R
14	T	t	T
15	Y	y	Y
16	U	u	U
17	I	i	I
18	O	o	O
19	P	p	P
1A	[{	[	{
1B	] }	]	}
1C		(undefined)	
1D	1	1	1 (Numeric pad)
1E	2	2	2 (Numeric pad)
1F	3	3	3 (Numeric pad)
20	A	a	A
21	S	s	S
22	D	d	D
23	F	f	F
24	G	g	G

Raw Key Number	Keycap Legend	Unshifted Default Value	Shifted Default Value
25	H	h	H
26	J	j	J
27	K	k	K
28	L	l	L
29	; :	;	:
2A	' "	' (single quote)	"
2B		(RESERVED)	(RESERVED)
2C		(undefined)	
2D	4	4	4 (Numeric pad)
2E	5	5	5 (Numeric pad)
2F	6	6	6 (Numeric pad)
30		(RESERVED)	(RESERVED)
31	Z	z	Z
32	X	x	X
33	C	c	C
34	V	v	V
35	B	b	B
36	N	n	N
37	M	m	M
38	, <	, (comma)	<
39	. >	. (period)	>
3A	/ ?	/	?
3B		(undefined)	
3C	.	.	. (Numeric pad)
3D	7	7	7 (Numeric pad)
3E	8	8	8 (Numeric pad)
3F	9	9	9 (Numeric pad)
40	(Space bar)	20	20
41	Back Space	08	08
42	Tab	09	09
43	Enter	0D	0D (Numeric pad)
44	Return	0D	0D
45	Esc	1B	1B
46	Del	7F	7F
47		(undefined)	
48		(undefined)	
49		(undefined)	
4A		-	- (Numeric Pad)
4B		(undefined)	

Raw Key Number	Keycap Legend	Unshifted Default Value	Shifted Default Value
4C	Up arrow	<CSI>A	<CSI>T
4D	Down arrow	<CSI>B	<CSI>S
4E	Forward arrow (note blank space after <CSI>)	<CSI>C	<CSI> A
4F	Backward arrow (note blank space after <CSI>)	<CSI>D	<CSI> @
50	F1	<CSI>0~	<CSI>10~
51	F2	<CSI>1~	<CSI>11~
52	F3	<CSI>2~	<CSI>12~
53	F4	<CSI>3~	<CSI>13~
54	F5	<CSI>4~	<CSI>14~
55	F6	<CSI>5~	<CSI>15~
56	F7	<CSI>6~	<CSI>16~
57	F8	<CSI>7~	<CSI>17~
58	F9	<CSI>8~	<CSI>18~
59	F10	<CSI>9~	<CSI>19~
5A		(undefined)	
5B		(undefined)	
5C		(undefined)	
5D		(undefined)	
5E		(undefined)	
5F	HELP	<CSI>?~	<CSI>?~

Raw Key Number	Function or Keycap Legend	
60	Shift (left of space bar)	
61	Shift (right of space bar)	
62	Caps Lock	
63	Ctrl	
64	(Left) Alt	
65	(Right) Alt	
66	Amiga (left of space bar)	Close Amiga
67	Amiga (right of space bar)	Open Amiga
68	Left mouse button (not converted)	Inputs are only for the mouse connected to Intuition, currently "gameport" one.
69	Right mouse button (not converted)	
6A	Middle mouse button (not converted)	
6B	(undefined)	
6C	(undefined)	
6D	(undefined)	
6E	(undefined)	
6F	(undefined)	

Raw Key Number	Function
70-7F	(undefined)
80-F8	Up transition (release or unpress key of one of the above keys) (80 for 00, F8 for 7F)
F9	Last keycode was bad (was sent in order to resynchronize)
FA	Keyboard buffer overflow
FB	(undefined, reserved for keyboard processor catastrophe)
FC	Keyboard selftest failed
FD	Power-up key stream start. Keys pressed or stuck at power-up will be sent between FD and FE.
FE	Power-up key stream end
FF	(undefined, reserved)
FF	Mouse event, movement only, no button change (not converted)

Notes about the preceding table:

1) "(undefined)" indicates that the current keyboard design should not generate this number. If you are using **SetKeyMap()** to change the key map, the entries for these numbers must still be included.

2) "(not converted)" refers to mouse button events. You must use the sequence "<CSI>2{" to inform the console driver that you wish to receive mouse events; otherwise these will not be transmitted.

3) "(RESERVED)" indicates that these keycodes have been reserved for non-US keyboards. The "2B" code key will be between the double-quote(") and Return keys. The "30" code key will be between the Shift and "Z" keys.

Keymapping

The Amiga has the capability of mapping the keyboard in any manner that you wish. In other computers, this capability is normally provided through the use of "keyboard enhancers." In the Amiga, however, the capability is already present and the vectors that control the remapping are user-accessible.

The functions called **AskKeyMap()** and **SetKeyMap()** each deal with a set of eight longword pointers, known as the **KeyMap** data structure. The **KeyMap** data structure is shown below.

```
struct KeyMap {
    UBYTE *km_LoKeyMapTypes;
    ULONG *km_LoKeyMap;
    UBYTE *km_LoCapsable;
    UBYTE *km_LoRepeatable;
    UBYTE *km_HiKeyMapTypes;
    ULONG *km_HiKeyMap;
    UBYTE *km_HiCapsable;
    UBYTE *km_HiRepeatable;
    };
```

The function **AskKeyMap()** shown below does not return a pointer to a table of pointers to currently assigned key mapping. Instead, it *copies* the current set of pointers to a user-designated area of memory. **AskKeyMap()** returns a TRUE/FALSE value that says whether or not the function succeeded.

The function **SetKeyMap()**, also shown below, copies the designated key map data structure to the console device. Thus this routine is complementary to **AskKeymap()** in that it can restore an original key mapping as well as establish a new one.

```
/* this include file is needed as well as
 * other normal console includes */

#include "devices/keymap.h"

int AskKeyMap(request,keymap)
    struct IOStdReq *request;
    struct KeyMap *keymap;
{
    int i;
    request->io_Command = CD_ASKKEYMAP;
    request->io_Length = sizeof(struct KeyMap);
    request->io_Data = keymap;/* where to put it */
    DoIO(request);
    i = request->io_Error;
    if(i) return(FALSE);
    else  return(TRUE);/* if no error, it worked. */
}
```

```
int SetKeyMap(request,keymap)
     struct IOStdReq *request;
     struct KeyMap *keymap;
{
     int i;
     request->io_Command = CD_SETKEYMAP;
     request->io_Length = sizeof(struct KeyMap);
     request->io_Data = keymap;     /* where to get it */
     DoIO(request);
     i = request->io_Error;
     if(i) return(FALSE);
     else  return(TRUE);     /* if no error, it worked. */
}
```

As a prelude to the following material, note that the Amiga keyboard transmits raw key information to the computer in the form of a key position and a transition. Figure 8-1 shows a physical layout of the keys and the hexadecimal number that is transmitted to the system when a key is pressed. When the key is released, its value, plus hexadecimal 80, is transmitted to the computer. The key mapping described herein refers to the translation from this raw key transmission into console device output to the user.

The low key map provides translation of the key values from hex 00-3F; the high key map provides translation of key values from hex 40-67. Raw output from the keyboard for the low key map does not include the space bar, Tab, Alt, Ctrl, arrow keys, and several other keys (see figure 8-2 and table 8-7).

```
00  01  02  03  04  05  06  07  08  09  0A  0B  0C  0D    3D  3E  3F
      10  11  12  13  14  15  16  17  18  19  1A  1B      2D  2E  2F
       20  21  22  23  24  25  26  27  28  29  2A         1D  1E  1F
         31  32  33  34  35  36  37  38  39  3A           0F      3C

`~  1!  2@  3#  4$  5%  6^  7&  8*  9(  0)  -_  =+  \|     7   8   9
      qQ  wW  eE  rR  tT  yY  uU  iI  oO  pP  [{  ]}       4   5   6
       aA  sS  dD  fF  gG  hH  jJ  kK  lL  ;:  '"          1   2   3
         zZ  xX  cC  vV  bB  nN  mM  ,<  .>  /?           0       .
```

Figure 8-2: Low Key Map Translation Table

Table 8-7: High Key Map Hex Values

Key Number	Function or Keycap Legend
40	Space
41	Backspace
42	Tab
43	Enter
44	Return
45	Escape
46	Delete
4A	Numeric Pad - character
4C	Cursor Up
4D	Cursor Down
4E	Cursor Forward
4F	Cursor Backward
50-59	Function keys F1-F10
5F	Help
60	Left Shift
61	Right Shift
62	Caps Lock
63	Control
64	Left Alt
65	Right Alt
66	Left Amiga
67	Right Amiga

The keymap table for the low and high keymaps consists of 4-byte entries, one per hex keycode. These entries are interpreted in one of two possible ways:

- As four separate bytes, specifying how the key is to be interpreted when pressed alone, with one qualifier, with another qualifier, or with both qualifiers (where a qualifier is one of three possible keys: Ctrl, Alt, or Shift).

- As a longword containing the address of a string descriptor, where a string of hex digits is to be output when this key is pressed. If a string is to be output, any combination of qualifiers may affect the string that may be transmitted.

Note: The keymap table *must* begin aligned on a word boundary. Each entry is four bytes long, thereby maintaining word alignment throughout the table. This is necessary because some of the entries may be longword addresses and *must* be aligned properly for the 68000.

ABOUT QUALIFIERS

As you may have noticed, there are three possible qualifiers, but only a 4-byte space in the table for each key. This does not allow space to describe what the computer should output for all possible combinations of qualifiers. This problem is solved by only allowing all three qualifiers to affect the output at the same time in string mode. Here is how that works.

For "vanilla" keys, such as the alphabetic keys, use the 4 bytes to represent the data output for the key alone, Shifted key, Alt'ed key, and Shifted-and-Alt'ed key. Then for the Ctrl-key-plus-vanilla-key, use the code for the key alone with bits 6 and 5 set to 0.

For other keys, such as the Return key or Esc key, the qualifiers specified in the keytypes table (up to two) are the qualifiers used to establish the response to the key. This is done as follows. In the keytypes table, the values listed for the key types are those listed for the qualifiers in *devices/keymap.h* and *devices/keymap.i*. Specifically, these qualifier equates are:

KC_NOQUAL	0x00
KCF_SHIFT	0x01
KCF_ALT	0x02
KCF_CONTROL	0x04
KC_VANILLA	0x07
KCF_DOWNUP	0x08
KCF_STRING	0x40

As shown above, the qualifiers for the various types of keys occupy specific bit positions in the key types control byte.

In assembly code, a keymap table entry looks like this:

```
SOME_KEY:
    DC.B    VALUE_1, VALUE_2, VALUE_3, VALUE_4
```

Table 8-8 shows how to interpret the keymap for various combinations of the qualifier bits.

Table 8-8: Keymap Qualifier Bits

If Keytype is:	Then value in this position in the keytable is output when the key is pressed along with:			
KC_NOQUAL	-	-	-	alone
KCF_SHIFT	-	-	Shift	alone
KCF_ALT	-	-	Alt	alone
KCF_CONTROL	-	-	Ctrl	alone
KCF_ALT+KCF_SHIFT	Shift+Alt	Alt	Shift	alone
KCF_CONTROL+KCF_ALT	Ctrl+Alt	Ctrl	Alt	alone
KCF_CONTROL+KCF_SHIFT	Ctrl+Shift	Ctrl	Shift	alone
KC_VANILLA	Shift+Alt	Alt	Shift	alone*

* Special case—Ctrl key, when pressed with one of the alphabet keys and certain others, is to output key-alone value with the bits 6 and 5 set to zero.

KEYTYPE TABLE ENTRIES

The vectors named km_LoKeyTypes and km_HiKeyTypes contain one byte per raw key code. This byte defines the entry type that is made in the key table by a set of bit positions.

Possible key types are:

- Any of the qualifier groupings noted above

- KCF_STRING + any combination of KCF_SHIFT, KCF_ALT, KCF_CONTROL (or KC_NOQUAL) if the result of pressing the key is to be a stream of bytes (and key-with-one-or-more-qualifiers is to be one or more alternate streams of bytes).

  Any key can be made to output up to eight unique byte streams if KCF_STRING is set in its keytype. The only limitation is that the total length of all of the strings assigned to a key be within the "jump range" of a single byte increment. See the "String-Output Keys" section below for more information.

The low keytype table covers the raw keycodes from hex 00-3F and contains one byte per keycode. Therefore this table contains 64 (decimal) bytes. The high keytype table covers the raw keycodes from hex 40-67 and contains 38 (decimal) bytes.

STRING-OUTPUT KEYS

When a key is to output a string, the keymap table contains the address of a string descriptor in place of a 4-byte mapping of a key as shown above. Here is a partial table for a new high key map table that contains only three entries thus far. The first two are for the space bar and the backspace key; the third is for the tab key, which is to output a string that says "[TAB]." An alternate string, "[SHIFTED-TAB]," is also to be output when a shifted TAB key is pressed.

```
newHiMapTypes:
    DC.B        KCF_ALT,KC_NOQUAL,
    DC.B        KCF_STRING+KCF_SHIFT,
                ...                          ;(more)

newHiMap:
    DC.B        0,0,$A0,$20                  ;space bar, and Alt-space bar
    DC.B        0,0,0,$08                    ;Back Space key only
    DC.L        newkey42                     ;new definition for string to
                                             ;output for Tab key
                ...                          ;(more)
newkey42:
    DC.B        new42ue - new42us            ;length of the
                                             ;unshifted string
    DC.B        new42us - newkey42
                                             ;number of bytes from start of
                                             ;string descriptor to start of
                                             ;this string
    DC.B        new42se - new42ss
                                             ;length of the shifted string
    DC.B        new42ss - newkey42
                                             ;number of bytes from start of
                                             ;string descriptor to start of
                                             ;this string

new42us:
    DC.B        '[TAB]'
new42ue:
new42ss:
    DC.B        '[SHIFTED-TAB]'
new42se:
```

The new high map table points to the string descriptor at address newkey42. The new high map types table says that there is one qualifier, which means that there are two strings in the key string descriptor.

Each string in the descriptor takes two bytes in this part of the table: the first byte is the length of the string, and the second byte is the distance from the start of the descriptor to the start of the string. Therefore, a single string (KCF_STRING + KC_NOQUAL) takes 2 bytes of string descriptor. If there is one qualifier, 4 bytes of descriptor are used. If there are two qualifiers, 8 bytes of descriptor are used. If there are 3 qualifiers, 16 bytes of descriptor are used. All strings start immediately following the string descriptor in that they are accessed as single-byte offsets from the start of the descriptor itself. Therefore, the distance from the start of the descriptor to the last string in the set (the one that uses the entire set of specified qualifiers) must start within 255 bytes of the descriptor address.

Because the length of the string is contained in a single byte, the length of any single string must be 255 bytes or less while also meeting the "reach" requirement. However, the console input buffer size limits the string output from any individual key to 32 bytes maximum.

The length of a keymap containing string descriptors and strings is variable and depends on the number and size of the strings that you provide.

CAPSABLE BIT TABLE

The vectors called km_LoCapsable and km_HiCapsable point to the first byte in an 8-byte table that contains more information about the keytable entries. Specifically, if the Caps Lock key has been pressed (the Caps Lock LED is on) and if there is a bit *on* in that position in the capsable map, then this key will be treated as though the Shift key is now currently pressed. For example, in the default key mapping, the alphabetic keys are "capsable" but the punctuation keys are not. This allows you to set the Caps Lock key, just as on a normal typewriter, and get all capital letters. However, unlike a normal typewriter, you need not go out of Caps Lock to correctly type the punctuation symbols or numeric keys.

In the table, the bits that control this feature are numbered from the lowest bit in the byte, and from the lowest memory byte address to the highest. For example, the bit representing capsable status for the key that transmits raw code 00 is bit 0 in byte 0; for the key that transmits raw code 08 it is bit 0 in byte 1, and so on.

There are 64 bits (8-bytes) in each of the two capsable tables.

REPEATABLE BIT TABLE

For both the low and high key maps there is an 8-byte table that provides one bit per possible raw key code. This bit indicates whether or not the specified key should repeat at the rate set by the Preferences program. The bit positions correspond to those specified in the capsable bit table.

If there is a 1 in a specific position, the key can repeat. The vectors that point to these tables are called km_LoRepeatable and km_HiRepeatable.

DEFAULT LOW KEY MAP

In the default low key map, all of the keys are treated in the same manner:

- When pressed alone, they transmit the ASCII equivalent of the unshifted key.
- When Shifted, they translate the ASCII equivalent of the shifted value when printed on the keycap.
- When "Alt'ed" (pressed along with an Alt key), they transmit the alone-value with the high bit of a byte set (value plus hex 80).
- When Shifted and Alt'ed, they transmit the shifted-value plus hex 80.

In this table, the bytes that describe the data to be transmitted are positioned as the example for the "A" key shown here:

```
key_A   DC.B   ('A')+$80   ;Shifted and Alt'ed
        DC.B   ('a')+$80   ;Alt'ed only
        DC.B   ('A')       ;Shifted only
        DC.B   ('a')       ;not Shifted or Alt'ed
```

In addition to the response to the key alone, Shifted, Alt'ed, and Shifted-and-Alt'ed, the default low keymap also responds to the key combination of "Ctrl + key" by stripping off bits 6 and 5 of the generated data byte. For example, Ctrl + A generates the translated keycode 01 (61 with bits 6 and 5 set to 0).

All keys in the low key map are mapped to their ASCII equivalents, as noted in the low key map key table shown above.

Because the low key table contains 4 bytes per key, and describes the keys (raw codes) from hex 00-3F, there are 64 times 4 or 256 bytes in this table.

DEFAULT HIGH KEY MAP

Most of the keys in the high key map generate strings rather than single-character mapping. The following keys map characters with no qualifier, along with their byte mapping:

Key	Generates Value:
BACKSP	\$08
ENTER	\$0D
DEL	\$7F

The following keys map characters and use a single qualifier:

Key	Generates Value:	If Used with Qualifier, Generates Value:
SPACE	\$20	\$A0 (qualifier = ALT)
RETURN	\$0D	\$0A (qualifier = CONTROL)
ESC	\$1B	\$9B (qualifier = ALT)
numeric pad "-"	\$2D	\$FF (qualifier = ALT)

The following keys generate strings:

Key	Generates Value:	If Used with <SHIFT>, generates Value:
TAB	$09	$9B, followed by ’Z’
cursor:		
UP	$9B, followed by ’A’	$9B, followed by ’T’
DOWN	$9B, followed by ’B’	$9B, followed by ’S’
FWD	$9B, followed by ’C’	$9B, followed by ’ ’, followed by ’@’
BACKWD	$9B, followed by ’D’	$9B, followed by ’ ’, followed by ’A’
function keys:		
F1	$9B, followed by ’0~ ’	$9B, followed by ’10~ ’
F2	$9B, followed by ’1~ ’	$9B, followed by ’11~ ’
F3	$9B, followed by ’2~ ’	$9B, followed by ’12~ ’
F4	$9B, followed by ’3~ ’	$9B, followed by ’13~ ’
F5	$9B, followed by ’4~ ’	$9B, followed by ’14~ ’
F6	$9B, followed by ’5~ ’	$9B, followed by ’15~ ’
F7	$9B, followed by ’6~ ’	$9B, followed by ’16~ ’
F8	$9B, followed by ’7~ ’	$9B, followed by ’17~ ’
F9	$9B, followed by ’8~ ’	$9B, followed by ’18~ ’
F10	$9B, followed by ’9~ ’	$9B, followed by ’19~ ’
HELP	$9B, followed by ’?~ ’	(no qualifier used)

Closing a Console Device

When you have finished using a console, it must be closed so that the memory areas it utilized may be returned to the system memory manager. Here is a sequence that you can use to close a console device:

CloseDevice(requestBlock);

Note that you should also delete the messages and ports associated with this console after the console has been closed:

DeleteStdIO(consoleWriteMsg);
DeleteStdIO(consoleReadMsg);
DeletePort(consoleWritePort);
DeletePort(consoleReadPort);

If you have finished with the window used for the console device, you can now close it.

Example Program

The following is a console device demonstration program with supporting macro routines.

```
/* cons.c */

/* This program is supported by the Amiga C compiler, version 1.1 and beyond.
 * (v1.0 compiler has difficulties if string variables do not have their initial
 * character aligned on a longword boundary.  Compiles acceptably but won't run
 * correctly.)
 */

#include "exec/types.h"
#include "exec/io.h"
#include "exec/memory.h"

#include "graphics/gfx.h"
#include "hardware/dmabits.h"
#include "hardware/custom.h"
#include "hardware/blit.h"
#include "graphics/gfxmacros.h"
#include "graphics/copper.h"
#include "graphics/view.h"
#include "graphics/gels.h"
#include "graphics/regions.h"
#include "graphics/clip.h"
#include "exec/exec.h"
#include "graphics/text.h"
#include "graphics/gfxbase.h"

#include "devices/console.h"
#include "devices/keymap.h"

#include "libraries/dos.h"
```

```
#include "graphics/text.h"
#include "libraries/diskfont.h"
#include "intuition/intuition.h"

UBYTE escdata[] = { 0x9b, '@',  /* insert character */
            0x9b, 'A',          /* cursor up */
            0x9b, 'B',          /* cursor down */
            0x9b, 'C',          /* cursor left */
            0x9b, 'D',          /* cursor right */
            0x9b, 'E',          /* cursor next line */
            0x9b, 'F',          /* cursor prev line */
            0x9b, 'J',          /* erase to end of display */
            0x9b, 'K',          /* erase to end of line */
            0x9b, 'L',          /* insert line */
            0x9b, 'M',          /* delete line */
            0x9b, 'P',          /* delete character */
            0x9b, 'S',          /* scroll up */
            0x9b, 'T',          /* scroll down */
            0x1b, 'c',          /* reset to initial state */
            0x9b, 'q',          /* window status request */
            0x9b, 'n',          /* device status report */
            0x9b, ' ', 'p',     /* cursor on */
            0x9b, '0', ' ', 'p', /* cursor off */
            0x9b, '2', '0', 'h', /* set mode */
            0x9b, '2', '0', 'l', /* reset mode */
            };

    /* COVER A SELECTED SUBSET OF THE CONSOLE AVAILABLE FUNCTIONS */

#define INSERTCHARSTRING    &escdata[0]
#define CURSUPSTRING        &escdata[0+2]
#define CURSDOWNSTRING      &escdata[0+4]
#define CURSFWDSTRING       &escdata[0+6]
#define CURSBAKSTRING       &escdata[0+8]
#define CURSNEXTLINE        &escdata[0+10]
#define CURSPREVLINE        &escdata[0+12]
#define ERASEEODSTRING      &escdata[0+14]
#define ERASEEOLSTRING      &escdata[0+16]
#define INSERTLINESTRING    &escdata[0+18]
#define DELETELINESTRING    &escdata[0+20]
#define DELCHARSTRING       &escdata[0+22]
#define SCROLLUPSTRING      &escdata[0+24]
#define SCROLLDOWNSTRING    &escdata[0+26]
#define RESETINITSTRING     &escdata[0+28]
#define WINDOWSTATSTRING    &escdata[0+30]
```

```
#define DEVSTATSTRING          &escdata[0+32]
#define CURSONSTRING           &escdata[0+34]
#define CURSOFFSTRING          &escdata[0+37]
#define SETMODESTRING          &escdata[0+41]
#define RESETMODESTRING        &escdata[0+45]

#define BACKSPACE(r)           ConPutChar(r,0x08)
#define TAB(r)                 ConPutChar(r,0x09)
#define LINEFEED(r)            ConPutChar(r,0x0a)
#define VERTICALTAB(r)         ConPutChar(r,0x0b)
#define FORMFEED(r)            ConPutChar(r,0x0c)
#define CR(r)                  ConPutChar(r,0x0d)
#define SHIFTOUT(r)            ConPutChar(r,0x0e)
#define SHIFTIN(r)             ConPutChar(r,0x0f)
#define CLEARSCREEN(r)         ConPutChar(r,0x0c)

#define RESET(r)               ConWrite(r,RESETINITSTRING,2)
#define INSERT(r)              ConWrite(r,INSERTCHARSTRING,2)
#define CURSUP(r)              ConWrite(r,CURSUPSTRING,2)
#define CURSDOWN(r)            ConWrite(r,CURSDOWNSTRING,2)
#define CURSFWD(r)             ConWrite(r,CURSFWDSTRING,2)
#define CURSBAK(r)             ConWrite(r,CURSBAKSTRING,2)
#define CURSNEXTLN(r)          ConWrite(r,CURSNEXTLINE,2)
#define CURSPREVLN(r)          ConWrite(r,CURSPREVLINE,2)
#define ERASEEOD(r)            ConWrite(r,ERASEEODSTRING,2)
#define ERASEEOL(r)            ConWrite(r,ERASEEOLSTRING,2)
#define INSERTLINE(r)          ConWrite(r,INSERTLINESTRING,2)
#define DELETELINE(r)          ConWrite(r,DELETELINESTRING,2)
#define SCROLLUP(r)            ConWrite(r,SCROLLUPSTRING,2)
#define SCROLLDOWN(r)          ConWrite(r,SCROLLDOWNSTRING,2)
#define DEVICESTATUS(r)        ConWrite(r,DEVSTATSTRING,2)
#define WINDOWSTATUS(r)        ConWrite(r,WINDOWSTATSTRING,2)
#define DELCHAR(r)             ConWrite(r,DELCHARSTRING,2)
#define CURSORON(r)            ConWrite(r,CURSONSTRING,3)
#define CURSOROFF(r)           ConWrite(r,CURSOFFSTRING,4)
#define SETMODE(r)             ConWrite(r,SETMODESTRING,4)
#define RESETMODE(r)           ConWrite(r,RESETMODESTRING,4)

#define CloseConsole(r)        CloseDevice(r)

ULONG DosBase;
ULONG DiskfontBase;
ULONG IntuitionBase;
ULONG GfxBase;
```

```
struct NewWindow nw = {
        10, 10,         /* starting position (left,top) */
        620,90,         /* width, height */
        -1,-1,          /* detailpen, blockpen */
        0,              /* flags for idcmp */
        WINDOWDEPTH|WINDOWSIZING|WINDOWDRAG|SIMPLE_REFRESH
            |ACTIVATE|GIMMEZEROZERO,     /* window gadget flags */
        0,              /* pointer to 1st user gadget */
        NULL,           /* pointer to user check */
        "Console Test", /* title */
        NULL,           /* pointer to window screen */
        NULL,           /* pointer to super bitmap */
        100,45,         /* min width, height */
        640,200,   /* max width, height */
        WBENCHSCREEN};

struct Window *w;
struct RastPort *rp;

struct IOStdReq *consoleWriteMsg;     /* I/O request block pointer */
struct MsgPort *consoleWritePort;     /* a port at which to receive */
struct IOStdReq *consoleReadMsg;      /* I/O request block pointer */
struct MsgPort *consoleReadPort;      /* a port at which to receive */

extern struct MsgPort *CreatePort();
extern struct IOStdReq *CreateStdIO();

char readstring[200];  /* provides a buffer even though using only one char */

main()
{

        SHORT i;
        SHORT status;
        SHORT problem;
        SHORT error;
        problem = 0;

        if((DosBase = OpenLibrary("dos.library", 0)) == NULL)
              { problem = 1; goto cleanup1; }
        if((DiskfontBase=OpenLibrary("diskfont.library",0))==NULL)
              { problem = 2; goto cleanup2; }
        if((IntuitionBase=OpenLibrary("intuition.library",0))==NULL)
              { problem = 3; goto cleanup3; }
        if((GfxBase=OpenLibrary("graphics.library",0))==NULL)
```

```
        { problem = 4; goto cleanup4; }

    consoleWritePort = CreatePort("my.con.write",0);
    if(consoleWritePort == 0)
        { problem = 5; goto cleanup5; }
    consoleWriteMsg =  CreateStdIO(consoleWritePort);
    if(consoleWritePort == 0)
        { problem = 6; goto cleanup6; }

    consoleReadPort = CreatePort("my.con.read",0);
    if(consoleReadPort == 0)
        { problem = 7; goto cleanup7; }
    consoleReadMsg =  CreateStdIO(consoleReadPort);
    if(consoleReadPort == 0)
        { problem = 8; goto cleanup8; }

    w = (struct Window *)OpenWindow(&nw); /* create a window */
    if(w == NULL)
        { problem = 9; goto cleanup9; }

    rp = w->RPort;            /* establish its rastport for later */

/* ********************************************************************** */
/* NOW, Begin using the actual console macros defined above.              */
/* ********************************************************************** */

    error = OpenConsole(consoleWriteMsg,consoleReadMsg,w);
    if(error != 0)
        { problem = 10; goto cleanup10; }
        /* attach a console to this window, initialize
         * for both write and read */

    QueueRead(consoleReadMsg,&readstring[0]); /* tell console where to
                                               * put a character that
                                               * it wants to give me
                                               * and queue up first read */
    ConWrite(consoleWriteMsg,"Hello, World\r\n",14);

    ConPutStr(consoleWriteMsg,"testing BACKSPACE");
    for(i=0; i<10; i++)
        { BACKSPACE(consoleWriteMsg); Delay(30); }

    ConPutStr(consoleWriteMsg,"\r\n");

    ConPutStr(consoleWriteMsg,"testing TAB\r");
```

```
for(i=0; i<6; i++)
        { TAB(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing LINEFEED\r");
for(i=0; i<4; i++)
        { LINEFEED(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing VERTICALTAB\r");
for(i=0; i<4; i++)
        { VERTICALTAB(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing FORMFEED\r");
Delay(30);
for(i=0; i<2; i++)
        { FORMFEED(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing CR");
Delay(30);
CR(consoleWriteMsg);
Delay(60);
ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing INSERT\r");
for(i=0; i<4; i++)
        { INSERT(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"    testing DELCHAR\r");
CR(consoleWriteMsg);
for(i=0; i<4; i++)
        { DELCHAR(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing INSERTLINE\r");
CR(consoleWriteMsg);
```

```
for(i=0; i<3; i++)
        { INSERTLINE(consoleWriteMsg); Delay(30); }
ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing DELETELINE\r");
CR(consoleWriteMsg);
LINEFEED(consoleWriteMsg);
Delay(60);
for(i=0; i<4; i++)
        { DELETELINE(consoleWriteMsg); Delay(30); }
ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing CURSUP\r");
for(i=0; i<4; i++)
        { CURSUP(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing CURSDOWN\r");
for(i=0; i<4; i++)
        { CURSDOWN(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing CURSFWD\r");
for(i=0; i<4; i++)
        { CURSFWD(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing CURSBAK");
for(i=0; i<4; i++)
        { CURSBAK(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing CURSPREVLN");
for(i=0; i<4; i++)
        { CURSPREVLN(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing CURSNEXTLN");
for(i=0; i<4; i++)
        { CURSNEXTLN(consoleWriteMsg); Delay(30); }
```

```
ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing ERASEEOD");
CURSPREVLN(consoleWriteMsg);
CURSPREVLN(consoleWriteMsg);
CURSPREVLN(consoleWriteMsg);
Delay(60);
for(i=0; i<4; i++)
      { ERASEEOD(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing ERASEEOL.junk");
CURSBAK(consoleWriteMsg);
CURSBAK(consoleWriteMsg);
CURSBAK(consoleWriteMsg);
CURSBAK(consoleWriteMsg);
CURSBAK(consoleWriteMsg);
Delay(60);
ERASEEOL(consoleWriteMsg);
Delay(30);
ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing SCROLLUP");
for(i=0; i<4; i++)
      { SCROLLUP(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");
ConPutStr(consoleWriteMsg,"testing SCROLLDOWN");
ConPutStr(consoleWriteMsg,"\n\n\n");
for(i=0; i<4; i++)
      { SCROLLDOWN(consoleWriteMsg); Delay(30); }

ConPutStr(consoleWriteMsg,"\r\n");

ConPutStr(consoleWriteMsg,"testing CURSOROFF");
CURSOROFF(consoleWriteMsg);
ConPutStr(consoleWriteMsg, "printed.with.cursor.off");
Delay(60);
ConPutStr(consoleWriteMsg,"\r\n");

CURSORON(consoleWriteMsg); Delay(30);
ConPutStr(consoleWriteMsg,"testing CURSORON");
```

```
/* ********************************************************************* */
    Delay(120);/* wait 2 seconds (120/60 ticks) */

    status = CheckIO(consoleReadMsg);    /* see if console read
                                          * anything, abort if not */
    if(status == FALSE) AbortIO(consoleReadMsg);
    WaitPort(consoleReadPort);       /* wait for abort to complete */
    GetMsg(consoleReadPort);         /* and strip message from port */

    CloseConsole(consoleWriteMsg);
  cleanup10:
  cleanup9:
    CloseWindow(w);
  cleanup8:
    DeleteStdIO(consoleReadMsg);
  cleanup7:
    DeletePort(consoleReadPort);
  cleanup6:
    DeleteStdIO(consoleWriteMsg);
  cleanup5:
    DeletePort(consoleWritePort);
  cleanup4:
    CloseLibrary(GfxBase);
  cleanup3:
    CloseLibrary(IntuitionBase);
  cleanup2:
    CloseLibrary(DiskfontBase);
  cleanup1:
    CloseLibrary(DosBase);
    if(problem > 0) exit(problem+1000);
    else
        return(0);

}     /* end of main() */


/* Open a console device */

    /* this function returns a value of 0 if the console
     * device opened correctly and a nonzero value (the error
     * returned from OpenDevice) if there was an error.
     */

    int
OpenConsole(writerequest,readrequest,window)
```

```
    struct IOStdReq *writerequest;
    struct IOStdReq *readrequest;
    struct Window *window;
    {
        int error;
        writerequest->io_Data = (APTR) window;
        writerequest->io_Length = sizeof(*window);
        error = OpenDevice("console.device", 0, writerequest, 0);
        readrequest->io_Device = writerequest->io_Device;
        readrequest->io_Unit   = writerequest->io_Unit;
            /* clone required parts of the request */
        return(error);
    }

/* Output a single character to a specified console */

    int
ConPutChar(request,character)
    struct IOStdReq *request;
    char character;
    {
        request->io_Command = CMD_WRITE;
        request->io_Data = (APTR)&character;
        request->io_Length = 1;
        DoIO(request);
        /* command works because DoIO blocks until command is
         * done (otherwise pointer to the character could become
         * invalid in the meantime).
         */
        return(0);
    }

/* Output a stream of known length to a console */

    int
ConWrite(request,string,length)
    struct IOStdReq *request;
    char *string;
    int length;
    {
        request->io_Command = CMD_WRITE;
        request->io_Data = (APTR)string;
        request->io_Length = length;
        DoIO(request);
        /* command works because DoIO blocks until command is
```

```
         * done (otherwise pointer to string could become
         * invalid in the meantime).
         */
        return(0);
    }

/* Output a NULL-terminated string of characters to a console */

    int
ConPutStr(request,string)
    struct IOStdReq *request;
    char *string;
    {
        request->io_Command = CMD_WRITE;
        request->io_Data = (APTR)string;
        request->io_Length = -1;  /* tells console to end when it sees
                                   * a terminating zero on the string. */
        DoIO(request);
        return(0);
    }

    /* queue up a read request to a console, show where to put the
     * character when ready to be returned.  Most efficient if this is
     * called right after console is opened */

    int
QueueRead(request,whereto)
    struct IOStdReq *request;
    char *whereto;
    {
        request->io_Command = CMD_READ;
        request->io_Data = (APTR)whereto;
        request->io_Length = 1;
        SendIO(request);
        return(0);
    }

    /* see if there is a character to read.  If none, don't wait,
     * come back with a value of -1 */

    int
ConMayGetChar(request,requestPort, whereto)
    struct IOStdReq *request;
    char *whereto;
    {
```

```
        register temp;

        if ( GetMsg(requestPort) == NULL ) return(-1);
        temp = *whereto;
        QueueRead(request,whereto);
        return(temp);
    }

    /* go and get a character; put the task to sleep if
     * there isn't one present */

    UBYTE
ConGetChar(consolePort,request,whereto)
    struct IOStdReq *request;
    struct MsgPort *consolePort;
    char *whereto;
    {
        register UBYTE temp;
        while((GetMsg(consolePort) == NULL)) WaitPort(consolePort);
        temp = *whereto;     /* get the character */
        QueueRead(request,whereto);
        return(temp);
    }
```

Chapter 9

Input Device

This chapter describes the Amiga input device, which is a combination of three other devices: keyboard device, gameport device, and timer device. The input device merges separate input event streams from the keyboard, mouse, and timer into a single stream. This single stream can then be interpreted by the prioritized linked list of input handlers that are watching the input stream.

Note that two additional messages can appear in the input stream: "disk inserted" and "disk removed." These messages come from AmigaDOS and are sent to the input device for further propagation.

Introduction

The input device is automatically opened by AmigaDOS by any call to open the console device. When the input device is opened, a task, appropriately named "input.device", is started. The input device task communicates directly with the keyboard device to obtain raw key inputs. It also communicates with the gameport device to obtain mouse button and mouse movement events and with the timer device to obtain time events. In addition to these event streams, you can also directly input an event to the input device, to be fed to the handler chain. This topic is also covered below.

The keyboard device is also accessible directly (see chapter 10). However, while the input device task is operating, that task attempts to retrieve all incoming keyboard events and add them to the input stream.

The gameport device has two units. As you view the Amiga, looking at the gameport connectors, connector "1" is assigned as the primary mouse input for Intuition and contributes gameport input events to the input event stream. Connector "2" is handled by the other gameport unit and is currently unassigned. Each unit of the gameport device is an exclusive access object, in that you can specify what type of controller is attached. It is then assumed that only one task is sending requests for input from that unit. While the input device task is running, that task expects to read the input from connector 1. Direct use of the gameport device is covered in a separate chapter of this manual.

The timer device provides time events for the input device. It also provides time interval reports for controlling key repeat rate and key repeat threshold. The timer device is a shared-access device and is described in its own separate chapter.

Input Device Commands

The input device allows the following system functions:

Command	**Operation**
OpenDevice()	Obtain shared use of the input device
CloseDevice()	Relinquish use of the input device
DoIO()	Initiate a command, and wait for it to complete
SendIO()	Initiate a command, and return immediately
AbortIO()	Abort a command already in the queue

Only the Start, Stop, Invalid, and Flush commands have been implemented for this device. All other commands are no-operations.

The input device also supports the device-specific commands shown in table 9-1.

Table 9-1: Input Device Commands

I/O Command	Operation
IND_WRITEEVENT	Propagate an input event stream to all devices
IND_ADDHANDLER	Add an input-stream handler into the handler chain
IND_REMHANDLER	Remove an input-stream handler from the handler chain
IND_SETTHRESH	Set the repeating key hold-down time before repeat starts
IND_SETPERIOD	Set the period at which a repeating key repeats.
IND_SETMPORT	Set the gameport port to which the mouse is connected
IND_SETMTRIG	Read conditions that must be met by a mouse before a pending read request will be satisfied
IND_SETMTYPE	Set the type of device at the mouse port

The device-specific commands outlined above are described in the following paragraphs. A description of the contents of an input event is given first because the input device deals in input events. An input event is a data structure that describes the following:

- The class of the event—often describes the device that generated the event
- The subclass of the event—space for more information if needed
- The code—keycode if keyboard, button information if mouse, others
- A qualifier such as "Alt key also down," "key repeat active"
- A position field that contains a data address or a mouse position count
- A time stamp, showing the sequence in which events have occurred
- A link-field by which input events are linked together

The various types of input events are listed in the include file *devices/inputevent.h*. That information is not repeated here. You can find more information about input events in the chapters titled "Gameport Device" and "Console Device."

There is a difference between simply receiving an input event from a device (gameport, keyboard, or console) and actually becoming a handler of an input event stream. A handler is a routine that is passed an input event, and it is up to the handler to decide if it can process the input event. If the handler does not recognize the event, it passes the address of the event as a return value.

Because of the input event field called **ie_NextEvent**, it is possible for the input event to be a pointer to the first event in a linked list of events to be handled. Thus, the handler should be designed to handle multiple events if such a link is used. Note that handlers can themselves generate new linked lists of events which can be passed down to lower priority handlers.

IND_ADDHANDLER COMMAND

You add a handler to the chain using the command IND_ADDHANDLER. Assuming that you have a properly initialized an **IOStdReq** block as a result of a call to **OpenDevice()** (for the input device), here is a typical C-language call to the IND_ADDHANDLER function:

```
struct Interrupt handlerStuff;
handlerStuff.is_Data = &hsData;
            /* address of its data area */
handlerStuff.is_Code = myhandler;
            /* address of entry point to handler */
handlerStuff.is_Node.ln_Pri = 51;
            /* set the priority one step higher than Intuition, so that our
             * handler enters the chain ahead of Intuition.
             */
inputRequestBlock.io_Command = IND_ADDHANDLER;
inputRequestBlock.io_Data = &handlerStuff;

DoIO(&inputRequestBlock);
```

Notice from the above that Intuition is one of the input device handlers and normally distributes all of the input events. Intuition inserts itself at priority position 50. You can choose the position in the chain at which your handler will be inserted by setting the priority field in the list-node part of the interrupt data structure you are feeding to this routine.

Note also that *any* processing time expended by a handler subtracts from the time available before the next event happens. Therefore, handlers for the input stream must be fast.

Rules for Input Device Handlers

The following rules should be followed when you are designing an input handler:

- If an input handler is capable of processing a specific kind of an input event and that event has no links (**ie_NextEvent** = 0), the handler can end the handler chain by returning a NULL (0) value.

- If there are multiple events linked together, the handler is free to delink an event from the input event chain, thereby passing a shorter list of events to subsequent handlers. The starting address of the modified list is the return value.

- If a handler wishes to add new events to the chain that it passes to a lower-priority handler, it may initialize memory to contain the new event or event chain. The handler, when it again gets control on the next round of event handling, should assume nothing about the current contents of the memory blocks it attached to the event chain. Lower priority handlers may have modified the memory as they handled their part of the event. The handler that allocates the memory for this purpose should keep track of the starting address and the size of this memory chunk so that the memory can be returned to the free memory list when it is no longer needed.

Your routine should be structured so that it can be called as though from the following C-language statement:

newEventChain = yourHandlerCode(oldEventChain, yourHandlerData);

where

- **yourHandlerCode** is the entry point to your routine

- **oldEventChain** is the starting address for the current chain of input events

- **newEventChain** is the starting address of an event chain which you are passing to the next handler, if any

A NULL (0) value terminates the handling.

Memory that you use to describe a new input event that you have added to the event chain is available for reuse or deallocation when the handler is called again or after the IND_REMHANDLER command for the handler is complete.

Because IND_ADDHANDLER installs a handler in any position in the handler chain, it can, for example, ignore specific types of input events as well as act upon and modify existing streams of input. It can even create new input events for Intuition or other programs to interpret.

IND_REMHANDLER COMMAND

You remove a handler from the handler chain with the command IND_REMHANDLER. Assuming that you have a properly initialized **IOStdReq** block as a result of a call to **OpenDevice()** (for the input device) and you have already added the handler using IND_ADDHANDLER, here is a typical C-language call to the IND_REMHANDLER function:

```
inputRequestBlock.io_Command = IND_REMHANDLER;
inputRequestBlock.io_Data = &handlerStuff;
     /* tell it which one to remove */
DoIO(&inputRequestBlock);
```

IND_WRITEEVENT COMMAND

As noted in the overview of this chapter, input events are normally generated by the timer device, keyboard device or gameport device. A user can also generate an input event and send it to the input device. It will then be treated as any other event and passed through to the input handler chain. You can create your own stream of events and then send them to the input device using the IND_WRITEEVENT command. Here is an example, assuming a correctly initialized **input_request_block**. The example sends in a single event, which is a phony mouse-movement:

```
struct InputEvent phony;

input_request_block.io_Command = IND_WRITEEVENT;
input_request_block.io_Flags = 0;
input_request_block.io_Length = sizeof(struct InputEvent);
input_request_block.io_Data = &phony;

phony.ie_NextEvent = NULL;      /* only one */
phony.ie_Class = IECLASS_RAWMOUSE;
phony.ie_TimeStamp.tv_secs = 0;
phony.ie_TimeStamp.tv_micro = 0;
phony.ie_Code = IECODE_NOBUTTON;
phony.ie_Qualifier = IEQUALIFIER_RELATIVEMOUSE;
phony.ie_X = 10;
phony.ie_Y = 5;
     /* mouse didn't move, but program made system think that it did. */
DoIO(&input_request_block);
```

Note: This command adds the input event to the end of the current event stream. The system links other events onto the end of this event, thus modifying the contents of the data structure you constructed in the first place.

IND_SETTHRESH COMMAND

This command sets the timing in seconds and microseconds for the input device to indicate how long a user must hold down a key before it begins to repeat. This command is normally performed by the Preferences tool or by Intuition when it notices that the Preferences have been changed. If you wish, you can call this function. The following typical sequence assumes that you have already correctly initialized the request block by opening the input device. Only the fields shown here need be initialized.

```
struct InputEvent thresh_event;

input_request_block.io_Command = IND_SETTHRESH;
input_request_block.io_Flags = 0;
input_request_block.io_Data = &thresh_event;

thresh_event.ie_NextEvent = 0;
thresh_event.ie_TimeStamp.tv_secs = 1;      /* one second */
thresh_event.ie_TimeStamp.tv_micro = 500000;
            /* 500,000 microseconds = 1/2 second */
DoIO(&input_request_block);
```

IND_SETPERIOD COMMAND

This command sets the time period between key repeat events once the initial period threshold has elapsed. Again, it is a command normally issued by Intuition and preset by the Preferences tool. A typical calling sequence is as shown above; change the command number and the timing period values to suit your application.

Input Device and Intuition

There are several ways to receive information from the various devices that are part of the input device. The first way is to communicate directly with the device. This way is, as specified above, occasionally undesirable (while the input device task is running). The second way is to become a handler for the stream of events which the input device produces. That method is also shown above.

The third method of getting input from the input device is to retrieve the data from the console device or from the IDCMP (Intuition Direct Communications Message Port).

If you choose this third method, you should be aware of what happens to input events if your task chooses not to respond to them. If there is no active window and no active console, then input events (keystrokes or left-button mouse clicks usually) will simply be ignored. If, however, there is an active window (yours), and you choose to simply let the messages pile up without responding to them as quickly as possible, here is what happens:

- Another event occurs. If the system has no empty message that it can fill in to report this new event, then memory is dynamically allocated to hold this new information and the new message is transmitted to the message port for the task.

- When the task finally responds to the message, the allocated memory is not returned to the system until the window is closed. Therefore, a task that chooses not to respond to its incoming messages for a long period of time can potentially remove a great deal of memory from the system free-memory list, making that memory space unavailable to this or other tasks until this task is completed.

Thus it is always a good idea to respond to input messages as quickly as possible to maximize the amount of free memory in the system while your task is running.

Sample Program

```
/* Sample program for adding an input handler to the input stream
 * Note that compiling this program native on the Amiga requires
 * a separate compile for this program, a separate assembly for the
 * handler.interface.asm, and a separate alink phase. Alink will
 * be used to tie together the object files produced by the separate
 * language phases. If compiling under Amiga C, disable stack checking
 * code in pass 2 of the compiler ( e.g.,  lc2 -v filename.q).
 *
 * Linking information:
 *   inputdev.with:
 *
 *   FROM lib:Lstartup.obj,inputdev.o, input.timerstuff.o, handler.interface.o
 *   TO inputdev
 *   LIBRARY lib:lc.lib, lib:amiga.lib
 */

#include <exec/types.h>
#include <exec/ports.h>
#include <exec/memory.h>
#include <exec/io.h>
#include <exec/tasks.h>
```

```
#include <exec/interrupts.h>
#include <devices/input.h>
#include <exec/devices.h>
#include <devices/inputevent.h>

#define F1KEYUP 0xD0
struct InputEvent copyevent;      /* local copy of the event */
                         /* assumes never has a next.event attached */
struct MsgPort *inputDevPort;
struct IOStdReq *inputRequestBlock;
struct Interrupt handlerStuff;

struct InputEvent dummyEvent;

extern struct MsgPort *CreatePort();
extern struct IOStdReq *CreateStdIO();

struct MemEntry me[10];

      /* If we want the input handler itself to add anything to the
       * input stream, we will have to keep track of any dynamically
       * allocated memory so that we can later return it to the system.
       * Other handlers can break any internal links the handler puts
       * in before it passes the input events.
       */

struct InputEvent
*myhandler(ev, mydata)
      struct InputEvent *ev;/* and a pointer to a list of events */
      struct MemEntry *mydata[];
      /* system will pass me a pointer to my own data space.  */
{
      /* Demo version of program simply reports input events as
       * its sees them; passes them on unchanged.  Also, if there
       * is a linked chain of input events, reports only the lead
       * one in the chain, for simplicity.
       */
      if(ev->ie_Class == IECLASS_TIMER)
      {
            return(ev);
      }
      /* don't try to print timer events!!! they come every 1/10th sec. */
      else
      {
            Forbid();  /* don't allow a mix of events to be reported */
```

```
        copyevent.ie_Class = ev->ie_Class;
        copyevent.ie_SubClass = ev->ie_SubClass;
        copyevent.ie_Code =  ev->ie_Code;
        copyevent.ie_Qualifier = ev->ie_Qualifier;
        copyevent.ie_X = ev->ie_X;
        copyevent.ie_Y = ev->ie_Y;
        copyevent.ie_TimeStamp.tv_secs = ev->ie_TimeStamp.tv_secs;
        copyevent.ie_TimeStamp.tv_micro = ev->ie_TimeStamp.tv_micro;
        Permit();
    }

    /* There will be lots of events coming through here;
     * rather than make the system slow down because something
     * is busy printing the previous event, let's just print what
     * we find is current, and if we miss a few, so be it.
     *
     * Normally this loop would "handle" the event or perhaps
     * add a new one to the stream. (At this level, the only
     * events you should really be adding are mouse, rawkey or timer,
     * because you are ahead of the intuition interpreter.)
     * No printing is done in this loop (lets main() do it) because
     * printf can't be done by anything less than a 'process'
     */
    return(ev);
    /* pass on the pointer to the event (most handlers would
     * pass on a pointer to a changed or an unchanged stream)
     * (we are simply reporting what is seen, not trying to
     * modify it in any way) */
}

/* NOTICE: THIS PROGRAM LINKS ITSELF INTO THE INPUT STREAM AHEAD OF
 * INTUITION. THEREFORE THE ONLY INPUT EVENTS THAT IT WILL SEE AT
 * ALL ARE TIMER, KEYBOARD AND GAMEPORT. AS NOTED IN THE PROGRAM,
 * THE TIMER EVENTS ARE IGNORED DELIBERATELY */

extern struct Task *FindTask();
struct Task *mytask;
LONG mysignal;
extern VOID HandlerInterface();

struct timerequest *mytimerRequest;

extern struct timerequest *PrepareTimer();
extern int WaitTimer();
extern int DeleteTimer();
```

```
main()
{
    SHORT error;
    ULONG oldseconds, oldmicro, oldclass;

    /* init dummy event, this is what we will feed to other handlers
     * while this handler is active */

    dummyEvent.ie_Class = IECLASS_NULL;  /* no event happened */
    dummyEvent.ie_NextEvent = NULL;  /* only this one in the chain */

    inputDevPort = CreatePort(0,0); /* for input device */
    if(inputDevPort == NULL) exit(-1);   /* error during createport */
    inputRequestBlock = CreateStdIO(inputDevPort);
    if(inputRequestBlock == 0) { DeletePort(inputDevPort); exit(-2); }
                                /* error during createstdio */

    mytimerRequest = PrepareTimer();
    if(mytimerRequest == NULL) exit(-3);

    handlerStuff.is_Data = (APTR)&me[0];
                /* address of its data area */
    handlerStuff.is_Code = HandlerInterface;
                /* address of entry point to handler */
    handlerStuff.is_Node.ln_Pri = 51;
                /* set the priority one step higher than
                 * Intuition, so that our handler enters
                 * the chain ahead of Intuition.
                 */
    error = OpenDevice("input.device",0,inputRequestBlock,0);
    if(error == 0) printf("\nOpened the input device");

    inputRequestBlock->io_Command = IND_ADDHANDLER;
    inputRequestBlock->io_Data = (APTR)&handlerStuff;

    DoIO(inputRequestBlock);
    copyevent.ie_TimeStamp.tv_secs = 0;
    copyevent.ie_TimeStamp.tv_micro = 0;
    copyevent.ie_Class = 0;
    oldseconds = 0;
    oldmicro = 0;
    oldclass =0;

    for(;;)             /* FOREVER */
    {
```

```
WaitForTimer(mytimerRequest, 0, 100000);
            /* TRUE = wait; time = 1/10th second */

/* note: while this task is asleep, it is very very likely that
 * one or more events will indeed pass through the input handler.
 * This task will only print a few of them, but won't intermix
 * the pieces of the input event itself because of the Forbid()
 * and Permit() (not allow task swapping when a data structure
 * isn't internally consistent)
 */
if(copyevent.ie_Class == IECLASS_RAWKEY && copyevent.ie_Code == F1KEYUP)
      break;                        /* exit from forever */
else
   {
      Forbid();
      if(copyevent.ie_TimeStamp.tv_secs != oldseconds ||
            copyevent.ie_TimeStamp.tv_micro != oldmicro ||
            copyevent.ie_Class != oldclass )
      {
            oldseconds = copyevent.ie_TimeStamp.tv_secs;
            oldmicro   = copyevent.ie_TimeStamp.tv_micro;
            oldclass   = copyevent.ie_Class;
            showEvents(&copyevent);
      }
      Permit();
   }
}
/* Although this task sleeps (main loop), the handler is independently
 * called by the input device.
 */

/* For keystrokes that might be recognized by AmigaDOS, such as
 * alphabetic or numeric keys, you will notice that after the
 * first such keystroke, AmigaDOS appears to lock out your task
 * and accepts all legal keystrokes until you finally hit return.
 * This is absolutely true.... when both you and AmigaDOS try to
 * write into the same window, as is true if you run this program
 * from the CLI, the first keystroke recognized by AmigaDOS locks
 * the layer into which it is writing.  Any other task trying
 * to write into this same layer is put to sleep.  This allows
 * AmigaDOS to edit the input line and prevents other output to
 * that same window from upsetting the input line appearance.
 * In the same manner, while your task is sending a line of output,
 * AmigaDOS can be put to sleep it too must output at that time.
 *
```

```
    * You can avoid this problem if you wish by opening up a separate
    * window and a console device attached to that window, and output
    * strings to that console. If you click the selection button on
    * this new window, then AmigaDOS won't see the input and your
    * task will get to see all of the keystrokes. The other alternative
    * you can use, for demonstration sake, is to:
    *
    *    1. Make the AmigaDOS window slightly smaller in the
    *          vertical direction.
    *    2. Then click in the Workbench screen area outside
    *          of any window.
    *
    * Now there is no console device (particularly not AmigaDOS's
    * console) receiving the raw key stream and your task will report
    * as many keystrokes as it can catch (while not sleeping, that is).
    */

    /* remove the handler from the chain */
    inputRequestBlock->io_Command = IND_REMHANDLER;
    inputRequestBlock->io_Data = (APTR)&handlerStuff;
    DoIO(inputRequestBlock);

    /* close the input device */
    CloseDevice(inputRequestBlock);

    /* delete the IO request */
    DeleteStdIO(inputRequestBlock);

    /* free other system stuff */
    DeletePort(inputDevPort);
    DeleteTimer(mytimerRequest);
}                              /* end of main */

int
showEvents(e)
struct InputEvent *e;
{
    printf("\n\nNew Input Event");
    printf("\nie_Class = %lx",e->ie_Class);
    printf("\nie_SubClass = %lx",e->ie_SubClass);
    printf("\nie_Code = %lx", e->ie_Code);
    printf("\nie_Qualifier = %lx",e->ie_Qualifier);
    printf("\nie_X = %ld", e->ie_X);
    printf("\nie_Y = %ld", e->ie_Y);
    printf("\nie_TimeStamp(seconds) = %lx", e->ie_TimeStamp.tv_secs);
```

```
        return(0);
}

/* input.timerstuff.c */

#include "exec/types.h"
#include "exec/nodes.h"
#include "exec/lists.h"
#include "exec/memory.h"
#include "exec/interrupts.h"
#include "exec/ports.h"
#include "exec/libraries.h"
#include "exec/io.h"
#include "exec/tasks.h"
#include "exec/execbase.h"
#include "exec/devices.h"
#include "devices/timer.h"

extern struct MsgPort *CreatePort();
extern struct IORequest *CreateExtIO();

struct timerequest
*PrepareTimer(precision)
SHORT precision;
{
        /* return a pointer to a time request.  If any problem, return NULL */

        int error;
        SHORT whichunit;

        struct MsgPort *timerport;
        struct timerequest *timermsg;

         timerport = CreatePort(0,0);
         if (timerport == NULL)
              return(NULL);   /* error during CreatePort */

        timermsg = (struct timerequest *)
                CreateExtIO(timerport,sizeof(struct timerequest));
        if (timermsg == NULL)
              {
              DeletePort(timerport);
              return(NULL);   /* error during CreateExtIO */
              }
```

```
    if(precision)       /* if true, use precision timer  ( under 1 second ) */
          whichunit = UNIT_MICROHZ;
    else
          whichunit = UNIT_VBLANK;

    error = OpenDevice(TIMERNAME, whichunit, timermsg, 0);
    if (error != 0)
          {
          DeleteExtIO(timermsg,sizeof(struct timerequest));
          DeletePort(timerport);
          return(NULL);   /* Error during OpenDevice */
          }
    return(timermsg);
}

int
WaitForTimer(tr,seconds,microseconds)
ULONG seconds,microseconds;
struct timerequest *tr;
{
    tr->tr_node.io_Command = TR_ADDREQUEST;  /* add a new timer request */
    tr->tr_time.tv_secs =  seconds;        /* seconds */
    tr->tr_time.tv_micro = microseconds;        /* microseconds */
    DoIO( tr );                     /* post request to the timer */
                                    /* goes to sleep till done */
    return(0);
}

int
DeleteTimer(tr)
struct timerequest *tr;
{
    struct MsgPort *tp;

    tp = tr->tr_node.io_Message.mn_ReplyPort;
    if(tr != 0)
    {
          CloseDevice(tr);
          DeleteExtIO(tr,sizeof(struct timerequest));
    }
    if(tp != 0)
          DeletePort(tp);
    return(0);
}
```

```
* handler.interface.asm

************************************************************************
*  HandlerInterface()
*
*  This code is needed to convert the calling sequence performed by
*  the input.task for the input stream management into something
*  that a C program can understand.
*
*  This routine expects a pointer to an InputEvent in A0, a pointer
*  to a data area in A1.  These values are transferred to the stack
*  in the order that a C program would need to find them.  Since the
*  actual handler is written in C, this works out fine.

    XREF  _myhandler
    XDEF  _HandlerInterface

_HandlerInterface:
    MOVEM.L    A0/A1,-(A7)  ; save registers
    JSR        _myhandler   ; go to the C language routine we provided
    ADDQ.L     #8,A7        ; restore the registers on the way out.
    RTS

    END
```

Chapter 10

Keyboard Device

Introduction

The keyboard device gives system access to the Amiga keyboard. When you send this device the command to read one or more keystrokes from the keyboard, for each keystroke (whether key-up or key-down) the keyboard device creates a data structure called an input event to describe what happened. A keyboard input event includes the key code (including up or down transition status), information about the current state of the left and right Shift keys, and whether the key came from the numeric keypad area.

Thus, the keyboard device provides more information than simply the "raw" key input that might be obtained by directly reading the hardware registers. In addition, the keyboard device can buffer keystrokes for you. If your task takes more time to process prior keystrokes, the keyboard device senses additional keystrokes and saves several keystrokes as a type-ahead feature. If your task takes an exceptionally long time to read this information from the keyboard, any keystrokes queued up beyond the number the system can handle will be ignored. Normally, the input device task processes these keyboard events, turning them into input device events so that no keystrokes are lost. You can find more information about keyboard event-queuing in the chapter, "Input Device," in the topic titled "Input Device and Intuition."

Keyboard Device Commands

The keyboard device allows the following system functions. The system functions operate normally.

Command	Operation
OpenDevice()	Obtain shared use of the keyboard device
CloseDevice()	Relinquish use of the keyboard device
DoIO()	Initiate a command, and wait for it to complete
SendIO()	Initiate a command, and return immediately
AbortIO()	Abort a command already in the queue

The keyboard device also responds to the following commands:

I/O Command	Operation
KBD_ADDRESETHANDLER	Add a reset handler to the device
KBD_REMRESETHANDLER	Remove a reset handler from the device
KBD_RESETHANDLERDONE	Indicate that a handler has completed its job and reset could possibly occur now
KBD_READMATRIX	Read the state of every key in the keyboard
KBD_READEVENT	Read one (or more) key event from the keyboard device

KBD_ADDRESETHANDLER

This command adds a routine to a chain of reset-handlers. When a user presses the key sequence Ctrl-left Amiga-right Amiga (the reset sequence), the keyboard device senses this and calls a prioritized chain of reset-handlers. These might be thought of as clean-up routines that "must" be performed before reset is allowed to occur. For example, if a disk write is in progress, the system should finish that before resetting the hardware so as not to corrupt the contents of the disk. There are probably a few reasons why a program may wish to add its own reset handler as well. Note that if you add your own handler to this chain, you *must* ensure that your handler allows the rest of reset processing to occur. Reset *must* continue to function.

You add a handler to the chain by the command KBD_ADDRESETHANDLER. Assuming that you have a properly initialized **IOStdReq** block as a result of a call to **OpenDevice()** (for the input device), here is a typical C-language call to the KBD_ADDRESETHANDLER function:

```
struct Interrupt resetHandlerStuff;
resetHandlerStuff.is_Data = &resetHandlerData;
        /* address of its data area */
resetHandlerStuff.is_Code = myResetHandler;
        /* address of entry point to handler */
resetHandlerStuff.is_Node.ln_Pri = myPriority;
keyboardRequestBlock.io_Command = KBD_ADDRESETHANDLER;
keyboardRequestBlock.io_Data = &resetHandlerStuff;

DoIO(&keyboardRequestBlock);
```

The priority field in the list node structure establishes the sequence in which reset handlers are processed by the system. Your routine should be structured so that it can be called as though from the following C-language sequence:

```
myResetHandler(resetHandlerData);
```

Any return value from this routine is ignored. All keyboard reset handlers are activated if time permits.

The final command in your handler routine should be KBD_RESETHANDLERDONE, as described below.

Note: Because of the time-critical nature of handlers, handlers are usually written in assembly code. However, keyboard reset processing can take a little longer and is therefore less critical if written in a language such as C.

KBD_REMRESETHANDLER

This command is used to remove a keyboard reset handler from the system. The only difference from the calling sequence shown in KBD_ADDRESETHANDLER above is a change in the command number to KBD_REMRESETHANDLER, and there is no need to specify the priority of the handler.

KBD_RESETHANDLERDONE

This command tells the system that this handler is finished with its essential activities. If this is the last handler in the chain, it completes the reset sequence. If not, the next handler in the chain gets its chance to function.

Here is a typical statement sequence used to end a keyboard reset handler, again assuming a properly initialized **inputRequestBlock**:

```
keyboardRequestBlock.io_Command = KBD_RESETHANDLERDONE;
keyboardRequestBlock.io_Data = &resetHandlerStuff;
SendIO(&keyboardRequestBlock);
return;          /* return so that other handlers can also do their jobs */
```

Note that **SendIO()** is used instead of **DoIO()**. This routine is being executed within a software interrupt, and it is illegal to allow a **Wait()** within such routines.

KBD_READMATRIX

This command lets you discover the current state (UP = 0, DOWN = 1) of every key in the key matrix. You provide a data area that is at least large enough to hold one bit per key, approximately 16 bytes. The keyboard layout is shown in figure 10-1 below, indicating the numeric value each transmits (raw) when it is pressed. This value is the numeric position that this key occupies in the key matrix read by this command.

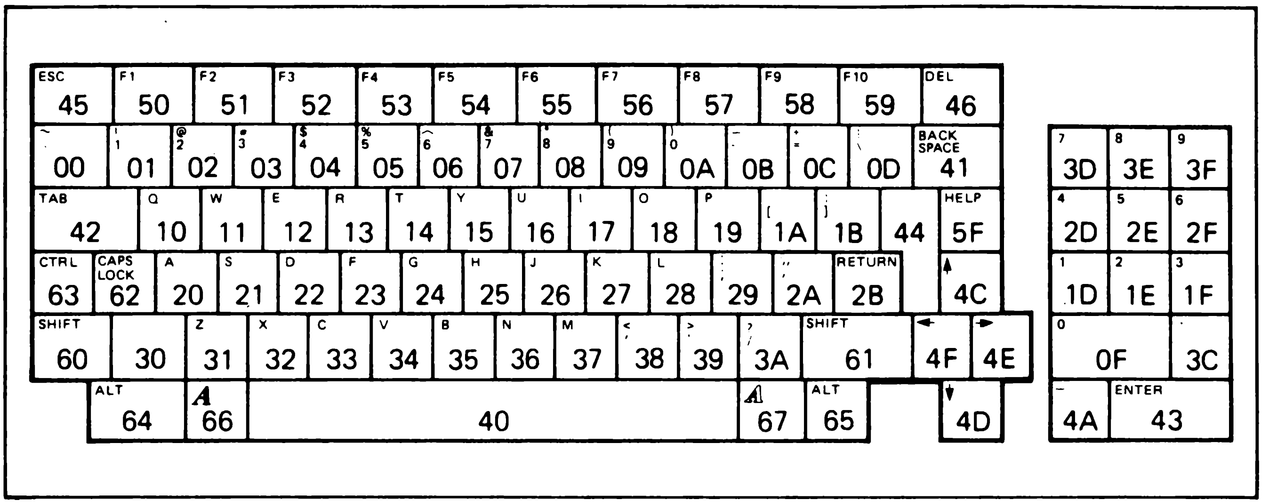

Figure 10-1: Raw Key Matrix

Assuming that you have already initialized an **IOStdReq** block for communication with the keyboard device, here is a typical calling sequence for sending the read-matrix command:

```
UBYTE keyMatrix[16];
keyboardRequestBlock.io_Command = KBD_READMATRIX;
keyboardRequestBlock.io_Data = &keyMatrix[0];
      /* where to put the key matrix */
DoIO(&keyboardRequestBlock);
```

To find the status of a particular key (for example, to find out if the F2 key is down), you find the bit that specifies the current state by dividing the key matrix value (hex 51 = decimal 81) by 8. This indicates that the bit is in byte number 10 of the matrix. Then take the same number (decimal 81) modulo 8 to determine which bit position within that byte represents the state of the key. This yields a value of 1. So, by reading bit position 1 of byte number 10, you determine the status of the function key F2.

KBD_READEVENT

Reading keyboard events is normally not done through direct access to the keyboard device. See chapter 9, "Input Device," for the intimate linkage between that device and the keyboard device. This section is provided primarily to show you the component parts of a keyboard input event.

The figure above shows the code value that each key places into the **ie_Code** field of the input event for a key down event. For a key-up event, a value of hexadecimal 80 is or'ed with the value shown above. Additionally, if either shift key is down, or if the key is one of those in the numeric keypad, the qualifier field of the keyboard input event will be filled in accordingly.

Note: The keyboard device can queue up several keystrokes without a task requesting a report of keyboard events. However, when the keyboard event buffer has been filled with no task interaction, additional keystrokes will be discarded.

Example Keyboard Read-event Program

Note: This sample program will run properly only if AmigaDOS and the input device are not active.

```
/* sample program to demonstrate direct communications with the keyboard,
 * won't work unless input device is disabled, so that keyboard can
 * be accessed individually. (It will compile and it will run, but
 * this program will get some of the keyboard's inputs, and the input
 * device will steal the rest... no guarantee that F1 Key can break it out.)
 *
 * To try the program, if run under the AmigaDOS CLI, strike any key, then
 * hit return. (You won't see any responses until each return key... DOS
 * is sitting on the input stream with its input editor as well as the
 * input device.) By rapidly hitting F1 then Return several times,
 * eventually you can generate a hex 50 that exits the program. This
 * program is provided for those who are taking over the machine. It
 * is not intended as a general purpose keyboard interface under DOS.
 */

#include <exec/types.h>
#include <exec/io.h>
#include <exec/devices.h>
#include <devices/keyboard.h>
#include <devices/inputevent.h>

#define F1KEY 0x50

extern struct MsgPort *CreatePort();
extern struct IOStdReq *CreateStdIO();

SHORT error;

struct IOStdReq *keyreq;
struct MsgPort *keyport;
struct InputEvent *keydata;       /* pointer into the returned data area
                                   * where an input event has been sent */
```

```
BYTE keybuffer[sizeof( struct InputEvent )];

main()
{
      keyport = CreatePort(0,0);
      if(keyport === 0) { printf("\nError during CreatePort");
                    exit(-1);
                  }
      keyreq = CreateStdIO(keyport);
            /* make an io request block for
             * communicating with the keyboard */
      if(keyreq == 0) { printf("\nError during CreateStdIO");
                    DeletePort(keyport);
                    exit(-2);
                  }
      error = OpenDevice("keyboard.device",0,keyreq,0);
                  /* open the device for access */

      if (error != 0) { printf("\nCan't open keyboard!");
                    ReturnMemoryToSystem();
                    exit(-100);
                  }
      keyreq->io_Length = sizeof(struct InputEvent);
      /* read one event each time we go back to the keyboard */

      keyreq->io_Data = (APTR)keybuffer;
      /* show where to put the data when read */

      keydata = (struct InputEvent *)keybuffer;

      keyreq->io_Command = KBD_READEVENT;    /* get an event!! */


      for(;;)       /* FOREVER */
      {
      printf("\n Ready to retrieve another key0);
      DoIO( keyreq );
      if(keydata->ie_Code == F1KEY) break;
      printf("\n Raw key found this time was %lx",keydata->ie_Code);
      }
      printf("\nFINALLY found an F1 key!!!  Exiting...");
      ReturnMemoryToSystem(); /* can't get here because of FOREVER,
                               * but if user provides an exit..... */
}
```

```
ReturnMemoryToSystem()
{
        DeleteStdIO(keyreq);
        DeletePort(keyport);
        return(0);
}
```

Chapter 11

Gameport Device

Introduction

The gameport device is the means of access to the Amiga gameports. There are two units in the gameport device. Unit 0 controls the front gameport connector (connector 1). Unit 1 controls the rear gameport connector (connector 2).

You must tell the system the type of device connected to the gameport connector and how the device is to respond. That is, should the device return status immediately each time you ask for information or should it only return status once certain conditions have been met?

When the input device is operating, the left gameport connector is usually dedicated to that device. Therefore, this chapter's examples concentrate on the right connector, which is not dedicated to the input device. Note that if the input device is not started, the left connector, as gameport unit 0, can perform the same functions as shown below for the right connector.

When a gameport unit finally reponds to a request for input, it formulates an input event. The contents of the input event vary based on the type of device you have told the unit is connected and the trigger conditions it must look for.

Gameport Device Commands

The gameport device allows the following system functions.

Command	Operation
OpenDevice()	Obtain exclusive use of one unit of the gameport device. Returns an error value of -1 if another task already has control of the unit you have requested.
CloseDevice()	Relinquish use of the gameport device
DoIO()	Initiate a command and wait for it to complete
SendIO()	Initiate a command and return immediately
AbortIO()	Abort a command already in the queue

The gameport device also responds to the following commands:

I/O Command	Operation
GPD_SETCTYPE	Set the type of the controller to be monitored
GPD_ASKCTYPE	Ask the type of the controller being monitored
GPD_SETTRIGGER	Preset the conditions that will trigger a gameport event
GPD_ASKTRIGGER	Inquire the conditions that have been preset for triggering
GPD_READEVENT	Read one or more gameport events from an initialized unit

GPD_SETCTYPE

This command establishes the type of controller that is to be connected to the specific gameport device. You must have already successfully opened that specific unit before you will be able to tell it what type of controller is connected. As of this writing, there are three different legal controller types: mouse, absolute joystick, relative joystick, and "no controller."

A mouse controller can report input events for one, two, or three buttons and for positive or negative (x,y) movements. A trackball controller or driving controller for various games is generally of the same type, and can be declared as a mouse controller.

An absolute joystick is one that reports one single event for each change in its current location. If, for example, the joystick is centered and a user pushes the stick forward, a forward-switch event will be generated. A relative joystick, on the other hand, is comparable to an absolute joystick with "autorepeat" installed. As long as the user holds the stick in a position other than centered, the gameport device continues to generate position reports.

As of this writing, there is no direct system software support for proportional joysticks or proportional controllers.

You specify the controller type by the following code or its equivalent:

```
struct IOStdReq *gameIOMsg;

setControllerType(type)
UBYTE *type;
{
     /* set type of controller */
gameIOMsg->io_Command = GPD_SETCTYPE;
gameIOMsg->io_Data = type;     /* show where data can be found */
DoIO(gameIOMsg);
return(0);
}
```

GPD_GETCTYPE

You use this command to find out what kind of controller has been specified for a particular unit. This command puts the controller type into the data area that you specify with the command. Here is a sample call:

```
SHORT getControllerType(type);
UBYTE *type;
{
     /* get type of controller */
gameIOMsg->io_Command = GPD_GETCTYPE;
gameIOMsg->io_Data = type;     /* show where data should be placed */
DoIO(gameIOMsg);
return (gamebuffer[0]);
}
```

The value that is returned corresponds to one of the four controller types noted in GPD_SETCTYPE above. Controller type definitions can be found in the include file named *devices/gameport.h*.

GPD_SETTRIGGER

You use this command to specify the conditions that can trigger a gameport event. The device won't reply to your read request until the trigger conditions have been satisfied.

For a mouse device, you can trigger on a certain minimum-sized move in either the x or y direction, on up or down transitions of the mouse buttons, on a timed basis, or any combination of these conditions. Here is an example that shows why you might want to use both time and movement. Suppose you normally signal mouse events if the mouse moves at least 10 counts in either the x or y directions. If you are moving the cursor to keep up with mouse movements and the user moves the mouse less than 10 counts, after a period of time you will want to update the position of the cursor to exactly match the mouse position. Thus the timed report with current mouse counts will be desirable.

For a joystick device, you can select timed reports as well as button-up and button-down report trigger conditions.

The information needed for gameport trigger setting is placed into a **GameTrigger** data structure:

```
struct GamePortTrigger {
    UWORD  gpt_Keys;        /* key transition triggers */
    UWORD  gpt_Timeout;     /* time trigger (vertical blank units) */
    UWORD  gpt_XDelta;      /* X distance trigger */
    UWORD  gpt_YDelta;      /* Y distance trigger */
    };
```

The field **gpt_Keys** can be set to a value of GPTF_UPKEYS to report upward transitions or GPTF_DOWNKEYS to report downward transitions.

The field **gpt_Timeout** is set to count how many vertical blank units should occur (1/60th of a second each) between reports in the absence of another trigger condition. Thus, this specifies the maximum report interval.

Note: If a task sets trigger conditions and does not ask for the position reports (by sending an I/O request to be filled in with available reports), the gameport device will queue up several additional reports. If the trigger conditions again occur and as many events as the system can handle are already queued, the additional triggers will be ignored until the buffer of one or more of the existing triggers is read by a device read request.

```
struct GamePortTrigger mousetrigger = {
    GPTF_UPKEYS + GPTF_DOWNKEYS,
    1800,
    XMOVE,
    YMOVE };
     /* trigger on all mouse key transitions, every 30 seconds,
      * (1800 = 30 times 60 per sec) for any 10 in an x or y direction */
```

You set the trigger by using the following code or the equivalent:

```
gameIOMsg->io_Command = GPD_SETTRIGGER;
      /* command to set the trigger conditions */
gameIOMsg->io_Data = &mousetrigger;
      /* show where to find the trigger condition info */
DoIO(gameIOMsg);
```

Example Programs

MOUSE PROGRAM

Here is a complete sample program that lets you open the right gameport device unit and define it as a mouse device. You are directed to unplug the mouse and plug it into the right connector. Mouse moves and button clicks are reported to the console device that started the program. If you do not move the mouse for 30 seconds, a report is generated automatically. If you do not move it for 2 minutes, the program exits.

```
/* ****************************************************************
 * mouse test, for right game port on the Amiga
 *
 * Notes: The right port is used for this test because the input.device task is
 * busy continuously with the lefthand port, feeding input events to Intuition or
 * console devices. If Intuition is not activated (applications that take over the
 * whole machine may decide not to activate Intuition) and if no console device is
 * activated, * the input device will never activate, allowing the application free
 * rein to use either the left OR the right hand joystick/mouse port. If either
 * Intuition or the console device is activated, the lefthand port will yield, at
 * best, every alternate input event to an external application such as this test program.
 *
 * This will undoubtedly mess up either of the two applications and should,
```

```
* therefore, be avoided. It was ok to use the right port in this case, because
* the system has no particular interest in monitoring it.
*
* Using a function called SetMPort(), you can reconfigure so that the
* mouse is expected in the other port, but that isn't demonstrated here.
****************************************************************** */

#include <exec/types.h>
#include <exec/devices.h>
#include <graphics/gfx.h>
#include <devices/gameport.h>
#include <devices/inputevent.h>

LONG GfxBase=0;

#define XMOVE 10
#define YMOVE 10
#define MAX(m,n) (m > n ? m : n)

/* trigger on all mouse key transitions, and every
 * 30 seconds, and for any 10 in an x or y direction */

struct GamePortTrigger mousetrigger = {
      GPTF_UPKEYS + GPTF_DOWNKEYS,
      1800,
      XMOVE,
      YMOVE };

struct InputEvent *game_data;   /* pointer into the returned data area
                                 * where input event has been sent */
SHORT          error;

struct IOStdReq *game_io_msg;

BYTE           gamebuffer[sizeof( struct InputEvent )];
BYTE           *gamedata;

SHORT          testval;

struct MsgPort  *game_msg_port;

SHORT movesize;
extern struct MsgPort *CreatePort();
extern struct IOStdReq *CreateStdIO();
```

```
SHORT codeval, timeouts;

#define IF_NOT_IDLE_TWO_MINUTES while(timeouts < 4)

main()
{
	GfxBase = OpenLibrary("graphics.library", 0);
	if (GfxBase == NULL)
	{
		printf("Unable to open graphics library\n");
		exit(1000);
	}
	printf("Mouseport Demo\n");
	printf("\nMove Mouse from Left Port to Right Port\n");
	printf("\nThen move the mouse and click its buttons");


	timeouts = 0;

	gamedata = &gamebuffer[0];
	/* point to first location in game buffer */

	game_msg_port = CreatePort(0,0);
	/* provide a port for the IO response */
	if(game_msg_port == 0)
	{
		printf("\nError While Performing CreatePort");
		exit(-1);
	}

	game_io_msg = CreateStdIO(game_msg_port);
	/* make an io request block for communicating with
				the keyboard */

	if(game_io_msg == 0)
	{
		printf("\nError While Performing CreateStdIO");
		DeletePort(game_msg_port);
		exit(-2);
	}

	error = OpenDevice("gameport.device",1,game_io_msg,0);
	/* open the device for access, unit 1 is right port */

	if(error != 0)
```

```
{
	printf("\nError while opening the device, exiting");
	DeleteStdIO(game_io_msg);
	DeletePort(game_msg_port);
	exit(-3);
}

game_io_msg->io_Length = sizeof(struct InputEvent);
/* read one event each time we go back to the gameport */

game_io_msg->io_Data = (APTR)gamebuffer;
/* show where to put the data when read */

game_data = (struct InputEvent *)gamebuffer;

/* test the mouse in this loop */
set_controller_type(GPCT_MOUSE);

/* specify the trigger conditions */
game_io_msg->io_Command = GPD_SETTRIGGER;
/* show where to find the trigger condition info */
game_io_msg->io_Data = (APTR)&mousetrigger;

/* this command doesn't wait... returns immediately */
SendIO(game_io_msg);
WaitPort(game_msg_port);
GetMsg(game_msg_port);

printf("\nI will report:");
printf("\n	Mouse X or Y moves if either is over 10 counts");
printf("\n	Button presses (along with mouse moves if any)");
printf("\n	Or every 30 seconds (along with mouse moves if any)");
printf("\n		if neither move or click happens\n");
printf("\nIf no activity for 2 minutes, the program exits\n");

/* from now on, just read input events into the input buffer, one at a
 *time.  read-event waits for the preset conditions */

game_io_msg->io_Command = GPD_READEVENT;
game_io_msg->io_Data = (APTR)gamebuffer;

IF_NOT_IDLE_TWO_MINUTES
{
	game_io_msg->io_Length = sizeof(struct InputEvent);
	/* read one event each time we go back to the gameport */
```

```
printf("\n Waiting For Mouse Report\n");

SendIO(game_io_msg);

WaitPort(game_msg_port);
/* this is NOT a busy wait... it is a task-sleep */

GetMsg(game_msg_port);

codeval = game_data->ie_Code;
switch(codeval)
{
case IECODE_LBUTTON:
        printf("\nMouse Left Button Pressed");
        maybe_mouse_moved();
        break;

case IECODE_RBUTTON:
        printf("\nMouse Right Button Pressed");
        maybe_mouse_moved();
        break;

case (IECODE_LBUTTON + IECODE_UP_PREFIX):
        printf("\nMouse Left Button Released");
        maybe_mouse_moved();
        break;

case (IECODE_RBUTTON + IECODE_UP_PREFIX):
        printf("\nMouse Right Button Released");
        maybe_mouse_moved();
        break;

case IECODE_NOBUTTON:
        timeouts++;     /* after 2 minutes, dump program if
                         * user loses interest */
        movesize = maybe_mouse_moved();
        if(movesize == 0)
        {
            printf("\n30 seconds passed, no trigger events");
        }
        else if(movesize < XMOVE && movesize < YMOVE )
        {
            printf("\n(Even though less than trigger count,");
            printf("\n reporting mouse move at the selected");
            printf("\n timing interval for user info)");
```

```
                    }
                    break;
            default:
                    break;
            }
    }

    set_controller_type(GPCT_NOCONTROLLER);

    CloseDevice(game_io_msg);
    DeleteStdIO(game_io_msg);
    DeletePort(game_msg_port);

    printf("\nExiting program... 2 minutes with no activity sensed\n1> ");
    return(0);
}

    /* if mouse didn't move far enough to trigger a report, then caller
     * will also report that 30 seconds (1800 vblanks) has elapsed
     */

int maybe_mouse_moved()
{
    int xmove, ymove;
    xmove = game_data->ie_X;
    ymove = game_data->ie_Y;

    if(xmove != 0 || ymove != 0)
    {
        printf("\nMouse Moved by X-value %ld, Y-value %ld",
        xmove, ymove);
        timeouts = 0;
    }
    if(xmove < 0) xmove = -xmove;
    if(ymove < 0) ymove = -ymove;

    return(MAX(xmove,ymove));
}

int set_controller_type(type)
SHORT type;
{
    /* set type of controller to mouse */
    game_io_msg->io_Command = GPD_SETCTYPE;
```

```
	*gamedata = type;

	/* set it up */
	/* this command doesn't wait... returns immediately */
	SendIO(game_io_msg);

	WaitPort(game_msg_port);
	GetMsg(game_msg_port);
	return(0);
}
```

JOYSTICK PROGRAM

```
/* ********************************************************************* */
 * joystick test, for right game port on the Amiga.

 * Notes:  The right port is used for this test because the input.device task is
 * busy continuously with the lefthand port, feeding input events to Intuition or
 * console devices. If Intuition is not activated (applications that take over the
 * whole machine may decide not to activate Intuition) and no console device is
 * activated either, the input device will never activate, allowing the application
 * free rein to use either the left OR the right hand joystick/mouse port. If
 * either Intuition or the console device is activated, the lefthand port will
 * yield, at best, every alternate input event to an external application such as
 * this test program. This will undoubtedly mess up either of the two applications
 * and should therefore be avoided. It was ok to use the right port in this case,
 * because the system has no particular interest in monitoring it.

********************************************************************* */

#include <exec/types.h>
#include <exec/devices.h>
#include <graphics/gfx.h>
#include <devices/gameport.h>
#include <devices/inputevent.h>

LONG GfxBase=0;

#define XMOVE 10
#define YMOVE 10
#define MAX(m,n) (m > n ? m : n)
#define FOREVER for(;;)
struct InputEvent *game_data;	/* pointer into the returned data area
				 * where input event has been sent */
```

```
SHORT    error;

struct IOStdReq *game_io_msg;

BYTE     gamebuffer[sizeof( struct InputEvent )];
BYTE     *gamebuff;

SHORT    testval;
SHORT    codevalue;

struct MsgPort  *game_msg_port;

SHORT movesize;
extern struct MsgPort *CreatePort();
extern struct IOStdReq *CreateStdIO();

SHORT codeval, timeouts;

main()
{
    int events_reported;
    events_reported = 0;
    printf("Joystick Demo\n");
    printf("\nPlug a Joystick Into Right Port\n");
    printf("\nThen move the stick and click its buttons");

    /* point to first location in game buffer */
    gamebuff = &gamebuffer[0];

    /* SYSTEM DEVICE COMMUNICATIONS SUPPORT SETUP ROUTINES ****** */

    /* provide a port for the IO response */
    game_msg_port = CreatePort(0,0);
    if(game_msg_port == 0)
    {
        printf("\nError While Performing CreatePort");
        exit(-1);
    }

    /* make an io request block for communicating with the gameport */
    game_io_msg = CreateStdIO(game_msg_port);

    if(game_io_msg == 0)
    {
        printf("\nError While Performing CreateStdIO");
```

```
        DeletePort(game_msg_port);
        exit(-2);
}
/* ***************************************************** */
/* OPEN THE DEVICE */

/* open the device for access, unit 1 is right port */
error = OpenDevice("gameport.device",1,game_io_msg,0);

if(error != 0)
{
        printf("\nError while opening the device, exiting");
        DeleteStdIO(game_io_msg);
        DeletePort(game_msg_port);
        exit(-3);
}
/* **************************************************** */
/* SET THE DEVICE TYPE */

game_data = (struct InputEvent *)gamebuffer;

/* test the joystick in this loop */

if (set_controller_type(GPCT_ABSJOYSTICK) != 0)
{
        printf("\nError while trying to set GPCT_ABSJOYSTICK");
        DeleteStdIO(game_io_msg);
        DeletePort(game_msg_port);
        exit(-4);
}
/* ******************************************************* */
/* SET THE DEVICE TRIGGER */
if (set_controller_trigger() != 0)
{
        printf("\nError while trying to set controller trigger");
        DeleteStdIO(game_io_msg);
        DeletePort(game_msg_port);
        exit(-4);
}
/* ******************************************************* */
/* TELL USER WHAT YOU WILL BE DOING */

printf("\nI will report: \n");
printf("\n     Stick X or Y moves");
printf("\n     Button presses (along with stick moves if any)");
```

```
/* ******************************************************** */
/* SETUP THE IO MESSAGE BLOCK FOR THE ACTUAL DATA READ */

/* from now on, just read input events into the input buffer, one at a
 * time; read-event waits for the preset conditions */

game_io_msg->io_Command = GPD_READEVENT;
game_io_msg->io_Data = (APTR)gamebuffer;

/* read one event each time we go back to the gameport */
game_io_msg->io_Length = sizeof(struct InputEvent);

/* don't use quick io */
game_io_msg->io_Flags = 0;

/* ******************************************************* */
/* LOOP FOREVER */

FOREVER
{
        /* read one event each time we go back to the gameport */
        game_io_msg->io_Length = sizeof(struct InputEvent);

        printf("\n Waiting For Joystick Report\n");
        SendIO(game_io_msg);
        WaitPort(game_msg_port);
        /* this is NOT a busy wait... it is a task-sleep */
        GetMsg(game_msg_port);

        codevalue = game_data->ie_Code;

        if(codevalue == IECODE_LBUTTON)
                printf("\nFire Button pressed");
        if(codevalue == (IECODE_LBUTTON + IECODE_UP_PREFIX))
                printf("\nFire Button released");

        which_direction();
        showbugs();
        if (events_reported++>12) break;
}

set_controller_type(GPCT_NOCONTROLLER);

CloseDevice(game_io_msg);
DeleteStdIO(game_io_msg);
```

```
    DeletePort(game_msg_port);

    printf("\nExiting program... 12 events reported.\n1> ");
    return(0);
}

int which_direction()
{
    SHORT xmove, ymove;
    xmove = game_data->ie_X;
    ymove = game_data->ie_Y;

    switch(ymove)
    {
        case (-1):
        printf("\nForward");
        break;
        case (1):
        printf("\nBack");
        break;
    default:
        break;
    }
    switch(xmove)
    {
        case (-1):
        printf("\nLeft");
        break;
        case (1):
        printf("\nRight");
        break;
    default:
        break;
    }
    return(0);
}

int set_controller_type(type)
SHORT type;
{
    game_io_msg->io_Command = GPD_SETCTYPE;
    /* set type of controller to mouse */
    game_io_msg->io_Length = 1;
    game_io_msg->io_Data = (APTR)gamebuff;
    *gamebuff = type;
```

```
    SendIO(game_io_msg);
    /* set it up */
    /* this command doesn't wait... returns immediately */
    WaitPort(game_msg_port);
    GetMsg(game_msg_port);
    return((int)game_io_msg->io_Error);
}

int set_controller_trigger()
{
    struct GamePortTrigger gpt;

    game_io_msg->io_Command = GPD_SETTRIGGER;
    game_io_msg->io_Length = sizeof(gpt);
    game_io_msg->io_Data = (APTR)&gpt;
    gpt.gpt_Keys = GPTF_UPKEYS+GPTF_DOWNKEYS;
    gpt.gpt_Timeout = 0;
    gpt.gpt_XDelta = 1;
    gpt.gpt_YDelta = 1;

    return(DoIO(game_io_msg));
}

showbugs()
{
    struct InputEvent *e;

    e = (struct InputEvent *)&gamebuffer[0];
    /* where the input event gets placed */
    printf("\nie_Class = %lx",e->ie_Class);
    printf("\nie_SubClass = %lx",e->ie_SubClass);
    printf("\nie_Code = %lx", e->ie_Code);
    printf("\nie_Qualifier = %lx",e->ie_Qualifier);
    printf("\nie_X = %ld", e->ie_X);
    printf("\nie_Y = %ld", e->ie_Y);
    printf("\nie_TimeStamp(seconds) = %lx", e->ie_TimeStamp.tv_secs);
    return(0);
}
```

Chapter 12

Narrator Device

This chapter provides routines for accessing both the narrator device and the translator library and shows how some of the parameters passed to the device can affect the output. In addition, this chapter contains a nontechnical explanation of how to effectively utilize the speech device. A more technical explanation is also provided for those who may be interested in how the speech is actually produced.

Introduction

Two different subsystems comprise the speech system on the Amiga. They are the *narrator device*, which communicates with the audio device to actually produce human-like speech, and the *translator library*, which contains a routine that translates English text into phonemes suitable for the narrator device.

The Translator Library

The translator library provides a single routine, named **Translate()**, that converts an English language string into a phonetic string. To use this function, you must first open the library.

Setting a global variable, **TranslatorBase**, to the value returned from the call to **OpenLibrary()** enables the Amiga linker to correctly locate the translator library:

```
struct Library *TranslatorBase;
    ...
TranslatorBase = OpenLibrary("translator.library",REVISION);
if(TranslatorBase === NULL) exit (CANT_OPEN_TRANSLATOR);
```

Note that for the **OpenLibrary()** call to succeed, the directory currently assigned by AmigaDOS as *LIBS:* must contain *translator.library.*

USING THE TRANSLATE FUNCTION

Once the library is open, you can call the translate function:

```
UBYTE *sampleinput;          /* pointer to sample input string */
UBYTE outputstring[500];     /* place to put the translation */
SHORT rtnCode;               /* return code from function */

sampleinput = "this is a test";     /* a test string of 14 characters */
rtnCode = Translate(sampleinput,14,outputstring,500);
```

The input string will be translated into its phoneme equivalent and can be used to feed the narrator device. If you receive a nonzero return code, you haven't provided enough output buffer space to hold the entire translation. In this case, the **Translate()** function breaks the translation at the end of a word in the input stream and returns the position in the input stream at which the translation ended. You can use the output buffer, then call the **Translate()** function again, starting at this original ending position, to continue the translation where you left off.

Note, however, that the value returned is *negative*. Therefore, you must use **-rtnCode** as the starting point for a new translation.

ADDITIONAL NOTES ABOUT TRANSLATE

The English language has many words that do not sound the same as they are spelled. The translator library has an exception table that it consults as the translation progresses. Words that are not in the exception table are translated literally. Therefore, it is possible that certain words will not translate well. You can improve the quality of the translation by handling those words on your own, using the tutorial information included at the end of this chapter.

As with all other libraries of routines, if you have opened the translator library for use, be sure to close it before your program exits. If the system needs memory resources, it can then expel closed libraries to gain additional space.

The Narrator Device

The narrator device on the Amiga provides two basic functions:

- You can write to the device and ask it to speak a phoneme-encoded string in a specific manner—pitch, male/female, various speaking rates, and so on.

- You can read from the device. As it speaks, the device can generate mouth shapes for you and you can use the shapes to perform a graphics rendering of a face and mouth.

OPENING THE NARRATOR DEVICE

To use the narrator device, you must first open the device. The narrator device is disk-resident. For the **OpenDevice()** call to succeed, the narrator device must be present in the directory currently assigned by AmigaDOS to the *DEVS:* directory.

To communicate with the narrator device, like any other device, you must pass an **IORequest** block to **OpenDevice()**. The block used by the narrator device for a write is a special format called a **narrator_rb**. The block used for a read is also a special format, called a **mouth_rb**. Both blocks are described in the sections that follow. A sample **OpenDevice()** sequence for the narrator device follows. Notice that two request blocks are created, one for writing to the device and one for reading from it. For brevity, the error checking is left out of this short example. It is, however, utilized in the sample program later on.

```
struct narrator_rb *writeNarrator;
struct narrator_rb *readNarrator;
writeport = CreatePort(0,0);
readport = CreatePort(0,0);
writeNarrator = (struct narrator_rb *)CreateExtIO(writeport,
        sizeof(struct narrator_rb));
readNarrator = (struct mouth_rb *)CreateExtIO(readport,
        sizeof(struct mouth_rb));
```

The routine **CreateExtIO()** is in the "Other Routines" appendix of the *Amiga ROM Kernel Reference Manual: Exec*. **CreatePort()** is contained in *amiga.lib* and can be accessed by linking your program to *amiga.lib*.

CONTENTS OF THE WRITE REQUEST BLOCK

You can control several characteristics of the speech, as indicated in the narrator request block structure shown below.

```
struct narrator_rb {
    struct IOStdReq  message;   /* Standard IORB */
    UWORD   rate;               /* Speaking rate (words/minute) */
    UWORD   pitch;              /* Baseline pitch in Hertz */
    UWORD   mode;               /* Pitch mode */
    UWORD   sex;                /* Sex of voice */
    UBYTE   *ch_masks;          /* Pointer to audio alloc maps */
    UWORD   nm_masks;           /* Number of audio alloc maps */
    UWORD   volume;             /* Volume. 0 (off) thru 64 */
    UWORD   sampfreq;           /* Audio sampling freq */
    UBYTE   mouths;             /* If non-zero, generate mouths */
    UBYTE   chanmask;           /* Which ch mask used (internal)*/
    UBYTE   numchan;            /* Num ch masks used (internal) */
    UBYTE   pad;                /* For alignment */
  };
```

where

rate
is the speed in words per minute that you wish it to speak.

pitch
is the baseline pitch. If you are using an expressive voice rather than a monotone, the pitch will vary above and below this baseline pitch.

mode
determines whether you have a monotone or expressive voice.

sex
determines if the voice is male or female.

ch_masks, nm_masks, volume, sampfreq
are described in the chapter called "Audio Device."

mouths
is set to nonzero before starting a write if you want to read mouths using the read command while the system is speaking.

chanmask, numchan, pad
are for system use only.

The system default values are shown in the files *devices/narrator.h* and *devices/narrator.i.* When you call **OpenDevice()**, the system initializes the request block to the default values. If you want other than the defaults, you must change them *after* the device is open.

CONTENTS OF THE READ REQUEST

The **mouth_rb** data structure follows. Notice that it is an extended form of the **narrator_rb** structure.

```
struct mouth_rb {
    struct narrator_rb voice;   /* Speech IORB */
    UBYTE  width;               /* Width (returned value) */
    UBYTE  height;              /* Height (returned value) */
    UBYTE  shape;               /* Internal use, do not modify */
    UBYTE  pad;                 /* For alignment */
    };
```

The fields **width** and **height** will, on completion of a read-request, contain an integer value proportional to the mouth width and height that are appropriate to the phoneme currently being spoken. When you send a read request, the system does not return a response until one of two things happens. Either a different mouth size is available (this prevents you from drawing and redrawing the same shape or having to check whether or not it is the same) or the speaking has completed. You must check the error return field when the read request block is returned to determine if the request block contains a new mouth shape or simply is returning status of **ND_NoWrite** (no write in progress, all speech ended for this request).

OPENING THE NARRATOR DEVICE

This section demonstrates opening the device as well as synchronizing a read request so that it responds only to the write request for which the device is opened. You can read the mouth shapes only if the write request contains the same unit number and a write is currently in progress; the system returns an error if the numbers don't match or if the write has completed. Note again that error checking is deferred to the example program at the end of the chapter.

```
SHORT openError;

openError = OpenDevice("narrator.device",0,writeNarrator,0);
     /* after error checking, synchronize the read and write requests */
readNarrator->narrator_rb.message.io_Device =
     writeNarrator->message.io_Device;      /* copy device info */
readNarrator->narrator_rb.message.io_Unit =
     writeNarrator->message.io_Unit;        /* copy unit info */
```

At this point, it is acceptable to change the default values before issuing a write.

More details about what **OpenDevice()** performs are contained in the narrator device summary pages.

PERFORMING A WRITE AND A READ

You normally perform a write command by using the functions **BeginIO()** or **SendIO()** to transmit the request block to the narrator device. This allows the narrator's task to begin the I/O, while your task is free to do something else. The something else may be issuing a series of read commands to the device to determine mouth shapes and drawing them on-screen. The following sample set of function calls implements both the write and read commands in a single loop. Again, error checking is deferred to the sample program.

```
SHORT readError;

writeNarrator->message.io_Length = strlen(outputstring);
     /* tell it how many characters the translate function returned */
writeNarrator->message.io_Data = outputstring;
     /* tell it where to find the string to speak */
SendIO(writeNarrator);
     /* return immediately, run tasks concurrently */

readNarrator->voice.message.io_Error = 0;
while((readError = readNarrator->voice.message.io_Error) !=
     ND_NoWrite)
{
     DoIO(readNarrator);
          /* put task to sleep waiting for a different mouth shape or
           * return of the message block with the error field showing
           * no write in progress
           */
     DrawMouth(readNarrator->width,readNarrator->height);
          /* user's own unique routine, not provided here */
}
GetMsg(writeport); /* remove the write message from the
                    * writeport so that it can be reused */
```

The loop continues to send read requests to the narrator device until the speech output has ended. **DoIO()** automatically removes the read request block from the readport for reuse. **SendIO()** is used to transmit the write request. When it completes, the write request will be appended to the writeport, and must be removed before it can be reused.

Sample Program

The following sample program uses the system default values returned from the **OpenDevice()** call. It translates and speaks a single phrase.

```
#include "exec/types.h"
#include "exec/exec.h"

#include "exec/nodes.h"
#include "exec/lists.h"
#include "exec/memory.h"
#include "exec/interrupts.h"
#include "exec/ports.h"
#include "exec/libraries.h"
#include "exec/io.h"
#include "exec/tasks.h"
#include "exec/execbase.h"

#include "devices/narrator.h"
#include "libraries/translator.h"

struct MsgPort *readport=0;
struct MsgPort *writeport=0;

extern struct MsgPort *CreatePort();
extern struct IORequest *CreateExtIO();

struct narrator_rb *writeNarrator=0;
struct mouth_rb *readNarrator=0;
struct Library *TranslatorBase=0;
UBYTE *sampleinput;       /* pointer to sample input string */
UBYTE outputstring[500];  /* place to put the translation */
SHORT rtnCode;            /* return code from function */
SHORT readError;
SHORT writeError;
SHORT error;
BYTE  audChanMasks[4] = { 3,5,10,12 };    /* which channels to use */

#define CANT_OPEN_TRANSLATOR -100
#define CANT_OPEN_NARRATOR -200
#define CREATE_PORT_PROBLEMS -300
#define CREATE_IO_PROBLEMS -400
#define CANT_PERFORM_WRITE -500
#define REVISION 1

extern struct Library *OpenLibrary();

main()
{
      TranslatorBase = OpenLibrary("translator.library",REVISION);
```

```
    if(TranslatorBase == NULL) exit (CANT_OPEN_TRANSLATOR);
    sampleinput = "this is a test"; /* a test string of 14 characters */
    rtnCode = Translate(sampleinput,14,outputstring,500);
    error = rtnCode + 100;
    if(rtnCode != 0) goto cleanup0;

    writeport = CreatePort(0,0);
    if(writeport == NULL) { error=CREATE_PORT_PROBLEMS; goto cleanup1; }
    readport = CreatePort(0,0);
    if(readport == NULL) { error=CREATE_PORT_PROBLEMS; goto cleanup2; }
    writeNarrator = (struct narrator_rb *)CreateExtIO(writeport,
                            sizeof(struct narrator_rb));
    if(writeNarrator == NULL) { error=CREATE_IO_PROBLEMS; goto cleanup3; }
    readNarrator = (struct mouth_rb *)CreateExtIO(readport,
                            sizeof(struct mouth_rb));

    if(readNarrator == NULL) { error=CREATE_IO_PROBLEMS; goto cleanup4; }
/* SET UP PARAMETERS FOR WRITE-MESSAGE TO THE NARRATOR DEVICE */

    /* show where to find the channel masks */
    writeNarrator->ch_masks = (audChanMasks);

    /* and tell it how many of them there are */
    writeNarrator->nm_masks = sizeof(audChanMasks);

    /* tell it where to find the string to speak */
    writeNarrator->message.io_Data = (APTR)outputstring;

    /* tell it how many characters the translate function returned */
    writeNarrator->message.io_Length = strlen(outputstring);

    /* if nonzero, asks that mouths be calculated during speech */
    writeNarrator->mouths = 1;

    /* tell it this is a write-command */
    writeNarrator->message.io_Command = CMD_WRITE;

/* Open the device */

    error = OpenDevice("narrator.device", 0, writeNarrator, 0);
    if(error != 0) goto cleanup4;

/* SET UP PARAMETERS FOR READ-MESSAGE TO THE NARRATOR DEVICE */

    /* tell narrator for whose speech a mouth is to be generated */
```

```
	readNarrator->voice.message.io_Device =
		writeNarrator->message.io_Device;
	readNarrator->voice.message.io_Unit =
		writeNarrator->message.io_Unit;

	readNarrator->width = 0;
	readNarrator->height = 0; /* initial mouth parameters */

	readNarrator->voice.message.io_Command = CMD_READ;
		/* initial error value */
	readNarrator->voice.message.io_Error = 0;

/* Send an asynchronous write request to the device */

	writeError = SendIO(writeNarrator);
	if(writeError != NULL) { error=CANT_PERFORM_WRITE; goto cleanup5; }
	/* return immediately, run tasks concurrently */

/* keep sending reads until it comes back saying "no write in progress" */

	while((readError = readNarrator->voice.message.io_Error) !=
		ND_NoWrite)
	{
		DoIO(readNarrator);
		/* put task to sleep waiting for a different mouth shape
		 * or return of the message block  with the error field
		 * showing no write in progress
		 */
		DrawMouth(readNarrator->width,readNarrator->height);
		/* user's own unique routine, not provided here */
	}

	Delay(30);

	rtnCode = Translate("No it is not",13,outputstring,500);
	writeNarrator->sex = FEMALE;
	writeNarrator->pitch = MAXPITCH;  /* raise pitch from default value */
	writeNarrator->message.io_Data = (APTR)outputstring;
	writeNarrator->message.io_Length = strlen(outputstring);
	DoIO(writeNarrator);

	Delay(30);

	rtnCode = Translate("Please! I am speaking now!",26,outputstring,500);
	writeNarrator->sex = MALE;
```

```
    writeNarrator->pitch = DEFPITCH;
    writeNarrator->message.io_Data = (APTR)outputstring;
    writeNarrator->message.io_Length = strlen(outputstring);
    DoIO(writeNarrator);

    Delay(30);

    rtnCode = Translate(
            "Well, you are not very interesting, so I am going home!",
            55,outputstring,500);
    writeNarrator->sex = FEMALE;
    writeNarrator->pitch = MAXPITCH;
    writeNarrator->message.io_Data = (APTR)outputstring;
    writeNarrator->message.io_Length = strlen(outputstring);
    DoIO(writeNarrator);

    Delay(30);

    rtnCode = Translate("Bye Bye",7,outputstring,500);
    writeNarrator->sex = MALE;
    writeNarrator->pitch = DEFPITCH;
    writeNarrator->rate = 7;   /* slow him down */
    writeNarrator->message.io_Data = (APTR)outputstring;
    writeNarrator->message.io_Length = strlen(outputstring);
    DoIO(writeNarrator);

cleanup5:
    if(writeNarrator != 0)
            CloseDevice(writeNarrator);
                        /* terminate access to the device */

    /* now return system memory to the memory allocator */

cleanup4:
    if(readNarrator != 0)
            DeleteExtIO(readNarrator,sizeof(struct mouth_rb));
cleanup3:
    if(writeNarrator != 0)
            DeleteExtIO(writeNarrator,sizeof(struct narrator_rb));
cleanup2:
    if(readport != 0)
            DeletePort(readport);
cleanup1:
    if(writeport != 0)
            DeletePort(writeport);
```

```
    cleanup0:
        if(TranslatorBase != 0)
            CloseLibrary(TranslatorBase);
                        /* terminate access to the library */

        if(error != 0) exit(error);
} /* end of test */

DrawMouth(w,h)
SHORT w,h;
{       return(0);          /* dummy routine */ }

int strlen(string)
char *string;
{
        int i,length;
        length = -1;
        for(i=0; i<256; i++) /* 256 characters max length at this time */
            {
            if(*string++ == ' ') { length = i+1; break; };
            }
        return(length);
}
```

The loop continues to send read requests to the narrator device until the write request has completed. Then the program cleans up and exits.

You can experiment with the narrator device by using values other than the default, changing them before the write command is sent to the device.

How to Write Phonetically for Narrator

This section describes in detail the procedure used to specify phonetic strings to the *Narrator* speech synthesizer. No previous experience with phonetics is required. The only thing you may need is a good pronouncing dictionary for those times when you doubt your own ears. You do not have to learn a foreign language or computer language. You are just going to learn how to write down the English that comes out of your own mouth. In writing phonetically you do not have to know how a word is spelled, just how it is said.

Narrator works on utterances at the sentence level. Even if you want to say only one word, Narrator will treat it as a complete sentence. Therefore, Narrator wants one of two punctuation marks to appear at the end of every sentence—a period (.) or a question mark (?). If no punctuation appears at the end of a string, Narrator will append a period to it. The period is used for almost all utterances and will cause a final fall in pitch to occur at the end of a sentence. The question mark is used at the end of yes/no questions only, and results in a final rise in pitch. For example, the question, *Do you enjoy using your Amiga?* would take a question mark at the end because the answer to the question is either yes or no. The question, *What is your favorite color?* would not take a question mark and should be followed by a period. Narrator recognizes other punctuation marks as well, but these are left for later discussion.

PHONETIC SPELLING

Utterances are usually written phonetically using an alphabet of symbols known as I.P.A. (for "International Phonetic Alphabet"). This alphabet is found at the front of most good dictionaries. The symbols can be hard to learn and are not available on computer keyboards, so the Advanced Research Projects Agency (ARPA) came up with *Arpabet,* a way of representing each symbol using one or two upper-case letters. Narrator uses an expanded version of Arpabet to specify phonetic sounds.

A phonetic sound, or *phoneme,* is a basic speech sound, almost a speech atom. Working backwards, sentences can be broken into words, words into syllables, and syllables into phonemes. The word *cat* has three letters and (coincidentally) three phonemes. Looking at the table of phonemes we find the three sounds that make up the word *cat.* They are K, AE, and T, written as KAET. The word *cent* translates as S, EH, N and T, or SEHNT. Notice that both words begin with a *c* but because the *c* says *k* in *cat* we use the phoneme K. In *cent* the *c* says *s* so we use the phoneme S. You may also have noticed that there is no C phoneme.

The above example illustrates that a word rarely sounds like it looks in English spelling. These examples introduce you to a very important concept: spell it like it sounds, not like it looks.

CHOOSING THE RIGHT VOWEL

Phonemes, like letters, are divided into the two categories of vowels and consonants. Loosely defined, a vowel is a continuous sound made with the vocal cords vibrating and air exiting the mouth (as opposed to the nose). All vowels use a two-letter code. A consonant is any other sound, such as those made by rushing air (like S or TH), or by interruptions in air flow by the lips or tongue (like B or T). Consonants use a one- or two-letter code.

In English we write with only five vowels: a, e, i, o and u. It would be easy if we only *said* five vowels. Unfortunately, we say more than 15 vowels. Narrator provides for most of them. You choose the proper vowel by listening. Say the word out loud, perhaps extending the vowel sound you want to hear. Compare the sound you are making to the sounds made by the vowels in the example words to the right of the phoneme list. For example, the *a* in *apple* sounds the same as the *a* in *cat,* not like the *a*s in *Amiga, talk,* or *made.* Notice also that some of the example words in the list do not even use any of the same letters contained in the phoneme code; for example, AA as in *hot.*

Vowels are divided into two groups: those that maintain the same sound throughout their durations and those that change their sound. The ones that change are called *diphthongs.* Some of us were taught the terms *long* and *short* to describe vowel sounds. Diphthongs fall into the long category, but these two terms are inadequate to fully differentiate between vowels and should be avoided. The diphthongs are the last six vowels listed in the table. Say the word *made* out loud very slowly. Notice how the *a* starts out like the *e* in *bet* but ends up like the *e* in *beet.* The *a* therefore is a diphthong in this word and we would use EY to represent it. Some speech synthesis systems require you to specify the changing sounds in diphthongs as separate elements, but Narrator takes care of the assembly of diphthongal sounds for you.

CHOOSING THE RIGHT CONSONANT

Consonants are divided into many categories by phoneticians, but we need not concern ourselves with most of them. Picking the correct consonant is very easy if you pay attention to just two categories: voiced and unvoiced. A voiced consonant is made with the vocal cords vibrating, and an unvoiced one is made when the vocal cords are silent. Sometimes English uses the same letter combinations to represent both. Compare the *th* in *thin* and in *then.* Notice that the first is made with air rushing between the tongue and upper teeth. In the second, the vocal cords are vibrating also. The voiced *th* phoneme is DH, the unvoiced is TH. Therefore, *thin* is spelled TH, IH, N or THIHN, and *then* is spelled DH, EH, N or DHEHN. A sound that is particularly subject to mistakes is voiced and unvoiced *s* spelled Z or S. To put it clearly, *bats* ends in S, *suds* ends in Z. What kind of *s* does *closet* have? How about *close*? Say all of these words out loud to find out. Actually *close* changes its meaning when the *s* is voiced or unvoiced: *I love to be close to you.* versus *What time do you close?*

Another sound that causes some confusion is the *r* sound. There are two different r-like phonemes in the Narrator alphabet: R under the consonants and ER under the vowels. Which one do you use? Use ER if the *r* sound is the vowel sound in the syllable. Words that take ER are *absurd, computer* and *flirt.* Use R if the *r* sound precedes or follows another vowel sound in that syllable, such as in *car, write,* or *craft. Rooster* uses both kinds of *r.* Can you tell which is which?

CONTRACTIONS AND SPECIAL SYMBOLS

There are several phoneme combinations that appear very often in English words. Some of these are caused by our laziness in pronunciation. Take the word *connector* for example. The *o* in the first syllable is almost swallowed out of existence. You would not use the AA phoneme; you would use the AX instead. It is because of this *relaxation* of vowels that we find ourselves using AX and IX very often. Since this relaxation frequently occurs before l, m and n, Narrator has a shortcut for typing these combinations. Instead of *personal* being spelled PERSIXNAXL, we can spell it PERSINUL, making it a little more readable. *Anomaly* goes from AXNAAMAXLIY to UNAAMULIY, and KAAMBIXNEYSHIXN becomes KAAMBINEYSHIN for *combination.* It may be hard to decide whether to use the AX or IX brand of relaxed vowel. The only way to find out is to try both and see which sounds best.

Other special symbols are used internally by Narrator. Sometimes they are inserted into or substituted for part of your input sentence. You can type them in directly if you wish. The most useful is probably the Q or glottal stop; an interruption of air flow in the glottis. The word *Atlantic* has one between the *t* and the *l.* Narrator knows there should be a glottal stop there and saves you the trouble of typing it. But Narrator is only close to perfect, so sometimes a word or word pair might slip by that would have sounded better with a Q stuck in someplace.

STRESS AND INTONATION

It is not enough to tell Narrator what you want said. For the best results you must also tell Narrator how you want it said. In this way you can alter a sentence's meaning, stress important words, and specify the proper accents in polysyllabic words. These things improve the naturalness and thus the intelligibility of Narrator's spoken output.

Stress and intonation are specified by the single digits 1-9 following a vowel phoneme code. Stress and intonation are two different things but are specified by a single number. Stress is, among other things, the elongation of a syllable. Because a syllable is either stressed or not, the presence of a number after the vowel in a syllable indicates stress on that syllable. The value of the number indicates the intonation. From this point onward, these numbers will be referred to as *stress marks.* Intonation here means the pitch pattern or contour of an utterance. The higher the stress mark, the higher the potential for an accent in pitch (a rise and fall). A sentence's basic contour is comprised of a quickly rising pitch gesture up to the first stressed syllable in the sentence, followed by a slowly declining tone throughout the sentence, and finally a quick fall to a low pitch on the last syllable. The presence of additional stressed syllables causes the pitch to break its slow, declining pattern with rises and falls around each stressed syllable. Narrator uses a very sophisticated procedure to generate natural pitch contours based on how you mark the stressed syllables.

HOW AND WHERE TO PUT THE STRESS MARKS

The stress marks go immediately to the right of vowel phoneme codes. The word *cat* has its stress marked after the AE so we get KAE5T or KAE9T. You generally have no choice about the location of a number; there is definitely a right and wrong location. Either a number should go after a vowel or it should not. Narrator will not flag an error if you forget to put a stress mark in or if you place one on the wrong vowel. It will only tell you if a stress mark is in the wrong place, such as after a consonant.

The rules for placing stress marks are as follows:

- o Always place a stress mark in a *content* word. A content word is one that contains some meaning. Nouns, verbs, and adjectives are all content words. *Boat, huge, tonsils* and *hypertensive* are all content words; they tell the listener what you are talking about. Words like *but, the, if* and *is* are not content words. They do not convey any real-world meaning at all but are required to make the sentence function. Thus, they are given the name *function words.*

- o Always place a stress mark on the accented syllable(s) of polysyllabic words, whether they are content or function words. A polysyllabic word is any word of more than one syllable. *Commodore* has its stress (or accent as it is often called) on the first syllable and would be spelled KAA5MAXDOHR. *Computer* is stressed on the second syllable, producing KUMPYUW5TER.

  If you are in doubt about which syllable gets the stress, look the word up in a dictionary and you will find an accent mark over the stressed syllable. If more than one syllable in a word receives stress, they usually are not of equal value. These are referred to as primary and secondary stresses. The word *understand* has its first and last syllables stressed, with *stand* getting primary stress and *un* secondary, which produces AH1NDERSTAE4ND. Syllables with secondary stress should be marked with a value of only 1 or 2.

  Compound words (words with more than one root) such as *base/ball, soft/ware, lunch/wagon,* and *house/boat* can be written as one word but should be thought of as separate words when marking stress. Thus, *lunchwagon* would be spelled LAH5NCHWAE2GIN. Notice that *lunch* got a higher stress mark than *wagon.* This is common in compound words; the first word usually receives the primary stress.

WHAT STRESS VALUE DO I USE?

If you get the spelling and stress mark positions correct, you are 95 percent of the way to a good sounding sentence. The next thing to do is decide on the stress mark values. They can be roughly related to parts of speech, and you can use table 12-1 as a guide to assigning values.

Table 12-1: Recommended Stress Values

Part of Speech	Stress Value	
Nouns	5	
Pronouns	3	
Verbs	4	
Adjectives	5	
Adverbs	7	
Quantifiers	7	
Exclamations	9	
Articles	0	(no stress)
Prepositions	0	
Conjunctions	0	
Secondary stress	1	(sometimes 2)

The above values merely suggest a range. If you want attention directed to a certain word, raise its value. If you want to downplay a word, lower it. Sometimes even a function word can be the focus of a sentence. It is quite conceivable that the word "to" in the sentence "Please deliver this to Mr. Smith." could receive a stress mark of 9. This would add focus to the word "to" indicating that the item should be delivered to Mr. Smith in person.

PUNCTUATION

In addition to the period or question mark that is required at the end of a sentence, Narrator recognizes several other punctuation marks: dashes, commas, and parentheses. The comma goes where you would normally put a comma in an English sentence. It causes Narrator to pause with a slightly rising pitch, indicating that there is more to come. The use of additional commas—that is, more than would be required for written English—is often helpful. They serve to set clauses off from one another. There is a tendency for a listener to lose track of the meaning of a sentence if the words run together. Read your sentence aloud while pretending to be a newscaster. The locations for additional commas should leap out at you.

The dash serves almost the same purpose as the comma, except that the dash does not cause the pitch to rise so severely. A rule of thumb is: Use dashes to divide phrases, commas to divide clauses. For a definition of these terms, consult a high school English book.

Parentheses provide additional information to Narrator's intonation routine. They should be put around noun phrases of two or more content words. This means that the noun phrase, "a giant yacht" should be surrounded with parentheses because it contains two content words, *giant* and *yacht*. The phrase *my friend* should not have parentheses around it because it contains only one content word. Noun phrases can get pretty big, like "the silliest guy I ever saw" or "a big basket of fruit and nuts." The parentheses really are most effective around these large phrases; the smaller ones can sometimes go without. The effect of parentheses is subtle, and in some sentences you might not even notice their presence. In sentences of great length, however, they help provide for a very natural contour.

HINTS FOR INTELLIGIBILITY

There are a few tricks you can use to improve the intelligibility of a sentence. Often, a polysyllabic word is more recognizable than a monosyllabic word. For instance, instead of saying *huge*, say *enormous*. The longer version contains information in every syllable, thus giving the listener three times the chance to hear it correctly. This can be taken to extremes, so try not to say things like "This program has a plethora of insects in it."

Another good practice is to keep sentences to an optimal length. Writing for reading and writing for speaking are two different things. Try not to write a sentence that cannot be easily spoken in one breath. Such a sentence tends to give the impression that the speaker has an infinite lung capacity. Try to keep sentences confined to one main idea. A run-on sentence tends to lose its meaning after a while.

New terms should be highly stressed the first time they are heard. If you are doing a tutorial or something similar, stress a new term at its first occurrence. All subsequent occurrences of that term need not be stressed as highly because it is now "old news."

The above techniques are but a few ways to enhance the performance of Narrator. You will probably find some of your own. Have fun.

EXAMPLE OF ENGLISH AND PHONETIC TEXTS

Cardiomyopathy. I had never heard of it before, but there it was listed as the form of heart disease that felled not one or two but all three of the artificial heart recipients. A little research produced some interesting results. According to an article in the Nov. 8, 1984, *New England Journal of Medicine*, cigarette smoking causes this lethal disease that weakens the heart's pumping power. While the exact mechanism is not clear, Dr. Arthur J. Hartz speculated that nicotine or carbon monoxide in the smoke somehow poisons the heart and leads to heart failure.

KAA1RDIYOWMAYAA5PAXTHIY. AY /HAED NEH1VER HER4D AXV IHT BIXFOH5R, BAHT DHEH5R IHT WAHZ - LIH4STIXD AEZ (DHAX FOH5RM AXV /HAA5RT DIHZIY5Z) DHAET FEH4LD (NAAT WAH5N OHR TUW5) - BAHT (AO7L THRIY5 AXV DHAX AA5RTAXFIHSHUL /HAA5RT RIXSIH5PIYINTS). (AH LIH5TUL RIXSER5CH) PROHDUW5ST (SAHM IH5NTRIHSTIHNX RIXZAH5LTS). AHKOH5RDIHNX TUW (AEN AA5RTIHKUL IHN DHAX NOWVEH5MBER EY2TH NAY5NTIYNEYTIYFOH1R NUW IY5NXGLIND JER5NUL AXV MEH5DIXSIN), (SIH5GEREHT SMOW5KIHNX) KAO4ZIHZ

(DHIHS LIY5THUL DIHZIY5Z) DHAET WIY4KINZ (DHAX /HAA5RTS PAH4MPIHNX PAW2ER). WAYL (DHIY IHGZAE5KT MEH5KINIXZUM) IHZ NAAT KLIY5R, DAA5KTER AA5RTHER JEY2 /HAA5RTS SPEH5KYULEYTIHD DHAET NIH5KAXTIYN OHR KAA5RBIN MUNAA5KSAYD IHN DHAX SMOW5K - SAH5M/HAW1 POY4ZINZ DHAX /HAA5RT - AEND LIY4DZ TUW (/HAA5RT FEY5LYER).

CONCLUDING REMARKS

This guide should get you off to a good start in phonetic writing for Narrator. The only way to get really proficient is to practice. Many people become good at it in as little as one day. Others make continual mistakes because they find it hard to let go of the rules of English spelling, so trust your ears.

The More Technical Explanation

The *SoftVoice* speech synthesis system is a computer model of the human speech production process. It attempts to produce accurately spoken utterances of any English sentence, given only a phonetic representation as input. Another program in the system, *Translator*, derives the required phonetic spelling from English text. Timing and pitch contour are produced automatically by the synthesizer software.

In humans, the physical act of producing speech sounds begins in the lungs. To create a voiced sound, the lungs force air through the vocal folds (sometimes called the vocal cords), which are held under tension and which periodically interrupt the flow of air, thus creating a buzz-like sound. This buzz, which has a spectrum rich in harmonics, then passes through the vocal tract and out the lips, which alters its spectrum drastically. This is because the vocal tract acts as a frequency filter, selectively reinforcing some harmonics and suppressing others.

It is this filtering that gives a speech sound its identity. The amplitude versus frequency graph of the filtering action is called the *vocal tract transfer function.* Changing the shape of the throat, tongue, and mouth retunes the filter system to accent different frequencies.

The sound travels as a pressure wave through the air, and it causes the listener's eardrum to vibrate. The ear and brain of the listener decodes the incoming frequency pattern. From this the listener can subconsciously make a judgment about what physical actions were performed by the speaker to make the sound. Thus the speech chain is completed, the speaker having encoded his physical actions on a buzz via selective filtering and the listener having turned the sound into guesses about physical actions by frequency decoding.

Now that we know how we do it, how does a machine do it? It turns out that the vocal tract is not random, but tends to accentuate energy in narrow regions called *formants*. The formant positions move smoothly as we speak, and it is the formant frequencies to which our ears are sensitive. So, luckily, we do not have to model throat, tongue, teeth and lips with our computer, we can imitate formant action.

A good representation of speech requires up to five formants, but only the lowest three are required for intelligibility. We begin with an oscillator that produces a waveform similar to that which is produced by the vocal folds, and we pass it through a series of resonators, each tuned to a different formant frequency. By controlling the volume and pitch of the oscillator and the frequencies of the resonators, we can produce highly intelligible and natural-sounding speech. Of course the better the model, the better the speech; but more importantly, experience has shown that the better the control of the model's parameters, the better the speech.

Oscillators, volume controls and resonators can all be simulated mathematically in software, and it is by this method that the SoftVoice system operates. The input phonetic string is converted into a series of target values for the various parameters illustrated. A system of rules then operates on the string to determine things such as the duration of each phoneme and the pitch contour. Transitions between target values are created and smoothed to produce natural continuous changes from one sound to the next.

New values are computed for each parameter for every 8 milliseconds of speech, which produces about 120 acoustic changes per second. These values drive a mathematical model of the speech synthesizer. The accuracy of this simulation is quite good. Human speech has more formants than the SoftVoice model, but they are low in energy content.

The human speech production mechanism is a complex and wonderful thing. The more we learn about it, the better we can make our computer simulations. Meanwhile, we can use synthetic speech as yet another computer output device to enhance the man/machine dialogue.

Table of Phonemes

Table 12-2 lists all the available phonemes.

Table 12-2: Phonemes

Vowels

Phoneme	Example	Phoneme	Example
IY	beet	IH	bit
EH	bet	AE	bat
AA	hot	AH	under
AO	talk	UH	look
ER	bird	OH	border
AX*	about	IX*	solid

*AX and IX should never be used in stressed syllables.

Diphthongs

Phoneme	Example	Phoneme	Example
EY	made	AY	hide
OY	boil	AW	power
OW	low	UW	crew

Consonants

Phoneme	Example	Phoneme	Example
R	red	L	yellow
W	away	Y	yellow
M	men	N	men
NX	sing	SH	rush
S	sail	TH	thin
F	fed	ZH	pleasure
Z	has	DH	then
V	very	J	judge
CH	check	/C	loch
/H	hole	P	put
B	but	T	toy
D	dog	G	guest
K	Commodore		

Special Symbols

Phoneme	Example	
DX	pity	(tongue flap)
Q	kitt_en	(glottal stop)
QX	pause	(silent vowel)
RX	car	(postvocalic
LX	call	R and L)

Contractions

(see text)

UL	=	AXL
IL	=	IXL
UM	=	AXM
IM	=	IXM
UN	=	AXN
IN	=	IXN

Digits and Punctuation

Digits 1-9	Syllabic stress, ranging from secondary through emphatic
.	Period—sentence final character
?	Question mark—sentence final character
-	Dash—phrase delimiter
,	Comma—clause delimiter
( )	Parentheses—noun phrase delimiters (see text)

Chapter 13

Serial Device

This chapter describes software access to the serial port. The serial device is accessed via the standard system device-access routines and provides some additional functions specifically appropriate to use of this device.

Introduction

The serial device can be opened in either exclusive access mode or shared mode. It can be set to transmit and receive many different baud rates (send and receive baud rates are identical). It can support a seven-wire handshaking as well as a three-wire interconnect to a serial hardware device. Handshaking and access mode must be specified before the serial device is opened. Other serial parameters can be specified using the **SDCMD_SETPARAMS** command after the device has been opened.

Opening the Serial Device

Typically, you open the serial device by using the following function calls:

```
LONG error;
struct Port *mySerPort;
struct IOExtSer *mySerReq;

/* create a reply port to which serial device can return the request */
mySerPort = CreatePort("mySerial",0);
if(mySerPort == NULL) exit(100);          /* can't create port? */

/* create a request block appropriate to serial */
mySerReq = (struct IOExtSer *)CreateExtIO(mySerPort,
                sizeof(struct IOExtSer));
if(mySerReq == NULL) goto cleanup1;       /* error during CreateExtIO? */

mySerReq->io_SerFlags = 0;
/* Accept the default, i.e., exclusive Access and XON/XOFF protocol
 * is enabled. Remaining flags all zero, see devices/serial.h
 * for bit-positions. Definitions included in this chapter. */

error = OpenDevice("serial.device",0,mySerReq,0);
if(error != 0) goto cleanup2;  /* device not available? */

...
cleanup2:
  DeleteExtIO(mySerReq,sizeof(struct IOExtSer));
cleanup1:
  DeletePort(mySerPort);
```

The routines **CreatePort()** and **DeletePort()** are part of amiga.lib. Information about the routines **CreateExtIO()** and **DeleteExtIO()** can be found in the appendixes of the *Amiga ROM Kernel Reference Manual: Exec.*

During the open, the only flags that the serial device pays any attention to are the shared/exclusive-access flag and the seven-wire flag (the seven-wire flag enables RS-232-C DTR/DSR,RTS/CTS handshaking protocol). All other bits in **io_SerFlags** are ignored. However, for consistency, the other flag bits should be set to zero when the device is opened.

When the serial device is opened, it opens the timer device and then allocates an input buffer of the size last used (default and minimum = 512 bytes). As with any of the other serial port parameters, you can later change the value used for the read buffer size with the **SDCMD_SETPARMS** command. The **OpenDevice()** routine will fill the latest parameter settings into the **io_Request** block.

Once the serial device is opened, all characters received will be saved, even if there is no current request for them. Note that a parameter change cannot be performed while an I/O request is actually being processed, because it would invalidate request-handling already in progress. Therefore you must use **SDCMD_SETPARAMS** only when you have no serial I/O requests pending.

Reading from the Serial Device

You read from the serial device by sending your **IORequest** (**IOExtSer**) to the device with a read command. You specify how many bytes are to be transferred and where the data is to be placed. Depending on how you have set your parameters, the request may read the requested number of characters or it may terminate early.

Here is a sample read command:

```
char myDataArea[100];
mySerReq->IOSer.io_Data = &myDataArea[0];  /* where to put the data */
mySerReq->IOSer.io_Length = 100;            /* read 100 characters */
mySerReq->IOSer.io_Command = CMD_READ;/* say it is a read */
DoIO(mySerReq);                             /* synchronous request */
```

If you use this example, your task will be put to sleep waiting until the serial device reads 100 bytes (or terminates early) and copies them into your read-buffer. Early termination can be caused by error conditions or by the serial device sensing an end of file condition.

Note that the **io_Length** value, if set to -1, tells the serial device that you want to read a null-terminated string. The device will read all incoming characters up to and including a byte value of 0x00 in the input stream and will then report to you an **io_Actual** value that is the actual length of the string, excluding the 0 value. Be aware that you must encounter a 0 value in the input stream before the system fills up the buffer you have specified. The **io_Length** is, for all practical purposes, indefinite. Therefore, you could potentially overwrite system memory if you never encountered the null termination (zero value byte) in the input stream.

FIRST ALTERNATIVE MODE FOR READING

As an alternative to **DoIO()** you can use **SendIO()** to transmit the command to the device. In this case, your task can go on to do other things while the serial device is collecting the bytes for you. You can occasionally do a **CheckIO(mySerReq)** to see if the I/O is completed.

```
struct Message *myIO;

/* same code as in above example, except: */
SendIO(mySerReq);

      /* do something */
      /* (user code)  */
myIO = CheckIO(mySerReq);
if(myIO != FALSE) goto ioDone;  /* this IO is done */

      /* do something else */
      /* (user code) */
WaitIO(mySerReq);
myIO = mySerReq;       /* if had to wait, need a value for myIO */
}
ioDone:
      Remove(mySerPort->mp_MsgList,myIO);
/* use the Remove function rather than the GetMsg function */

/* now check for errors, and so on. */
```

The **Remove()** function is used instead of the **GetMsg()** function to demonstrate that you might have established only one port at which all of your I/O requests will be returned, and you may be checking each request, in turn, with **CheckIO()** to see if it has completed (maybe a disk request, a serial request and a parallel request, all simultaneously outstanding, all using **SendIO()** to transmit their commands to the respective devices).

It is possible that while you are doing other things and checking for completion of I/O, one device may complete its operations and append its message block to your reply port while you are about to check the status of a later-arriving block. If you find that this later one has completed and you call **GetMsg()**, you will remove whichever message is at the head of the list. This message may not necessarily be the one you expect to be removing from the port. **CheckIO()** returns the address of the **IORequest** if the I/O is complete, and you can use this address for the **Remove()** function to remove the correct request block for processing and reuse.

SECOND ALTERNATIVE MODE FOR READING

Instead of transmitting the read command with either **DoIO()** or **SendIO()**, you might elect to use **BeginIO()**, (the lowest level interface to a device) with the "quick I/O" bit set in the **io_Flags** field.

```
/* same code as in read example, except: */
mySerReq->IOSer.io_Flags = IOF_QUICK; /* use QUICKIO */

BeginIO(mySerReq);
```

The serial device may support quick I/O for certain read requests. As documented in the "Input/Output" chapter in *Amiga ROM Kernel Reference Manual: Exec*, this command may be synchronous or asynchronous. Any write request always clears the quick I/O bit. Various read commands may or may not clear it, depending on whether or not quick I/O occurs.

After executing the code shown above, your program needs to know if the I/O happened synchronously, and it must also test to see if the I/O took place.

```
if((mySerReq->IOSer.io_Flags & IOF_QUICK) == 0)
    {
    /* QUICKIO couldn't happen for some reason, so it did it normally...
     * queued the request, cleared the QUICKIO bit, and used the equivalent
     * of SendIO. Might want to have the task doing something else while
     * awaiting the completion * of the I/O. After knowing it is done, must
     * remove the message from the reply port for possible reuse.
     */
    WaitIO(mySerReq);
        /* assumes single-threaded I/O, as compared to
         * the SendIO() example in the previous section */
    }
else
    {
    /* If flag is still set, IO was synchronous, IORequest was NOT appended
     * to the reply port and there is no need to remove the message from
     * the reply port; continue on with something else.
     */
    ;
    }
```

The way you read from the device depends on your need for processing speed. Generally the **BeginIO()** route provides the lowest system overhead when quick I/O is possible. However, if quick I/O did not work, it still requires some overhead for handling of the **IORequest** block.

TERMINATION OF THE READ

Reading from the serial device can terminate early if an error occurs or if an end-of-file is sensed. You can specify a set of possible end-of-file characters that the serial device is to look for in the input stream. These are contained in an **io_TermArray** that you provide, using the **SDCMD_SETPARAMS** command. *Note*: **io_TermArray** is used only when EOF mode is selected.

If EOF mode is selected, each input data character read into the user's data block is compared against those in **io_TermArray**. If a match is found, the **IORequest** is terminated as complete, and the count of characters read (including the **TermChar**) is stored in **io_Actual**. To keep this search overhead as efficient as possible, the serial device requires that the array of characters be in descending order (an example is shown in the summary page in the "Device Summaries" appendix for **SDCMD_SETPARAMS**). The array has eight bytes and all must be valid (that is, do not pad with zeros unless zero is a valid EOF character).

Fill to the end of the array with the least value **TermChar**. When making an arbitrary choice of EOF character(s), it is advisable to use the lowest value(s) available.

Writing to the Serial Device

You can write to the serial device as well as read from it. It may be wise to have a separate block for reading and writing to allow simultaneous operation of both reading and writing. The sample code below creates a separate reply port and request for writing to the serial device. Note that it assumes that the **OpenDevice()** function worked properly for the read. It copies the initialized read request block to initialize the write request block. Error-checking has been deliberately left out of this code fragment for brevity but should, of course, be provided in a functional program.

```
/* code fragment to "clone" an existing serial I/O request block instead of
 * opening the device once for read and once for write */

      /* pointer to an existing serial read request block initialized by a
       * call to OpenDevice(SERIALNAME,0,mySerReq,0) */
struct IOExtSer *mySerReq;
LONG i;
BYTE *b,*c;

struct Port *mySerWritePort;      /* pointer to a MsgPort at which to receive
                                   * replies to write requests */
struct IOExtSer *mySerWriteReq; /* pointer to a new request block for serial
                                   * communications */
```

```
mySerWritePort = CreatePort("mySerialWrite",0);

mySerWriteReq = (struct IOExtSer *)CreateExtIO(mySerWritePort,
                sizeof(struct IOExtSer));

b = (BYTE *)mySerReq;            /* start of read request block */
c = (BYTE *)mySerWriteReq;       /* start of write request block */

for(i=0; i< sizeof(struct IOExtSer); i++)
     *c++ = *b++;
mySerWriteReq->IOSer.io_Message.mn_ReplyPort = mySerWritePort;
/* clones the request block on a byte by byte basis */
/* Note: it might simply be easier here to have opened the serial device
 * twice. This would reflect the fact that there are two "software entities"
 * that are currently using the device. However, if you are using exclusive
 * access mode, this is not possible and the request block must be copied anyway.
 */
```

Note that this code would require the following clean-up at the termination of the program:

```
cleanupWriteIO:
     DeleteExtIO(mySerWriteReq);
cleanupWritePort:
     DeletePort(mySerWritePort);
```

Now, to perform a write:

```
char dataToWrite[100];
mySerReq->IOSer.io_Data = &dataToWrite[0]; /* where to get the data */
mySerReq->IOSer.io_Length = n;            /* write n characters */
mySerReq->IOSer.io_Command = CMD_WRITE;     /* say it is a write */
DoIO(mySerReq);                           /* synchronous request */
```

You can use the **SendIO()** or **BeginIO()** functions as well as **DoIO()**. The same warnings apply as shown above in the discussions about alternative modes of reading.

Note that if **io_Length** is set to -1, the serial device will output your serial buffer until it encounters a value of 0x00 in the data. It transmits this 0 value in addition to the data to match the technique used for serial read shown above. (You can also read data zero-terminated).

Setting Serial Parameters

You can control the following serial parameters. The parameter name within the serial data structure is shown in table 13-1. All of the fields described in this section are filled in when you call **OpenDevice()** to reflect the current settings of the serial device. Thus, you need not worry about any parameter that you do not need to change.

Table 13-1: Serial Parameters

Parameter Name	Characteristic It Controls
io_CtlChar	Control characters to use for xON, xOFF, INQ, ACK respectively. Positioned within an unsigned longword in the sequence from low address to high as listed. INQ and ACK handshaking is not currently supported.
io_RBufLen	Size of the buffer that the serial device should allocate for incoming data. Minimum size is 512 bytes. It will not accept a smaller value. This buffer is dynamically allocated by the serial device. If, as you do an **SDCMD_SETPARAMS** command, it senses a difference between its current value and the value of buffer size you request, it deallocates the old buffer and allocates a new one. Note that it discards all characters that may already be in that old buffer and that you may not have yet had a chance to read. Thus it is wise to make sure that you do not attempt buffer size changes (or any change to the serial device, for that matter) while any I/O is actually taking place.
io_ExtFlags	Reserved for future use.
io_Baud	The real baud rate you wish to use. A long value from 110 to 292,000. When a value of 110 is requested, it defaults to 112 (the lowest value the hardware can support). Although baud rates above 19,200 are supported by the hardware, software overhead may limit your ability to "catch" every single character that should be received. Output data rate, however, is not software-dependent.
io_BrkTime	If you issue a break command, this variable specifies how long, in microseconds, the break condition lasts. This value controls the break time for all future break commands until modified by another **SDCMD_SETPARAMS**.

io_TermArray A byte-array of eight termination characters, must be in descending order. If EOFMODE is set in the serial flags, this array specifies eight possible choices of character to use as an end of file mark. See the section above titled "Termination of the Read" and the **SDCMD_SETPARAMS** summary page in the "Device Summaries" appendix for more information.

io_ReadLen How many bits per read character; typically a value of 7 or 8.

io_WriteLen How many bits per write character; typically a value of 7 or 8.

io_StopBits How many stop bits are to be expected when reading a character and to be produced when writing a character; typically 1. A value of 2 is allowed if **io_WriteLen** = 7.

io_SerFlags Explained below; see "Serial Flags."

Bit	Active	Function
0	low	Busy
1	low	Paper out
2	low	Select
3	low	Data set ready
4	low	Clear to send
5	low	Carrier detect
6	low	Ready to send
7	low	Data terminal ready
8	high	Read overrun
9	high	Break sent
10	high	Break received
11	high	Transmit x-OFFed
12	high	Receive x-OFFed
13-15	(not)	(reserved)

SERIAL FLAGS

Table 13-2 shows the flags that can be set to affect the operation of the serial device. Note that the default state of all of these flags is zero.

Flag Name	Effect on Device Operation
SERB_XDISABLED	Disable XON-XOFF feature.
SERB_EOFMODE	Set this bit if you want the serial device to check I/O characters against **io_TermArray** and to terminate the **IORequest** immediately if an end-of-file character has been encountered. *Note*: This bit can be set and reset directly in the user's **IORequest** (**IOExtSer**) block without a call to **SDCMD_SETPARAMS**.
SERB_SHARED	Set this bit if you want to allow other tasks to simultaneously access the serial port. The default is exclusive-access. If someone already has the port, whether for exclusive or shared access, and you ask for exclusive-access, your **OpenDevice()** call will fail (should be modified only at **OpenDevice()**).
SERB_RAD_BOOGIE	If set, this bit activates high-speed mode. Certain peripheral devices (MIDI, for example) may require high serial throughput. Setting this bit high causes the serial device to skip certain of its internal checking code to speed throughput. In particular, it: - Disables parity checking - Bypasses XON/XOFF handling - Uses only 8-bit character length - Will not test for a break signal - Automatically sets SERB_XDISABLED bit Note that the Amiga is a multitasking system and has immediate processing of software interrupts. If there are other tasks running, it is possible that the serial driver may be unable to keep up with high data transfer rates, even with this bit set.
SERB_QUEUEDBRK	If set, every break command that you transmit will be enqueued. This means that the current serial output commands will be executed in sequence. Then the break command will be executed, all on a FIFO (first in, first out) basis. If this bit is cleared (the default), a break command takes immediate precedence over any serial output already enqueued. When the break command has finished, the interrupted request will continue (if it is not aborted by the user).

SERB_7WIRE	If set (should be established only at **OpenDevice()**), the serial device is to use a seven-wire handshaking for RS-232-C communications. Default is three-wire (pins 2, 3, and 7).
SERB_PARTY_ODD	If set, selects odd parity. If clear, selects even parity.
SERB_PARTY_ON	If set, parity usage and checking is enabled.

SETTING THE PARAMETERS

You set the serial parameters by setting the flags and parameters as you desire and then transmitting the command **SDCMD_SETPARAMS** to the device. Here is an example:

```
mySerReq->IOSer.io_SerFlags &= ~ SERF_PARTY_ODD;     /* 'and' with inv
mySerReq->IOSer.io_SerFlags |= SERF_QUEUEDBRK | SERF_PARTY_ON;
mySerReq->io_BrkTime = 500000;     /* 500k microseconds = 1/2 second */
mySerReq->IOSer.io_Command = SDCMD_SETPARAMS;
DoIO(mySerReq);                     /* synchronous request */
```

The above command would set the bits for queued break and even parity while leaving the other flags unchanged. Notice the difference between the flag names and the flags that you actually set using C. "SERB..." is the name applied to the bit position within the flag word. "SERF..." is the name of a 1 bit in a mask at that bit position.

Errors from the Serial Device

The possible error returns from the serial device are listed in table 13-3.

Table 13-3: Serial Device Errors

```
#define SerErr_DevBusy          1
#define SerErr_BaudMismatch     2
#define SerErr_InvBaud          3
#define SerErr_BufErr           4
#define SerErr_InvParam         5
#define SerErr_LineErr          6
#define SerErr_NotOpen          7
#define SerErr_PortReset        8
#define SerErr_ParityErr        9
#define SerErr_InitErr          10
#define SerErr_TimerErr         11
#define SerErr_BufOverflow      12
#define SerErr_NoDSR            13
#define SerErr_NoCTS            14
#define SerErr_DetectedBreak    15
```

Closing the Serial Device

When the (final, if shared access) **CloseDevice()** is performed, the input buffer is deallocated, the timer device is closed, and the latest parameter settings are saved for the next open.

Typically, you close the serial device with the following function call:

CloseDevice(mySerReq);

This assumes that the serial device has completed all activities you have requested and has returned all I/O requests to you.

When you have finished with the serial device, it is up to you to deallocate any memory and dependencies you might have used for the serial device communications. If you have used the techniques shown earlier in this chapter to establish the communications in the first place, your clean-up typically will consist of the following code:

```
cleanup2:
  DeleteExtIO(mySerReq,sizeof(struct IOExtSer));
cleanup1:
  DeletePort(mySerPort);
cleanupWriteIO:
  DeleteExtIO(mySerWriteReq);
cleanupWritePort:
  DeletePort(mySerWritePort);
```

Example Program

Here is an example program that uses static rather than dynamic allocation of the **IOExtSer** request block. It assumes that you have connected a serial terminal device to the Amiga serial port, and it uses the baud rate you have established in Preferences. The program outputs the following status lines to the CLI window:

Serial device opened and accepted parameters

Testing character exact-count output thru SendWaitWrite

Test string length of -1 (make system find end of string)

Type 16 characters to send to Amiga...

If no external terminal is attached, waits forever!

and outputs the following lines to the external terminal:

Device opened ok

User counts characters in string to send, or if null-terminated string, says '-1'

Types 16 characters to send to Amiga

At this point, you must type 16 characters on your external terminal. This sample program does not echo characters that you type, so you will not see anything more until all 16 have been typed. Finally the program will respond (to the external terminal) with:

You typed these printable characters:
<here it lists the 16 characters>
End of test
54321.....exit

Then the program exits, printing "Test completed!" to the CLI window.

```
#include        "exec/types.h"
#include        "exec/nodes.h"
#include        "exec/lists.h"
#include        "exec/ports.h"
#include        "exec/libraries.h"
#include        "exec/devices.h"
#include        "exec/io.h"
#include        "devices/serial.h"

struct IOExtSer *IORser;
struct MsgPort *port;
char   buffer[200];
extern struct MsgPort *CreatePort();
extern struct IORequest *CreateExtIO();

/* Note:  to run this program, you must have an external terminal, set
 * at 9600 baud, attached to the Amiga serial port.  Additionally the
 * serial.device file must be located in the directory currently
 * assigned to DEVS: (to check this, in AmigaDOS, type:  ASSIGN
 * then check the directory (usually the boot CLI disk volume, devs directory.)
 */

main()
{
      int     error;
      int     actual;
      unsigned long rbl;
      unsigned long brk;
      unsigned long baud;
      unsigned char rwl;
      unsigned char wwl;
      unsigned char sf;
      unsigned long t0;
      unsigned long t1;

      /* SET UP the message port in the I/O request */
      port = CreatePort (SERIALNAME,0);
      if (port == NULL) {
            printf("\nProblems during CreatePort");
            exit(100);
      }

      /* Create the request block for passing info
```

```
 * to and from the serial device. */

	IORser = (struct IOExtSer *)CreateExtIO(port,sizeof(struct IOExtSer));
	if (IORser == NULL)
	{
		printf("\nProblems during CreateExtIO");
		goto cleanup1;
	}

open:
	/* OPEN the serial.device */
	if ((error = OpenDevice (SERIALNAME, 0, IORser, 0)) != 0) {
		printf ("Serial device did not open, error = %ld",error);
		goto cleanup1;
	}

	/*	SET PARAMS for the serial.device */
	rbl = 4096;
	rwl = 0x08;
	wwl = 0x08;
	brk = 750000;
	baud= 9600;
	sf  = 0x00;
	t0  = 0x51040303;
	t1  = 0x03030303;

	if ((error = SetParams (IORser,rbl,rwl,wwl,brk,baud,sf,t0,t1)) != 0) {
		printf ("Set parameters command returned an error: %ld",error);
		goto cleanup2;
	}

	printf("\nSerial Device opened and accepted parameters");
	WriteSer (IORser,"\n\015Device opened ok\n\015", -1);

	printf("\nTesting character exact-count output thru SendWaitWrite");
	SendWaitWrite (IORser,
		"User counts characters in string to send\n\015", 42);

	printf("\nTest string length of -1 (make system find end of string)");
	SendWaitWrite (IORser,
		"or if null terminated string, say '-1'\n\015", -1);

	printf("\nType 16 characters to send to amiga...");
	printf("\nIf no external terminal is attached, waits forever!!");
	WriteSer (IORser,
```

```
        "\n\015Type 16 characters to send to amiga\n\015", -1);
    actual = ReadSer (IORser,buffer,16);
    WriteSer (IORser,
        "\n\015You typed these printable characters:\n\015", -1);
    WriteSer (IORser,buffer, actual);
    WriteSer (IORser,"\n\015End of test\n\015", -1);
    WriteSer (IORser,"54321.....exit\n\015", 16);
    printf("\nTest completed!\n");

    /* CLOSE the serial.device */
cleanup2:
    CloseDevice (IORser);
cleanup1:
    DeletePort (port);
    exit (0);
}

/* SERIAL I/O functions */

SetParams(io,rbuf_len,rlen,wlen,brk,baud,sf,ta0,ta1)

struct IOExtSer *io;
unsigned long rbuf_len;
unsigned char rlen;
unsigned char wlen;
unsigned long brk;
unsigned long baud;
unsigned char sf;
unsigned long ta0;
unsigned long ta1;

{
    int error;

    io->io_ReadLen      = rlen;
    io->io_BrkTime      = brk;
    io->io_Baud         = baud;
    io->io_WriteLen     = wlen;
    io->io_StopBits     = 0x01;
    io->io_RBufLen      = rbuf_len;
    io->io_SerFlags     = sf;
    io->IOSer.io_Command = SDCMD_SETPARAMS;
    io->io_TermArray.TermArray0 = ta0;
    io->io_TermArray.TermArray1 = ta1;
```

```
	if ((error = DoIO (io)) != 0) {
		printf ("serial.device setparams error %ld \n", error);
	}
	return (error);
}

ULONG ReadSer(io,data,length)
struct IOExtSer *io;
char *data;
ULONG length;
{
	int error;

	io->IOSer.io_Data = (APTR)data;
	io->IOSer.io_Length = length;
	io->IOSer.io_Command = CMD_READ;

	if ((error = DoIO (io)) != 0) {
		printf ("serial.device read error %ld \n", error);
	}
	return (io->IOSer.io_Actual);
}


WriteSer(io,data,length)
struct IOExtSer *io;
char *data;
int length;
{
	int	error;

	io->IOSer.io_Data = (APTR)data;
	io->IOSer.io_Length = length;
	io->IOSer.io_Command = CMD_WRITE;

	if ((error = DoIO (io)) != 0) {
		printf ("serial.device write error %ld \n", error);
	}
	return (error);
}

ULONG SendWaitWrite(io,data,length)
struct IOExtSer *io;
char *data;
int length;
```

```
{
        int     error;

        io->IOSer.io_Data = (APTR)data;
        io->IOSer.io_Length = length;
        io->IOSer.io_Command = CMD_WRITE;

        SendIO (io);

        if ((error = WaitIO (io)) != 0) {
                printf ("serial.device waitio error %ld \n", error);
        }
        return (io->IOSer.io_Actual);
}
```

Chapter 14

Parallel Device

This chapter describes software access to the parallel port. The parallel device is accessed via the standard system device access routines and provides some additional functions specifically appropriate to use of this device.

Introduction

The parallel device can be opened either in exclusive-access or shared mode. Other parallel device parameters can be specified using the PDCMD_SETPARAMS command after the device has been opened.

Opening the Parallel Device

Typically, you open the parallel device by using the following function calls:

```
LONG error;
struct Port *myParPort;
struct IOExtPar *myParReq;

/* create a reply port to which parallel
 * device can return the request */
myParPort = CreatePort("myParallel",0);
if(myParPort == NULL) exit(100);    /* can't create port? */

/* create a request block appropriate to parallel */
myParReq = (struct IOExtPar *)CreateExtIO(myParPort,
                sizeof(struct IOExtPar));
if(myParReq == NULL) goto cleanup1; /* error during CreateExtIO? */

myParReq->io_ParFlags = 0;
/* accept the default, i.e., exclusive access. Remaining flags all zero,
 * see devices/parallel.h for bit-positions. Definitions included in this
 * chapter. */

error = OpenDevice("parallel.device",0,myParReq,0);
if(error != 0) goto cleanup2; /* device not available? */

...
cleanup2:
  DeleteExtIO(myParReq,sizeof(struct IOExtPar));
cleanup1:
  DeletePort(myParPort);
```

The routines **CreatePort()** and **DeletePort()** are part of amiga.lib. Information about the routines **CreateExtIO()** and **DeleteExtIO()** can be found in the appendixes of the *Amiga ROM Kernel Reference Manual: Exec.*

The parallel device is disk-resident. If it has not yet been loaded from disk, it will be read from *DEVS:parallel.device* on the boot AmigaDOS disk. Its parameters will be set up from default values.

During the opening process, the only flag used by the parallel device is the shared/exclusive-access flag. For consistency, however, the other flag bits should be set to zero when the device is opened.

When the parallel device is opened, it opens the timer device and fills the latest parameter settings into the **io_Request** block. The **OpenDevice()** routine will fill the latest parameter settings into the **io_Request** block. Note that a parameter change cannot be performed while an I/O request is being processed, because it would invalidate request handling already in progress. Therefore, you must use **PDCMD_SETPARAMS** only when you have no parallel I/O requests pending.

Reading from the Parallel Device

You read from the parallel device by sending your **IORequest** (**IOExtPar**) to the device with a read command. You specify how many bytes are to be transferred and where the data is to be placed. Depending on how you have set your parameters, the request may read the requested number of characters, or it may terminate early.

Here is a sample read command:

```
char myDataArea[100];
myParReq->IOPar.io_Data = &myDataArea[0]; /* where to put the data */
myParReq->IOPar.io_Length = 100;          /* read 100 characters */
myParReq->IOPar.io_Command = CMD_READ;    /* say it is a read */
DoIO(myParReq);                           /* synchronous request */
```

If you use this example, your task will be put to sleep waiting until the parallel device reads 100 bytes (or terminates early) and copies them into your read-buffer. Early termination can be caused by error conditions or by the parallel device sensing an end-of-file condition.

Note that the **io_Length** value, if set to -1, tells the parallel device that you want to read a null-terminated string. The device will read all incoming characters up to and including a byte value of 0x00 in the input stream, then report to you an **io_Actual** value that is the actual length of the string, excluding the 0 value. Be aware that you must encounter a 0 value in the input stream before the system fills up the buffer you have specified. The **io_Length** is, for all practical purposes, indefinite. Therefore, you could potentially overwrite system memory if you never encountered the null termination (zero-value byte) in the input stream.

ALTERNATIVE MODE FOR READING

As an alternative to **DoIO()**, you can use **SendIO()** to transmit the command to the device. In this case, your task can go on to do other things while the parallel device is collecting the bytes for you. You can occasionally do a **CheckIO(myParReq)** to see if the I/O is completed.

```
struct Message *myIO;

/* same code as in above example, except: */
SendIO(myParReq);

     /* do something */
     /* (user code)  */
myIO = CheckIO(myParReq);
if(myIO != FALSE) goto ioDone;          /* this IO is done */

     /* do something else */
     /* (user code) */
WaitIO(myParReq);
myIO = myParReq;      /* if had to wait, need a value for myIO */
}
ioDone:
     Remove(myParPort->mp_MsgList,myIO);
/* use the Remove function rather than the GetMsg function */

/* now check for errors, and so on. */
```

The **Remove()** function is used instead of the **GetMsg()** function to demonstrate that you might have established only one port at which all of your I/O requests will be returned, and you may be checking each request in turn with **CheckIO()** to see if it has completed. These requests could be, for example, a disk request, a parallel request, and a serial request, all simultaneously outstanding and all using **SendIO()** to transmit their commands to the respective devices.

It is possible that while you are doing other things and checking for completion of I/O, one device may complete its operations and append its message block to your reply port when you are about to check the status of a later-arriving block. If you find that this later one has completed and you call **GetMsg()**, you will remove the message at the head of the list. This message may not necessarily be the one you expect to remove from the port. **CheckIO()** returns the address of the **IORequest** if the I/O is complete, and you can use this address for the **Remove()** function to remove the correct request block for processing and reuse.

TERMINATION OF THE READ

Reading from the parallel device can terminate early if an error occurs or if end of file is sensed. You can specify a set of possible end-of-file characters that the parallel device is to look for in the input stream. These are contained in an **io_TermArray** that you provide, using the **PDCMD_SETPARAMS** command. *Note*: **io_TermArray** is used only when EOF mode is selected.

If EOF mode is selected, each input data character that is read into the user's data block is compared against those in **io_TermArray**. If a match is found, the **IORequest** is terminated as complete, and the count of characters read (including the **TermChar**) is stored in **io_Actual**. To keep this search overhead as efficient as possible, the parallel device requires that the array of characters be in descending order (an example is shown in the **PDCMD_SETPARAMS** summary in the "Device Summaries" appendix. The array has eight bytes and all must be valid (that is, do not pad with zeros unless zero is a valid EOF character). Fill to the end of the array with the least-value **TermChar**. When making an arbitrary choice of EOF character(s), it is advisable to use the lowest value(s) available.

Writing to the Parallel Device

You can write to the parallel device as well as read from it. It may be wise to have a separate **IORequest** block for reading and writing to allow both operations to take place simultaneously. If you wish to queue multiple commands to the parallel device (either read or write commands), it is acceptable to clone (copy) the I/O request block you receive from the call to **OpenDevice()**. A sample of cloning code is shown in the "Serial Device" chapter.

To perform a write:

```
char dataToWrite[100];
myParReq->IOPar.io_Data = &dataToWrite[0]; /* where to get the data */
myParReq->IOPar.io_Length = n;             /* write n characters */
myParReq->IOPar.io_Command = CMD_WRITE; /* say it is a write */
DoIO(myParReq);                        /* synchronous request */
```

You can use the **SendIO()** or **BeginIO()** functions as well as **DoIO()**. The same warnings apply as shown above in the discussions about alternative modes of reading.

Note that if **io_Length** is set to -1, the parallel device will output your parallel buffer until it encounters a value of 0x00 in the data. It transmits this 0 value in addition to the data to match the technique used for parallel read shown above. (You can also read data zero-terminated.)

Setting Parallel Parameters

You can control the parallel parameters shown in table 14-1. The parameter name within the parallel data structure is shown below. All of the fields described in this section are filled in when you call **OpenDevice()** to reflect the current settings of the parallel device. Thus, you need not worry about any parameter that you do not need to change.

Table 14-1: Parallel Parameters

Parameter Name	Characteristic It Controls
io_PExtFlags	Reserved for future use.
io_PTermArray	A byte-array of eight termination characters, must be in descending order. If EOFMODE is set in the parallel flags, this array specifies eight possible choices of character to use as an end-of-file mark. See the **PDCMD_SETPARAMS** summary page in the "Device Summaries" appendix and the section above titled "Termination of the Read" for more information.
io_ParFlags	Explained below; see "Parallel Flags."

PARALLEL FLAGS

The flags shown in table 14-2 can be set to affect the operation of the parallel device. Note that the default state of all of these flags is zero.

Table 14-2: Parallel Flags

Flag Name	Effect on Device Operation
PARB_EOFMODE	Set this bit if you want the parallel device to check I/O characters against **io_TermArray** and terminate the **IORequest** immediately if an end-of-file character has been encountered. *Note*: This bit can be set and reset directly in the user's **IORequest** (**IOExtPar**) block without a call to **PDCMD_SETPARAMS**.
PARB_SHARED	Set this bit if you want to allow other tasks to simultaneously access the parallel port. The default is exclusive access. If someone already has the port, whether for exclusive or shared access, and you ask for exclusive access, your **OpenDevice()** call will fail (should be modified only at **OpenDevice()**).

SETTING THE PARAMETERS

You set the parallel parameters by setting the flags and parameters as you desire and then transmitting the command **PDCMD_SETPARAMS** to the device. Here is an example:

```
myParReq->IOPar.io_ParFlags &= ~ PARF_EOFMODE;
          /* "and" with inverse */
myParReq->IOPar.io_Command = PDCMD_SETPARAMS;
DoIO(myParReq);                    /* synchronous request */
```

The above command would cancel EOFMODE (use of the **io_TermArray**), leaving the other flags unchanged. Notice the difference between the flag names and the flags that you actually set using C. "PARB..." is the name applied to the bit position within the flag word. "PARF..." is the name of a 1 bit in a mask at that bit position.

Errors from the Parallel Device

The possible error returns from the parallel device are listed in table 14-3.

Table 14-3: Parallel Device Errors

```
#define ParErr_DevBusy     1
#define ParErr_BufToBig    2
#define ParErr_InvParam    3
#define ParErr_LineErr     4
#define ParErr_NotOpen     5
#define ParErr_PortReset   6
#define ParErr_InitErr     7
```

Closing the Parallel Device

When the (final, if shared access) **CloseDevice()** is performed, the timer device is closed, and the latest parameter settings are saved for the next open.

Typically, you close the parallel device with the following function call:

```
CloseDevice(myParReq);
```

This assumes that the parallel device has completed all activities you have requested and has returned all I/O requests to you. When you have finished with the parallel device, it is up to you to deallocate any memory and dependencies you might have used for the parallel device communications. If you have used the techniques shown earlier in this chapter to establish the communications in the first place, your clean-up typically will consist of the following code:

```
cleanup2:
  DeleteExtIO(myParReq,sizeof(struct IOExtPar));
cleanup1:
  DeletePort(myParPort);
cleanupWriteIO:
  DeleteExtIO(myParWriteReq);
cleanupWritePort:
  DeletePort(myParWritePort);
```

Example Program

Here is an example program that uses static rather than dynamic allocation of the **IOExtPar** request block. It assumes that you have connected a parallel I/O device to the Amiga parallel port.

```
#include "exec/types.h"
#include "exec/nodes.h"
#include "exec/lists.h"
#include "exec/ports.h"
#include "exec/libraries.h"
#include "exec/devices.h"
#include "exec/io.h"
#include "devices/parallel.h"

struct IOExtPar IORpar;
struct MsgPort *port;
char   buffer[64000];
extern struct MsgPort *CreatePort();

main()
{
   int     error;
   int     actual;
   unsigned char pflags;
   unsigned long pt0;
   unsigned long pt1;

open:
 /* OPEN the parallel.device */
   if ((error = OpenDevice (PARALLELNAME, 0, &IORpar, 0)) != 0) {
      printf ("bad news %ld on Open \n", error);
      exit (error);
   }

 /* SET UP the message port in the I/O request */
   port = CreatePort (PARALLELNAME,0);
   IORpar.IOPar.io_Message.mn_ReplyPort = port;

/*   SET PARAMS for the parallel.device */
   pflags = PARF_EOFMODE;
   pt0  = 0x51040303;
   pt1  = 0x03030303;
```

```
  if ((error = setparams (pflags,pt0,pt1)) != 0) {
       printf ("bad news %ld on setup \n", error);
       DeletePort();
       exit (error);
    }

    actual = readPar (buffer,60000);

 /* CLOSE the parallel.device */
    CloseDevice (&IORpar);
    DeletePort (port);
    exit (0);
}

 /* PARALLEL I/O functions */

setparams(pf,ta0,ta1)

    unsigned char pf;
    unsigned long ta0;
    unsigned long ta1;

{
    int error;

    IORpar.io_ParFlags       = pf;
    IORpar.IOPar.io_Command = PDCMD_SETPARAMS;
    IORpar.io_PTermArray.PTermArray0 = ta0;
    IORpar.io_PTermArray.PTermArray1 = ta1;

    if ((error = DoIO (&IORpar)) != 0) {
        printf ("parallel.device setparams error %ld \n", error);
    }
    return (error);
}

 readPar(data,length)
    char *data;
    ULONG length;
{
    int error;

    IORpar.IOPar.io_Data = data;
    IORpar.IOPar.io_Length = length;
    IORpar.IOPar.io_Command = CMD_READ;
```

```
    if ((error = DoIO (&IORpar)) != 0) {
        printf ("parallel.device read error %ld \n", error);
    }
    return (IORpar.IOPar.io_Actual);
}

writePar(data,length)
    char *data;
    int length;
{
    int     error;

    IORpar.IOPar.io_Data = data;
    IORpar.IOPar.io_Length = length;
    IORpar.IOPar.io_Command = CMD_WRITE;

    if ((error = DoIO (&IORpar)) != 0) {
        printf ("parallel.device write error %ld \n", error);
    }
    return (error);
}
```

Chapter 15

Printer Device

Introduction

There are four basic ways of doing output to a printer on the Amiga computer and three basic kinds of output you can send. You can send your output to these devices:

- **PRT:**—the DOS printer device

- **SER:**— the DOS serial device
- **PAR:**— the DOS parallel device
- **printer.device**— to directly access the printer device itself

Your output can take the following form:

- A character stream, consisting of commands and data (if sent through DOS or directly to the printer device)
- A command (if sent directly to the printer device)
- A graphics dump (also sent directly to the printer device)

The following section explains the various possible access pathways to the printer itself, along with the advantages and disadvantages of each pathway.

PRT:— THE AMIGADOS PRINTER DEVICE

PRT: is the AmigaDOS printer device. By using the Workbench Preferences tool, you can direct the output to either a serial or parallel printer, which is the generic printer configured on the system. You may print (output) escape sequences to **PRT:** to specify the options you want. The escape sequences you send are interpreted by the printer driver and (usually different) escape sequences are forwarded to the printer. This is by far the easiest method for most applications. **PRT:** may be opened just like any other AmigaDOS file.

SER:— THE AMIGADOS SERIAL DEVICE

SER: is the AmigaDOS serial device. If you "know" that the printer is connected to the serial port (you should not) and you "know" what kind of printer it is (again, you should not) then you could use AmigaDOS to open **SER:** and output characters to it, causing it to print. *This practice is strongly discouraged!* Characters you send are not examined or converted.

PAR:— THE AMIGADOS PARALLEL DEVICE

PAR: is the AmigaDOS parallel device. The warnings given in the paragraph above apply here as well.

By opening the Exec printer device directly, you have full control over the printer. You can either send escape sequences as shown in the command definitions table below for printer control or call the **RawWrite()** routine to send raw characters directly to your printer with no processing at all. Using this technique would be similar to sending raw characters to **SER:** or **PAR:** from AmigaDOS (but you do not need to know which one is connected to the printer). Also note that all "commands" to the printer transmitted through the DOS printer access path must take the form of a character stream. Direct access to the printer device allows you to transmit other commands, such as reset or flush or, for graphics dumps, **DumpRPort()** (dump a raster to a graphics-capable printer).

Printer Device Output

The printer device can be thought of as kind of a filter, in that some printers respond in one way to a command output and some respond in another. The printer device, as a standard printer interface, recognizes command sequences. Depending on the printer-dependent configuration that is currently loaded (by the Preferences tool), the printer device either ignores the command sequences or perhaps translates them into an entirely different sequence that this printer can actually understand and obey.

Opening the AmigaDOS Printer Device

You can open the DOS printer device just as though it were a normal DOS output file. Here is an example program segment that accomplishes this:

```
struct File *file;

file = Open( "PRT:", MODE_NEWFILE );
if (file == 0) exit(PRINTER_WONT_OPEN);
```

Then, to print use code like this:

```
actual_length = Write(file, dataLocation, length);
```

where

file
is a file handle (see the *AmigaDOS Developers Manual*).

dataLocation
is a pointer to the first character in the output stream you wish to write.

length
is the length of the output stream.

actual_length
is the actual length of the write. For the printer device, if there are no errors, this is likely to always be the same as the length of write requested. The only exception is if you specify a value of -1 for length. In this case, -1 for length means that a null (0) terminated stream is being written to the printer device. The device returns the count of characters written prior to encountering the null. If it returns a value of -1 as **actual_length**, there has been an error.

Note that the **Open()** function could be called with **SER:** or **PAR:** if you do not want to have any character translation performed during the printer I/O. When the printer I/O is complete, and your program is ready to exit, you should close the device. Here is a sample function call that you could use:

Close(file);

Note that printer I/O through the DOS versions of the printer device must be done by a process, not by a task. DOS utilizes information in the process control block and would become confused if a simple task attempted to perform these activities. Printer I/O using the printer device directly, however, *can* be performed by a task.

Data Structures Used During Printer I/O

This section shows you how to set up for Exec printer I/O. There are three distinct kinds of data structures required by the printer I/O routines. Some of the printer commands, such as start, stop, and flush, require only an **IOStdReq**. Others, such as write, require a larger data structure called an **IODRPReq** (for "dump a RastPort") or **IOPrtCmdReq** (for "printer command request"). For convenience, the printer device has defined a single data structure, called **printerIO**, that can be used to represent any of the three different kinds of printer communications request blocks.

The data structure type **printerIO** used in the following examples is a C-language union defined as:

```
union printerIO{
struct IOStdReq ios;
struct IODRPReq iodrp;
struct IOPrtCmdReq iopc;
}
```

This means that one memory area can be used to represent three distinct forms of memory layout for the three different types of data structures that must be used to pass commands to the printer device. Some of the commands are simple and can use an **IOStdReq**. Some of the commands require many more parameters and extend the basic I/O request block accordingly. If you use the function **CreateExtIO()**, you can automatically allocate enough memory to hold the largest structure in the union statement.

Creating an I/O Request

Printer I/O, like the I/O of other devices, requires that you create an I/O request message that you pass to the printer device for processing. The message contains the command as well as a data area. For a write, there will be a pointer in the data area to the stream of information you wish to write to the printer.

The following program fragment can be used to create the message block that you use for printer communications.

```
union printerIO *printerMsg; /* I/O request block pointer */
struct Port *printerPort;          /* a port at which to receive */

printerPort = CreatePort("my.print.port",0);
printerMsg = (union printerIO *)CreateExtIO(printerPort,
        sizeof(union printerIO));
```

Error handling is not shown here. It is deferred to the example at the end of the chapter.

The routine **CreatePort()**, which is part of *amiga.lib*, and the routine **CreateExtIO()** may be found in the appendixes of the *Amiga ROM Kernel Reference Manual: Exec*.

Note that there are two additional kinds of I/O request blocks that, for some commands, must be prepared for sending to the printer. They are called **IODRPReq** and **IOPrtCmdReq**. Both are outlined in the include file *devices/printer.h*. The function call to **CreateExtIO()** returns a pointer to a memory block the size of the largest form of printer **IORequest**.

Opening a Printer Device

You open a path to the printer device using code like the following:

```
int
OpenPrinter(request)
union printerIO *request;
{
    return(OpenDevice("printer.device",0,request,0));
}
```

This routine returns a value of zero if the printer device was opened successfully and a value other than zero if it did not open.

Writing to the Printer

There are three forms of writing to the printer. The first uses a character stream that you create, possibly containing escape sequences to be processed by the printer driver ("PrintString" example) or containing just about anything else that is to be passed directly to the printer ("PrintRaw" example). The second form of write passes a command to the printer ("PrintCmd" example). The third form asks for a graphics dump of a drawing area ("Printer-Dump" example).

To write to the printer, you pass to the printer device the system standard command **CMD_WRITE**. Here are routines that can be used to send this command:

```
/* Send a NULL-terminated string to the printer */

/* Assumes printer device is open and printerMsg is correctly initialized.
 * Watches for embedded "escape-sequences" and handles them as defined.
 */

int
PrintString(request,string)
union printerIO *request;
char *string;
{
    request->ios.io_Command = CMD_WRITE;
    request->ios.io_Data = string;
    request->ios.io_Length = -1;
        /* if -1, the printer assumes it has been given
```

```
        * a null-terminated string.
        */
    return(DoIO(request));
}

/* Send RAW character stream to the printer directly,
 * avoid "escape-sequence" parsing by the device.
 */

int
PrintRaw(request,buffer,count)
union printerIO *request;    /* a properly initialized request block */
char *buffer;                /* where is the output stream of characters */
int count;                   /* how many characters to output */
{
    /* queue a printer raw write */
    request->ios.io_Command = PRD_RAWWRITE;
    request->ios.io_Data = buffer;
    request->ios.io_Length = count;
    return(DoIO(request));
}
```

PRINTER COMMAND DEFINITIONS

The following table describes the supported printer functions. You can use the escape sequences with **PRT:** and the printer device.

To transmit a command to the printer device, you can either formulate a character stream containing the material shown in the "Escape Sequence" column of table 15-1 below or send an **IORequest** to the printer device specifying which of these commands you wish to have performed. A sample routine for transmitting commands is shown immediately following the command table.

Again, recall that **SER:** and **PAR:** will ignore all of these and pass them directly on to the attached device.

Table 15-1: Printer Device Command Functions

Name	Cmd No.	Escape Sequence	Function	Defined by:
aRIS	0	ESCc	Reset	ISO
aRIN	1	ESC#1	Initialize	+++
aIND	2	ESCD	Lf	ISO
aNEL	3	ESCE	Return,lf	ISO
aRI	4	ESCM	Reverse lf	ISO
aSGR0	5	ESC[0m	Normal char set	ISO
aSGR3	6	ESC[3m	Italics on	ISO
aSGR23	7	ESC[23m	Italics off	ISO
aSGR4	8	ESC[4m	Underline on	ISO
aSGR24	9	ESC[24m	Underline off	ISO
aSGR1	10	ESC[1m	Boldface on	ISO
aSGR22	11	ESC[22m	Boldface off	ISO
aSFC	12	ESC[nm	Set foreground color where n stands for a pair of ASCII digits, 3 followed by any number 0-9	ISO
aSBC	13	ESC[nm	Set background color Where n stands for a pair of ASCII digits, 4 followed by any number 0-9	ISO
aSHORP0	14	ESC[0w	Normal pitch	DEC
aSHORP2	15	ESC[2w	Elite on	DEC
aSHORP1	16	ESC[1w	Elite off	DEC
aSHORP4	17	ESC[4w	Condensed fine on	DEC
aSHORP3	18	ESC[3w	Condensed off	DEC
aSHORP6	19	ESC[6w	Enlarged on	DEC
aSHORP5	20	ESC[5w	Enlarged off	DEC
aDEN6	21	ESC[6"z	Shadow print on	DEC (sort of)
aDEN5	22	ESC[5"z	Shadow print off	DEC
aDEN4	23	ESC[4"z	Doublestrike on	DEC
aDEN3	24	ESC[3"z	Doublestrike off	DEC
aDEN2	25	ESC[2"z	NLQ on	DEC
aDEN1	26	ESC[1"z	NLQ off	DEC
aSUS2	27	ESC[2v	Superscript on	+++
aSUS1	28	ESC[1v	Superscript off	+++
aSUS4	29	ESC[4v	Subscript on	+++
aSUS3	30	ESC[3v	Subscript off	+++
aSUS0	31	ESC[0v	Normalize the line	+++
aPLU	32	ESCL	Partial line up	ISO

aPLD	33	ESCK	Partial line down	ISO
aFNT0	34	ESC(B	US char set	DEC
aFNT1	35	ESC(R	French char set	DEC
aFNT2	36	ESC(K	German char set	DEC
aFNT3	37	ESC(A	UK char set	DEC
aFNT4	38	ESC(E	Danish I char set	DEC
aFNT5	39	ESC(H	Swedish char set	DEC
aFNT6	40	ESC(Y	Italian char set	DEC
aFNT7	41	ESC(Z	Spanish char set	DEC
aFNT8	42	ESC(J	Japanese char set	+++
aFNT9	43	ESC(6	Norwegian char set	DEC
aFNT10	44	ESC(C	Danish II char set	+++
aPROP2	45	ESC[2p	Proportional on	+++
aPROP1	46	ESC[1p	Proportional off	+++
aPROP0	47	ESC[0p	Proportional clear	+++
aTSS	48	ESC[n E	Set proportional offset	ISO
aJFY5	49	ESC[5 F	Auto left justify	ISO
aJFY7	50	ESC[7 F	Auto right justify	ISO
aJFY6	51	ESC[6 F	Auto full justify	ISO
aJFY0	52	ESC[0 F	Auto justify off	ISO
aJFY3	53	ESC[3 F	Letter space (justify)	ISO (special)
aJFY1	54	ESC[1 F	Word fill(auto center)	ISO (special)
aVERP0	55	ESC[0z	1/8" line spacing	+++
aVERP1	56	ESC[1z	1/6" line spacing	+++
aSLPP	57	ESC[nt	Set form length n	DEC
aPERF	58	ESC[nq	Perf skip n (n>0)	+++
aPERF0	59	ESC[0q	Perf skip off	+++
aLMS	60	ESC#9	Left margin set	+++
aRMS	61	ESC#0	Right margin set	+++
aTMS	62	ESC#8	Top margin set	+++
aBMS	63	ESC#2	Bottom margin set	+++
aSTBM	64	ESC[n;nr	T&B margins	DEC
aSLRM	65	ESC[n;ns	L&R margin	DEC
aCAM	66	ESC#3	Clear margins	+++
aHTS	67	ESCH	Set horiz tab	ISO
aVTS	68	ESCJ	Set vertical tabs	ISO
aTBC0	69	ESC[0g	Clr horiz tab	ISO
aTBC3	70	ESC[3g	Clear all h tab	ISO
aTBC1	71	ESC[1g	Clr vertical tabs	ISO
aTBC4	72	ESC[4g	Clr all v tabs	ISO
aTBCALL	73	ESC#4	Clr all h & v tabs	+++
aTBSALL	74	ESC#5	Set default tabs	+++
aEXTEND	75	ESC[n"x	Extended commands	+++

Legend:

ISO	indicates that the sequence has been defined by the International Standards Organization. This is also very similar to ANSI x3.64.
DEC	indicates a control sequence defined by Digital Equipment Corporation.
+++	indicates a sequence unique to Amiga.
n	stands for a decimal number expressed as a set of ASCII digits, for example 12.

Transmitting a Command to the Printer Device

As noted above, to transmit a command to the printer device, you can either formulate an escape sequence and send it via the **CMD_WRITE** command, or you can utilize the command names and pass parameters and the command to the device. Here is a sample routine that uses the system command **PRD_PRTCOMMAND** to transmit a command to the device:

```
int
PrintCommand(request,command, p0, p1, p2, p3)
union printerIO *request;
int command, p0, p1, p2, p3;  /* command and its parameters */
{
     /* queue a printer command */
     request->iopc.io_Command = PRD_PRTCOMMAND;
     request->iopc.io_PrtCommand = command;
     request->iopc.io_Parm0 = p0;
     request->iopc.io_Parm1 = p1;
     request->iopc.io_Parm2 = p2;
     request->iopc.io_Parm3 = p3;
     return(DoIO(request));
}
```

As an example, suppose you wanted to set the left and right margins on your printer to columns 1 and 79 respectively. Here is a sample call to the **PrintCommand()** function for this purpose:

```
PrintCommand(aSLRM, 1, 79, 0, 0);
```

Consult the function table. Wherever there is a value of "n" to be substituted, it will be utilized from the next available parameter for this command. Most of the commands in the table need no parameters; some need one and others need two. Few, if any, require more than two parameters; however, this function provides room for expansion.

Dumping a RastPort to the Printer

You can dump a **RastPort** (drawing area) to the printer by sending the command **PRD_DUMPRPORT** to the printer, along with several parameters that define how the dump is to be accomplished. The parameters shown in the sample dump function below are completely described in the summary for **DumpRPort()** in the "Device Summaries" appendix.

```
int
DumpRPort(request,rastPort, colorMap, modes, sx,sy, sw,sh, dc,dr, s)
  union printerIO *request;
  struct RastPort *rastPort;
  struct ColorMap *colorMap;
  ULONG modes;
  UWORD sx, sy, sw, sh;
  LONG dc, dr;
  UWORD s;
    {
    request->iodrp.io_Command = PRD_DUMPRPORT;
    request->iodrp.io_RastPort = rastPort;
    request->iodrp.io_ColorMap = colorMap;
    request->iodrp.io_Modes = modes;
    request->iodrp.io_SrcX = sx;
    request->iodrp.io_SrcY = sy;
    request->iodrp.io_SrcWidth = sw;
    request->iodrp.io_SrcHeight = sh;
    request->iodrp.io_DestCols = dc;
    request->iodrp.io_DestRows = dr;
    request->iodrp.io_Special = s;
    return(DoIO(request));
    }
```

As an example of this function, suppose you wanted to dump the current contents of the Workbench screen to the printer. The typical program code shown below would accomplish it. Note that during the dump no other tasks should be writing to the screen, nor should you use the mouse to move windows or otherwise modify the screen appearance.

```
/*
 * Author:    Rob Peck, 12/1/85
 * Modified:  Carolyn Scheppner, 04/08/86
 *
 * This code may be freely utilized to develop programs for the Amiga.
 */

#include "exec/types.h"
#include "intuition/intuition.h"
#include "devices/printer.h"
#define INTUITION_WONT_OPEN 1000

union printerIO {
      struct IOStdReq ios;
      struct IODRPReq iodrp;
      struct IOPrtCmdReq iopc;
      };

union printerIO *request;   /* a pointer to a request block */

extern int DumpRPort();
extern struct IORequest *CreateExtIO();
extern struct MsgPort   *CreatePort();

struct IntuitionBase    *IntuitionBase;

main()
{
       struct Screen   *screen;
       struct RastPort *rp;
       struct ViewPort *vp;
       struct ColorMap *cm;
       struct MsgPort  *printerPort;     /* at which to receive reply */
       int modes,width,height,error;

       IntuitionBase = (struct IntuitionBase *)OpenLibrary(
               "intuition.library", 0);
       if (IntuitionBase == NULL) exit(INTUITION_WONT_OPEN);

       screen = IntuitionBase->FirstScreen;  /* ptr to front Screen */

       vp = &screen->ViewPort; /* get screen's ViewPort, from
                                * which the ColorMap will be gotten */
       rp = &screen->RastPort; /* get screen's RastPort, which
                                * is what gets dumped to printer */
```

```
    cm = vp->ColorMap;          /* retrieve pointer to colormap for
                                 * the printer dump */
    modes =  vp->Modes;         /* retrieve the modes variable */
    width =  screen->Width;     /* retrieve width and */
    height = screen->Height;    /*  height to print */

    printerPort = CreatePort("my.print.port",0);
    request =  (union printerIO *)CreateExtIO(printerPort,
        sizeof(union printerIO));

    error = OpenPrinter(request);
    if(error != 0) goto cleanup2;

    Delay(300);        /* 300/60 = 6 seconds delay before it starts */
    error = DumpRPort(
                request,        /* pointer to initialized request */
                rp,             /* RastPort pointer */
                cm,             /* color map pointer */
                modes,          /* low, high res, etc (display modes)*/
                0, 0,           /* x and y offsets into rastport */
                width,height,   /* source size */
                0,0,            /* dest size 0 because of Special */
                SPECIAL_FULLCOLS | SPECIAL_ASPECT  /* Special */
                                /* Special = print max width */
                                /*  with proportional height */
                );
    ClosePrinter(request);

cleanup2:
    DeleteExtIO(request, sizeof(union printerIO));
    DeletePort(printerPort);
cleanup1:
    CloseLibrary(IntuitionBase);

}           /* end of demo screen dump */


/*********************************************************************/
/* printersupport.c rtns
/*********************************************************************/

/* OPEN THE PRINTER */
int
OpenPrinter(request)
```

```
  union printerIO *request;
    {
    return(OpenDevice("printer.device",0,request,0));
    }

/* CLOSE THE PRINTER */
int
ClosePrinter(request)
  union printerIO *request;
    {
    CloseDevice(request);
    return(0);
    }


/* Send a null-terminated string to the printer. Assumes printer device
 * is open and printerMsg is correctly initialized. Watches for embedded
 * "escape-sequences" and handles them as defined.
 */

int
PrintString(request,string)
  union printerIO *request;
  char *string;
  {
  request->ios.io_Command = CMD_WRITE;
  request->ios.io_Data = (APTR)string;
  request->ios.io_Length = -1;
  /* if -1, the printer assumes it has been given a null terminated string. */
  return(DoIO(request));
  }


/* Send RAW character stream to the printer directly,
 * avoid "escape-sequence" parsing by the device.
 */
int
PrintRaw(request,buffer,count)
  union printerIO *request; /* a properly initialized request block */
  char *buffer;         /* where is the output stream of characters */
  int count;                /* how many characters to output */
  {
  /* queue a printer raw write */
  request->ios.io_Command = PRD_RAWWRITE;
  request->ios.io_Data = (APTR)buffer;
```

```
    request->ios.io_Length = count;

    return(DoIO(request));
    }


/* Send Printer Command */
int
PrintCommand(request,command, p0, p1, p2, p3)
    union printerIO *request;
    int command, p0, p1, p2, p3;    /* command and its parameters */
        {
        /* queue a printer command */
        request->iopc.io_Command = PRD_PRTCOMMAND;
        request->iopc.io_PrtCommand = command;
        request->iopc.io_Parm0 = p0;
        request->iopc.io_Parm1 = p1;
        request->iopc.io_Parm2 = p2;
        request->iopc.io_Parm3 = p3;
        return(DoIO(request));
        }
```

ADDITIONAL NOTES ABOUT GRAPHICS DUMPS

The print command accepts a "use the largest area you have" specification that looks at the Preferences active print width and active print height to bound the size of the print. These values are specified as a character count and a character size specification. Thus, the width of the print is bounded by the number of inches specified by the following equation: (RIGHT_MARGIN - LEFT_MARGIN + 1) / CHARACTERS_PER_INCH. The height is specified by the equation: LENGTH / LINES_PER_INCH.

NumRows in the printer tag refers to the number of dots in the graphics print element, and can be used by graphics render code to determine how much buffer space is needed to compose a line of graphics output. It has not been used in practice; the number has instead been hard coded into the render function specific to the printer.

If the printer for which you are developing can be set to unidirectional mode under software control, we recommend that you put this in the initialization code for the printer (see case 0 Master Initialization, below). This produces better-looking printouts and under most conditions (believe it or not) a faster printout.

Creating a Printer Driver

Creating a printer-dependent code fragment for the printer device involves writing the data structures and code, compiling and assembling it, and linking it to produce an Amiga object binary file. The first piece in that file is the **PrinterSegment** structure described in *devices/prtbase.h* and *devices/prtbase.i* (which is pointed to by the BPTR returned by the **LoadSeg()** of the object file).

You specify the printer-dependent object file to load by specifying "custom printer" in Preferences and filling in the custom printer name with the name of the object file (relative to the directory *DEVS:printers/*).

The printer-dependent code **PrinterSegment** contains the **PrinterExtendedData** (PED) structure (also described in *devices/prtbase.h* and *devices/prtbase.i* at the beginning of the object). The PED structure contains data describing the capabilities of the printer, as well as pointers to code and other data. Here is the assembly code for a sample **PrinterSegment**, which would be linked to the beginning of the sequence of files describing the printer-dependent code fragment.

```
**********************************************************************
*
*       printer device dependent code tag
*
**********************************************************************
                ; named sections are easier to exactly place in the linked file
                SECTION     custom

*------ Included Files -----------------------------------------------

                INCLUDE     "exec/types.i"
                INCLUDE     "exec/nodes.i"

                INCLUDE     "revision.i"        ; contains VERSION & REVISION

                INCLUDE     "devices/prtbase.i"

*------ Imported Names -----------------------------------------------

                XREF        _Init
                XREF        _Expunge
                XREF        _Open
                XREF        _Close
                XREF        _CommandTable
                XREF        _DoSpecial
```

```
        XREF        _Render

*------ Exported Names ----------------------------------------------

        XDEF        _PEDData

*********************************************************************

        ; in case anyone tries to execute this
        MOVEQ       #0,D0
        RTS

        DC.W        VERSION
        DC.W        REVISION
_PEDData:
        DC.L        printerName
        DC.L        _Init
        DC.L        _Expunge
        DC.L        _Open
        DC.L        _Close
        DC.B        PPC_BWGFX               ; PrinterClass
        DC.B        PCC_BW                  ; ColorClass
        DC.B        80                      ; MaxColumns
        DC.B        1                       ; NumCharSets
        DC.W        8                       ; NumRows
        DC.L        960                     ; MaxXDots
        DC.L        0                       ; MaxYDots
        DC.W        120                     ; XDotsInch
        DC.W        82                      ; YDotsInch
        DC.L        _CommandTable           ; Command Strings
        DC.L        _DoSpecial              ; Command Code
        DC.L        _Render                 ; Graphics Render
        DC.L        30                      ; Timeout

printerName:
        DC.B        'Custom Printer Name'
        DC.B        0
        EVEN
```

The printer name should be the brand name of the printer that is available for use by programs wishing to be specific about the printer name in any diagnostic or instruction messages. The four functions at the top of the structure are used to initialize this printer-dependent code:

(*(PED->ped_Init))(PD);

This is called when the printer-dependent code is loaded and provides a pointer to the printer device for use by the printer-dependent code. It can also be used to open up any libraries or devices needed by the printer-dependent code.

(*(PED->ped_Expunge))();
This is called immediately before the printer-dependent code is unloaded, to allow it to close any resources obtained at initialization time.

(*(PED->ped_Open))(ior);
This is called in the process of an **OpenDevice()** call, after the Preferences are read and the correct primitive I/O device (parallel or serial) is opened. It must return zero if the open is successful, or nonzero to terminate the open and return an error to the user.

(*(PED->ped_Close))(ior);
This is called in the process of a **CloseDevice()** call to allow the printer-dependent code to close any resources obtained at open time.

The **pd_** variable provided as a parameter to the initialization call is a pointer to the **PrinterData** structure described in *devices/prtbase.h* and *devices/prtbase.i*. This is also the same as the **io_Device** entry in printer I/O requests.

pd_SegmentData
This points back to the **PrinterSegment**, which contains the PED.

pd_PrintBuf
This is available for use by the printer-dependent code—it is not otherwise used by the printer device.

(*pd_PWrite)(data, length);
This is the interface routine to the primitive I/O device. This routine uses two I/O requests to the primitive device, so writes are double-buffered. The data parameter points to the byte data to send, and the length is the number of bytes.

(*pd_PBothReady)();
This waits for both primitive I/O requests to complete. This is useful if your code does not want to use double buffering. If you want to use the same data buffer for successive **pd_PWrites**, you must separate them with a call to this routine.

pd_Preferences
This is the copy of Preferences in use by the printer device, obtained when the printer was opened.

The timeout field is the number of seconds that an I/O request from the printer device will remain posted and unsatisfied to the primitive I/O device (parallel or serial) before the timeout requester is presented to the user. This value should be large enough to avoid the requester during normal printing.

SAMPLE CODE

To help you in developing custom printer drivers for the Amiga, four sets of source files have been included as a part of this document. The files include *init.asm*, *printertag.asm*, *data.c*, *render.c*, and *dospecial.c*.

Four sets of files for four different types of printers are provided:

diablo_c - an example of a ymcb color printer
epson - an example of a b/w printer
okimate20 - an example of a ymc_bw printer (has two render.c functions)
hpplus - an example of a single-sheet, multiple-density printer

The source files for the hpplus includes one additional C-language source, named *density.c*.

In addition, you will also need certain files that are common to all printer drivers. These are called *macros.i* and are printer assembly code macros that *init.asm* uses. All of these files are in the "Printer Device Source Code" appendix of this manual.

WRITING A GRAPHICS PRINTER DRIVER

Designing the graphics portion of a custom printer driver consists of two steps: writing a printer-specific *render.c* function, and replacing the printer-specific values in *printertag.asm*. Note that a printer that does *not* support graphics has a very simple form of **Render()**; it returns an error. Here is sample code for **Render()** for a non-graphics printer (typically, an alphacom or diablo_630):

```
#include "exec/types.h"
#include "devices/printer.h"
int
Render()
{
    return(PDERR_NOTGRAPHICS);
}
```

The following section describes the contents of a typical driver for a printer that actually supports graphics. The example code for the Epson printer, contained in the "Printer Device Source Code" appendix, shows a typical **Render()** function based on this description.

Render.c

This function is the main printer-specific code module and consists of six parts:

- o Master initialization
- o Pixel rendering
- o Dumping a pixel buffer to the printer
- o Clearing and initializing the pixel buffer
- o Closing down
- o Density selection

Master Initialization (case 0). When this call is made, you are passed the width (in pixels) in x and the height (in pixels) in y of the picture as it should appear on the printer. Note that the printer non-specific code (using the printer-specific values in *printertag.asm* (that will be discussed later), has already verified that these values are within range for the printer. It is recommended that you use these values to allocate enough memory for a temporary buffer in which to build a command buffer for the printer. The buffer size needed is dependent on the specific printer, the width (usually), and the height (sometimes). In general, the buffer represents the commands and data required for one pass of the print head and usually takes the following form:

<start gfx cmd> <data> <end gfx cmd>

where:

<start
: is the command required to define the graphic dump for each line.

<data>
: is the binary data.

<end
: is a terminator telling the printer to print the data (usually a carriage return).

For color printers, enough buffer space must usually be allocated for each different color ribbon, ink, and so on that the printer offers (the okimate-20 and diablo_c-150 are provided as examples of this). Please refer to the sample drivers.

The example *render.c* functions use double buffering to reduce the dump time, which is why the **AllocMem()** call is for

(BUFSIZE times two)

where BUFSIZE represents the amount of memory for one entire print cycle (usually one pass of the print head).

Printers that would do more than one pass of the print head on a dump call are those that have to do a pass for each different main color that they want to lay down on the paper (like the Okidata-20 with three colors and the Epson_jx-80 with four colors). A printer such as the Diablo_c-150 that can lay down all the colors in a single pass needs to do only one pass.

The number of passes the printer has to do is irrelevant to you. This topic was introduced mainly to illustrate the true meaning of the term "one print cycle." You want to send the printer an entire print cycle to allow the main non-printer-specific driver to continue onward, computing the values for the next print cycle while the printer is printing the previous dots. This is why you will find double buffering used in the example driver code.

Any other initialization that the printer requires should also be done at this time. It is advisable that you also do a reset command so that you know what state the printer is in before you try to send it any further commands.

In addition, after performing a reset command it is advisable to send no other commands for at least one second to allow the printer to "calm down". Waiting after a reset is *strongly* recommended. The function **PWait(seconds,microseconds)** has been provided in the *wait.asm* file (see the "Printer Device Source Code" appendix) for this purpose. The *wait.asm* file must be assembled and linked into your custom printer device code.

Render Pixel (Case 1). When this call is made, your routine will be passed the x,y position of a single pixel and its color type. Note that the x,y value is an absolute value and you will have to do some modulus math (usually an AND) to compute the relative pixel position in your buffer. The absolute values will range from 0 to width-1 for x and 0 to height-1 for y. The color types are 0-black, 1-yellow, 2-magenta, and 3-cyan. Currently there is no provision for an RGB (red-green-blue) printer.

Dump Buffer to Printer (Case 2). When this call is made, you must send the buffer to the printer. As it now stands, there should be no need for you to change this routine. It should be common to all printers. It simply sends the buffer that you have been filling (via case 1) to the printer.

You would want to change this routine only if you need to do some post-processing on the buffer before it is sent to the printer. For example, if your printer uses the hexadecimal number $03 as a command and requires that you send $03 $03 to send $03 as data, you would probably want to scan the buffer and expand $03's to $03 $03. Of course, you'll need to allocate space somewhere in order to expand the buffer.

Because the printer driver does not send you the blank pixels, you must initialize the buffer to values for blank pixels (usually 0). Clearing the buffer should be the same for all printers. Initializing the buffer is printer-specific, and it includes placing the printer-specific control codes in the buffer ahead of and behind where the data will go.

Closing Down (Case 3). When this call is made you must wait for the print buffers to clear and then de-allocate the memory. This routine should be common to all printers. It simply waits for both buffers to empty, and then deallocates the memory that they used. There should be no need for you to change this routine. If you do change it, however, make sure that the amount of memory allocated for case 0 is deallocated by this routine.

Pre-Master Initialization (Case 4). Currently this option is implemented only on the HPLaserJet and HPLaserJet PLUS printers, although the call is made to each printer-specific driver. Ignoring it causes no problems as the call is made simply to give you a chance to select a different density from the default one. You should note that this call is made *before* the master initialization call (case 0) and gives you a chance to alter any variables that the master initialization may use to program the printer. Refer to the HPLaserJet PLUS printer driver for an example of density selection.

Printertag.asm

The printer-specific values that need to be filled in here are as follows:

MaxXDots
: the maximum number of dots the printer can print across the page.

MaxYDots
: the maximum number of dots the printer can print down the page. Generally, if the printer supports roll or form feed paper, this value should be 0 indicating that there is no limit. If the printer has a definite y dots maximum (as the HPLaserJet does), this number should be entered here.

XDotsInch
: the dot density in x (for example, 120 dpi).

YDotsInch
: the dot density in y (for example, 144 dpi).

PrinterClass
: the printer class the printer falls into. Current choices are:

PPC_BWALPHA - alphanumeric, no graphics.
PPC_BWGFX - black&white (only) graphics.
PPC_COLORGFX - color (and maybe b/w) graphics.

ColorClass
the color class the printer falls into. Current choices are:

PCC_BW - Black&White only (for example, EPSON).
PCC_YMC - Yellow Magenta Cyan only.
PCC_YMC_BW - Yellow or Black&White but not both
(for example, Okimate 20).
PCC_YMCB - YellowMagentaCyanBlack (for example, Diablo_c-150).

NumRows
the number of pixel rows printed by one pass of the print head. This number is used by the non-printer-specific code to determine when to make a case 2 (see above) call to you. You have to keep this number in mind when determining how big a buffer you'll need to store one print cycle's worth of data.

WRITING AN ALPHANUMERIC PRINTER DRIVER

This alphanumeric section is meant to be read with the alpha listing for the EpsonX80 and Diablo Adv 25 close at hand.

The alphanumeric portion of the printer driver is designed to convert ANSI x3.64 style commands into the specific escape codes required by each individual printer. For example, the ANSI code for italics on is ESC[3m. The Epson FX80 printer would like a ESC%G to begin italic output mode. By using the printer driver all printers may be handled in a similar manner.

There are two parts to the alphanumeric portion of the printer driver: the **CommandTable** data table and the **DoSpecial()** routine.

Command Table

The **CommandTable** is used to convert all escape codes that can be handled by simple substitution. It has one entry per ANSI command supported by the printer driver. When you are creating a custom **CommandTable**, you must maintain the order of the commands in the same sequence as that shown in *printer.h* and *printer.i*. By placing the specific codes for your printer in the proper position, the conversion takes place automatically.

Note: If the code for your printer requires a decimal 0 (an ASCII NULL character), you enter this NULL into the **CommandTable** as octal 376 (decimal 254).

Placing an octal value of 377 (255 decimal) in a position in the command table indicates to the printer device that no simple conversion is available on this printer for this ANSI command. For example, if a printer does not support one of the functions (for instance, if a daisy-wheel printer does not have a foreign character set), 377 octal (255 decimal) is placed in that position. However, 377 in a position can also mean that the ANSI function is to be handled by code located in the **DoSpecial()** function.

DoSpecial() Function

The **DoSpecial()** function is meant to implement all the ANSI functions that cannot be done by simple substitution, but can be handled by a more complex sequence of control characters sent to the printer. These are functions that need parameter conversion, read values from Preferences, and so on.

The **DoSpecial()** function is set up as follows:

```
#include "exec/types.h"
#include "devices/printer.h"
#include "devices/prtbase.h"

extern struct PrinterData *PD;

DoSpecial(command,outputBuffer,vline,currentVMI,crlfFlag,Parms)
      char outputBuffer[];
      UWORD *command;
      BYTE *vline;
      BYTE *currentVMI;
      BYTE *crlfFlag;
      UBYTE Parms[];
{           /* code begins here... */
```

where

command
: points to the command number. The *devices/printer.h* file contains the definitions for the routines to use (aRIN is initialize, and so on).

vline
: points to the value for the current line position.

currentVMI
points to the value for the current line spacing.

crlfFlag
points to the setting of the "add line feed after carriage return" flag.

Parms
contain whatever parameters were given with the ANSI command.

outputBuffer
points to the memory buffer into which the converted command is returned.

Almost every printer will require an aRIN (initialize) command in **DoSpecial()**. This command reads the printer settings from Preferences and creates the proper control sequence for the specific printer. Also, it returns the character set to normal (not italicized, not bold, and so on). Other functions depend on the printer.

Certain functions are implemented both in the **CommandTable** and in the **DoSpecial()** routine. These are functions such as superscript, subscript, PLU (partial line up), and PLD (partial line down), which can often be handled by a simple conversion. However, certain of these functions must also adjust the printer device's line-position variable.

Chapter 16

Clipboard Device

Introduction

The clipboard device is implemented as an Exec-style device. It is responsible for caching data that has been "cut" and providing data to "paste" in an application.

Clipboard Commands

The clipboard responds to the following system functions:

OpenDevice()	Open the clipboard device
CloseDevice()	Close the clipboard device
BeginIO()	Initiate clipboard I/O
SendIO()	Initiate a command and return immediately
DoIO()	

The I/O commands and their implementations are as follows:

CMD_INVALID	Always an invalid command.
CMD_READ	Read data from the clipboard for a paste. **io_Offset** and **io_ClipID** must be set to zero for the first read of a paste sequence. An **io_Actual** that is less than the **io_Length** indicates that all the data has been read. After all the data has been read, a subsequent read must be performed (one whose **io_Actual** returns zero) to indicate to the clipboard device that all the data has been read. This allows random access of the clip while reading (provided only valid reads are performed).
CMD_WRITE	Write data to the clipboard as a cut. **io_Offset** and **io_ClipID** must be set to zero for the first write of a cut sequence. An update command indicates that all the data has been written.
CMD_UPDATE	Indicate that the data provided with a write command is complete and available for subsequent read/pastes.
CMD_CLEAR	Clear any cut from this unit. Subsequent read/pastes will have no data available.
CMD_STOP	Service no commands except invalid, start, flush.
CMD_START	Resume command servicing.
CMD_FLUSH	Abort all pending commands.
CBD_POST	Post the availability of clip data. **io_ClipID** must be set to zero, a subsequent write of this data does not have **io_ClipID** set to zero as described above, but to the value in **io_ClipID**.
CMD_CLIPREADID	Return the **io_ClipID** of the current clip to read.
CMD_CLIPWRITEID	Return the **io_ClipID** of the latest clip written.

Clipboard Data

Data on the clipboard resides in one of three places. When an application posts a cut, the data resides in that application's private memory space. When an application writes to the clipboard, either of its own volition or in response to a message from the clipboard to satisfy a post, the data is copied to the clipboard, either to memory or to a special disk file. When the clipboard is not open, the data resides in the special disk file.

Data on the clipboard is self-identifying. It must be a correct IFF (Interchange Format Files) file; the rest of this this section refers to IFF concepts. See the appendixes of the *Amiga ROM Kernel Reference Manual: Exec* for a complete description of IFF. If the top-level chunk is of type CAT or LIST with an identifier of CLIP, that indicates that the contained chunks are different representations of the same data, in decreasing order of preference on the part of the producer of the clip. Any other data is as defined elsewhere (probably a single representation of the cut data produced by an application).

The clipboard tool, which is the application that allows a Workbench user to view a clip, understands only the text (FTXT) and graphics (ILBM) form types. Applications using the clipboard to export data should include at least one of these types in a CLIP CAT so that their data can be represented on the clipboard in some form for user feedback.

The clipboard device nonstandard I/O request is called an **IOClipReq** and looks like a standard request except for the addition of the **io_ClipID** field, which is assigned by the device to identify clips. It must be set to zero by the application for a post or an initial write or read, but preserved for subsequent writes or reads. The same initialization must be performed for the **io_Offset** field, but for different reasons.

```
struct IOClipReq {
    struct  Message io_Message;
    struct  Device  *io_Device;     /* device node pointer  */
    struct  Unit    *io_Unit;       /* unit (driver private)*/
    UWORD   io_Command;             /* device command */
    UBYTE   io_Flags;               /* including QUICK and SATISFY */
    BYTE    io_Error;               /* error or warning num */
    ULONG   io_Actual;              /* number of bytes transferred */
    ULONG   io_Length;              /* number of bytes requested */
    SPTR    io_Data;                /* either clip stream or post port */
    ULONG   io_Offset;              /* offset in clip stream */
    LONG    io_ClipID;              /* ordinal clip identifier */
}
```

Clipboard Messages

When an application performs a post, it must specify a message port for the clipboard to send a message to if it needs the application to satisfy the post with a write called the **SatisfyMsg**.

```
struct SatisfyMsg {
    struct  Message sm_Message;     /* the length will be 6 */
    UWORD   sm_Unit;                /* 0 for the primary clip unit */
    LONG    sm_ClipID;              /* the clip identifier of the post */
}
```

If the application wishes to determine if a post it has recently performed is still the current clip, it should check the **io_ClipID** found in the post request upon return with that returned by the **CLIPREADID** command.

If an application has a pending post and wishes to determine if it should satisfy it (for example, before it exits), it should check the **io_ClipID** of the post I/O request with that of the **CLIPWRITEID** command. If the application receives a satisfy message from the clipboard device (format described below), it must immediately perform the write with the **io_ClipID** of the post. The satisfy message from the clipboard may be removed from the application message port by the clipboard device at any time (because it is re-used by the clipboard device). It is not dangerous to spuriously satisfy a post, however, because it is identified by the **io_ClipID**.

The cut data is provided to the clipboard device via either a write or a post of the cut data. The write command accepts the data immediately and copies it onto the clipboard. The post command allows an application to inform the clipboard of a cut, but defers the write until the data is actually required for a paste. In the preceding discussion, references to the read and write commands of the clipboard device actually refer to a sequence of read or write commands, where the clip data is acquired and provided in pieces instead of all at once. The clipboard has an end-of-clip concept that is somewhat analogous to end-of-file for both read and write. The read end-of-file must be triggered by the user of the clipboard in order for the clipboard to move on to service other users' requests, and consists of reading data past the end of file. The write end-of-file is indicated by use of the update command, which indicates to the clipboard that the previous write commands are completed See the description of the commands above for more information.

Multiple Clips

The clipboard also supports multiple clips. This is not to be confused with the multiple IFF CLIP chunks in a clip, which allow for different representation of the same data. Multiple clips store different data. Applications performing cut and paste operations generally specify the primary clip. The alternate clips are provided to aid applications in the maintenance of a set of clips (like a scrapbook). The multiple clips are implemented as different units in the clipboard device, and are thus accessed at open time:

OpenDevice("clipboard.device", unit, &IOClipReq, 0);

The primary clip unit used by applications to share data is unit 0; use of alternate clip units is by private convention.

Example Program

```
#include "exec/types.h"
#include "graphics/gfx.h"
#include "graphics/gfxbase.h"
#include "graphics/view.h"
#include "intuition/intuition.h"
#include "libraries/dos.h"
#include "libraries/dosextens.h"
#include "devices/clipboard.h"

extern int stdout;
struct GfxBase *GfxBase;

char buffer[80], *b, c;
int rawConsole, oldStdout, postID;

readS()
{
   b = buffer;
   while (Read(rawConsole, &c, 1), ((c != '\34') && (c != '\r'))) {
      *b++ = c;
      printf("%lc", c);
   }
   *b = '\0';
}

main()
{
   int i;
   GfxBase = (struct GfxBase *) OpenLibrary("graphics.library", 0);

   printf("CBOpen returned %ld.\n", CBOpen(PRIMARY_CLIP));
```

```
printf("    CBOpen RAW: file is %lx.\n", rawConsole =
      Open("RAW:25/25/615/150/clipboard.device test", MODE_OLDFILE));

oldStdout = stdout;
stdout = rawConsole;
printf("\033[20h");

c = 0;
postID = 0;
while (c != '\34') {
   while((postID) && (!WaitForChar(rawConsole, 1000000)))
      if (CBCheckSatisfy(&postID)) {
         if (postID) {
            printf("Satisfy post data\n");
            readS();
            printf("\nsatisfying \"%s\"\n", buffer);
            CBSatisfyPost(buffer);
            postID = 0;
         }
      }
   Read(rawConsole, &c, 1);
   switch (c) {
      case 'w':
         printf("Enter cut data\n");
         readS();
         printf("\ncutting \"%s\"\n", buffer);
         CBCutS(buffer);
         break;
      case 'r':
         CBPasteS(buffer);
         printf("paste is \"%s\"\n");
         break;
      case 'p':
         printf("Posting post...\n");
         postID = CBPost();
         break;
      default:;
   }
}

CBClose();
printf("CBClose returned.\n");

Close(rawConsole);
stdout = oldStdout;
```

```
    printf("\nTest Done.\n");
}

strcpy( to, from )
register char *to, *from;
{
    do {
        *to++ = *from;
    } while( *from++ );
}

strcat( to, from )
register char *to, *from;
{
    while( *to ) to++;

    strcpy( to, from );
}

strlen( s )
register char *s;
{
    register i = 0;

    while( *s++ ) i++;

    return( i );
}

strcmp( a, b )
register char *a, *b;
{
    while( *a++ == *b ) {
        if( ! *b++ ) return( 0 );
    }

    if( *--a < *b ) return( -1 );
    return( 1 );
}

char *
index( s, c )
char *s, c;
{
    char sc;
```

```
    while( sc = *s ) {
        if( sc == c ) return( s );
        s++;
    }
    return( 0 );
}

char *
rindex( origs, c )
char *origs, c;
{
    char sc, *s;

    s = &origs[strlen( origs ) - 1];

    while( s >= origs ) {
        if( *s == c ) return( s );
        s--;
    }
    return( 0 );
}

char *
TailPath( path )
char *path;
{
    char *last;

    /* looking for "volume:/name/bar/tail".
     * The routine breaks if volume has a slash...
     */

    /* check for a slash */
    if( ! (last = rindex( path, '/' )) ) {

        /* no slash.  Check for a colon */
        if( ! (last = rindex( path, ':' )) ) {

            /* no colon either.  Return the original */
            return( path );
        }
    }
    return( last );
}
```

Support Functions Called from Example Program

```
/***********************************************************/
 * Program name: cbio
 * Purpose: Provide standard clipboard device interface routines
 *          such as Open, Post, Read, Write, etc.
/**********************************************************/
#include "exec/types.h"
#include "exec/ports.h"
#include "exec/io.h"
#include "devices/clipboard.h"

struct IOClipReq clipboardIO = 0;
struct MsgPort clipboardMsgPort = 0;
struct MsgPort satisfyMsgPort = 0;

int CBOpen(unit)
int unit;
{
   int error;

   /* open the clipboard device */
   if ((error = OpenDevice("clipboard.device", unit, &clipboardIO, 0)) != 0)
      return(error);

   /* Set up the message port in the I/O request */
   clipboardMsgPort.mp_Node.ln_Type = NT_MSGPORT;
   clipboardMsgPort.mp_Flags = 0;
   clipboardMsgPort.mp_SigBit = AllocSignal(-1);
   clipboardMsgPort.mp_SigTask = (struct Task *) FindTask((char *) NULL);
   AddPort(&clipboardMsgPort);
   clipboardIO.io_Message.mn_ReplyPort = &clipboardMsgPort;

   satisfyMsgPort.mp_Node.ln_Type = NT_MSGPORT;
   satisfyMsgPort.mp_Flags = 0;
   satisfyMsgPort.mp_SigBit = AllocSignal(-1);
   satisfyMsgPort.mp_SigTask = (struct Task *) FindTask((char *) NULL);
   AddPort(&satisfyMsgPort);

   return(0);
}

CBClose()
{
   RemPort(&satisfyMsgPort);
   RemPort(&clipboardMsgPort);
```

```
   CloseDevice(&clipboardIO);
}

CBCut(stream, length)
char *stream;
int length;
{
   clipboardIO.io_Command = CMD_WRITE;
   clipboardIO.io_Data = stream;
   clipboardIO.io_Length = length;
   clipboardIO.io_Offset = 0;
   clipboardIO.io_ClipID = 0;
   DoIO(&clipboardIO);
   clipboardIO.io_Command = CMD_UPDATE;
   DoIO(&clipboardIO);
}

writeLong(ldata)
LONG *ldata;
{
   clipboardIO.io_Command = CMD_WRITE;
   clipboardIO.io_Data = ldata;
   clipboardIO.io_Length = 4;
   DoIO(&clipboardIO);
}

CBSatisfyPost(string)
char *string;
{
   int length;
   char *s;

   length = 0;
   s = string;
   while(*s++) length++;

   clipboardIO.io_Offset = 0;
   writeLong("FORM");                 /* "FORM" */
   length += 12;
   writeLong(&length);                /* #  */
   writeLong("TEST");                 /* "TEST" */
   writeLong("TEST");                 /* "TEST" */
   length -= 12;
   writeLong(&length);                /* #  */

   clipboardIO.io_Command = CMD_WRITE;
   clipboardIO.io_Data = string;
```

```
    clipboardIO.io_Length = length;
    DoIO(&clipboardIO);                /* text string */

    clipboardIO.io_Command = CMD_UPDATE;
    DoIO(&clipboardIO);
}

CBCutS(string)
char *string;
{
    clipboardIO.io_ClipID = 0;
    CBSatisfyPost(string);
}

CBPasteS(string)
char *string;
{
    int length;

    clipboardIO.io_Command = CMD_READ;
    clipboardIO.io_Data = 0;
    clipboardIO.io_Length = 16;
    clipboardIO.io_Offset = 0;
    clipboardIO.io_ClipID = 0;
    DoIO(&clipboardIO);

    clipboardIO.io_Command = CMD_READ;
    clipboardIO.io_Data = &length;
    clipboardIO.io_Length = 4;
    DoIO(&clipboardIO);

    clipboardIO.io_Command = CMD_READ;
    clipboardIO.io_Data = string;
    clipboardIO.io_Length = length;
    DoIO(&clipboardIO);

    string[length] = '\0';

    /* force end of file to terminate read */
    clipboardIO.io_Command = CMD_READ;
    clipboardIO.io_Length = 1;
    clipboardIO.io_Data = 0;
    DoIO(&clipboardIO);
}

int
CBPost()
{
```

```
    clipboardIO.io_Command = CBD_POST;
    clipboardIO.io_Data = &satisfyMsgPort;
    clipboardIO.io_ClipID = 0;
    DoIO(&clipboardIO);
    return(clipboardIO.io_ClipID);
}

int
CBCurrentReadID()
{
    clipboardIO.io_Command = CMD_CLIPREADID;
    DoIO(&clipboardIO);
    return(clipboardIO.io_ClipID);
}

int
CBCurrentWriteID()
{
    clipboardIO.io_Command = CMD_CLIPWRITEID;
    DoIO(&clipboardIO);
    return(clipboardIO.io_ClipID);
}

BOOL
CBCheckSatisfy(idVar)
int *idVar;
{
    struct SatisfyMsg *sm;

    if (*idVar == 0)
        return(TRUE);
    if (*idVar < CBCurrentWriteID()) {
        *idVar = 0;
        return(TRUE);
    }
    if (sm = (struct SatisfyMsg *) GetMsg(&satisfyMsgPort)) {
        if (*idVar == sm->sm_ClipID)
            return(TRUE);
    }
    return(FALSE);
}
```

PART III

Chapter 17

Math Functions

This chapter describes the structure and calling sequences required to access the Motorola Fast Floating Point and IEEE Double Precision math libraries via the Amiga-supplied interfaces.

Introduction

In its present state, the FFP library consists of three separate entities: the basic math library, the transcendental math library, and C and assembly-language interfaces to the basic math library plus FFP conversion functions. The IEEE Double Precision library presently consists of one entity: the basic math library.

FFP Floating Point Data Format

FFP floating-point variables are defined within C by the float or FLOAT directive. In assembly language they are simply defined by a DC.L/DS.L statement. All FFP floating-point variables are defined as 32-bit entities (longwords) with the following format:

MMMMMMMM	MMMMMMMM	MMMMMMMM	SEEEEEEE
31	23	15	7

where

M = 24-bit mantissa

S = Sign of FFP number

E = Exponent in excess-64 notation

The mantissa is considered to be a binary fixed-point fraction; except for 0, it is always normalized (has a 1 bit in its highest position). Thus, it represents a value of less than 1 but greater than or equal to 1/2.

The sign bit is reset (0) for a positive value and set (1) for a negative value.

The exponent is the power of two needed to correctly position the mantissa to reflect the number's true arithmetic value. It is held in excess-64 notation, which means that the two's-complement values are adjusted upward by 64, thus changing $40 (-64) through $3F (+63) to $00 through $7F. This facilitates comparisons among floating-point values.

The value of 0 is defined as all 32 bits being 0s. The sign, exponent, and mantissa are entirely cleared. Thus, 0s are always treated as positive.

The range allowed by this format is as follows:

DECIMAL:

```
 9.22337177 x 10**18  >  +VALUE  >  5.42101070 x 10**-20
-9.22337177 x 10**18  <  -VALUE  <  -2.71050535 x 10**-20
```

BINARY (HEXADECIMAL):

```
 .FFFFFF x 2**63  >  +VALUE  >  .800000 x 2**-63
-.FFFFFF x 2**63  <  -VALUE  <  -.800000 x 2**-64
```

Remember that you cannot perform *any* arithmetic on these variables without using the fast floating-point libraries. The formats of the variables are *incompatible* with the arithmetic format of C-generated code; hence, all floating-point operations are performed through function calls.

FFP Basic Mathematics Library

The FFP basic math library resides in ROM and is opened by making a call to the **OpenLibrary()** function with **mathffp.library** as the argument. In C, this might be implemented as shown below:

```
int MathBase;

main()
{
    char lib_name[] = "mathffp.library";

    if ((MathBase = OpenLibrary(lib_name, 0)) < 1 ) {
        printf("Can't open %s: vector = %08x\n", lib_name,
            MathBase);
            exit(); }
                .
                .
                .
}
```

The global variable **MathBase** is used internally for all future library references.

This library contains entries for the basic mathematics functions such as add, subtract, and so on. The C-called entry points are accessed via code generated by the C compiler when standard numerical operators are given within the source code. Note that to use either the C or assembly language interfaces to the basic math library all user code must be linked with the library *amiga.lib*. The C entry points defined for the basic math functions are as follows:

ffixi — Convert FFP variable to integer

Usage: i1 = (int) f1;

fflti — Convert integer variable to FFP

Usage: f1 = (FLOAT) i1;

fcmpi — Compare two FFP variables

Usage: if (f1 <> f2) {};

ftsti — Test an FFP variable against zero

Usage: if (!f1) {};

fabsi — Take absolute value of FFP variable

Usage: f1 = abs(f2);

fnegi — Take two's complement of FFP variable

Usage: f1 = -f2;

faddi — Add two FFP variables

Usage: f1 = f2 + f3;

fsubi — Subtract two FFP variables

Usage: f1 = f2 - f3;

fmuli — Multiply two FFP variables

Usage: f1 = f2 * f3;

fdivi — Divide two FFP variables

Usage: f1 = f2 / f3;

Be sure to include proper data type definitions as shown in the example below.

```
#include <libraries/mathffp.h>
int MathBase;

main()
{
    FLOAT f1, f2, f3;
    int   i1, i2, i3;
    char lib_name[] = "mathffp.library";

    if((MathBase = OpenLibrary(lib_name, 0)) < 1 ) {
        printf("Can't open %s: vector = %08x\n", lib_name,
            MathBase);
        exit(); }

    i1 = (int) f1;          /* Call ffixi entry */
    fi = (FLOAT) i1;        /* Call fflti entry */

    if (f1 < f2) {};        /* Call fcmpi entry */
    if (!f1) {};            /* Call ftsti entry */

    f1 = abs(f2);           /* Call fabsi entry */
    f1 = -f2;               /* Call fnegi entry */
    f1 = f2 + f3;           /* Call faddi entry */
    f1 = f2 - f3;           /* Call fsubi entry */
    f1 = f2 * f3;           /* Call fmuli entry */
    f1 = f2 / f3;           /* Call fdivi entry */
}
```

The Amiga assembly language interface to the Motorola Fast Floating Point basic math routines is shown below, including some details about how the system flags are affected by each operation. This interface resides in *amiga.lib* and must be linked with the user code. Note that the access mechanism from assembly language is as follows:

```
MOVEA.L     _MathBase,A6
JSR _LVOSPFix,A6
```

_LVOSPFix - Convert FFP to integer

Inputs:	D0 = FFP argument
Outputs:	D0 = Integer (two's complement) result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if overflow occurred
	C = undefined
	X = undefined

_LVOSPFlt - Convert integer to FFP

Inputs:	D0 = Integer (two's complement) argument
Outputs:	D0 = FFP result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 0
	C = undefined
	X = undefined

_LVOSPCmp - Compare

Inputs:	D1 = FFP argument 1
	D0 = FFP argument 2
Outputs:	D0 = +1 if arg1 < arg2
	D0 = -1 if arg1 > arg2
	D0 = 0 if arg1 = arg2
Condition codes:	N = 0
	Z = 1 if result is zero
	V = 0
	C = undefined
	X = undefined
	GT = arg2 > arg1
	GE = arg2 >= arg1
	EQ = arg2 = arg1
	NE = arg2 <> arg1
	LT = arg2 < arg1
	LE = arg2 <= arg1

_LVOSPTst - Test

Inputs:	D1 = FFP argument
Outputs:	D0 = +1 if arg > 0.0
	D0 = -1 if arg < 0.0
	D0 = 0 if arg = 0.0
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 0
	C = undefined
	X = undefined
	EQ = arg = 0.0
	NE = arg <> 0.0
	PL = arg >= 0.0
	MI = arg < 0.0

Note: This routine trashes the argument in D1.

_LVOSPAbs - Absolute value

Inputs:	D0 = FFP argument
Outputs:	D0 = FFP absolute value result
Condition codes:	N = 0
	Z = 1 if result is zero
	V = 0
	C = undefined
	X = undefined

_LVOSPNeg - Negate

Inputs:	D0 = FFP argument
Outputs:	D0 = FFP negated result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 0
	C = undefined
	X = undefined

_LVOSPAdd - Addition

Inputs:	D1 = FFP argument 1
	D0 = FFP argument 2
Outputs:	D0 = FFP addition of arg1+arg2 result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if result overflowed
	C = undefined
	Z = undefined

_LVOSPSub - Subtraction

Inputs:	D1 = FFP argument 1
	D0 = FFP argument 2
Outputs:	D0 = FFP subtraction of arg2-arg1 result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if result overflowed
	C = undefined
	Z = undefined

_LVOSPMul - Multiply

Inputs:	D0 = FFP argument 1
	D2 = FFP argument 2
Outputs:	D0 = FFP multiplication of arg1*arg2 result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if result overflowed
	C = undefined
	Z = undefined

_LVOSPDiv - Divide

Inputs:	D1 = FFP argument 1
	D0 = FFP argument 2
Outputs:	D0 = FFP division of arg2/arg1 result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if result overflowed
	C = undefined
	Z = undefined

FFP Transcendental Mathematics Library

The FFP transcendental math library resides on disk and must be accessed in the same way as the basic math library after it is loaded into system RAM. The name to be included in the **OpenLibrary()** call is *mathtrans.library.* In C, this might be implemented as follows:

```
int MathBase;
int MathTransBase;

main()
{
    char bmath_name[] = "mathffp.library";
    char tmath_name[] = "mathtrans.library";

    if((MathBase = OpenLibrary(bmath_name, 0)) < 1 ) {
        printf("Can't open %s: vector = %08x\n", bmath_name,
            MathBase);
        exit(); }

    if((MathTransBase = OpenLibrary(tmath_name, 0)) < 1 ) {
        printf("Can't open %s: vector = %08x\n", tmath_name,
        MathTransBase);
    exit(); }
        .
        .
        .
}
```

The global variables **MathBase** and **MathTransBase** are used internally for all future library references. Note that the transcendental math library is dependent upon the basic math library and, therefore, is opened after the basic math library has been opened.

This library contains entries for the transcendental math functions sine, cosine, and so on. The C-called entry points are accessed via code generated by the C compiler when the actual function names are given within the source code. The C entry points defined for the transcendental math functions are as follows:

SPAsin Return arcsine of FFP variable.

Usage: f1 = SPAsin(f2);

SPAcos Return arccosine of FFP variable.

Usage: f1 = SPAcos(f2);

SPAtan — Return arctangent of FFP variable.

Usage: f1 = SPAtan(f2);

SPSin — Return sine of FFP variable. This function accepts an FFP radian argument and returns the trigonometric sine value. For extremely large arguments where little or no precision would result, the computation is aborted and the "V" condition code is set. A direct return to the caller is made.

Usage: f1 = SPSin(f2);

SPCos — Return cosine of FFP variable. This function accepts an FFP radian argument and returns the trigonometric cosine value. For extremely large arguments where little or no precision would result, the computation is aborted and the "V" condition code is set. A direct return to the caller is made.

Usage: f1 = SPCos(f2);

SPTan — Return tangent of FFP variable. This function accepts an FFP radian argument and returns the trigonometric tangent value. For extremely large arguments where little or no precision would result, the computation is aborted and the "V" condition code is set. A direct return to the caller is made.

Usage: f1 = SPTan(f2);

SPSincos — Return sine and cosine of FFP variable. This function accepts an FFP radian argument and returns both the trigonometric sine and cosine values. If both the sine and cosine are required for a single radian value of interest, this function will result in almost twice the execution speed of calling the sin and cos functions independently. For extremely large arguments where little or no precision would result, the computation is aborted and the "V" condition code is set. A direct return to the caller is made.

Usage: f1 = SPSincos(&f3, f2);

SPSinh — Return hyperbolic sine of FFP variable.

Usage: f1 = SPSinh(f2);

SPCosh — Return hyperbolic cosine of FFP variable.

Usage: f1 = SPCosh(f2);

SPTanh — Return hyperbolic tangent of FFP variable.

Usage: f1 = SPTanh(f2);

SPExp — Return e to the FFP variable power. This function accepts an FFP argument and returns the result representing the value of e (2.71828...) raised to that power.

Usage: f1 = SPExp(f2);

SPLog Return natural log (base *e*) of FFP variable.

Usage: f1 = SPLog(f2);

SPLog10 Return naparian log (base 10) of FFP variable.

Usage: f1 = SPLog10(f2);

SPPow Return FFP arg2 to FFP arg1.

Usage: f1 = SPPow(f3, f2);

SPSqrt Return square root of FFP variable.

Usage: f1 = SPSqrt(f2);

SPTieee Convert FFP variable to IEEE format

Usage: i1 = SPTieee(f1);

SPFieee Convert IEEE variable to FFP format.

Usage: f1 = SPFieee(i1);

Be sure to include proper data type definitions, as shown in the example below.

```
#include <mathffp.h>

int MathBase;
int MathTransBase;

main()
{
    FLOAT f1, f2, f3;
    int  i1, i2, i3;
    char bmath_name[] = "mathffp.library";
    char tmath_name[] = "mathtrans.library";

    if((MathBase = OpenLibrary(bmath_name, 0)) < 1 ) {
        printf("Can't open %s: vector = %08x\n", bmath_name, MathBase);
        exit(); }

    if((MathTransBase = OpenLibrary(tmath_name, 0)) < 1 ) {
    printf("Can't open %s: vector = %08x\n", tmath_name, MathTransBase);
        exit(); }
     f1 = SPAsin(f2);           /* Call SPAsin entry */
```

```
f1 = SPAcos(f2);              /* Call SPAcos entry */
f1 = SPAtan(f2);              /* Call SPAtan entry */

f1 = SPSin(f2);               /* Call SPSin entry */
f1 = SPCos(f2);               /* Call SPCos entry */
f1 = SPTan(f2);               /* Call SPTan entry */
f1 = SPSincos(&f3, f2);       /* Call SPSincos entry */

f1 = SPSinh(f2);              /* Call SPSinh entry */
f1 = SPCosh(f2);              /* Call SPCosh entry */
f1 = SPTanh(f2);              /* Call SPTanh entry */

f1 = SPExp(f2);               /* Call SPExp entry */
f1 = SPLog(f2);               /* Call SPLog entry */
f1 = SPLog10(f2);             /* Call SPLog10 entry */
f1 = SPPow(f2);               /* Call SPPow entry */
f1 = SPSqrt(f2);              /* Call SPSqrt entry */

i1 = SPTieee(f2);             /* Call SPTieee entry */
f1 = SPFieee(i1);             /* Call SPFieee entry */
}
```

The section below describes the Amiga assembly language interface to the Motorola Fast Floating Point transcendental math routines and includes some details about how the system flags are affected by the operation. Again, this interface resides in the library file *mathlink.lib* and must be linked with the user code. Note that the access mechanism from assembly language is as shown below:

```
LEA    _LVOSPAsin,A6
JSR    _MathTransBase(A6)
```

_LVOSPAsin - Arcsine

Inputs:	D0 = FFP argument
Outputs:	D0 = FFP arctangent radian result
Condition codes:	N = 0
	Z = 1 if result is zero
	V = 0
	C = undefined
	X = undefined

_LVOSPAcos - Arccosine

Inputs:	D0 = FFP argument
Outputs:	D0 = FFP arctangent radian result
Condition codes:	N = 0
	Z = 1 if result is zero
	V = 0
	C = undefined
	X = undefined

_LVOSPAtan - Arctangent

Inputs:	D0 = FFP argument
Outputs:	D0 = FFP arctangent radian result
Condition codes:	N = 0
	Z = 1 if result is zero
	V = 0
	C = undefined
	X = undefined

_LVOSPSin - Sine

Inputs:	D0 = FFP argument in radians
Outputs:	D0 = FFP sine result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if result is meaningless
	(that is, input magnitude too large)
	C = undefined
	X = undefined

_LVOSPCos - Cosine

Inputs:	D0 = FFP argument in radian
Outputs:	D0 = FFP cosine result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if result is meaningless
	(that is, input magnitude too large)
	C = undefined
	X = undefined

_LVOSPTan - Tangent

Inputs:	D0 = FFP argument in radians
Outputs:	D0 = FFP tangent result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if result is meaningless
	(that is, input magnitude too large)
	C = undefined
	X = undefined

_LVOSPSincos - Sine and cosine

Inputs:	D0 = FFP argument in radians
	D1 = Address to store cosine result
Outputs:	D0 = FFP sine result
	(D1) = FFP cosine result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if result is meaningless
	(that is, input magnitude too large)
	C = undefined
	X = undefined

_LVOSPSinh - Hyperbolic sine

Inputs:	D0 = FFP argument in radians
Outputs:	D0 = FFP hyperbolic sine result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if overflow occurred
	C = undefined
	X = undefined

_LVOSPCosh - Hyperbolic cosine

Inputs:	D0 = FFP argument in radians
Outputs:	D0 = FFP hyperbolic cosine result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if overflow occurred
	C = undefined
	X = undefined

_LVOSPTanh - Hyperbolic tangent

Inputs:	D0 = FFP argument in radians
Outputs:	D0 = FFP hyperbolic tangent result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if overflow occurred
	C = undefined
	X = undefined

_LVOSPExp - Exponential

Inputs:	D0 = FFP argument
Outputs:	D0 = FFP exponential result
Condition codes:	N = 0
	Z = 1 if result is zero
	V = 1 if overflow occurred
	C = undefined
	Z = undefined

_LVOSPLog - Natural logarithm

Inputs:	D0 = FFP argument
Outputs:	D0 = FFP natural logarithm result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if argument negative or zero
	C = undefined
	Z = undefined

_LVOSPLog10 - Naparian (base 10) logarithm

Inputs:	D0 = FFP argument
Outputs:	D0 = FFP natural logarithm result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if argument negative or zero
	C = undefined
	Z = undefined

_LVOSPPow - Power

Inputs:	D1 = FFP argument value
	D0 = FFP exponent value
Outputs:	D0 = FFP result of arg taken to exp power
Condition codes:	N = 0
	Z = 1 if result is zero
	V = 1 if result overflowed or arg $<$ 0
	C = undefined
	Z = undefined

_LVOSPSqrt - Square root

Inputs:	D0 = FFP argument
Outputs:	D0 = FFP square root result
Condition codes:	N = 0
	Z = 1 if result is zero
	V = 1 if argument was negative
	C = undefined
	Z = undefined

_LVOSPTieee - Convert to IEEE format

Inputs:	D0 = FFP format argument
Outputs:	D0 = IEEE floating-point format result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = undefined
	C = undefined
	Z = undefined

_LVOSPFieee - Convert from IEEE format

Inputs:	D0 = IEEE floating-point format argument
Outputs:	D0 = FFP format result
Condition codes:	N = undefined
	Z = 1 if result is zero
	V = 1 if result overflowed FFP format
	C = undefined
	Z = undefined

FFP Mathematics Conversion Library

The FFP mathematics conversion library is accessed by linking code into the executable file being created. The name of the file to include in the library description of the link command line is *mathlink_lib.lib*. When this is included, direct calls are made to the conversion functions. Only a C interface exists for the conversion functions; there is no assembly language interface. The basic math library is required in order to access these functions and might be opened as shown below.

```
int MathBase;

main()
{
    char bmath_name[] = "mathffp.library";

    if ((MathBase = OpenLibrary(bmath_name, 0)) < 1 ) {
        printf("Can't open %s: vector = %08x\n", bmath_name,
            MathBase);
        exit(); }

                .
                .
                .
}
```

The global variable **MathBase** is used internally for all future basic math library references.

This library contains entries for the conversion functions associated with math library usage. The C-called entry points are accessed via code generated by the C compiler when the actual function names are given within the source code. The C entry points defined for the math conversion functions are as follows:

afp — Convert ASCII string into FFP equivalent.

Usage: `fnum = afp(&string[0]);`

fpa — Convert FFP variable into ASCII equivalent.

Usage: `exp = fpa(fnum, &string[0]);`

arnd — Round ASCII representation of FFP number.

Usage: `arnd(place, exp, &string[0]);`

dbf Convert FFP dual-binary number to FFP equivalent.

Usage: fnum = dbf(exp, mant);

fpbcd Convert FFP variable to BCD equivalent.

Usage: fpbcd(fnum, &string[0]);

Be sure to include proper data type definitions, as shown in the example below. Print statements have been included to help clarify the format of the math conversion function calls.

```
#include <mathffp.h>

char st1[80] = "3.1415926535897";
char st2[80] = "2.718281828459045";
char st3[80], st4[80];

int MathBase;

main()
{
    FLOAT num1, num2, num3, num4, num5, num6, num7, num8, num9;
    FLOAT n1, n2, n3, n4, n5, n6, n7, n8, n9;
    int  i1, i2, i3, i4, i5, i6, i7, i8, i9;
    int exp1, exp2, exp3, exp4, mant1, mant2,
        mant3, mant4, place1, place2;

 if ((MathBase=OpenLibrary("mathffp.library",0)) < 1 ) {
        printf("Can't open mathffp.library:vector =%08x\n",
            MathBase);
        exit();
    }

    n1 = afp(st1);              /* Call afp entry */
    n2 = afp(st2);              /* Call afp entry */
    printf("\n\nASCII %s converts to floating point %f",
        st1, n1);
    printf("\nASCII %s converts to floating point %f",
        st2, n2);

    num1 = 3.1415926535897;
    num2 = 2.718281828459045;

    exp1 = fpa(num1, st3);      /* Call fpa entry */
    exp2 = fpa(num2, st4);      /* Call fpa entry */
    printf("\n\nfloating point %f converts to ASCII %s", num1, st3);
```

```
    printf("\nfloating point %f converts to ASCII %s",
          num2, st4);

    place1 = -2;
    place2 = -1;
    arnd(place1, exp1, st3);      /* Call arnd entry */
    arnd(place2, exp2, st4);      /* Call arnd entry */
    printf("\nASCII round of %f to %d places yields %s",
          num1, place1, st3);
    printf("\nASCII round of %f to %d places yields %s",
          num2, place2, st4);

    exp1  = -3;  exp2  = 3;   exp3  = -3;  exp4  = 3;
    mant1 = 12345;  mant2 = -54321;  mant3 = -12345;
    t4 = 54321;
    n1 = dbf(exp1, mant1);            /* Call dbf entry */
    n2 = dbf(exp2, mant2);            /* Call dbf entry */
    n3 = dbf(exp3, mant3);            /* Call dbf entry */
    n4 = dbf(exp4, mant4);            /* Call dbf entry */
    printf("\n\ndbf of exp = %d and mant = %d yields FFP number
          of %f",      exp1, mant1, n1);
    printf("\ndbf of exp = %d and mant = %d yields FFP number
          of %f",      exp2, mant2, n2);
    printf("\ndbf of exp = %d and mant = %d yields FFP number
          of %f",      exp3, mant3, n3);
    printf("\ndbf of exp = %d and mant = %d yields FFP number
          of %f",          exp4, mant4, n4);

    num1 = -num1;
    fpbcd(num1, st3);                 /* Call fpbcd entry */
    st3[8] = '\0';
    strcpy(&i2, &st3[4]);
    st3[4] = '\0';
    strcpy(&i1, st3);
    printf("\n\nfloating point %f converts to BCD %08x%08x", num1, i1, i2);
    num2 = -num2;
    fpbcd(num2, st4);                 /* Call fpbcd entry */
    st4[8] = '\0';
    strcpy(&i4, &st4[4]);
    st4[4] = '\0';
    strcpy(&i3, st4);
    printf("\nfloating point %f converts to BCD
          %08x%08x", num2, i3, i4);
}
```

IEEE Double-precision Basic Math Library

The IEEE double-precision basic math library resides on disk and is opened by making a call to the **OpenLibrary()** function with **mathieeedoubbas.library** as the argument. In C, this might be implemented as shown below.

```
int MathIeeeDoubBasBase;

main()
{
    char lib_name[] = "mathieeedoubbas.library";

    if ((MathIeeeDoubBasBase = OpenLibrary(lib_name, 0)) < 1 ) {
        printf("Can't open %s: vector = %08x\n", lib_name,
            MathIeeeDoubBasBase);
            exit(); }
                .
                .
                .
}
```

The global variable **MathIeeeDoubBasBase** is used internally for all future library references.

This library contains entries for the basic mathematics functions, such as add, subtract, and so on. The C-called entry points are accessed via code generated by the C compiler when the actual function names are given within the source code. The C entry points defined for the IEEE double-precision basic math functions are listed below:

IEEEDPFix

Convert IEEE double-precision variable to integer

Usage: i1 = IEEEDPFix(f1);

IEEEDPFlt

Convert integer variable to IEEE double precision

Usage: f1 = IEEEDPFlt(i1);

IEEEDPCmp

Compare two IEEE double-precision variables

Usage: switch (IEEEDPCmp(f1, f2)) {};

IEEEDPTst

Test an IEEE double-precision variable against zero

Usage: switch (IEEEDPTst(f1)) {};

IEEEDPAbs

Take absolute value of IEEE double-precision variable

Usage: f1 = IEEEDPAbs(f2);

IEEEDPNeg

Take two's complement of IEEE double-precision variable

Usage: f1 = IEEEDPNeg(f2);

IEEEDPAdd

Add two IEEE double-precision variables

Usage: f1 = IEEEDPAdd(f2, f3);

IEEEDPSub

Subtract two IEEEDPSub variables

Usage: f1 = IEEEDPSub(f2, f3);

IEEEDPMul

Multiply two IEEE double-precision variables

Usage: f1 = IEEEDPMul(f2, f3);

IEEEDPDiv

Divide two IEEE double-precision variables

Usage: f1 = IEEEDPDiv(f2, f3);

Be sure to include proper data type definitions, as shown in the example below.

```
int MathIeeeDoubBasBase;

main()
{
    double f1, f2, f3;
    int    i1, i2, i3;
    char lib_name[] = "mathieeedoubbas.library";

    if((MathIeeeDoubBasBase = OpenLibrary(lib_name, 0)) < 1 ) {
        printf("Can't open %s: vector = %08x\n", lib_name,
            MathIeeeDoubBasBase);
        exit(); }

    i1 = IEEEDPFix(f1);                 /* Call IEEEDPFix entry */
    fi = IEEEDPFlt(i1);                 /* Call IEEEDPFlt entry */
```

```
    switch (IEEEDPCmp(f1, f2)) {};      /* Call IEEEDPCmp entry */
    switch (IEEEDPTst(f1)) {};          /* Call IEEEDPTst entry */
    f1 = IEEEDPAbs(f2);                 /* Call IEEEDPAbs entry */
    f1 = IEEEDPNeg(f2);                 /* Call IEEEDPNeg entry */
    f1 = IEEEDPAdd(f2, f3);             /* Call IEEEDPAdd entry */
    f1 = IEEEDPSub(f2, f3);             /* Call IEEEDPSub entry */
    f1 = IEEEDPMul(f2, f3);             /* Call IEEEDPMul entry */
    f1 = IEEEDPDiv(f2, f3);             /* Call IEEEDPDiv entry */
}
```

The Amiga assembly language interface to the IEEE double-precision floating-point basic math routines is shown below, including some details about how the system flags are affected by each operation. Note that the access mechanism from assembly language is as shown below:

```
LEA    _LVOIEEEDPFix,A6
JSR    _MathIeeeDoubBasBase(A6)
```

_LVOIEEEDPFix - Convert IEEE double-precision to integer

Inputs:	D0/D1 = IEEE double-precision argument
Outputs:	D0 = Integer (two's complement) result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if overflow occurred
	C = undefined
	X = undefined

_LVOIEEEDPFlt - Convert integer to IEEE double-precision

Inputs:	D0 = Integer (two's complement) argument
Outputs:	D0/D1 = IEEE double-precision result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 0
	C = undefined
	X = undefined

_LVOIEEEDPCmp - Compare two IEEE double-precision values

Inputs:	D0/D1 = IEEE double-precision argument 1
	D2/D3 = IEEE double-precision argument 2
Outputs:	D0 = +1 if arg1 < arg2
	D0 = -1 if arg1 > arg2
	D0 = 0 if arg1 = arg2
Condition codes:	N = 0
	Z = 1 if result is zero
	V = 0
	C = undefined
	X = undefined
	GT = arg2 > arg1
	GE = arg2 >= arg1
	EQ = arg2 = arg1
	NE = arg2 <> arg1
	LT = arg2 < arg1
	LE = arg2 <= arg1

_LVOIEEEDPTst - Test an IEEE double-precision value against zero

Inputs:	D0/D1 = IEEE double-precision argument
Outputs:	D0 = +1 if arg > 0.0
	D0 = -1 if arg < 0.0
	D0 = 0 if arg = 0.0
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 0
	C = undefined
	X = undefined
	EQ = arg = 0.0
	NE = arg <> 0.0
	PL = arg >= 0.0
	MI = arg < 0.0

_LVOIEEEDPAbs - Absolute value

Inputs:	D0/D1 = IEEE double-precision argument
Outputs:	D0/D1 = IEEE double-precision absolute value result
Condition codes:	N = 0
	Z = 1 if result is zero
	V = 0
	C = undefined
	X = undefined

_LVOIEEEDPNeg - Negate

Inputs:	D0/D1 = IEEE double-precision argument
Outputs:	D0/D1 = IEEE double-precision negated result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 0
	C = undefined
	X = undefined

_LVOIEEEDPAdd - Addition

Inputs:	D0/D1 = IEEE double-precision argument 1
	D2/D3 = IEEE double-precision argument 2
Outputs:	D0/D1 = IEEE double-precision addition of arg1+arg2 result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if result overflowed
	C = undefined
	Z = undefined

_LVOIEEEDPSub - Subtraction

Inputs:	D0/D1 = IEEE double-precision argument 1
	D2/D3 = IEEE double-precision argument 2
Outputs:	D0/D1 = IEEE double-precision subtraction of arg1-arg2 result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if result overflowed
	C = undefined
	Z = undefined

_LVOIEEEDPMul - Multiply

Inputs:	D0/D1 = IEEE double-precision argument 1
	D2/D3 = IEEE double-precision argument 2
Outputs:	D0/D1 = IEEE double-precision multiplication of arg1*arg2 result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if result overflowed
	C = undefined
	Z = undefined

_LVOIEEEDPDiv - Divide

Inputs:	D0/D1 = IEEE double-precision argument 1
	D2/D3 = IEEE double-precision argument 2
Outputs:	D0/D1 = IEEE double-precision division of arg1/arg2 result
Condition codes:	N = 1 if result is negative
	Z = 1 if result is zero
	V = 1 if result overflowed
	C = undefined
	Z = undefined

Chapter 18

Workbench

This chapter shows how to use the Workbench facilities in your applications. For information about *IconEd*, the icon editor for making Workbench icons, see the appendixes of the *Introduction to Amiga* manual for revision 1.1 of the system software.

Introduction

Workbench is both an application program and a screen in which other applications can run. Workbench allows users to interact with the Amiga file system by using icons, and it gives the programmer access to a body of library functions for manipulating the application's objects and icons.

Here are definitions of some terms that may be unfamiliar or used in unfamiliar ways in this chapter.

Workbench object
: A Workbench object contains all the information that Workbench needs to display and use a project, tool, drawer, etc. The two kinds of Workbench objects are **WBObject** (as Workbench uses objects) and **DiskObject** (as most other users will view objects in memory or in a file on disk).

icon
: This is a shorthand name for a Workbench object. An icon may be in memory or on disk or both.

info file
: The disk representation of an icon. The format of an icon on disk is slightly different from an icon in memory, but one is obtainable from the other.

strings
: A null-terminated sequence of bytes.

activating
: The act of starting a tool, opening a drawer, and so on. The term *opening* is reserved for windows and files.

tool
: An application program or system utility.

project
: Something produced by an executable program and associated with an executable program, for example, a text file or a drawing.

drawer
: A disk-based directory.

The Icon Library

The icon library, *icon.library,* has memory-management routines, icon input and output routines, and string manipulation routines. The "Library Summaries" appendix to this manual contains the reference pages for this library.

The Info File

The *info file* is the center of interaction between applications and Workbench. This file stores all the necessary information to display an icon and to start up an application. An info file can contain several different types of icons, as shown in table 17-1.

Table 18-1: Contents of a Workbench Info File

Icon Name	**Object**
WBDISK	The root of a disk
WBDRAWER	A directory on the disk
WBTOOL	A directly runnable program
WBPROJECT	A data file of some sort
WBGARBAGE	The trash can directory
WBKICK	A non-DOS disk

The actual data present in the info file depends on the icon type. Note that *any* graphical image can be used for any icon type in the info file. In fact, the graphical image need not be unique for each type of icon. However, it is strongly recommended as a matter of programming style that each type of icon have a unique graphical image associated with it. In fact, you may want to have several unique images associated with an icon type. For example, you can have several different images associated with the WBTOOL type of icon info file.

Most people will not access the info file directly. The icon manipulation library does all the work needed to read and write info files. The **GetDiskObject()**, **PutDiskObject()**, and **FreeDiskObject()** routines are especially helpful. The calling sequence of each of these is given in the icon library reference pages in the "Library Summaries" appendix.

THE DISKOBJECT STRUCTURE

The **DiskObject** structure is at the beginning of all info files, and is used in the routines **GetDiskObject()**, **PutDiskObject()**, and **FreeDiskObject()**. The structure is defined in *workbench/workbench.h* and contains the following elements:

do_Magic
: A magic number that the icon library looks for to make sure that the file it is reading really contains an icon. It should be the manifest constant WB_DISKMAGIC. **PutDiskObject()** will put this value in the structure, and **GetDiskObject** will not believe that a file is really an icon unless this value is correct.

do_Version

This provides a way to enhance the info file in an upwardly-compatible way. It should be WB_DISKVERSION. The icon library will set this value for you and will not believe weird values.

do_Gadget

This contains all the imagery for the icon. See the "Gadget Structure" section for more details.

do_Type

The type of the icon (WBTOOL, WBPROJECT, and so on).

do_DefaultTool

Default tools are used for projects and disks. For projects the default tool is the program invoked when the project is activated. This tool may be absolute (DISK:file), relative to the root of this disk (:file), or relative to the project (file). If the icon is of type WBDISK, the default tool is the diskcopy program that will be used when this disk is the source of a copy.

Note that if the tool is run via the default tool mechanism (for example, a project was activated, not a tool), all the information in the project's info file is used, and the tool's info file is ignored. This is especially important for variables like **StackSize** and **ToolWindow**.

do_ToolTypes

ToolTypes is an array of free-format strings. Workbench does not enforce any rules on these strings, but they are useful for passing environment information. See the "ToolTypes" section for more information.

do_CurrentX, **do_CurrentY**

Drawers have a virtual coordinate system. The user can scroll around in this system using the scroll gadgets on the "drawers" window. Each icon in the drawer has a position in the coordinate system. **CurrentX** and **CurrentY** contain the icon's current position in the drawer.

do_DrawerData

If the icon is capable of being opened as a drawer (WBDISK, WBDRAWER, WBGARBAGE), it needs a **DrawerData** structure to go with it. This structure contains an Intuition **NewWindow** structure. (see *Amiga Intuition Reference Manual* for more information about windows.) Workbench uses this to hold the current window position and size of the window so it will reopen in the same place. The **CurrentX** and **CurrentY** of the origin of the window is also stored.

do_ToolWindow

By default, Workbench will start a program without a window. If **ToolWindow** is set, this file will be opened and made the standard input and output of the program. This window will also be put into the process's **pr_WindowPtr** variable and will be used for all system requesters. Note that this work is actually done in the language-dependent start-up script; if you are coding in assembly language or an unsupported language, you will have to do the work yourself. The only two files that it makes sense to open are *CON:* or *RAW:*. See the AmigaDOS manuals for the full syntax accepted by these devices.

do_StackSize
This is the size of the stack used for running the tool. If this is null, then Workbench will use a reasonable default stack size (currently 4K bytes).

THE GADGET STRUCTURE

To hold the icon's image, Workbench uses an Intuition **Gadget** structure, defined in *intuition/intuition.h* or *intuition/intuition.i* for the assembly language version. Workbench restricts some of the values of the gadget. Any unused field should be set to 0. For clarity in presentation, you can use the assembly language version of these structures,

Note: The C version has the leading "gg_" stripped off. (Workbench structure members have the same name in all languages supported by Amiga). The Intuition gadget structure members that Workbench pays attention to are listed below:

gg_Width
This is the width (in pixels) of the active icon's active region. Any mouse button press within this range will be interpreted as having selected this icon.

gg_Height
The same as **Width**, only in the vertical direction.

gg_Flags
Currently the gadget *must* be of type GADGIMAGE. Three highlight modes are supported: GADGHCOMP, GADGHIMAGE, and GADGBACKFILL. GADGHCOMP complements the image specified (as opposed to Intuition, which complements the select box). GADGHIMAGE uses an alternate selection image. GADGBACKFILL is similar to GADGHCOMP, but ensures that there is no "orange ring" around the selected image. It does this by first complementing the image, and then flooding all orange pixels that are on the border of the image to blue. (In case you do not use the default colors, orange is color 3 and blue is color 0.) All other flag bits should be 0.

gg_Activation
The activation should have only RELVERIFY and GADGIMMEDIATE set.

gg_Type
The gadget type should be BOOLGADGET.

gg_GadgetRender
Set this to an appropriate **Image** structure.

gg_SelectRender
Set this if and only if the highlight mode is GADGHIMAGE.

The **Image** structure is typically the same size as the gadget, except that **ig_Height** is often one pixel less than the gadget height. This allows a blank line between the icon image and the icon name. The image depth *must* be 2; **ig_PlanePick** *must* be 3; and **ig_PlaneOnOff** should be 0. The **ig_NextImage** field should be null.

ICONS WITH NO POSITION

Picking a position for a newly created icon can be tricky. NO_ICON_POSITION is a magic value for **do_CurrentX** and **do_CurrentY** that instructs Workbench to pick a reasonable place for the icon. Workbench will place the icon in an unused region of the drawer. If there is no space in the drawers window, the icon will be placed just to the right of the visible region.

Workbench Environment

When a user activates a tool or project, Workbench runs a program. This program is a separate process and runs asynchronously to Workbench. This allows the user to take advantage of the multiprocessing features of the Amiga.

The environment for a tool under the Workbench is quite different from the environment when a tool is run from the CLI. The CLI does not create a new process for a program; it jumps to the program's code and the program shares the process with the CLI. This means that the program has access to all the CLI's environment, but the program must be very careful to restore all the correct defaults before returning. Workbench starts a tool from scratch and explicitly passes the environment to the tool.

One of the things that a Workbench program must set up is stdin and stdout. By default, a Workbench program does not have a window to which its output will go. Therefore, stdin and stdout do not point to legal file handles. If your program attempts to **printf()**, it will destroy the system.

START-UP MESSAGE

Right after the tool is started, Workbench sends the tool a message, which is posted to the message port in the tool's process. This message contains the environment and the arguments for the tool.

Each icon that is selected in the Workbench is passed to the tool. The first argument is the tool itself. If the tool was derived from a default tool, then this is passed in addition to the project. All other arguments are passed in the order in which the user selected them; the first icon selected will be first.

The tool may do what it wishes with the start-up message; however, it must deallocate the message sooner or later. If the message is replied to Workbench, then Workbench will take care of all the clean-up. The tool should not do this until it finishes executing, because part of the clean-up is freeing the tool's data space.

The start-up message, whose structure is outlined in *workbench/startup.h*, has the following structure elements:

sm_Message
A standard Exec message. The reply port is set to the Workbench.

sm_Process
The process descriptor for the tool (as returned by **CreateProcess()**)

sm_Segment
The loaded code for the tool (returned by **LoadSeg()**)

sm_NumArgs
The number of arguments in **sm_ArgList**

sm_ToolWindow
This is the same string as the **DiskObject**'s **do_ToolWindow**. It is passed here so the tool's start-up code can open a window for the tool. If it is null, no default window is opened.

sm_ArgList
This is the argument list itself.

Each argument has two parts. The **wa_Name** element is the name of the argument. If this is not a default tool or a drawer-like object, this will be the same as the string displayed under the icon. A default tool will have the text of the **do_DefaultTool** pointer; a drawer will have a null name passed. The **wa_Lock** is always a lock on a directory, or is NULL (if that object type does not support locks).

The following code fragment will work for all arguments (assuming that open will work on them at all).

```
LockArg( arg )
struct WBArg *arg;
int openmode;
{
   LONG olddir;
   LONG lock;

   /* see if this type can be locked */
   if( arg->wa_Lock == NULL ) {
      /* cannot lock it -- it must be a device (for example, DF0:) */
      return( NULL );
   }

   /* change directory to where the argument is */
   olddir = CurrentDir( arg->wa_Lock );

   /* open the argument up */
   lock = Lock( arg->wa_Name, SHARED_LOCK );
   if( lock == NULL ) {
      /* who knows: maybe the user canceled a disk insertion
       * request.  The real reason can be gotten  by IoErr()
       */
      return( NULL );
   }

   /* set the directory back */
   CurrentDir( olddir );

   return( lock );
}
```

For more routines to manipulate Workbench arguments, see the function appendix.

THE STANDARD START-UP CODE

The standard start-up code handles the worst of the detail work of interfacing with the system. The C start-up code (**startup.obj**) waits for the start-up message, opens the tool window (if one has been requested), sets up **SysBase** and **DOSBase**, and passes the start-up message on to **main()**. When **main()** returns (or **exit()** is called) it replies the message back to Workbench.

The **main()** procedure is called with two parameters: **argv** and **argc**. If **argc** is not NULL, you have been called from the CLI. If **argc** is NULL, you have been called from Workbench. The global variable **WBenchMsg** points to the Workbench start-up message.

Note: A word of warning for those of you who do not use the standard start-up sequence: you *must* turn off task switching (with **Forbid()**) before replying the message to Workbench. This will prevent Workbench from unloading your code before you can tell the DOS that you want to exit. See the C start-up code in the "Example Programs" section.

The ToolTypes Array

This section shows how the **ToolTypes** array should be formatted, and describes the standard entries in the **ToolTypes** array. In brief, **ToolTypes** is an array of strings. These strings can be used to encode information about the icon that will be available to all who wish to use it. The formats are user-definable and user-extensible.

Workbench does not enforce much about the **ToolTypes** array, but some conventions are strongly encouraged. A string may be up to 32K bytes large, but you should not make it over a line long. The alphabet is 8-bit ANSI (for example, normal ASCII with foreign-language extensions). To see what it looks like, try typing with the Alt key held down. Avoid special or non-printing characters. The case of the characters is significant. The general format is

<name>=<value>[|<value>]*

where <name> is the field name and <value> is the text to associate with that name. If the ID has multiple values, the values may separated by a vertical bar. Currently, the value should be the name of the application that understands this file. For example, a basic program might be

FILETYPE=ABasiC.program|text

This notifies the world that this file is acceptable to either a program that is expecting any arbitrary type of text (for example, an editor) or to a program that only understands a basic program.

Two routines are provided to help you deal with the **Tooltype** array. **FindToolType()** returns the value of a **Tooltype** element. Using the above example, if you are looking for FILETYPE, the string "ABasiC.program|text" will be returned.

MatchToolValue() returns nonzero if the specified string is in the reference value string. This routine knows how to parse vertical bars. For example, using the reference value string of "ABasiC.program|text", **MatchToolValue()** will return TRUE for "text" and "ABasiC.program" and FALSE for everything else.

Example Programs

Some example programs, including a start-up sequence, are provided in the following sections.

FRIENDLYTOOL

This program tells the application if it can understand a particular object.

```
/* INPUTS
 *     diskobj -- a workbench DiskObject (a returned by GetDiskObject)
 *     id -- the application identifier
 *
 * OUTPUTS
 *     nonzero if it understands this object's type
*/

#include "exec/types.h"
#include "workbench/workbench.h"
#include "workbench/icon.h"

LONG IconBase;

FriendlyTool( diskobj, id )
struct DiskObject *diskobj;
char *id;
{
    char **toolarray;
    char *value;

    /* default return value is failure */
    int isfriendly = 0;

    /* this assumes that you have not already opened the icon library
     * elsewhere in your program.  You undoubtedly have, because
     * you managed to get a DiskObject structure.
     */
```

```
    IconBase = OpenLibrary( ICONNAME, 1 );
    if( IconBase == NULL ) {
        /* couldn't find the library??? */
        return( 0 );
    }

    /* extract the tool type value array */
    toolarray = diskobj->do_ToolType;


    /* find the FILETYPE entry */
    value = FindToolType( toolarray, "FILETYPE" );
    if( value ) {
        /* info file did define the FILETYPE entry */

        isfriendly = MatchToolValue( value, id );
    }

    Close( IconBase );

    /* protect ourselves from inadvertent use */
    IconBase = -1;

    return( isfriendly );
}
```

START-UP PROGRAM

```
************************************************************************
*
*      C Program Startup/Exit (Combo Version: CLI and WorkBench)
*
************************************************************************

******* Included Files *************************************************

        INCLUDE "exec/types.i"
        INCLUDE "exec/alerts.i"
        INCLUDE "exec/nodes.i"
        INCLUDE "exec/lists.i"
        INCLUDE "exec/ports.i"
        INCLUDE "exec/libraries.i"
        INCLUDE "exec/tasks.i"
        INCLUDE "libraries/dos.i"
```

```
        INCLUDE "libraries/dosextens.i"
        INCLUDE "workbench/startup.i"

******* Imported *******************************************************

xlib    macro
        xref    _LVO\1
        endm

        xref    _AbsExecBase
        xref    _Input
        xref    _Output

        xref    _main                   ; C code entry point

        xlib    Alert
        xlib    FindTask
        xlib    Forbid
        xlib    GetMsg
        xlib    OpenLibrary
        xlib    CloseLibrary
        xlib    ReplyMsg
        xlib    Wait
        xlib    WaitPort

        xlib    CurrentDir
        xlib    Open

******* Exported *******************************************************

        xdef    _SysBase
        xdef    _DOSBase

        xdef    _errno
        xdef    _stdin
        xdef    _stdout
        xdef    _stderr

        xdef    _exit           ; standard C exit function
        xdef    _WBenchMsg


callsys     macro
        CALLLIB  _LVO\1
        endm
```

```
*********************************************************************
*
*     Standard Program Entry Point
*
*     main (argc, argv)
*        int  argc;
*        char *argv[];
*
*********************************************************************

startup:                        ; reference for Wack users
            move.l    sp,initialSP        ; initial task stack pointer
            move.l    d0,dosCmdLen
            move.l    a0,dosCmdBuf
            clr.l     _WBenchMsg

     ;------ get Exec's library base pointer:
            move.l    _AbsExecBase,a6
            move.l    a6,_SysBase

     ;------ get the address of our task
            suba.l    a1,a1
            callsys   FindTask
            move.l    d0,a4

     ;------ are we running as a son of Workbench?
            tst.l     pr_CLI(A4)
            beq       fromWorkbench

;=======================================================================
;======= CLI Start-up Code =============================================
;=======================================================================
fromCLI:
     ;------ attempt to open DOS library:
            bsr       openDOS

     ;------ find command name:
            move.l    pr_CLI(a4),a0
            add.l     a0,a0       ; bcpl pointer conversion
            add.l     a0,a0
            move.l    cli_CommandName(a0),a0
            add.l     a0,a0       ; bcpl pointer conversion
            add.l     a0,a0

     ;------ create buffer and array:
```

```
*               link         a6,#-(100+16*4+2*4)
                movem.l      d2/a2/a3,-(sp)
                lea          argvBuffer,a2
                lea          argvArray,a3
*               move.l       a3,16(sp)    ; save
                moveq.l      #1,d2              ; param counter

        ;------ fetch command name:
                moveq.l      #0,d0
                move.b       (a0)+,d0     ; size of command name
                move.l       a2,(a3)+     ; ptr to command name
                bra.s        1$
2$:             move.b       (a0)+,(a2)+
1$:             dbf          d0,2$
                clr.b        (a2)+

        ;------ collect parameters:
                move.l       dosCmdLen,d0
                move.l       dosCmdBuf,a0

        ;------ skip control characters and space:
3$:             move.b       (a0)+,d1
                subq.l       #1,d0
                ble.s        parmExit
                cmp.b        #' ',d1
                ble.s        3$

        ;------ copy parameter:
                addq.l       #1,d2
                move.l       a2,(a3)+
                bra.s        5$
4$:             move.b       (a0)+,d1
                subq.l       #1,d0
                cmp.b        #' ',d1
                ble.s        6$
5$:             move.b       d1,(a2)+
                bra.s        4$
6$:
                clr.b        (a2)+
                bra.s        3$
parmExit:       clr.b        (a2)+
                clr.l        (a3)+

                move.l       d2,d0
                movem.l      (sp)+,d2/a2/a3
```

```
        pea         argvArray
        move.l      d0,-(sp)

* The above code relies on the end of line containing a control
* character of any type, i.e. a valid character must not be the
* last.  This fact is ensured by DOS.


    ;------ get standard input handle:
        jsr         _Input
        move.l      d0,_stdin

    ;------ get standard output handle:
        jsr         _Output
        move.l      d0,_stdout
        move.l      d0,_stderr

    ;------ call C main entry point
        jsr         _main

    ;------ return success code:
        moveq.l     #0,D0
        move.l      initialSP,sp        ; restore stack ptr
        rts

;=======================================
;======= Workbench Start-up Code ==================
;=======================================
fromWorkbench:
    ;------ open the DOS library:
        bsr         openDOS

    ;------ we are now set up.  wait for a message from our starter
        bsr         waitmsg

    ;------ save the message so we can return it later
        move.l      d0,_WBenchMsg

    ;------ push the message on the stack for wbmain
        move.l      d0,-(SP)
        clr.l       -(SP)         indicate: run from Workbench

    ;------ get the first argument
        move.l      d0,a2
        move.l      sm_ArgList(a2),d0
```

```
            beq.s       docons

        ;------ and set the current directory to the same directory
            move.l      _DOSBase,a6
            move.l      d0,a0
            move.l      wa_Lock(a0),d1
            callsys     CurrentDir

docons:
        ;------ get the toolwindow argument
            move.l      sm_ToolWindow(A2),d1
            beq.s       domain

        ;------ open up the file
            move.l      #MODE_OLDFILE,d2
            callsys     Open

        ;------ set the C input and output descriptors
            move.l      d0,_stdin
            move.l      d0,_stdout
            move.l      d0,_stderr
            beq.s       domain

        ;------ set the console task (so Open( "*", mode ) will work
        ;       waitmsg has left the task pointer in A4 for us
            lsl.l       #2,d0
            move.l      d0,a0
            move.l      fh_Type(a0),pr_ConsoleTask(A4)

domain:
            jsr         _main
            moveq.l     #0,d0           Successful return code
            bra.s       exit2


************************************************************************
*
*       C Program Exit Function
*
*  Warning: this function really needs to do more than this.
*
************************************************************************

_exit:
            move.l      4(SP),d0    ; extract return code
```

```
exit2:
        move.l    initialSP,SP     ; restore stack pointer
        move.l    d0,-(SP)   ; save return code

    ;------ close DOS library:
        move.l    _AbsExecBase,A6
        move.l    _DOSBase,d0
        beq.s     1$
        move.l    d0,a1
1$:     callsys   CloseLibrary

    ;------ if we ran from CLI, skip workbench cleanup:
        tst.l     _WBenchMsg
        beq.s     exitToDOS

    ;------ return the startup message to our parent
    ;       we forbid so workbench can't UnLoadSeg() us
    ;       before we are done:
        callsys   Forbid
        move.l    _WBenchMsg,a1
        callsys   ReplyMsg

    ;------ this rts sends us back to DOS:
exitToDOS:
        move.l    (SP)+,d0
        rts


;-----------------------------------------------------------------------
noDOS:
        ALERT     (AG_OpenLib!AO_DOSLib)
        moveq.l   #100,d0
        bra.s     exit2


;-----------------------------------------------------------------------
; This routine gets the message that workbench will send to us
; called with task id in A4

waitmsg:
        lea       pr_MsgPort(A4),a0    * our process base
        callsys   WaitPort
        lea       pr_MsgPort(A4),a0    * our process base
        callsys   GetMsg
        rts
```

```
;--------------------------------------------------------------------
; Open the DOS library:

openDOS
        clr.l       _DOSBase
        lea         DOSName,A1
        move.l      #LIBRARY_VERSION,d0
        callsys     OpenLibrary
        move.l      D0,_DOSBase
        beq         noDOS
        rts

************************************************************************

    DATA

************************************************************************

VerRev          dc.w  1,0

_SysBase        dc.l  0
_DOSBase        dc.l  0

_errno          dc.l  0
_stdin          dc.l  -1
_stdout         dc.l  -1
_stderr         dc.l  -1

initialSP       dc.l  0
_WBenchMsg      dc.l  0

dosCmdLen       dc.l  0
dosCmdBuf       dc.l  0

argvArray       ds.l  32
argvBuffer      ds.b  256

DOSName         DOSNAME

    END
```

ECHO.C

The following example program prints out arguments passed by the CLI or the WorkBench.

```
/* Note: If WB startup, uses window opened by LStartup.obj */

#include <exec/types.h>
#include <workbench/startup.h>
#include <lattice/stdio.h>
extern struct WBStartup *WBenchMsg;

main(argc,argv)
int  argc;
char **argv;
      {
         BYTE c;
         if(argc>0) {
            printCliArgs(argc,argv);
         }
         else {
         printWBArgs(WBenchMsg);
         while ((c=getchar()) != '\n');
         }
      }

printCliArgs(argc,argv)
int  argc;
char **argv;
      {
         int i;
         for(i=0; i<argc; i++) {
            printf("Arg %2ld = %s\n",i,argv[i]);
         }
      }
printWBArgs(msg)
struct WBStartup *msg;
      {
         struct WBArg *arg;
         int i;
         for(i=0, arg=msg->sm_ArgList; i < msg->sm_NumArgs; i++,arg++) {
         printf("WBArg%2ld:Lock=0x%06lx:Name=%s\n",
                  i,arg->wa_Lock,arg->wa_Name);
         }
         printf("PRESS <RET> TO EXIT\n");
      }
```

Appendix A

Library Summaries

This appendix contains UNIX-like summaries for the routines that are built into the Amiga ROM (or kickstart) software, as well as summaries of routines in disk-loadable libraries. The debug library documentation is included here as well.

These documentation files are organized alphabetically. Following this introduction is a listing of each routine in this appendix, followed by the name of the library in which the routine is located. The tutorial sections of this manual show you how these routines relate to one another and give you the prerequisites for calling them.

Most routines are listed as part of a library of routines. Before you can use a routine within your program, you must make sure that the library is opened. Opening libraries is explained fully in the "Libraries" chapter of *Amiga ROM Kernel Reference Manual: Exec* but it bears repeating here. You open a library by using the **OpenLibrary()** function as follows:

```
struct LibBase *LibBase;
LibBase = OpenLibrary("library.name",version);
```

where

library.name
: is a string that describes the name of the library you wish to open.

version
: is the version number of the library that you wish to have opened. A value of 0 says give me any version. A value of 31, for example (which is the latest version as of this writing) means specifically to open version 31 of this library or a later version if 31 is not available.

If the library is disk-resident, it is loaded and initialized. The **OpenLibrary()** function returns the address of the library base, which you must assign to a specific variable. In this way your program links into the library-specific interface code that is contained in *amiga.lib*.

The names of the libraries that are currently part of the Amiga software and the corresponding names of the library base pointers associated with them are as follows:

Library Name	Library Base Pointer Name	
exec.library	ExecBase	
clist.library	ClistBase	
graphics.library	GfxBase	
layers.library	LayersBase	
intuition.library	IntuitionBase	
mathffp.library	MathBase	
mathtrans.library	MathTransBase	
mathieeedoubbas.library	MathIeeeDoubBasBase	
dos.library	DosBase	
translator.library	TranslatorBase	
icon.library	IconBase	
diskfont.library	DiskfontBase	
ramlib.library	---	(not useful to C language)

For example:

```
#include "graphics/gfx.h"
struct GfxBase *GfxBase;
GfxBase = OpenLibrary("graphics.library",0);
if(GfxBase == NULL) exit(NO_GRAPHICS_LIBRARY_FOUND);
```

Note: If your program is coming up through the normal start-up code (see the "Workbench" chapter), *exec.library* and *dos.library* are already opened for you. Thus you need not open them yourself.

The logic of this code is as follows:

1. When calling a routine, C takes the parameters for the routine and pushes them onto the stack. For example:

   ```
   x = Routine(parmA, parmB);
   ```

   Then it calls a routine named "_Routine" (adds an underscore to the head of the routine name).

2. The underlying ROM (or disk-based) code usually expects its parameters to be passed in registers rather than on the stack. This is to make the code truly general-purpose (that is, it does not impose a particular stack frame) and more efficient for assembly language coding.

   Therefore, the interface code **at _Routine**, in turn, saves the contents of registers the routine will use, pulls parameters off the stack, jams them into registers, and finally passes control directly to the actual starting location of the routine itself.

   The linker needs the library base location because it is through a "jump-with-offset" from a machine register that the **_Routine** entry point is found. The Amiga uses a relocating loader in AmigaDOS, so you can never be sure exactly where a library of routines is located. However, once the system has loaded a library, it knows how and where to find it and gives you a way to use the library's routines.

The following shows typical interface code linked to your program from *amiga.lib*:

```
          xref _LibBase       ;library base name is defined in
                              ;user's file, this code gets linked
                              ;to user's program; get the value
                              ;from there when library is opened.
          xdef _Routine
                              ;make _Routine name external,
                              ;visible to linker.
_Routine:
          move.l   A6,-(sp)            ;save register(s)
          move.l   8(sp),A0/A1         ;copy params A and B to regs.
          move.l   _LibBase,A6         ;load library base address
          jsr      _LVORoutine(A6)     ;go to real routine
          move.l   (sp)+,A6            ;restore registers
          rts
```

where **_LVORoutine** is a value representing the offset, within the library, at which the "real" routine (the routine that expects parameters in registers) is located.

When you have finished using a library, at the end of your program, you should close it, using the **CloseLibrary()** function as follows:

```
CloseLibrary(LibBase);
```

If the system is running out of memory and needs to free up space, it can check the library-accessors field for various libraries. For those whose accessors value is zero, it can retrieve the memory that the library had used.

Contents

CloseDevice	exec.library
CloseFont	graphics.library
CloseLibrary	exec.library
CloseScreen	intuition.library
CloseWindow	intuition.library
CloseWorkBench	intuition.library
CMOVE	graphics.library
ColdReset	exec.library
ConcatCList	clist.library
CopyCList	clist.library
CopySBitMap	graphics.library
CreateBehindLayer	layers.library
CreateDir	dos.library
CreateExtIO	exec_support.library
CreateProc	dos.library
CreateStdIO	exec_support.library
CreateUpfrontLayer	layers.library
CurrentDir	dos.library
CurrentTime	intuition.library
CWAIT	graphics.library
DateStamp	dos.library
Deallocate	exec.library
Delay	dos.library
DeleteFile	dos.library
DeleteLayer	layers.library
DeletePort	exec_support.library
DeleteStdIO	exec_support.library
DeviceProc	dos.library
Disable	exec.library
DisownBlitter	graphics.library
DisplayAlert	intuition.library
DisplayBeep	intuition.library
DisposeLayerInfo	layers.library
DisposeRegion	graphics.library
DoCollision	graphics.library
DoIO	exec.library
DoubleClick	intuition.library
Draw	graphics.library
DrawBorder	intuition.library
DrawGList	graphics.library
DrawImage	intuition.library
DupLock	dos.library
Enable	exec.library
EndRefresh	intuition.library
EndRequest	intuition.library
EndUpdate	layers.library
Enqueue	exec.library
Examine	dos.library
Execute	dos.library
Exit	dos.library
ExNext	dos.library
faddi	mathffp.library
FattenLayerInfo	layers.library
fcmpi	mathffp.library
fdivi	mathffp.library
fflti	mathffp.library
FindName	exec.library
FindPort	exec.library
FindTask	exec.library
FindToolType	icon.library

Flood	graphics.library
Forbid	exec.library
FlushCList	clist.library
fmuli	mathffp.library
fnegi	mathffp.library
FreeCList	clist.library
FreeColorMap	graphics.library
FreeCopList	graphics.library
FreeCprList	graphics.library
FreeDiskObject	icon.library
FreeEntry	exec.library
FreeFreeList	icon.library
FreeGBuffers	graphics.library
FreeMem	exec.library
FreeRaster	graphics.library
FreeRemember	intuition.library
FreeSignal	exec.library
FreeSprite	graphics.library
FreeSysRequest	intuition.library
FreeTrap	exec.library
FreeVPortCopLists	graphics.library
FreeWBObject	icon.library
fsubi	mathffp.library
ftsti	mathffp.library
GetCC	exec.library
GetCLBuf	clist.library
GetCLChar	clist.library
GetCLWord	clist.library
GetColorMap	graphics.library
GetDefPrefs	intuition.library
GetDiskObject	icon.library
GetGBuffers	graphics.library
GetIcon	icon.library
GetMsg	exec.library
GetPrefs	intuition.library
GetRGB4	graphics.library
GetSprite	graphics.library
GetWBObject	icon.library
IEEEDPAbs	mathieeedoubbas.library
IEEEDPAdd	mathieeedoubbas.library
IEEEDPCmp	mathieeedoubbas.library
IEEEDPDiv	mathieeedoubbas.library
IEEEDPFlt	mathieeedoubbas.library
IEEEDPMul	mathieeedoubbas.library
IEEEDPNeg	mathieeedoubbas.library
IEEEDPSub	mathieeedoubbas.library
IEEEDPTst	mathieeedoubbas.library
IncrCLMark	clist.library
Info	dos.library
InitArea	graphics.library
InitBitMap	graphics.library
InitCLPool	clist.library
InitGels	graphics.library
InitGMasks	graphics.library
InitLayers	layers.library
InitMasks	graphics.library
InitRastPort	graphics.library
InitRequester	intuition.library
InitStruct	exec.library
InitTmpRas	graphics.library

InitView	graphics.library
InitVPort	graphics.library
Input	dos.library
Insert	exec.library
IntuiTextLength	intuition.library
IoErr	dos.library
IsInteractive	dos.library
ItemAddress	intuition.library
LoadRGB4	graphics.library
LoadSeg	dos.library
LoadView	graphics.library
Lock	dos.library
LockLayer	layers.library
LockLayerInfo	layers.library
LockLayerRom	graphics.library
LockLayers	layers.library
MakeLibrary	exec.library
MakeScreen	intuition.library
MakeVPort	graphics.library
MarkCList	clist.library
MatchToolValue	icon.library
ModifyIDCMP	intuition.library
ModifyProp	intuition.library
Move	graphics.library
MoveLayer	layers.library
MoveLayerInFrontOf	layers.library
MoveScreen	intuition.library
MoveSprite	graphics.library
MoveWindow	intuition.library
MrgCop	graphics.library
NewLayerInfo	layers.library
NewRegion	graphics.library
OffGadget	intuition.library
OffMenu	intuition.library
OnGadget	intuition.library
OnMenu	intuition.library
Open	dos.library
OpenDevice	exec.library
OpenDiskFont	diskfont.library
OpenFont	graphics.library
OpenLibrary	exec.library
OpenResource	exec.library
OpenScreen	intuition.library
OpenWindow	intuition.library
OpenWorkBench	intuition.library
OrRectRegion	graphics.library
Output	dos.library
OwnBlitter	graphics.library
ParentDir	dos.library
PeekCLMark	clist.library
Permit	exec.library
PolyDraw	graphics.library
PrintIText	intuition.library
PutCLBuf	clist.library
PutCLChar	clist.library
PutCLWord	clist.library
PutDiskObject	icon.library
PutIcon	icon.library
PutMsg	exec.library
PutWBObject	icon.library

QBlit	graphics.library
QBSBlit	graphics.library
Read	dos.library
ReadPixel	graphics.library
RectFill	graphics.library
RefreshGadgets	intuition.library
RemakeDisplay	intuition.library
RemDevice	exec.library
RemFont	graphics.library
RemHead	exec.library
RemIBob	graphics.library
RemIntServer	exec.library
RemLibrary	exec.library
Remove	exec.library
RemoveGadget	intuition.library
RemPort	exec.library
RemResource	exec.library
RemTail	exec.library
RemTask	exec.library
RemVSprite	graphics.library
Rename	dos.library
ReplyMsg	exec.library
ReportMouse	intuition.library
Request	intuition.library
RethinkDisplay	intuition.library
ScreenToBack	intuition.library
ScreenToFront	intuition.library
ScrollLayer	layers.library
ScrollRaster	graphics.library
ScrollVPort	graphics.library
Seek	dos.library
SendIO	exec.library
SetAPen	graphics.library
SetBPen	graphics.library
SetOPen	graphics.library
SetCollision	graphics.library
SetComment	dos.library
SetDMRequest	intuition.library
SetDrMd	graphics.library
SetExcept	exec.library
SetFont	graphics.library
SetFunction	exec.library
SetIntVector	exec.library
SetMenuStrip	intuition.library
SetPointer	intuition.library
SetProtection	dos.library
SetRast	graphics.library
SetRGB4	graphics.library
SetSignal	exec.library
SetSoftStyle	graphics.library
SetSR	exec.library
SetTaskPri	exec.library
SetWindowTitles	intuition.library
ShowTitle	intuition.library
Signal	exec.library
SizeCList	clist.library
SizeLayer	layers.library
SizeWindow	intuition.library
SortGList	graphics.library
SPAbs	mathffp.library

SPAcos	mathtrans.library
SPAdd	mathffp.library
SPAsin	mathtrans.library
SPAtan	mathtrans.library
SPCmp	mathffp.library
SPCos	mathtrans.library
SPCosh	mathtrans.library
SPDiv	mathffp.library
SPExp	mathtrans.library
SPFieee	mathtrans.library
SPFlt	mathffp.library
SplitCList	clist.library
SPLog	mathtrans.library
SPLog10	mathtrans.library
SPMul	mathffp.library
SPNeg	mathffp.library
SPPow	mathtrans.library
SPSin	mathtrans.library
SPSincos	mathtrans.library
SPSinh	mathtrans.library
SPSqrt	mathtrans.library
SPSub	mathffp.library
SPTan	mathtrans.library
SPTanh	mathtrans.library
SPTieee	mathtrans.library
SPTst	mathffp.library
SubCList	clist.library
SumLibrary	exec.library
SuperState	exec.library
SwapBitsRastPortClipRect	layers.library
SyncSBitMap	graphics.library
Text	graphics.library
TextLength	graphics.library
ThinLayerInfo	layers.library
UnGetCLChar	clist.library
UnGetCLWord	clist.library
UnLoadSeg	dos.library
UnLock	dos.library
UnlockLayer	layers.library
UnlockLayerInfo	layers.library
UnlockLayerRom	graphics.library
UnlockLayers	layers.library
UnPutCLChar	clist.library
UnPutCLWord	clist.library
UpfrontLayer	layers.library
UserState	exec.library
VBeamPos	graphics.library
ViewAddress	intuition.library
ViewPortAddress	intuition.library
Wait	exec.library
WaitBlit	graphics.library
WaitBOVP	graphics.library
WaitForChar	dos.library
WaitIO	exec.library
WaitPort	exec.library
WaitTOF	graphics.library
WBenchToBack	intuition.library
WBenchToFront	intuition.library
WhichLayer	layers.library
WindowLimits	intuition.library

WindowToBack	intuition.library
WindowToFront	intuition.library
Write	dos.library
WritePixel	graphics.library
XorRectRegion	graphics.library

abs

NAME

abs -- obtain the absolute value of the fast floating-point number

C USAGE

```
fnum2 = abs(fnum1);
            D0
```

FUNCTION

Accepts a floating-point number and returns the absolute value of said number. Note that this function is called by compiler-generated code, not by a user-generated function call.

INPUTS

fnum1 - floating-point number

RESULT

fnum2 - floating-point absolute value of fnum1

BUGS

None

SEE ALSO

SPAbs,

AddAnimOb

NAME

AddAnimOb -- add an AnimOb to the linked list of AnimObs

SYNOPSIS

```
AddAnimOb(anOb, anKey, RPort)
          a0    a1     a2
```

-156 (GRA)

FUNCTION

Links this AnimOb into the current list pointed to by animKey
Initializes all the Timers of the AnimOb's components
Calls AddBob with each component's Bob
Note that the RPort must be correctly initialized before you call here, including a valid GelsInfo

INPUTS

anOb = pointer to the AnimOb structure to be added to the list
anKey = address of a ptr to the first AnimOb in the list (NULL if none)
RPort = pointer to a valid RastPort

RESULT

Nothing

BUGS

None known

SEE ALSO

Nothing

AddBob

NAME
   AddBob -- adds a Bob to current GEL list

SYNOPSIS
```
   AddBob(Bob, RPort)
          a0   a1
```
-96 (GRA)

FUNCTION
   Sets up the system Bob flags, then links this GEL into the list via AddVSprite

INPUTS
   Bob = pointer to the Bob structure to be added to the GEL list
   RPort = pointer to a RastPort structure

RESULT
   Nothing

BUGS
   None known

SEE ALSO
   AddVSprite

AddDevice

NAME
   AddDevice -- add a device to the system

SYNOPSIS
```
   AddDevice(device)
             A1
```
-432 (EXEC)

FUNCTION
   This function adds a new device to the system, making it available to everyone. The device should be ready to be called at this time.

INPUTS
   device - pointer to a properly initialized device node

SEE ALSO
   RemDevice

AddFont

NAME
 AddFont -- add a font to the system list

SYNOPSIS
```
 AddFont(textFont), GraphicsLib
     A1      A6
```
-480(GRA)

FUNCTION
 This function adds the text font to the system, making it available for use by any application. The font added must be in public memory and must remain until successfully removed.

INPUTS
 textFont - a TextFont structure in public RAM.

AddFreeList

NAME
 AddFreeList -- add memory to the free list

SYNOPSIS
```
 status = AddFreeList( free, mem, len )
 D0                    A0    A1   A2
```
-72(ICON)

FUNCTION
 This routine adds the specified memory to the free list. The free list will be extended (if required). If there is not enough memory to complete the call, a null is returned.

 Note that AddFreeList does NOT allocate the requested memory. It only records the memory in the free list.

INPUTS
 free -- a pointer to a FreeList structure
 mem -- the base of the memory to be recorded
 len -- the length of the memory to be recorded

RESULTS
 status -- nonzero if the call succeeded.

EXCEPTIONS

SEE ALSO
 AllocEntry, FreeEntry, FreeFreeList

BUGS

AddGadget

NAME
```
    AddGadget  --  add a gadget to the gadget list of the window or
                   screen
```

SYNOPSIS
```
    AddGadget(Pointer, Gadget, Position)
              A0       A1      D0
```
-42(INT)

FUNCTION

Adds the specified gadget to the gadget list of the given window, linked in at the position in the list specified by the Position argument (that is, if Position == 0, the gadget will be inserted at the head of the list, and if Position == 1, the gadget will be inserted after the first gadget and before the second). If the Position you specify is greater than the number of gadgets in the list, your gadget will be added to the end of the list. This procedure returns the position at which your gadget was added.

Calling AddGadget() does not cause your gadget to be displayed. The benefit of this is that you may add several gadgets without having the gadget list redrawn every time. The drawback is that you are obliged to call RefreshGadgets() to have your added gadgets displayed.

NOTE: A relatively safe way to add the gadget to the end of the list is to specify a Position of -1. That way, only the 65,536th (and multiples of it) will be inserted at the wrong position. The return value of the procedure will tell you where it was actually inserted.

NOTE: The system window and screen gadgets are initially added to the front of the gadget list. The reason for this is: if you position your own gadgets in some way that interferes with the graphical representation of the system gadgets, the system's gadgets will be "hit" first by the user. If you then start adding gadgets to the front of the list, you will disturb this plan, so beware. On the other hand, if you do not violate the design rule of never overlapping your gadgets, there is no problem.

INPUTS
```
    Pointer = pointer to the window to get your gadget.
    Gadget = pointer to the new gadget.
    Position = integer position in the list for the new gadget
         (starting from zero as the first position in the list).
```

RESULT

Returns the position where the gadget was actually added.

BUGS

None.

SEE ALSO

RemoveGadget().

AddHead

NAME

AddHead -- insert node at the head of a list

SYNOPSIS
```
    AddHead(list, node)
            A0    A1
```
-240(EXEC)

FUNCTION

Add a node to the head of a doubly linked list.

INPUTS
```
    list - a pointer to the target list header
    node - the node to insert at head
```

AddIntServer

NAME

```
AddIntServer -- add an interrupt server to the system
```

SYNOPSIS

```
AddIntServer(intNum, interrupt)
             D0-0:4  A1
```

-168(EXEC)

FUNCTION

This function adds a new interrupt server to a given server chain. The node is located on the chain in a priority dependent position. Higher priority nodes will be serviced first.

If this server is the first one, interrupt will be enabled on this chain.

Servers are called with the following register conventions:

```
D0 - scratch
D1 - scratch

A0 - scratch
A1 - server data segment pointer (scratch)

A5 - jump vector register (scratch)
A6 - library base pointer (scratch)

all other registers - must be preserved
```

INPUTS

intNum - the Portia interrupt bit (0..14)
interrupt - pointer to an interrupt server node

SEE ALSO

RemIntServer

AddLibrary

NAME

```
AddLibrary -- add a library to the system
```

SYNOPSIS

```
AddLibrary(library)
           A1
```

-396(EXEC)

FUNCTION

This function adds a new library to the system making it available to everyone. The library should be ready to be called at this time. It will be added to the system library name list, and the checksum on the library entries will be calculated.

INPUTS

library - pointer to a properly initialized library structure

SEE ALSO

RemLibrary

AddPort

NAME
    AddPort -- add a message port to the system

SYNOPSIS
    AddPort(port)
            A1

-354(EXEC)

FUNCTION
    This function attaches a message port structure to the system's message port list. The name and priority fields of the port structure should be initialized prior to calling this function. If the user does not require the name and priority fields, they should be initialized to zero. As with the name field in other system list items, the name is useful when more than one task needs to rendezvous on at port.

INPUTS
    port - pointer to a message port

SEE ALSO
    RemPort, FindName

AddResource

NAME
    AddResource -- add a resource to the system

SYNOPSIS
    AddResource(resource)
                A1

-486(EXEC)

FUNCTION
    This function adds a new resource to the system and makes it available to other users. The resource should be ready to be called at this time.

INPUTS
    resource - pointer to a properly initialized resource node

SEE ALSO
    RemResource

AddTail

NAME
    AddTail -- append node to tail of a list

SYNOPSIS

```
AddTail(list, node)
        A0    A1
```

-246(EXEC)

FUNCTION
    Add a node to the tail of a doubly linked list.

INPUTS
    list - a pointer to the target list header
    node - the node to insert at tail

AddTask

NAME
    AddTask -- add a task to the system

SYNOPSIS

```
AddTask(task, initialPC, finalPC)
        A1    A2         A3
```

-282(EXEC)

FUNCTION
    Add a task to the system.

Certain fields of the task control block must be initialized and a minimal stack should be allocated prior to calling this function.

This function will temporarily use space from the new task's stack for the task's initial set of registers. This space is allocated starting at the SPREG location specified in the task control block (not from SPUPPER). This means that a task's stack may contain static data put there prior to its execution. This is useful for providing initialized global variables or some tasks may want to use this space for passing the task its initial arguments.

A task's initial registers are set to zero (except the PC).

INPUTS
    task - pointer to the task control block
    initialPC - the initial entry point
    finalPC - the finalization code entry point. If zero, the system will use a general finalizer. This pointer is placed on the stack as if it were the outermost return address.

SEE ALSO
    RemTask

AddVSprite

```
NAME
   AddVSprite  --  add a VSprite to the current GEL list

SYNOPSIS
   AddVSprite(VS, RPort)     as called by C
              a0  a1
                                              -102(GRA)
FUNCTION
   Sets up the system VSprite flags
   Links this VSprite into the current GEL list using its Y,X

INPUTS
   VS = pointer to the VSprite structure to be added to the GEL list
   RPort = pointer to a RastPort structure

RESULT
   Nothing

BUGS
   None known

SEE ALSO
   Nothing
```

Allocate

```
NAME
     Allocate -- allocate a block of memory

SYNOPSIS
     memoryBlock = allocate(freeList, byteSize)
     D0                     A0        D0
                                                 -186 (EXEC)
FUNCTION
     This function is used to allocate blocks of memory
     from a given free memory pool.  It will return the
     first free block that is greater than or equal to
     the requested size.

     All blocks, whether free or allocated, will be block
     aligned; hence, all allocation sizes are rounded
     up to the next block even value (e.g. the minimum
     allocation resolution is 8 bytes).

     This function, when used in conjunction with a private
     free list, can be used to manage an application's
     internal data memory.

INPUTS
     freeList - points to the memory list header
     byteSize - the size of the desired block in bytes

RESULT
     memoryBlock - a pointer to the just allocated free block.
             If there are no free regions large enough to satisfy
             the request, return zero.  If the amount of requested
             memory is invalid, return zero.

EXCEPTIONS
     If the free list is corrupt, the system will panic.

SEE ALSO
     Deallocate
```

AllocCList

NAME
    AllocCList -- allocate and initialize a clist

SYNOPSIS
```
cList = AllocCList(cLPool)
D0                 A1
```
-36(cList)

FUNCTION
    Get a descriptor that can be used to reference a clist. The clist described is empty. Clists that are no longer in use must be explicitly closed with FreeCList in order to free all their memory: an empty clist still consumes clist pool resources.

INPUTS
    cLPool -
        A clist pool that has already been initialized.

RESULTS
    cList -
        a longword descriptor for a clist that can be used for clist functions.

EXCEPTIONS
    if cList is negative, no space was available for a new clist.

NOTES
    This function is implicitly performed by BufToCL.

AllocEntry

NAME
    AllocEntry -- allocate many regions of memory

SYNOPSIS
```
memList = AllocEntry(memList)
D0                   A0
```
-222(Exec)

FUNCTION
    This routine takes a memList structure and allocates enough memory to hold the required memory as well as a MemList structure to keep track of it. These MemList structures may be linked together in a task control block to keep track of the total memory usage of this task.

INPUTS
    memList -- A memList structure filled in with memEntry structures.

RESULTS
    memList -- A different memList filled in with the actual memory allocated, and their sizes.
    If enough memory cannot be obtained, then the requirements of the failed allocation are returned and bit 31 is set.

EXAMPLES
    The user wants five regions of 2, 4, 8, 16, and 32 bytes in size with requirements of MEMF_CLEAR, MEMF_PUBLIC, MEMF_CHIP.OR.MEMF_CLEAR, MEMF_FAST.OR.MEMF_CLEAR, and MEMF_PUBLIC.OR.MEMF_CLEAR respectively. The following code fragment would do that:

```
MemListDecl:
    DS.B    LN_SIZE                     * reserve space for list node
    DC.W    5                           * number of entries
    DC.L    MEMF_CLEAR                      * entry #0
    DC.L    2
    DC.L    MEMF_PUBLIC                     * entry #1
    DC.L    4
    DC.L    MEMF_CHIP.OR.MEMF_CLEAR         * entry #2
    DC.L    8
    DC.L    MEMF_FAST.OR.MEMF_CLEAR         * entry #3
    DC.L    16
    DC.L    MEMF_PUBLIC.OR.MEMF_CLEAR       * entry #4
    DC.L    32

start:
    LEA     MemListDecl,A0
    CALLLIB _LVOAllocEntry,A5

    BCLR.L  #31,D0
    BEQ.S   success

    ------- Type of memory that we failed on is in D0
```

```
AllocMem

   NAME
        AllocMem -- allocate memory given certain requirements

   SYNOPSIS
        memoryBlock = AllocMem(byteSize, requirements)
        D0                       D0        D1-0:31
```

-198(EXEC)

```
   FUNCTION
        This is the memory allocator to be used by system code and
        applications.  It provides a means of specifying whether
        the allocation should be made in a memory area accessible
        to the chips, or accessible to shared system code.

        The proper allocation of memory is necessary for system
        code that needs to be compatible with memory mapped
        systems.

        Memory is allocated based on the "requirements" listed.
        The rule is that (requirements & attributes) == requirements
        for any particular memory block.

        AllocMem will try all memory spaces until one is found
        with the requested attributes and room for the memory request.

   INPUTS
        byteSize - the size of the desired block in bytes
                This number is rounded up to the next larger
                block size for the actual allocation.
        requirements - (still in flux)
                (see IA_Structs for bit definitions)

                MEMF_PUBLIC:    memory must not be mapped, swapped,
                                or otherwise made non-addressable.
                                ALL MEMORY THAT IS REFERENCED VIA
                                INTERRUPTS AND/OR BY OTHER TASKS MUST
                                BE EITHER PUBLIC OR LOCKED INTO MEMORY!
                                This includes both code and data.

                MEMF_CHIP:      Only certain parts of memory are
                                reachable by the special chip sets'
                                DMA circuitry.  Anything that will use
                                on-chip DMA must be in memory with
                                this attribute.  DMA includes screen
                                memory, things that are blitted,
                                audio blocks, raw disc buffers, etc.

                MEMF_FAST:      This is non-chip memory.  It is possible
                                for the processor to get locked out of
                                chip memory under certain conditions.
                                If one cannot accept these delays, then
                                one should use FAST memory (by default
                                the system will allocate from FAST
                                memory first anyway).

                MEMB_CLEAR:     The memory will be initialized to all
                                zeros.

   RESULT
        memoryBlock - a pointer to the allocated free block.
                If there are no free regions large enough to satisfy
                the request (or if the amount of requested memory
                is invalid), return zero.

   EXAMPLES
        AllocMem(321,MEMB_CHIP) - private chip memory
        AllocMem(25,MEMB_PUBLIC) - a "public" system structure that
                does not require chip memory.

   EXCEPTIONS
        If the free list is corrupt, the system will panic.

   SEE ALSO
        AllocAbs, FreeMem
```

AllocRaster

NAME
    AllocRaster -- allocate space for a Bit Plane

SYNOPSIS
```
D0= AllocRaster( width, height )          -492 (GRA)
                 d0     d1
```

FUNCTION
    This function calls the memory allocation routines
    to allocate memory space for a bitplane width bits
    wide and height bits high.

    Returns a pointer to the first word if successful.
    Returns 0 if unable to allocate that amount of space.

INPUTS
    x,y are maximum dimensions of the array in bits.

SEE ALSO
    FreeRaster

AllocRemember

NAME
    AllocRemember -- call AllocMem() and create a link node

SYNOPSIS
```
D0= AllocRemember(RememberKey, Size, Flags)   -396(INT)
                  A0           D0    D1
```

FUNCTION
    This routine calls the Exec AllocMem() function for you; it also links the parameters of the allocation into a master list, so that you can simply call the Intuition routine FreeRemember() at a later time to deallocate all allocated memory without being required to remember the details of the memory you have allocated.

    This routine has two primary uses:
- o Say that you are doing a long series of allocations in a procedure (such as the Intuition OpenWindow() procedure). If any one of the allocations fails for lack of memory, you need to abort the procedure. Abandoning ship correctly involves freeing up any memory you may have already allocated. This procedure allows you to free up that memory easily, without being required to keep track of how many allocations you have already done, what the sizes of the allocations were, or where the memory was allocated.
- o Also, in the more general case, you may do all of the allocations in your entire program using this routine. Then, when your program is exiting, you can free it all up at once with a simple call to FreeRemember().

    You create the "anchor" for the allocation master list by creating a variable that is a pointer to the Remember structure and initializing that pointer to NULL. This is called the RememberKey. Whenever you call AllocRemember(), the routine actually does two memory allocations, one for the memory you want and the other for a copy of a Remember structure. The Remember structure is filled in with data describing your memory allocation, and it is linked into the master list pointed to by your RememberKey. Then, to free up any memory that has been allocated, all you have to do is call FreeRemember() with your RememberKey.

    Please read the FreeRemember() function description. As you will see, you can choose to free just the link nodes and keep all the allocated memory for yourself, or you can elect to free both the nodes and your memory buffers.

    See this appendix for a description of the AllocMem() call and the values you should use for the Size and Flags variables.

INPUTS
    RememberKey = the address of a pointer to a Remember structure.
    Before the first call to AllocRemember(),
        initialize this pointer to NULL. For instance:

```
        struct Remember *RememberKey;
```

```
        RememberKey = NULL;
        AllocRemember(&RememberKey, BUFSIZE, MEMF_CHIP)
        FreeRemember(&RememberKey, TRUE)
```

Size = the size in bytes of the memory allocation. Please refer to the Exec AllocMem() function in this appendix for details.

Flags = the specifications for the memory allocation. Please refer to the Exec AllocMem() function in the this appendix for details.

RESULT

If the memory allocation is successful, this routine returns the byte address of your requested memory block. Also, the node to your block will be linked into the list pointed to by your RememberKey variable. If the allocation fails, this routine returns NULL and the list pointed to by RememberKey, if any, will be undisturbed.

BUGS

None.

SEE ALSO

FreeRemember().
The Exec AllocMem() function.

AllocSignal

NAME

AllocSignal -- allocate a signal bit

SYNOPSIS

```
signalNum = AllocSignal(signalNum)
D0                      D0
```

-330(EXEC)

FUNCTION

Allocate a signal bit from the current tasks pool. Either a particular bit, or the next free bit may be allocated. The signal associated with the newly allocated bit will be properly initialized (cleared).

If the signal is already in use (or no free signals are available) a -1 is returned.

This function can only be used by the currently running task.

WARNING

Signals may not be allocated or freed from exception handling code.

INPUTS

signalNum - the desired signal number {of 0..31} or -1 for no preference.

RESULTS

signalNum - the signal bit number allocated {0..31}. If no signals are available, this function returns -1.

SEE ALSO

FreeSignal

AllocTrap

NAME

    AllocTrap -- allocate a processor trap vector

SYNOPSIS

    trapNum = AllocTrap(trapNum)
    D0   D0

-342(EXEC)

FUNCTION

Allocate a trap number from the current task's pool. These trap numbers are those associated with the 68000 TRAP type instructions. Either a particular nnumber, or the next free number may be allocated.

If the trap is already in use (or no free traps are available) a -1 is returned.

This function can only be used by the currently running task.

WARNING

Signals may not be allocated or freed from exception handling code.

INPUTS

trapNum - the desired trap number {of 0..15} or -1 for no preference.

RESULTS

trapNum - the trap number allocated {of 0..15}. If no traps are available, this function returns -1.

SEE ALSO

FreeTrap

AllocWBObject

NAME

    AllocWBObject - allocate a Workbench object

SYNOPSIS

    object = AllocWBObject()
    D0

-66 (ICON)

FUNCTION

This routine allocates a Workbench object and initializes its free list. A subsequent call to FreeWBObject will free all of its memory.

If memory cannot be obtained, a NULL is returned.

This routine is intended only for internal users that can track changes to the Workbench.

INPUTS

RESULTS

object - the WBObject (if memory is available)

EXCEPTIONS

SEE ALSO

AllocEntry, FreeEntry, FreeWBObject

BUGS

AndRectRegion

NAME
```
        AndRectRegion -- Perform 2d AND operation of rectangle
                        with region, leaving result in region
```

SYNOPSIS
```
        AndRectRegion(region,rectangle)
                        a0      a1
```
-504(GRA)

Function
```
        Clip away any portion of the region that exists outside
        of the rectangle. Leave the result in region.
```

INPUTS
```
            region      = pointer to Region structure
            rectangle   = pointer to Rectangle structure
```

BUGS

Animate

NAME
```
   Animate  --  processes every AnimOb in the current animation list
```

SYNOPSIS
```
   Animate(key, RPort)
           a0   a1
```
-1621(GRA)

FUNCTION
```
   For every AnimOb in the list:
       - updates its location and velocities
       - calls the AnimOb's special routine if one is supplied
       - for each component of the AnimOb
           - if this sequence times out, switches to the new one
           - calls this component's special routine if one is supplied
           - sets the sequence's sprite's y,x coordinates based on all this
```

INPUTS
```
   key = address of the variable that points to the head AnimOb
   RPort = pointer to the RastPort structure
```

RESULT
```
   Nothing
```

BUGS
```
   None known
```

SEE ALSO
```
   Nothing
```

AreaDraw

NAME

    AreaDraw -- add a point to a list of end points for area-fill.

SYNOPSIS

```
error = (int) AreaDraw( rp,  x,  y)
                          A1  D0  D1
```

-258 (GRA)

FUNCTION

    Add point to the vector buffer.

INPUTS

    x,y are coordinates of a point in the raster

    rp points to a RastPort structure

RETURNS

    0 if no error
    -1 if no space left in vector list

SEE ALSO

    AreaMove, InitArea, AreaEnd

AreaEnd

NAME

    AreaEnd -- process table of vectors and produce areafill

SYNOPSIS

```
error = AreaEnd(rp)
                A1
```

-264 (GRA)

FUNCTION

    Triggers the filling operation.

    Processes the vector buffer and generates required fill into the raster planes. After the fill is complete, reinitializes for the next AreaMove. Uses the raster set up by InitTmpRas when generating an areafill mask.

INPUTS

    rp points to a RastPort structure

RETURNS

    0 if no error
    -1 if no space left in vector list

SEE ALSO

    InitArea, AreaMove, AreaDraw

AreaMove

NAME
```
    AreaMove -- define a new starting point for a new
                shape in the vector list
```

SYNOPSIS
```
    error =  AreaMove( rp,  x,  y)
                       A1  D0  D1
```
-252(GRA)

FUNCTION
```
    Closes the last polygon and starts another polygon
    at (x,y).  Enters necessary points in vector buffer.

    Closing a polygon may result in the generation of
    another AreaDraw() to close previous polygon.
```

INPUTS
```
    x,y are positions in the raster
    rp  points to a RastPort structure
```

RETURNS
```
    0 if no error
     -1 if no space left in vector list
```

SEE ALSO
```
    InitArea, AreaDraw, AreaEnd
```

AskFont

NAME
```
    AskFont -- get the text attributes of the current font
```

SYNOPSIS
```
    AskFont(rastPort, textAttr), graphicsLib
      A1      A0          A6
```
-474(GRA)

FUNCTION
```
    This function fills the text attributes structure with the
    attributes of the current font in the rastPort.
```

INPUTS
```
    rastPort - the RastPort from which the text attributes are
        extracted
    textAttr - the TextAttr structure to be filled
```

AskSoftStyle

NAME
    AskSoftStyle -- get the soft style bits of the current font

SYNOPSIS
```
enable = AskSoftStyle(rastPort), graphicsLib
                      A1        A6
```
-84 (GRA)

FUNCTION
    This function returns those style bits of the current font that are not intrinsic in the font itself but are algorithmically generated. These are the bits that are valid to set in the enable mask for SetSoftStyle

INPUTS
    rastPort - the RastPort from which the font and style are extracted

RESULTS
    enable - those bits in the style algorithmically generated. Style bits that are not defined are also set.

AutoRequest

NAME
    AutoRequest -- automatically build and get response from a requester

SYNOPSIS
```
AutoRequest(Window, BodyText, PositiveText, NegativeText,
            A0      A1        A2            A3
    PositiveFlags, NegativeFlags, Width, Height)
    D0             D1             D2     D3
```
-348(INT)

FUNCTION
    This procedure automatically builds a requester for you and then waits for a response from the user or the system to satisfy your request. If the response is positive, this procedure returns TRUE. If the response is negative, this procedure returns FALSE.

    This procedure first preserves the state of the IDCMP values of the window argument. Then it creates an IDCMPFlag specification by merging your PositiveFlags, NegativeFlags, and the IDCMP class GADGETUP. You may choose to specify no flags for either the PositiveFlags or NegativeFlags arguments.

    The IntuiText arguments and the Width and Height values are passed directly to the BuildSysRequest() procedure, along with your window pointer and the IDCMP flags. Please refer to BuildSysRequest() for a description of the IntuiText that you are expected to supply when calling this routine. It is an important but long-winded description that need not be duplicated here.

    If the BuildSysRequest() procedure does not return a pointer to a window, it will return TRUE or FALSE (not valid structure pointers) instead, and these BOOL values will be returned immediately.

    On the other hand, if a valid window pointer is returned, that window will have had its IDCMP ports and flags initialized according to your specifications. AutoRequest() then waits for an IDCMP message on the UserPort; this message will satisfy one of three requirements:

- o If the message is of a class that matches one of your PositiveFlags arguments (if you have supplied any), this routine returns TRUE.
- o If the message class matches one of your NegativeFlags arguments (if you have supplied any), this routine returns FALSE.
- o The only other possibility is that the IDCMP message is of class GADGETUP, which means that one of the two gadgets, as specified by the PositiveText and NegativeText arguments, was selected by the user. If the TRUE gadget was selected, TRUE is returned. If the FALSE gadget was selected, FALSE is returned.

```
    When the dust has settled, this routine calls FreeSysRequest(),
    if necessary, to clean up the requester and any
    other allocated memory.

INPUTS
    Window = pointer to a Window structure.
    BodyText = pointer to an IntuiText structure.
    PositiveText = pointer to an IntuiText structure.
    NegativeText = pointer to an IntuiText structure.
    PositiveFlags = flags for the IDCMP.
    NegativeFlags = flags for the IDCMP.
    Width, Height = the sizes required for the rendering of the
        requester.

RESULT
    The return value is either TRUE or FALSE.  See the text
    above for a complete description of the chain of events that
    might lead to either of these values being returned.

BUGS
    None.

SEE ALSO
    BuildSysRequest().
```



```
AvailFonts

  NAME
      AvailFonts - build an array of all fonts in memory / on disk

  SYNOPSIS
      error = AvailFonts(buffer, bufBytes, types);
                         A0      D0        D1
```

-36(DISKFONT)

```
  FUNCTION
      AvailFonts fills a user supplied buffer with the structure,
      described below, that contains information about all the
      fonts available in memory and/or on disk.  Those fonts
      available on disk need to be loaded into memory and opened
      via OpenDiskFont(); those already in memory are accessed via
      OpenFont.  The TextAttr structure required by the open calls
      is part of the information AvailFonts() supplies.

  INPUTS
      buffer - memory to be filled with struct AvailFontsHeader
               followed by an array of AvailFonts elements, which
               contains entries for the available fonts and their
               names.

      bufBytes - the number of bytes in the buffer
      types - AFF_MEMORY is set to search memory for fonts to fill
               the structure, AFF_DISK is set to search the disk for
               fonts to fill the structure.  Both can be specified.

  RESULTS
      buffer - filled with struct AvailFontsHeader followed by the
               AvailFonts elements, There will be duplicate entries
               for fonts found both in memory and on disk, differing
               only by type.  The existence of a disk font in the
               buffer indicates that it exists as an entry in a font
               contents file -- the underlying font file has not been
               checked for validity, thus an OpenDiskFont() of it may
               fail.
      error - if non-zero, this indicates the number of bytes needed
               for AvailFonts in addition to those supplied.  Thus
               structure elements were not returned because of
               insufficient bufBytes.
```

```
AvailMem

   NAME
        AvailMem -- memory available given certain requirements

   SYNOPSIS
        size = AvailMem(requirements)
        D0              D1
```

-216(EXEC)

```
   FUNCTION
        This function returns the size of memory given certain
        requirements.

   INPUTS
        requirements - a requirements mask as specified in AllocMem

   RESULT
       size - total free space remaining
```

```
BeginUpdate

NAME
       BeginUpdate -- prepare to repair damaged layer


SYNOPSIS
       BeginUpdate( l )
                    a0

INPUTS
       l   = pointer to a layer

FUNCTION
        Converts damage list to ClipRect list and swaps in for
        programmer to redraw through. This routine simulates
        the ROM library environment. The layer is locked against
        changes made by the layer library.

SEE ALSO
       layers.h EndUpdate()
```

BeginRefresh

NAME
    BeginRefresh -- set up a window for optimized refreshing

SYNOPSIS
```
BeginRefresh(Window)
             A0
```

FUNCTION
    This routine sets up your window for optimized refreshing. It sets Intuition internal states and then sets up the layer underlying your window for a call to the layer library. There, the "clip rectangles" of the layer are reorganized in a fashion that causes any drawing performed in your window (until you call EndRefresh()) to occur only in the regions that need to be refreshed. The term "clip rectangles" refers to the division of your window into visible and concealed rectangles. For more information about clipping rectangles and the layer library, refer to the main chapters of this manual.

    For instance, if you have a SIMPLE_REFRESH window that is partially concealed and the user brings it to the front, your program will receive a message asking it to refresh its display. If your program calls BeginRefresh() before doing any of the drawing, the layer that underlies your window will be arranged such that the only drawing that will actually take place will be that which goes to the newly revealed areas. This is very performance-efficient.

    After your program has performed its refresh of the display, it should call EndRefresh() to reset the state of the layer and the window. Then the program may proceed with drawing to the window as usual.

    Your program learns that the window needs refreshing by receiving either a message of class REFRESHWINDOW through the IDCMP or an input event of class IECLASS_REFRESHWINDOW through the console device. Whenever the program is told that the window needs refreshing, it should call BeginRefresh() and EndRefresh() to clear the refresh-needed state, even if no drawing will be done.

INPUTS
    Window = pointer to the Window structure that needs refreshing.

RESULT
    None.

BUGS
    None.

SEE ALSO
    EndRefresh().

BehindLayer

NAME
    BehindLayer -- put layer behind other layers.

SYNOPSIS
```
BehindLayer( li, l )
             a0  a1
```

INPUTS
    li = pointer to LayerInfo structure
    l = pointer to a layer

FUNCTION
    Moves this layer behind all others, swapping bits in and out of the display with other layers. If other layers are REFRESH, collects their damage lists and sets bit in Flags of those layers that may be revealed. If this layer is a a backdrop layer, puts it behind all other backdrop layers. If this layer is NOT a backdrop layer, puts it in front of the top backdrop layer and behind all other layers.

RETURNS
    TRUE   if operation successful
    FALSE   if operation unsuccessful (probably out of memory)

BUGS

SEE ALSO
    layers.h

```
BltBitMap

NAME
    BltBitMap -- move a rectangle in a raster

SYNOPSIS
    planes = BltBitMap(SrcBitMap, SrcX, SrcY, DestBitMap,
    D0                 A0         D0    D1    A1
          DestX, DestY, SizeX, SizeY, Minterm, Mask, TempA);
          D2     D3     D4     D5     D6       D7    A2

FUNCTION
    Performs non-destructive blits to move a rectangle from one area in
    a raster to another area, which can be on a different raster.

INPUTS
    SrcBitMap, DestBitMap - the BitMap(s) containing the rectangles
        - the planes copied from the source to the destination are
          only those whose plane numbers are identical and less
          than the minimum plane count and whose write mask is non-zero.
        - SrcBitMap and DestBitMap can be identical
    SrcX, SrcY - the x and y coordinates of the upper left corner of the
        source rectangle.  Valid range is positive signed integer such
        that the raster word's offset 0..(32767-Size)
    DestX, DestY - the x and y coordinates of the upper left corner of
        the destination for the rectangle.  Valid range is as for Src.
    SizeX, SizeY - the size of the rectangle to be moved.  Valid range
        is (X: 1..976; Y: 1..1023 such that final raster word's offset
        is 0..32767)
    Minterm - the logic function to apply to the rectangle when A is
        non-zero (i.e. within the rectangle).  B is the source
        rectangle and C, D is the destination for the rectangle.
        - $0C0 is a vanilla copy
        - $030 inverts the source before the copy
        - $050 ignores the source and inverts the destination
        - see the Amiga Hardware Reference Manual for other combinations.
    Mask - the write mask to apply to this operation.  Bits set indicate
        the corresponding planes (if not greater than the minimum plane
        count) are to participate in the operation.  Typically, this is set
        to 0xff.
    TempA - If the copy overlaps exactly to the left or right (i.e., the
        scan line addresses overlap), and TempA is non-zero, it points to
        enough chip-accessible memory to hold a line of A source for the blit.

RESULTS
    planes - the number of planes actually involved in the blit.

EXCEPTIONS
    This blt is assumed to be friendly: no errors conditions (e.g.,
    a rectangle outside the BitMap bounds) are tested or reported.
    A plane count that is less than expected can be attributed to
    a failure to allocate a TempA when it was needed.
```



```
BltBitMapRastPort

NAME

    BltBitMapRastPort -- blit from source bitmap to destination rastport

SYNOPSIS

    BltBitMapRastPort
        *(srcbm,srcx,srcy,destrp,destX,destY,sizeX,sizeY,minterm)
         *a0    d0   d1   a1     d2    d3    d4    d5    d6

FUNCTION

    Blits from source bitmap to position specified in destination rastport
     using minterm.

INPUTS

    srcbm -     a pointer to the source bitmap
    srcx  -     x offset into source bitmap
    srcy  -     y offset into source bitmap
    destrp -    a pointer to the destination rastport
    destX -     x offset into dest rastport
    destY -     y offset into dest rastport
    sizeX -     width of blit in pixels
    sizeY -     height of blit in rows
    minterm -   minterm to use for this blit

RETURNS

    TRUE -      if blit successfully completed
    FALSE -     if blit failed

 BUGS

SEE ALSO
```

BltClear

NAME

    BltClear -- clear a block of memory words to zero.

SYNOPSIS

```
BltClear( memBlock, bytecount, flags )
          a1        d0         d1
```

FUNCTION

    For memory that is local and blitter accessible.
    The most efficient way to clear a range of memory locations is
    to use the system's most efficient data mover, the blitter.
    This command accepts the starting location and count and clears
    that block to zeros.

INPUTS

```
memBlock    pointer to local memory to be cleared
            memBlock must be even
flags       set bit 0 to force function to wait until blit
            is done.
            set bit 1 to use row/bytesperrow
bytecount   if (flags & 2) == 0 then
                even number of bytes to clear.
            else
                low 16 bits is taken as number of bytes
                per row and upper 16 bits taken as
                number of rows.
```

    This function is somewhat hardware-dependent. In the
    rows/bytesperrow mode, rows must be <=1024 and
    bytesperrow must be <=128.
    In standard bytecount mode multiple runs of the blitter
    may be used to clear all the memory.

RESULT

    The block of memory is set to zeros.

BUGS

    None known.

SEE ALSO

BltPattern

NAME

    BltPattern -- Using standard drawing rules for areafill,
                   blit through a mask

SYNOPSIS

```
BltPattern(RastPort *,char *, x1, y1, maxx, maxy, bytecnt)
           a1,        a0      d0  d1  d2    d3    d4
```

FUNCTION

    Blit using drawmode,areafill pattern,outline, mask pointed to by
    a0, at position rectangle (x1,y1) (maxx,maxy). The image is not
    shifted but must be word aligned.

INPUTS

```
a1 points to RastPort
a0 points to 2 dimensional mask if needed
x1,y1 upper left of rectangular region in RastPort
maxx,maxy points to lower right of rectangular region in RastPort
bytecnt number of BytesPerRow for char * a0
```

RETURNS

SEE ALSO

BltTemplate

NAME
    BltTemplate -- cookie cut a shape in a rectangle to the RastPort

SYNOPSIS
```
    BltTemplate(source, srcX, srcMod, destRastPort,
                A0      D0    D1      A1
            destX,  destY, sizeX, sizeY),  graphicsLib
            D2      D3     D4     D5
```

FUNCTION
    This function draws the image in the template into the RastPort in the current color and drawing mode at the specified position. The template is assumed not to overlap the destination.

EXCEPTIONS
    If the template falls outside the RastPort boundary, it is truncated to that boundary.

BuildSysRequest

NAME
    BuildSysRequest -- build and display a system requester

SYNOPSIS
```
    BuildSysRequest(Window, BodyText, PositiveText, NegativeText,
                    A0      A1        A2            A3
           IDCMPFlags, Width, Height)
           D0          D1     D2
```

FUNCTION
    This procedure builds a requester based on the supplied information. If all goes well and the requester is constructed, this procedure returns a pointer to the window in which the requester appears. That window will have the IDCMP UserPort and WindowPort initialized to reflect the flags found in the IDCMPFlags argument. The program may then Wait() on those ports to detect the user's response to your requester, which may include either selecting one of the gadgets or causing some other event to be noticed by Intuition (such as DISKINSERTED, for instance). After the requester is satisfied, your program should call the FreeSysRequest() procedure to remove the requester and free any allocated memory.

    If it is not possible to construct the requester, this procedure will use the text arguments to construct a text string for a call to the DisplayAlert() procedure and then will return either TRUE or FALSE depending on whether DisplayAlert() returned FALSE or TRUE, respectively.

    If the Window argument you supply is equal to NULL, a new window will be created for you in the Workbench screen. If you want the requester created by this routine to be bound to a particular window, you should not supply a Window argument of NULL.

    The text arguments are used to construct the display. They are pointers to instances of the IntuiText structure.

    The BodyText argument should be used to describe the nature of the requester. As usual with IntuiText data, you may link several lines of text together, and the text may be placed in various locations in the requester. This IntuiText pointer will be stored in the ReqText variable of the new requester.

    The PositiveText argument describes the text that you want associated with the user choice of "Yes," "TRUE," "retry," or "good." If the requester is successfully opened, this text will be rendered in a gadget in the lower left of the requester; this gadget will have the GadgetID field set to TRUE. If the requester cannot be opened and the DisplayAlert() mechanism is used, this text will be rendered in the lower left corner of the alert display with additional text specifying that the left mouse button will select this choice. This pointer can be set to NULL, which specifies that there is no TRUE choice that can be made.

The NegativeText argument describes the text that you want associated with the user choice of "No," "FALSE," "cancel," or "bad." If the requester is successfully opened, this text will be rendered in a gadget in the lower right of the requester; this gadget will have the GadgetID field set to FALSE. If the requester cannot be opened and the DisplayAlert() mechanism is used, this text will be rendered in the lower right corner of the alert display with additional text specifying that the right mouse button will select this choice. This pointer cannot be set to NULL. There must always be a way for the user to cancel this requester.

The positive and negative gadgets created by this routine have the following features:
- o BOOLGADGET
- o RELVERIFY
- o REQGADGET
- o TOGGLESELECT

When defining the text for your gadgets, you may find it convenient to use the special definitions used by Intuition for the construction of the gadgets. These definitions include AUTODRAWMODE, AUTOLEFTEDGE, AUTOTOPEDGE and AUTOFRONTPEN. You can find these in your local intuition.h (or intuition.i) file.

The Width and Height values describe the size of the requester. All of your BodyText must fit within the Width and Height of your requester. The gadgets will be created to conform to your sizes.

IMPORTANT NOTE: For the preliminary release of this procedure, a new window is opened in the same screen as the one containing your window. However, with a forthcoming update of Intuition this will change; the requester will be opened in the window supplied as an argument to this routine, if possible. The primary implication of this will be that the IDCMP flags and ports will be disturbed by a call to this routine. To assure upward compatibility, it is your responsibility to make sure that the ports and IDCMPFlags of the window passed to the routine are protected before the call to this routine.

INPUTS

Window = pointer to a Window structure.
BodyText = pointer to an IntuiText structure.
PositiveText = pointer to an IntuiText structure.
NegativeText = pointer to an IntuiText structure.
IDCMPFlags = the IDCMP flags you want used for the initialization of the IDCMP of the window containing this requester.
Width, Height = the size required to draw your requester.

RESULT

If the requester was successfully drawn in a window, the value returned by this procedure is a pointer to the window in which the requester was drawn. If, however, the requester cannot be drawn in the window, this routine will have called DisplayAlert() before returning and will pass back TRUE if the user pressed the left mouse button and FALSE if the user pressed the right mouse button.

BUGS

This procedure currently opens a window and then opens the requester within that window. Also, if DisplayAlert() is called, the PositiveText and NegativeText are not rendered in the lower corners of the alert.

SEE ALSO

FreeSysRequest(), DisplayAlert(), ModifyIDCMP(), Wait(), AutoRequest()

```
BumpRevision

   NAME
        BumpRevision -- reformat a name for a second copy

   SYNOPSIS
        result = BumpRevision( newbuf, oldname  )
        D0                     A0      A1

   FUNCTION
        BumpRevision takes a name and turns it into a "copy of name."
        It knows how to deal with copies of copies.  The routine
        will truncate the new name to the maximum DOS name size
        (currently 30 characters).

   INPUTS
        newbuf - the new buffer that will receive the name (it must
                be at least 31 characters long).
        oldname - the original name

   RESULTS
        result - a pointer to newbuf

   EXCEPTIONS

   EXAMPLE
        oldname                          newbuf
        -------                          ------
        "foo"                            "copy of foo"
        "copy of foo"                    "copy 2 of foo"
        "copy 2 of foo"                  "copy 3 of foo"
        "copy 199 of foo"                "copy 200 of foo"
        "copy foo"                       "copy of copy foo"
        "copy 0 of foo"                  "copy 1 of foo"
        "012345678901234567890123456789" "copy of 0123456789012345678901"

   SEE ALSO

   BUGS
```

```
Cause

   NAME
       Cause -- cause a software interrupt

   SYNOPSIS
       Cause(interrupt)
             A1

   FUNCTION
        This function causes a software interrupt to occur.  If it
        is called from user mode (and processor level 0), the
        software interrupt will preempt the current task.

        Currently only 5 software interrupt priorities are
        implemented: -32, -16, 0, +16, and +32.  Priorities in
        between these values are truncated.  Priorities outside the
        -32/+32 range are not allowed.

   INPUTS
       interrupt - pointer to a properly initialized interrupt node
```

```
CEND

NAME
        CEND -- terminate user Copper list.

SYNOPSIS
        CEND( c )

FUNCTION
        Adds instruction to terminate user Copper list.

INPUTS
        c   = pointer to UCopList structure

RESULTS
        This is actually a macro that calls CWait(c) to
        wait for the end of the user Copper list and
        then calls CBump(c) to bump the local pointer
        to the next instruction.
BUGS
        None Known

SEE ALSO
        CINIT();
        CMOVE();
        CWAIT();
```

```
ChangeSprite

NAME
       ChangeSprite -- change the sprite image pointer.

SYNOPSIS
       ChangeSprite( vp, s, newdata)
                     a0 a1   a2

FUNCTION
        The sprite image is changed to use the data starting at newdata

INPUTS
       vp       = pointer to ViewPort structure that this sprite is
                  relative to.
                  or 0 if relative only top of View
        s       = pointer to SimpleSprite structure
        newdata = pointer to data structure of the following form:

                    struct spriteimage
                    {
                        UWORD   posctl[2];  /* used by simple sprite machine*/

                        UWORD   data[height][2];   /* actual sprite image */
                        UWORD   reserved[2];    /* initialized to */
                                               /*  0xFFFF,0xFF7F */
                    }

        Programmer must initialize reserved[2].  The spriteimage must be
        in CHIP memory. The height subfield of the SimpleSprite structure
        must be set to reflect the height of the new spriteimage BEFORE
        calling ChangeSprite. The programmer may allocate two sprites to
        handle a single attached sprite.  After GetSprite, ChangeSprite,
        the programmer can set the SPRITE_ATTACHED bit in posctl[1] of the
        odd-numbered sprite.

RESULTS

BUGS

SEE ALSO
       sprite.h FreeSprite ChangeSprite MoveSprite
```

```
CheckIO

   NAME
        CheckIO -- get the IO request status

   SYNOPSIS
        result = CheckIO(iORequest)
        D0               Al

   FUNCTION
        This function determines the current state of an I/O
        request and returns FALSE if the I/O has not yet completed.
        This function effectively hides the internals of the I/O
        completion mechanism.

        If the I/O has completed, CheckIO will not remove the
        returned IORequest from the reply port.  This should
        be performed with Remove.

        This function SHOULD NOT be used to busy loop, waiting
        for an IO to complete.

   INPUTS
        iORequest - pointer to an I/O request block

   RESULTS
        result - null if I/O is still in progress.  Otherwise
                D0 points to the IORequest block.
```

```
CINIT

NAME
        CINIT   -- initialize user Copper list to accept intermediate
                   user Copper instructions

SYNOPSIS
        struct CopperList  *CINIT( c , n )

FUNCTION
        allocates/initializes Copper list data structures/buffers

INPUTS
        c   = pointer to UCopList structure
        n   = number of instructions buffer must hold

RESULTS
        this is actually a macro that calls UCopperListInit(c,n)
        If ( c== 0) allocate CopperList structure and a buffer
        to hold n Copper instructions. If (c != 0) then
        just reinitialize the list to accept Copper instructions
        and ignore n.


BUGS
```

ClearDMRequest

NAME
    ClearDMRequest -- clear the DMRequest of the window

SYNOPSIS
```
ClearDMRequest(Window)
                A0
```

FUNCTION
    Attempts to clear the DMRequester from the specified window. The DMRequester is the special requester that you attach to the double-click of the menu button; the user can then bring up that requester on demand. This routine will not clear the DMRequester if it is active (in use by the user). If you want to change the DMRequester after having called SetDMRequest(), the correct way to start is by calling ClearDMRequest() until it returns a value of TRUE; then you can call SetDMRequest() with the new DMRequester.

INPUTS
    Window = pointer to the structure of a window from which the DMRequest is to be cleared.

RESULT
    If the DMRequest was not currently in use, this function zeroes out the DMRequest pointer in the window and returns TRUE.

    If the DMRequest was currently in use, this function does not change the pointer and returns FALSE.

BUGS
    None.

SEE ALSO
    SetDMRequest().
    Request().

ClearEOL

NAME
    ClearEOL -- clear from current position to end of line

SYNOPSIS
```
ClearEOL(rastPort), graphicsLib
         A1        A6
```

FUNCTION
    Clears a rectangular swath from the current position to the right edge of the rastPort. The height of the swath is taken from that of the current text font, and the vertical positioning of the swath is adjusted by the text baseline, such that text output at this position would lie wholly on this newly cleared area.

    Clearing consists of setting the color of the swath to zero, or, if the DrawMode is 2, to the BgPen.

ClearMenuStrip

NAME
    ClearMenuStrip -- clear the menu strip from the window

SYNOPSIS
```
ClearMenuStrip(Window)
               A0
```

FUNCTION
    Clears the menu strip from the window.

INPUTS
    Window = pointer to a Window structure.

RESULT
    None.

BUGS
    None.

SEE ALSO
    SetMenuStrip().

ClearPointer

NAME
    ClearPointer -- clear the pointer definition from a window

SYNOPSIS
```
ClearPointer(Window)
             A0
```

FUNCTION
    Clears the window of its own definition of the Intuition pointer. After ClearPointer() is called, every time this window is active the default Intuition pointer will be the pointer displayed to the user. If your window is active when this routine is called, the change will take place immediately.

INPUTS
    Window = pointer to the structure of the window to be cleared of its pointer definition.

RESULT
    None.

BUGS
    None.

SEE ALSO
    SetPointer().

ClearRegion

NAME

ClearRegion -- set this region to size 0

SYNOPSIS

```
ClearRegion(region)
            a0
```

Function

Clip away all rectangles in the region, leaving nothing.

INPUTS

region = pointer to Region structure

BUGS

ClearScreen

NAME

ClearScreen -- clear from current position to end of RastPort

SYNOPSIS

```
ClearScreen(rastPort), graphicsLib
            A1         A6
```

FUNCTION

Clears a rectangular swath from the current position to the right edge of the rastPort with ClearEOL, then clears the rest of the screen from just beneath the swath to the bottom of the rastPort.

Clearing consists of setting the color of the swath to zero, or, if the DrawMode is 2, to the BgPen.

ClipBlit

NAME

ClipBlit -- Calls BltBitMap() after accounting for windows

SYNOPSIS

```
ClipBlit(Src, SrcX, SrcY, Dest, DestX, DestY, XSize, YSize, Minterm );
         a0   d0    d1    a1    d2     d3     d4     d5     d6
```

FUNCTION

Performs the same function as BltBitMap(), except that it takes into account the Layers and ClipRects of the layer library, all of which are (and should be) transparent to you. So, whereas BltBitMap() requires pointers to BitMaps, ClipBlit requires pointers to the RastPorts that contain the Bitmaps, Layers, et cetera.

If you are going to blit blocks of data around via the RastPort of your Intuition Window, you must call this routine (rather than BltBitMap()).

Either the Src RastPort, the Dest RastPort, both, or neither, can have Layers. This routine takes care of all cases.

See BltBitMap() for a thorough explanation.

INPUTS

```
Src = pointer to the RastPort of the source for your blit
SrcX, SrcY = the topleft offset into Src for your data
Dest = pointer to the RastPort to receive the blitted data
DestX, DestY = the topleft offset into the destination RastPort
XSize = the width of the blit
YSize = the height of the blit
Minterm = the boolean blitter function, where SRCB is associated with the
          Src RastPort and SRCC goes to the Dest RastPort
```

RESULT

None

BUGS

None

SEE ALSO

BltBitMap();

Close

NAME

Close -- close a file for input or output

SYNOPSIS

```
Close( file )
       D1
```

FUNCTION

The file handle 'file' indicates the file that Close should close. You obtain this file handle as a result of a call to Open. You must remember to close explicitly all the files you open in a program. However, you should not close inherited file handles opened elsewhere.

INPUTS

file - BCPL pointer to a file handle

```
CloseDevice

   NAME
        CloseDevice -- conclude access to a device

   SYNOPSIS
        CloseDevice(iORequest)
                    A1

   FUNCTION
        This function informs the system that access to a
        device/unit previously opened has been concluded.  The
        device may perform certain house-cleaning operations.  The
        I/O request structure is now free to be recycled.

   INPUTS
        iORequest - pointer to an I/O request structure

   SEE ALSO
        OpenDevice
```

```
CloseFont

   NAME
    CloseFont -- release a pointer to a system font.

   SYNOPSIS
    CloseFont(font), GraphicsLib
          A1     A6

   FUNCTION
    This function indicates that the font specified is no longer
    in use.  It is used to close a font opened by OpenFont, so
    that fonts that are no longer in use do not consume system
    resources.

   INPUTS
    font -
        A font, as returned by OpenFont.
```

```
CloseLibrary

   NAME
        CloseLibrary -- conclude access to a library

   SYNOPSIS
        CloseLibrary(library)
                     A1

   FUNCTION
        This function informs the system that access to the given
        library has been concluded.  The user should not reference
        the library or any routine in the library after this close.

   INPUTS
        library - pointer to a library node

   SEE ALSO
        OpenLibrary
```

```
CloseScreen

NAME
     CloseScreen  --  close an Intuition screen

SYNOPSIS
     CloseScreen(Screen)
                 A0

FUNCTION
     This function unlinks the screen, unlinks the ViewPort, and
     deallocates everything.  It does not care whether or not
     there are still any windows attached to the screen and does
     not try to close any attached windows; in fact, it ignores
     them altogether.  If this is the last screen, this function
     attempts to reopen Workbench.

INPUTS
     Screen = pointer to the Screen structure to be cleared and
          deallocated.

RESULT
     None.

BUGS
     None.

SEE ALSO
     OpenScreen().
```

CloseWindow

NAME
    CloseWindow -- close an Intuition window

SYNOPSIS
```
CloseWindow(Window)
            A0
```

FUNCTION
    This function closes an Intuition window. It unlinks it from the system, unallocates its memory, and, if its screen is a system one that would be empty without the window, closes the system screen, too.

    Caution: if you are ever rude enough to CloseWindow() on a window that has an IDCMP without first having Reply()'d to all of the messages to the IDCMP port, Intuition in turn will be so rude as to reclaim and deallocate its messages without waiting for your permission.

    Caution: if you have added a menu strip to this window (via a call to SetMenuStrip()) you must be sure to remove that menu strip (via a call to ClearMenuStrip()) before closing your window. CloseWindow() does not check whether the menus of your window are currently being used when the window is closed. If this happens to be the case, as soon as the user releases the menu button the system will crash.

INPUTS
    Window = a pointer to a Window structure.

RESULT
    None.

BUGS
    None.

SEE ALSO
    OpenWindow(), CloseScreen()

CloseWorkBench

NAME
    CloseWorkBench -- close the Workbench screen

SYNOPSIS
```
BOOL CloseWorkBench()
```

FUNCTION
    This routine attempts to close the Workbench. If the Workbench is open, it tests whether or not any applications have opened windows on the Workbench and returns FALSE if so. Otherwise, it cleans up all special buffers, closes the Workbench screen, makes the Workbench program mostly inactive (it will still monitor disk activity), and returns TRUE.

    If the Workbench screen isn't open when this routine is called, TRUE is returned immediately.

INPUTS
    None.

RESULT
    TRUE if the Workbench screen is closed.
    FALSE if anything went wrong and the Workbench screen is still out there.

BUGS
    None.

SEE ALSO
    None.

```
CMOVE

NAME
        CMOVE   -- append Copper move instruction to user Copper list.

SYNOPSIS
        CMOVE( c , a , v )

FUNCTION
        Adds instruction to move value v to hardware register a.

INPUTS
        c   = pointer to UCopList structure
        a   = hardware register
        v   = 16 bit value to be written

RESULTS
        This is actually a macro that calls CMove(c,&a,v)
        and then calls CBump(c) to bump the local pointer
        to the next instruction.
BUGS
```

```
ColdReset

   NAME
       ColdReset -- cause a system coldstart to occur

   SYNOPSIS
       ColdReset()

   FUNCTION
       This function causes a coldstart system reset sequence
       identical to that which occurs at power-on.  All current
       system activities will be stopped, and the entire software
       system will be re-initialized.  Nothing will be preserved.
       This function will assert processor RESET to reset all
       hardware devices.

   EXCEPTION
       This function operates in supervisor mode only.  Any
       attempt to perform this function from user mode will result
       in a privilege violation trap.
```

```
ConcatCList

   NAME
        ConcatCList -- concatenate two character lists

   SYNOPSIS
        error = ConcatCList(sourceCList, destCList)
         D0                 A0           A1

   FUNCTION
        Exhaust the contents of the sourceCList onto the end of the
        destCList.  The resulting destCList is the concatenation of
        the original destCList and sourceCList; the resulting
        sourceCList is empty.

   INPUTS
        sourceCList -
                The clist descriptor used to manage the source
                character list.
        destCList   -
                The clist descriptor used to manage the destination
                character list.

   RESULT
        error       -
                An error code that, if non-zero, indicates the clist
                pool associated with the destCList had an out-of-memory
                condition during the concatenation process.
```



```
CopyCList

   NAME
        CopyCList -- copy a clist to a new clist

   SYNOPSIS
        cList = CopyCList(cList)
        D0                A0

   FUNCTION
        Copy a cList non-destructively into a new clist, created by
        this operation in the same cLPool.

   INPUTS
        cList   -
                The clist descriptor used to manage the original
                character list.
   RESULTS
        cList   -
                a longword descriptor for a clist that can be used
                for clist functions, and contains the same contents
                as the original clist.

   EXCEPTIONS
        if cList is negative, not enough space was available for the
        new clist.
```

CopySBitMap

```
NAME
       CopySBitMap --   synchronize Layer window with contents of
                        Super BitMap


SYNOPSIS
       CopySBitMap( layer * )
                    a0

FUNCTION
        This is the inverse of SyncSBitMap.
        Copies all bits from SuperBitMap to Layer bounds.
        This is used for those functions that do not
        want to deal with the ClipRect structures but do want
        to be able to work with a SuperBitMap Layer.

INPUTS

        layer * is a pointer to a Layer that has a SuperBitMap
                The Layer should already be locked by the caller.


SEE ALSO
        SyncSBitMap
```

CreateBehindLayer

```
NAME
        CreateBehindLayer -- create a new layer behind all existing
                             layers.


SYNOPSIS
        CreateBehindLayer(li,bm,x0,y0,xl,yl,flags [,bm2])
                          a0 al d0 dl d2 d3   d4  [ a2 ]

INPUTS
        li   = pointer to LayerInfo structure
        bm   = pointer to common BitMap used by all Layers
        bm2 = pointer to optional Super BitMap
        flags=  various types of layers supported as bit sets.
        x0,y0=  upper left hand corner of layer
        xl,yl=  lower right hand corner of layer

FUNCTION
        Creates a new Layer of position and size (x0,y0)->(xl,yl)
        Makes this layer of type found in flags
        If SuperBitMap, uses bm2 as pointer to real SuperBitMap.
        and copies contents of Superbitmap into display layer.
        If this layer is a backdrop layer, places it behind all
        other layers, including other backdrop layers. If this is
        not a backdrop layer, places it behind all nonbackdrop
        layers.

SEE ALSO
       layers.h
```

CreateDir

NAME
    CreateDir -- create a new directory

SYNOPSIS
```
    lock = CreateDir( name )
     D0               D1
```

FUNCTION
    CreateDir creates a new directory with the name you specified, if possible. It returns an error if it fails. Remember that AmigaDOS can only create directories on devices which support them, for example, disks.

    A return of zero means that AmigaDOS has found an error (such as, disk write protected), you should then call IoErr(); otherwise, CreateDir returns a shared read lock on the new directory.

INPUTS
    name - address of first character of a null-terminated string

RESULTS
    lock - BCPL pointer to a lock

CreateExtIO

NAME
    CreateExtIO -- create an I/O request

SYNOPSIS
```
    ioReq = CreateExtIO( ioReplyPort, size );
```

FUNCTION
    Allocates memory for and initializes a new I/O request block of a user-specified number of bytes. The number of bytes MUST be greater than the length of an Exec message, or some very nasty things will happen.

INPUTS
    ioReplyPort - a pointer to an already initialized message port to be used for this I/O request's reply port.
    size - the size of the I/O request to be created.

RESULT
    Returns a pointer to the new I/O Request block, or NULL if the request failed.

EXAMPLE
    This example allocates space for IOExtTD (e.g., a trackdisk driver I/O Request block for extended I/O operations).

```
    struct IORequest myBlock;
    struct MsgPort port;

    myBlock = CreateExtIO( port, sizeof(struct IOExtTD) );
    if( myBlock == NULL ) {
            exit( NO_MEM_OR_SIGNALS );
    }
```

SEE ALSO
    DeleteExtIO

CreateProc

NAME

CreateProc -- create a new process

SYNOPSIS

```
process = CreateProc( name, pri, segment, stackSize )
 D0                    D1    D2    D3      D4
```

FUNCTION

CreateProc creates a process with the name 'name'. It allocates a process control structure from the free memory area and then initializes it.

CreateProc takes a segment list as the argument 'segment'. (See also LoadSeg and UnLoadSeg.) This segment list represents the section of code that you intend to run as a new process. CreateProc enters the code at the first segment in the segment list, which should contain suitable initialization code or a jump to such.

'stackSize' represents the size of the root stack in bytes when CreateProc activates the process. 'pri' specifies the required priority of the new process. The result is the process identifier of the new process or zero if the routine failed.

The argument 'name' specifies the process name.

A zero return code implies an error of some kind.

INPUTS

name - address of first character of a null-terminated string
pri - integer
segment - BCPL pointer to a segment
stackSize - integer

RESULTS

process - process identifier

CreateStdIO

NAME

CreateStdIO -- create a standard I/O request

SYNOPSIS

```
ioStdReq = CreateStdIO( ioReplyPort )
```

FUNCTION

Allocates memory for and initializes a new I/O request block.

INPUTS

ioReplyPort - a pointer to an already initialized message port to be used for this I/O request's reply port.

RESULT

Returns a pointer to the new io request block. A NULL indicates that there was not enough memory for the I/O Request, or that the reply port was not a valid port.

EXAMPLE

```
struct IOStdReq myBlock;
struct MsgPort port;

myBlock = CreateStdIO( port );
if( myBlock == NULL) {
        printf( "Insufficient memory" );
}
```

SEE ALSO

DeleteStdIO, CreateExtIO

```
CreateUpfrontLayer

NAME
        CreateUpfrontLayer -- create a new layer on top of existing
                              layers.

SYNOPSIS
        CreateUpfrontLayer(li,bm,x0,y0,x1,y1,flags [,bm2])
                           a0 a1 d0 d1 d2 d3   d4  [ a2 ]

INPUTS
        li  = pointer to LayerInfo structure
        bm  = pointer to common BitMap used by all Layers
        bm2 = pointer to optional Super BitMap
        flags=  various types of layers supported as bit sets.
        x0,y0=  upper left hand corner of layer
        x1,y1=  lower right hand corner of layer

FUNCTION
        Creates a new Layer of position and size (x0,y0)->(x1,y1)
        and places it on top of all other layers.
        Makes this layer of type found in flags.
        If SuperBitMap, uses bm2 as pointer to real SuperBitMap
        and copies contents of Superbitmap into display layer.

SEE ALSO
       layers.h
```

```
CurrentDir

NAME
    CurrentDir -- make a directory associated with a lock the current
                  working directory

SYNOPSIS
    oldLock = CurrentDir( lock )
      D0                   D1

FUNCTION
    CurrentDir makes current a directory associated with a lock. (See
    also LOCK). It returns the old current directory lock.

    A value of zero is a valid result here and indicates that the current
    directory is the root of the initial start-up disk.

INPUTS
    lock - BCPL pointer to a lock

RESULTS
    oldLock - BCPL pointer to a lock
```

CurrentTime

NAME
    CurrentTime -- get the current time values

SYNOPSIS
```
ULONG Seconds, Micros;
CurrentTime(&Seconds, &Micros)
            A0        A1
```

FUNCTION
    This function puts copies of the current time into the supplied argument pointers. This time value is not extremely accurate, nor is it of a very fine resolution. The time will be updated no more than sixty times a second and will typically be updated far fewer times a second.

INPUTS
    Seconds = pointer to a ULONG variable to receive the current seconds value.
    Micros = pointer to a ULONG variable for the current microseconds value.

RESULT
    Puts the time values into the memory locations specified by the arguments.

BUGS
    None.

SEE ALSO
    None.

CWAIT

NAME
    CWAIT -- append Copper wait instruction to user Copper list.

SYNOPSIS
    CWAIT(c , v , h)

FUNCTION
    Adds instruction to wait for vertical beam position v and horizontal position h

INPUTS
    c = pointer to UCopList structure
    v = vertical beam position (relative to top of ViewPort)
    h = horizontal beam position

RESULTS
    This is actually a macro that calls CWait(c,v,h) and then calls CBump(c) to bump the local pointer to the next instruction.

BUGS

DateStamp

NAME
    DateStamp -- obtain the date and time in internal forma

SYNOPSIS
    DateStamp(v);

FUNCTION
    DateStamp takes a vector of three longwords that is set to the current time. The first element in the vector is a count of the number of days. The second element is the number of minutes elapsed in the day. The third is the number of ticks elapsed in the current minute. A tick happens 50 times a second. DateStamp ensures that the day and minute are consistent. All three elements are zero if the date is unset. DateStamp currently only returns even multiples of 50 ticks. Therefore the time you get is always an even number of ticks.

INPUTS
    v - address of the first element in an array of three longwords

RESULTS

    This array is filled as described under FUNCTION.

Deallocate

NAME
    Deallocate -- deallocate a block of memory

SYNOPSIS
```
Deallocate(freeList, memoryBlock, byteSize)
           A0        A1           D0
```

FUNCTION
    This function deallocates memory by returning it to the appropriate free memory pool. This function can be used to free an entire block allocated with the above function, or it can be used to free a sub-block of a previously allocated block.

    If memoryBlock is not on a block boundary (MEM_BLOCKSIZE) then it will be rounded down. Note that this will work correctly with all the memory allocation routines, but may cause surprises if one is freeing only part of a region. If byteSize is null, nothing happens.
    Also, the size of the block will be rounded up, so the freed block will fill an entire memory block.

INPUTS
    freeList - points to the free list
    memoryBlock - memory block to return
    byteSize - the size of the desired block in bytes

SEE ALSO
    Allocate

```
Delay

NAME
    Delay -- delay a process for a specified time

SYNOPSIS
    Delay( timeout )
           D1

FUNCTION
    The function Delay takes an argument 'timeout'. 'timeout' allows you
    to specify how long the process should wait in ticks (50 per second).

INPUTS
    timeout - integer
```

```
DeleteExtIO

NAME
        DeleteExtIO -- return memory allocated for extended I/O request

SYNOPSIS
        DeleteExtIO( ioReq );

FUNCTION
        Frees up an IO request as allocated by CreateExtIO().

INPUTS
        ioReq - A pointer to the IORequest block to be freed.

RESULTS
        No return value

EXAMPLE
        struct IORequest ioReq;
        DeleteExtIO( ioReq );

SEE ALSO
        CreateExtIO
```

DeletcFile

NAME
    DeleteFile -- delete a file or directory

SYNOPSIS
```
    success = DeleteFile( name )
       D0                 D1
```

FUNCTION
    DeleteFile attempts to delete the file or directory 'name'. It returns an error if the deletion fails. Note that you must delete all the files within a directory before you can delete the directory itself.

INPUTS
    name - address of first character of a null-terminated string

RESULTS
    success - boolean

DeleteLayer

NAME
    DeleteLayer -- delete layer from layer list.

SYNOPSIS
```
    DeleteLayer( li, l )
                 a0  a1
```

INPUTS
    li = pointer to LayerInfo structure
    l   = pointer to a layer

FUNCTION
    Removes this layer from the list of layers and releases memory associated with it. Restores other layers that may have been obscured by it. Triggers refresh in those that may need it. If this is a superbitmap, makes sure SuperBitMap is current. The SuperBitMap is not removed from the system but is available for program without rest of layer stuff.

SEE ALSO
    layers.h

DeviceProc

NAME

DeviceProc -- return the process identifier of the process handling that I/O

SYNOPSIS

```
process = DeviceProc( name )
 D0                   D1
```

FUNCTION

DeviceProc returns the process identifier of the process that handles the device associated with the specified name. If DeviceProc cannot find a process handler, the result is zero. If 'name' refers to a file on a mounted device, then IoErr() returns a pointer to a directory lock.

You can use this function to determine the process identification of the handler process where the system should send its messages.

INPUTS

name - address of first character of a null-terminated string

RESULTS

process - BCPL pointer to a Process

Disable

NAME

Disable -- Disable interrupts in a non-preemptive fashion.

SYNOPSIS

```
Disable();
```

FUNCTION

Disabling is similar to forbidding, but it also prevents interrupts from occurring during a critical section. Disabling is required when a task accesses structures that are shared by interrupt code. It eliminates the possibility of an interrupt accessing shared structures by preventing interrupts from occurring.

To disable interrupts you can call the Disable() function. If you are writing in assembly code, the DISABLE macro is more efficient (but consumes more code space). To enable interrupts again, use the Enable() function and ENABLE macros.

Like forbidden sections, disabled sections can be nested. Also like forbidden sections, the Wait() function implies an Enable() until the task again regains the processor.

It is important to realize that there is a danger in using disabled sections. Because the software on the Amiga depends heavily on its interrupts occurring in nearly real time, you cannot disable for more than a very brief instant. A rule of thumb is to disable for no more than 250 microseconds.

Masking interrupts by changing the 68000 processor interrupt priority levels with the MOVESR instruction can also be dangerous and is generally discouraged. The disable- and enable-related functions and macros control interrupts through the 4703 custom chip and not through the 68000 priority level. In addition, the processor priority level can be altered only from supervisor mode (which means this process is much less efficient).

It is never necessary to both disable and forbid. Because disable prevents interrupts, it also prevents preemptory task scheduling. Many Exec lists can only be accessed while disabled. Suppose you want to print the names of all waiting tasks. You would need to access the task list from a disabled section. In addition, you must avoid calling certain system functions that require multitasking to function properly (printf() for example). In this example, the names are gathered into a name array while the code section is disabled. Then the code section is enabled and the names are printed.

```
struct ExecBase *eb;
struct Task *tc;
char *names[ARRAYSIZE];
int count;

Disable();
for (tc = eb -> TaskWait.tc_Node.lh_Head;
```

```
                tc -> tc_Node.ln_Succ;
                tc = tc -> tc_Node.ln_Succ) {
            names[count++] = tc -> tc_Node.ln_Name;
        }
        Enable();
        for (i = 0; i < count; i++) {
            printf (" %s ", names[i]);
        }
```

Of course, the code in this example will have problems if a waiting task is removed before its name is printed. If this were to happen, the name-string pointer would no longer be valid. To avoid such problems it is a good programming practice to copy the entire name string into a temporary buffer.

DisownBlitter

NAME

DisownBlitter -- return blitter to free state.

SYNOPSIS

DisownBlitter()

FUNCTION

Free blitter for use by other blitter users

INPUTS

RETURNS

SEE ALSO

OwnBlitter

DisplayAlert

NAME

DisplayAlert -- create a display of an alert message

SYNOPSIS

```
DisplayAlert(AlertNumber, String, Height)
             D0           A0      D1
```

FUNCTION

Creates an alert display with the specified message.

If the system can recover from this alert, it is a RECOVERY_ALERT. The routine waits until the user presses one of the mouse buttons, after which the display is restored to its original state and a BOOL value is returned by this routine to specify whether or not the user pressed the left mouse button.

If the system cannot recover from this alert, it is a DEADEND_ALERT, and this routine returns immediately upon creating the alert display. The return value is FALSE.

The AlertNumber is a LONG value, related to the value sent to the Alert() routine. The only bits that are pertinent to this routine, however, are the ALERT_TYPE bits. These bits must be set to RECOVERY_ALERT for alerts from which the system may safely recover or DEADEND_ALERT for fatal alerts. These states are described in the paragraph above. A third type of alert, the DAISY_ALERT, is used only by the Executive.

The String argument points to an AlertMessage string. The AlertMessage string is composed of one or more substrings, each of which contains the following components:

- First, a 16-bit x coordinate and an 8-bit y coordinate, describing where on the alert display you want this string to appear. The y coordinate describes the offset to the baseline of the text.
- Then, the bytes of the string itself, which must be null-terminated (end with a byte of zero).
- Lastly, the continuation byte, which specifies whether or not another substring follows this one. If the continuation byte is non-zero, there is another substring to be processed in this AlertMessage. If the continuation byte is zero, this is the last substring in the message.

The last argument, Height, describes how many video lines tall you want the alert display to be.

INPUTS

AlertNumber = the number of this AlertMessage. The only pertinent bits of this number are the ALERT_TYPE bits. The rest of the number is ignored by this routine.

String = pointer to the alert message string, as described above.

Height = minimum display lines required for your message.

RESULT

A BOOL value of TRUE or FALSE. If this is a DEADEND_ALERT, FALSE is always the return value. If this is a RECOVERY_ALERT, the return value will be TRUE if the user presses the left mouse button in response to your message and FALSE if the user presses the right button.

BUGS

If the system is in more trouble than you think, the level of your alert may become DEADEND_ALERT without you ever knowing about it.

SEE ALSO

None

```
DisplayBeep


NAME
     DisplayBeep  --  "beep" the video display

SYNOPSIS
     DisplayBeep(Screen)
                 A0

FUNCTION
     "Beeps" the video display by flashing the background color
     of the specified screen.  If the Screen argument is NULL,
     every screen in the display will be beeped.  Flashing all
     screens is not a polite thing to do, so this should be
     reserved for dire circumstances.

     Such a routine is supported because the Amiga has no internal
     bell or speaker.  When the user needs to know of an
     event that is not serious enough to require the use of a
     requester, the DisplayBeep() function should be called.

INPUTS
     Screen = pointer to a Screen structure.  If NULL, every
          Intuition screen will be flashed.

RESULT
     None

BUGS
     None

SEE ALSO
     None
```

```
DisposeLayerInfo

NAME
        DisposeLayerInfo -- return all memory for LayerInfo to mem pool

SYNOPSIS
        DisposeLayerInfo(li)
                         a0

INPUTS
        li  = pointer to LayerInfo structure

FUNCTION
        Returns LayerInfo and any other memory attached to this LayerInfo
        to memory allocator

SEE ALSO
        layers.h
```

DisposeRegion

NAME
    DisposeRegion -- return all space for this region to free memory pool

SYNOPSIS
    DisposeRegion(region)
                  a0

Function
    Frees all RegionRectangles for this Region and then frees the Region itself

INPUTS
    region = pointer to Region structure

BUGS

DoCollision

NAME
    DoCollision -- tests every GEL in GEL list for collisions

SYNOPSIS
    DoCollision(RPort)
                a1

FUNCTION
    Tests each GEL in GEL list for boundary and GEL-to-GEL collisions On detecting one of these collisions, the appropriate collision-handling routine is called. See the documentation for a thorough description of which collision routine is called.

    This routine expects to find the GEL list correctly sorted in Y,X order. The system routine SortGList performs this function for the user

INPUTS
    RPort = pointer to a struct RastPort

RESULT
    Nothing

BUGS
    Does not handle GEL-to-GEL collisions completely correctly

SEE ALSO
    SortGList

DoIO

NAME
    DoIO -- perform an I/O command and wait for completion

SYNOPSIS
```
error = DoIO(iORequest)
D0           A1
```

FUNCTION
    This function requests a device driver to perform the I/O command specified in the I/O request. This function will always block until the I/O request is completed.

INPUTS
    iORequest - pointer to a properly initialized I/O request

RESULTS
    error - see WaitIO

SEE ALSO
    SendIO, WaitIO

DoubleClick

NAME
    DoubleClick -- test two time values for double-click timing

SYNOPSIS
```
DoubleClick(StartSeconds, StartMicros, CurrentSeconds, CurrentMicros)
            D0            D1           D2              D3
```

FUNCTION
    Compares the difference in the time values with the double-click timeout range that the user (using the Preferences tool or some other source) has configured into the system. If the difference between the specified time values is within the current double-click time range, this function returns TRUE; otherwise, it returns FALSE.

    These time values can be found in InputEvents and IDCMP messages. The time values are not perfect; however, they are precise enough for nearly all applications.

INPUTS
    StartSeconds, StartMicros = the timestamp value describing the start of the double-click time period you are considering.
    CurrentSeconds, CurrentMicros = the timestamp value describing the end of the double-click time period you are considering.

RESULT
    If the difference between the supplied timestamp values is within the double-click time range in the current set of Preferences, this function returns TRUE; otherwise, it returns FALSE.

BUGS
    None

SEE ALSO
    CurrentTime()

Draw

NAME
    Draw -- draw a line between the current pen position
            and the new x,y position

SYNOPSIS
    Draw(rp, x, y)
          A1 D0 D1

FUNCTION
    Draws a line from the current pen position to (x,y).

INPUTS

    rp   pointer to a RastPort
    x,y   point in the RastPort to end the line.

DrawBorder

NAME
    DrawBorder -- draw the specified border into the RastPort

SYNOPSIS
    DrawBorder(RastPort, Border, LeftOffset, TopOffset)
               A0   A1   D0   D1

FUNCTION
    First, this function sets up the drawing mode and pens in
    the RastPort according to the arguments of the Border structure
    Then, it draws the vectors of the Border argument
    into the RastPort, offset by the LeftOffset and TopOffset.
    This routine does Intuition window clipping as appropriate;
    if you draw a line outside of your window, your imagery will
    be clipped at the window's edge.

    If the NextBorder field of the Border argument is non-zero,
    the next Border is rendered as well (return to the top of
    this FUNCTION section for details).

INPUTS
    RastPort = pointer to the RastPort to receive the border
        crossing.
    Border = pointer to a Border structure.
    LeftOffset = the offset that will be added to each vector's
        x coordinate.
    TopOffset = the offset that will be added to each vector's y
        coordinate.

RESULT
    None

BUGS
    None

SEE ALSO
    None

```
DrawGList

NAME
   DrawGList  --  process the GEL list, queueing VSprites, drawing Bobs

SYNOPSIS
   DrawGList(RPort, VPort)       as called by C
             a1     a0

FUNCTION
   Performs one pass of the current GEL list
      - If nextLine and lastColor are defined, these are initialized
        for each GEL.
      - If it's a VSprite, build it into the Copper list
      - If it's a Bob, draw it into the current raster
      - Copy the save values into the "old" variables, double-buffering
        if required

INPUTS
   a1 = pointer to the RastPort where Bobs will be drawn
   a5 = pointer to GfxBase

RESULT
   Nothing

BUGS
   MUSTDRAW is not implemented yet and probably will not be for this
   release.  We are sad.

SEE ALSO
   Nothing
```

```
DrawImage

NAME
     DrawImage  --  draw the specified Image into the RastPort

SYNOPSIS
     DrawImage(RastPort, Image, LeftOffset, TopOffset)
               A0        A1     D0          D1

FUNCTION
     First, this function sets up the drawing mode and pens in
     the RastPort according to the arguments of the Image structure
     Then, it moves the image data of the Image argument
     into the RastPort, offset by the LeftOffset and TopOffset.
     This routine does Intuition window clipping as appropriate;
     if you draw an image outside of your window, your imagery
     will be clipped at the window's edge.

     If the NextImage field of the Image argument is non-zero,
     the next Image is rendered as well (return to the top of
     this section for details).

INPUTS
     RastPort = pointer to the RastPort to receive the border
          crossing.
     Image = pointer to an Image structure.
     LeftOffset = the offset that will be added to the Image's x
          coordinate.
     TopOffset = the offset that will be added to the Image's y
          coordinate.

RESULT
     None

BUGS
     None

SEE ALSO
     None
```

DupLock

NAME
    DupLock -- duplicate a lock

SYNOPSIS
```
newLock = DupLock( lock )
   D0                D1
```

FUNCTION

DupLock takes a shared filing system read lock and returns another shared read lock to the same object. It is impossible to create a copy of a write lock. (For more information on locks, see under LOCK.)

INPUTS
    lock - BCPL pointer to a lock

RESULTS
    newLock - BCPL pointer to a lock

Enable

NAME

Enable -- Enable interrupts following a Disable()

SYNOPSIS

```
Enable();
```

FUNCTION

Interrupts will not necessarily be enabled after this call since the Disable() function nests (only an equal number of Enable's following a set of Disable's finally re-enables interrupts).

SEE ALSO

Disable

EndRefresh

NAME
    EndRefresh -- end the optimized refresh state of the window

SYNOPSIS
```
    EndRefresh(Window, Complete)
               A0      D0
```

FUNCTION
    This function gets you out of the special refresh state of your window. It is called following a call to BeginRefresh(), which begins the special refresh state. While your window is in the refresh state, the only drawing that will be wrought in your window will be to those areas that were recently revealed and that need to be refreshed.

    After your program has done all the needed refreshing for this window, this routine is called to restore the window to its non-refreshing state. Then all rendering will go to the entire window as usual.

    The Complete argument is a Boolean TRUE or FALSE value used to describe whether or not the refreshing that has been done is all that needs to be done at this time. Most often, this argument will be TRUE. However, if, for instance, you have multiple tasks or multiple procedure calls that must run to completely refresh the window, each can call its own Begin/EndRefresh() pair with a Complete argument of FALSE, and only the last calls with a Complete argument of TRUE.

INPUTS
    Window = pointer to the Window currently in optimized-refresh mode.
    Complete = Boolean TRUE or FALSE describing whether or not this window is completely refreshed.

RESULT
    None

BUGS
    None

SEE ALSO
    BeginRefresh()

EndRequest

NAME
    EndRequest -- end the request and reset the window

SYNOPSIS
```
    EndRequest(Requester, Window)
               A0         A1
```

FUNCTION
    This function ends the request by erasing the requester and resetting the window. Note that this does not necessarily clear all requesters from the window, only the specified one. If the window labors under other requesters, they will remain in the window.

INPUTS
    Requester = pointer to the structure of the requester to be removed.
    Window = pointer to the Window structure with which this requester is associated.

RESULT
    None

BUGS
    None

SEE ALSO
    None

EndUpdate

NAME

    EndUpdate -- remove damage list and restore state of
                 layer to normal.

SYNOPSIS

    EndUpdate(l, flag)
               a0 d0

INPUTS

    l   = pointer to a layer
     flag= TRUE if update was successful. The damage list is cleared.

FUNCTION

After the programmer has redrawn his picture, he calls this routine to restore the ClipRects to point to his standard layer tiling. Use flag=0 if you are only making a partial update. You may use the other region functions to clip adjust the DamageList to reflect a partial update.

SEE ALSO

layers.h BeginUpdate()

Enqueue

NAME

Enqueue -- insert or append node to a system queue

SYNOPSIS

    Enqueue(list, node)
            A0   A1

FUNCTION

Insert or append a node into a system queue. The insert is performed based on the node priority -- it will keep the list properly sorted. New nodes will be inserted in front of the first node with a lower priority. Hence a FIFO queue for nodes of equal priority

INPUTS

    list - a pointer to the system queue header
    node - the node to enqueue

Examine

NAME
    Examine -- examine a directory or file associated with a lock

SYNOPSIS
```
success = Examine( lock, FileInfoBlock )
  D0                D1      D2
```

FUNCTION
    Examine fills in information in the FileInfoBlock concerning the file or directory associated with the lock. This information includes the name, size, creation date, and whether it is a file or directory.

    Note: FileInfoBlock must be longword-aligned. You can ensure this in C if you use Allocmem. (See the "Amiga ROM Kernel Reference Manual: Exec" for further details on the exec call Allocmem.)

    Examine gives a return code of zero if it fails.

INPUTS
    lock - BCPL pointer to a lock
    FileInfoBlock - address of a file info block

RESULTS
    success - boolean

Execute

NAME
    Execute -- execute a CLI command

SYNOPSIS
```
Success = Execute( commandString, input, output )
 D0                    D1           D2     D3
```

FUNCTION
    This function takes a string (commandString) that specifies a CLI command and arguments, and attempts to execute it. The CLI string can contain any valid input that you could type directly at a CLI, including input and output indirection.

    The input file handle will normally be zero, and in this case the EXECUTE command will perform whatever was requested in the commandString and then return. If the input file handle is nonzero, after the (possibly null) commandString is performed, subsequent input is read from the specified input file handle until end-of-file is reached.

    In most cases, the output file handle must be provided and will be used by the CLI commands as their output stream unless redirection was specified. If the output file handle is set to zero, the current window, normally specified as *, is used. Note that programs running under the Workbench do not normally have a current window.

    The Execute function may also be used to create a new interactive CLI process just like those created with the NEWCLI function. To do this, you should call Execute with an empty commandString, and pass a file handle relating to a new window as the input file handle. The output file handle should be set to zero. The CLI will read commands from the new window, and will use the same window for output. This new CLI window can only be terminated by using the ENDCLI command. For this command to work the program C:RUN must be present in C:.

INPUTS
    commandString - address of first character of a null-terminated string
    input - BCPL pointer to a file handle
    output - BCPL pointer to a file handle

RESULTS
    Success - boolean

Exit

NAME
    Exit -- exit from a program

SYNOPSIS
```
    Exit( returnCode )
              D1
```

FUNCTION
    Exit acts differently depending on whether you are running a program under a CLI or not. If you run a program that calls Exit as a command under a CLI, the command finishes and control reverts to the CLI. Exit then interprets the argument 'returnCode' as the return code from the program.

    If you run the program as a distinct process, Exit deletes the process and releases the space associated with the stack, segment list, and process structure.

INPUTS
    returnCode - integer

ExNext

NAME
    ExNext -- examine the next entry in a directory.

SYNOPSIS
```
    success = ExNext( lock, FileInfoBlock )
      D0                D1     D2
```

FUNCTION
    This routine is passed a lock, usually associated with a directory, and a FileInfoBlock filled in by a previous call to Examine. The FileInfoBlock contains information concerning the first file or directory stored in the directory associated with the lock. ExNext also modifies the FileInfoBlock so that subsequent calls return information about each following entry in the directory.

    ExNext gives a return code of zero if it fails for some reason. One reason for failure is reaching the last entry in the directory. However, IoErr() holds a code that may give more information on the exact cause of a failure. When ExNext finishes after the last entry, it returns ERROR_NO_MORE_ENTRIES

    Follow these steps to examine a directory:

    1) Use Examine to get a FileInfoBlock about the directory you wish to examine.

    2) Pass ExNext the lock related to the directory and the FileInfoBlock filled in by the previous call to Examine.

    3) Keep calling ExNext until it fails with the error code held in IoErr() equal to ERROR_NO_MORE_ENTRIES.

    4) Note that if you don't know what you are examining, inspect the type field of the FileInfoBlock returned from Examine to find out whether it is a file or a directory which is worth calling ExNext for.

    The type field in the FileInfoBlock has two values: if it is negative, then the file system object is a file; if it is positive, then it is a directory.

INPUTS
    lock - BCPL pointer to a lock
    FileInfoBlock - pointer to a file info block

RESULTS
    success - boolean

SPECIAL NOTE
    The FileInfoBlock must be longword-aligned.

faddi

NAME

faddi -- add two floating-point numbers

C USAGE

```
fnum3 = fnum1 + fnum2;
        D1      D0
```

FUNCTION

Accepts two floating-point numbers and returns the arithmetic sum of said numbers. Note that this function is called by compiler-generated code, not by a user-generated function call.

INPUTS

fnum1 - floating-point number
fnum2 - floating-point number

RESULT

fnum3 - floating-point number

BUGS

None

SEE ALSO

SPAdd,

FattenLayerInfo

NAME

FattenLayerInfo -- convert 1.0 LayerInfo to 1.1 LayerInfo

SYNOPSIS

```
FattenLayerInfo(li)
                a0
```

INPUTS

li = pointer to LayerInfo structure

FUNCTION

From 1.1 software and on, need to have more info in the Layer_Info structure. To do this in a 1.0-supportable manner requires allocation and deallocation of the memory whenever most layer library functions are called. To prevent unnecessary allocation/deallocation, FattenLayerInfo will preallocate the necessary data structures and fool the layer library into thinking it has a LayerInfo gotten from NewLayerInfo. NewLayerInfo is the approved method for getting this structure. When a program needs to give up the LayerInfo structure, it must call ThinLayerInfo before freeing the memory. ThinLayerInfo is not necessary if New/DisposeLayerInfo are used, however.

SEE ALSO

NewLayerInfo ThinLayerInfo DisposeLayerInfo layers.h fcmpi

NAME

    fcmpi -- compare two floating-point numbers and set
            appropriate condition codes

C USAGE

```
if (fnum1 <= fnum2) {...}
     D1       D0
```

FUNCTION

Accepts two floating-point numbers and returns the condition codes set to indicate the result of said comparison. Note that this function is called by compiler-generated code, not by a user-generated function call.

INPUTS

fnum1 - floating-point number
fnum2 - floating-point number

RESULT

Condition codes set to reflect the following branches:

```
GT - fnum2 >  fnum1
GE - fnum2 >= fnum1
EQ - fnum2 =  fnum1
NE - fnum2 != fnum1
LT - fnum2 <  fnum1
LE - fnum2 <= fnum1
```

BUGS

None

SEE ALSO

SPCmp,

fdivi

NAME

    fdivi -- divide two floating-point numbers

C USAGE

```
fnum3 = fnum1 / fnum2;
        D1      D0
```

FUNCTION

Accepts two floating-point numbers and returns the arithmetic division of said numbers. Note that this function is called by compiler-generated code, not by a user-generated function call.

INPUTS

fnum1 - floating-point number
fnum2 - floating-point number

RESULT

fnum3 - floating-point number

BUGS

None

SEE ALSO

SPDiv,

fflti

NAME

fflti -- convert integer number to fast floating point

C USAGE

```
fnum = (FLOAT) inum;
               D0
```

FUNCTION

Accepts an integer and returns the converted floating-point result of said number. Note that this function is called by compiler-generated code, not by a user-generated function call.

INPUTS

inum - signed integer number

RESULT

fnum - floating-point number

BUGS

None

SEE ALSO

SPFlt,

FindName

NAME

FindName -- find a system list node with a given name

SYNOPSIS

```
node = FindName(start, name)
D0              A0     A1
```

FUNCTION

Traverse a system list until a node with the given name is found. To find multiple occurences of a string, this function may be called with a node starting point.

INPUTS

start - a list header or a list node to start the search (if node, this one is skipped)

name - a pointer to a name string terminated with null

RESULTS

node - a pointer to the node with the same name else zero to indicate that the string was not found.

FindPort

NAME

FindPort -- find a given system message port

SYNOPSIS

```
port = FindPort(name)
D0              A1
```

FUNCTION

This function will search the system message port list for a port with the given name. The first port matching this name will be returned.

INPUT

name - name of the port to find

RETURN

port - a pointer to the message port, or zero if not found.

FindTask

NAME

FindTask -- find a task with the given name or find oneself

SYNOPSIS

```
task = FindTask(name)
D0              A1
```

FUNCTION

This function will check all task queues for a task with the given name, and return a pointer to its task control block. If a null name pointer is given a pointer to the current task will be returned.

INPUT

name - pointer to a name string

RESULT

task - pointer to the task

FindToolType

```
NAME
     FindToolType -- find the value of a ToolType variable

SYNOPSIS
     value = FindToolType( toolTypeArray, typeName  )
     D0                    A0             A1

FUNCTION
     This function searches a tool type array for a given entry
     and returns a pointer to that entry.  This is useful for
     finding standard tool type variables.  The returned
     value is not a new copy of the string but is only
     a pointer to the part of the string after typeName.

INPUTS
     toolTypeArray - an array of strings
     typeName - the name of the tooltype entry

RESULTS
     value - a pointer to a string that is the value bound to
         typeName, or NULL if typeName is not in
         the toolTypeArray.

EXCEPTIONS

EXAMPLE
     Assume the tool type array has two strings in it:
         "FILETYPE=text"
         "TEMPDIR=:t"

     FindToolType( toolTypeArray, "FILENAME" ) returns "text"
     FindToolType( toolTypeArray, "TEMPDIR" )  returns ":t"
     FindToolType( toolTypeArray, "MAXSIZE" )  returns NULL

SEE ALSO
     MatchToolValue

BUGS
```

Flood

```
NAME
        Flood -- flood rastport like areafill


SYNOPSIS
        Flood( rp, mode, x, y)
              a1   d2  d0  d1

FUNCTION
        Searches the BitMap starting at (x,y).  Fills all adjacent pixels
        if they:
        a: are not the same as AOLPen            Mode 0
        a: are the same as the one at (x,y)      Mode 1

        When actually doing the fill, uses the modes that apply to
        standard area-fill routines such as drawmodes and patterns.

INPUTS
        rp      pointer to RastPort
        (x,y)   coordinate in BitMap
        mode    0   fill all adjacent pixels searching for border
                1   fill all adjacent pixels that have same pen number
                    as (x,y)

SEE ALSO

BUGS

        None known
```

FlushCList

NAME

FlushCList -- clear a character list

SYNOPSIS

```
FlushCList(cList)
           A0
```

FUNCTION

ensure that the cList is empty.

INPUTS

cList -
The clist header used to manage this character list, as returned by AllocCList or StrToCL.

RESULTS

fmuli

NAME

fmuli -- multiply two floating-point numbers

C USAGE

```
fnum3 = fnum1 * fnum2;
        D1      D0
```

FUNCTION

Accepts two floating-point numbers and returns the arithmetic multiplication of said numbers. Note that this function is called by compiler-generated code, not by a user-generated function call.

INPUTS

fnum1 - floating-point number
fnum2 - floating-point number

RESULT

fnum3 - floating-point number

BUGS

None

SEE ALSO

SPMul,

fnegi

NAME

fnegi -- negate the supplied floating-point number

C USAGE

```
fnum2 = -fnum1;
          D0
```

FUNCTION

Accepts a floating-point number and returns the value of said number after having been subtracted from 0.0. Note that this function is called by compiler-generated code, not by a user-generated function call.

INPUTS

fnum1 - floating-point number

RESULT

fnum2 - floating-point negation of fnum1

BUGS

None

SEE ALSO

SPNeg,

Forbid

NAME

Forbid -- prevent task rescheduling on a non-preemptive basis.

SYNTAX

```
Forbid();
```

FUNCTION

Forbidding is used when a task is accessing shared structures that might also be accessed at the same time from another task. It effectively eliminates the possibility of simultaneous access by imposing nonpreemptive task scheduling. This has the net effect of disabling multitasking for as long as your task remains in its running state. While forbidden, your task will continue running until it performs a call to Wait() or exits from the forbidden state. Interrupts will occur normally, but no new tasks will be dispatched, regardless of their priorities.

When a task running in the forbidden state calls the Wait() function, it implies a temporary exit from its forbidden state. While the task is waiting, the system will perform normally. When the tasks receives one of the signals it is waiting for, it will again reenter the forbidden state. To become forbidden, a task calls the Forbid() function. To escape, the Permit() function is used. The use of these functions may be nested with the expected affects; you will not exit the forbidden mode until you call the outermost Permit().

As an example, Exec memory region lists should be accessed only when forbidden. To access these lists without forbidding jeopardizes the integrity of the entire system.

```
struct ExecBase *eb;
struct MemHeader *mh;
APTR firsts[ARRAYSIZE];
int count;

Forbid();
for (mh = (struct MemHeader *) eb  ->  MemList.lh_Head;
                mh  ->  mh_Node.ln_Succ;
                mh = mh  ->  mh_Node.ln_Succ) {
        firsts[count++] = mh  ->  mh_First;
}
Permit();
```

As this program traverses down the memory region list, it remains forbidden to prevent the list from changing as it is being accessed.

FreeCList

NAME
    FreeCList -- free a clist

SYNOPSIS
```
FreeCList(cList)
          A0
```

FUNCTION
    Release the cList descriptor and any resources it uses.
    References to the cList are no longer valid.

INPUTS
    cList   -
            a descriptor for a clist that is no longer to be used.

NOTES
    This function is implicitly performed by CLToBuf.

FreeColorMap

NAME
    FreeColorMap -- free the ColorMap structure and return memory
                    to free memory pool

SYNOPSIS
```
FreeColorMap( colormap )
              a0
```

INPUTS
    colormap   pointer to ColorMap allocated with GetColorMap

RESULT
    The space is made available for others to use.

BUGS

SEE ALSO
    SetRGB4 GetColorMap

FreeCopList

NAME
    FreeCopList -- deallocate intermediate Copper list

SYNOPSIS
    FreeCopList(coplist)

FUNCTION
    Deallocates all memory associated with this Copper list

INPUTS
    coplist = pointer to structure CopList

RESULTS
    memory returned to memory manager

BUGS
    none known

SEE ALSO

FreeCprList

NAME
    FreeCprList -- deallocate hardware Copper list

SYNOPSIS
    FreeCprList(cprlist)

FUNCTION
    Return cprlist to free memory pool

INPUTS
    cprlist = pointer to cprlist structure

RESULTS

BUGS
    none known

SEE ALSO

```
FreeDiskObject

NAME
        FreeDiskObject -- free all memory in a Workbench disk object

SYNOPSIS
        FreeDiskObject( diskobj )
                        A0

FUNCTION
        This routine frees all memory in a Workbench disk object
        and also frees and the object itself.  It is implemented
        via FreeFreeList().

        GetDiskObject() takes care of all the initialization required
        to set up the objects free list.  This procedure may ONLY
        be called on DiskObject allocated via GetDiskObject().

INPUTS
        diskobj -- a pointer to a DiskObject structure

RESULTS

EXCEPTIONS

SEE ALSO
        GetDiskObject, FreeFreeList

BUGS
```

```
FreeEntry

   NAME
        FreeEntry -- free many regions of memory

   SYNOPSIS
        FreeEntry(memList)
                  A0

   FUNCTION
        This routine takes a memList structure (as returned by
        AllocEntry) and frees all the entries.

   INPUTS
        memList -- pointer to structure filled in with memEntry
                structures
```

```
FreeFreeList

   NAME
        FreeFreeList -- free all memory in a free list

   SYNOPSIS
        FreeFreeList( free )
                     A0

   FUNCTION
        This routine frees all memory in a free list, and the
        free list itself.  It is useful for easily getting
        rid of all memory in a series of structures.  There is
        a free list in a Workbench object, and this contains
        all the memory associated with that object.

        A FreeList is a list of MemList structures.  See the
        MemList and MemEntry documentation for more information.

        If the FreeList itself is in the free list, it must be
        in the first MemList in the FreeList.

   INPUTS
        free -- a pointer to a FreeList structure

   RESULTS

   EXCEPTIONS

   SEE ALSO
        AllocEntry, FreeEntry, AddFreeList

   BUGS
```

```
FreeGBuffers

NAME
   FreeGBuffers  --  deallocate memory gotten by GetGBuffers

SYNOPSIS
   FreeGBuffers(anOb, RPort, db)   as called by C
                a0    a1     d0

FUNCTION
   For each sequence of each component of the AnimOb, deallocates memory for:
       SaveBuffer
       BorderLine
       CollMask and ImageShadow (point to same buffer)
       if db is set (user wants double-buffering) deallocate:
           DBufPacket
           BufBuffer

INPUTS
   a1 = pointer to the AnimOb structure
   a2 = pointer to the current RastPort
   d0 = double-buffer indicator (set TRUE for double-buffering)

RESULT

BUGS
   None known

SEE ALSO
   Nothing
```

FreeMem

NAME

    FreeMem -- deallocate with knowledge

SYNOPSIS

```
FreeMem(memoryBlock, byteSize)
        A1           D0
```

FUNCTION

Free a region of memory, returning it to the pool from which it came.

INPUTS

    memoryBlock - memory block to free
            If the memoryBlock previously returned by an allocation
            routine.
    byteSize - the size of the block in bytes

SEE ALSO

    AllocMem, AllocAbs

FreeRaster

NAME

    FreeRaster -- release an allocated area to the system free memory pool.

SYNOPSIS

```
FreeRaster( p, width, height)
            a0  d0     d1
```

INPUTS

    p = a pointer to a memory space returned as a
          result of a call to AllocRaster

    width = the width in bits of the bitplane

    height = the height in bits of the bitplane

            the same values of width and height with which you
            called AllocRaster in the first place, when the
            pointer p returned. This defines the size of the
            memory space which is to be returned to the free
            memory pool.

FUNCTION

Returns to the free memory pool the memory space that had been allocated by a call to AllocRast.

NOTE: Always use the same values that were used with AllocRaster

FreeRemember

NAME
    FreeRemember -- free the memory allocated by calls to AllocRemember()

SYNOPSIS
```
    FreeRemember(RememberKey, ReallyForget)
                 A0           D0
```

FUNCTION
    This function frees up memory allocated by the AllocRemember() function. It will free up just the Remember structures, which supply the link nodes that tie your allocations together, or it will deallocate both the link nodes and your memory buffers.

    If you want to deallocate just the Remember structure link nodes, you should set the ReallyForget argument to FALSE. However, if you want FreeRemember() to really forget about all the memory, including both the Remember structure link nodes and the buffers you requested via earlier calls to AllocRemember(), you should set the ReallyForget argument to TRUE.
    If you're not sure whether or not you want to Really Forget, refer to figure 11-1.

INPUTS
    RememberKey = the address of a pointer to a Remember structure This pointer should either be NULL or be set to some value (possibly NULL) by a call to AllocRemember(). For example:

```
        struct Remember *RememberKey;
        RememberKey = NULL;
        AllocRemember(&RememberKey, BUFSIZE, MEMF_CHIP)
        FreeRemember(&RememberKey, TRUE)
```

    ReallyForget = a BOOL FALSE or TRUE describing, respectively, whether you want to free up only the Remember nodes or whether you want this procedure to really forget about all of the memory, including both the nodes and the memory buffers pointed to by the nodes.

RESULT
    None

BUGS
    None

SEE ALSO
    AllocRemember()

FreeSignal

NAME
    FreeSignal -- free a signal bit

SYNOPSIS
```
    FreeSignal(signalNum)
               D0
```

FUNCTION
    This function frees a previously allocated signal bit for reuse. This call must be performed while running in the same task in which the signal was allocated.

WARNING
    Signals may not be allocated or freed from exception handling code.

INPUTS
    signalNum - the signal number to free {0..31}

FreeSprite

NAME

```
FreeSprite -- return sprite for use by others and virtual
              sprite machine
```

SYNOPSIS

```
FreeSprite( pick )
            d0
```

FUNCTION

Marks sprite as available for others to use.

INPUTS

```
pick    = 0-7
```

RESULTS

Sprite made available for subsequent callers of GetSprite as well as use by Virtual Sprite Machine

BUGS

These sprite routines are provided to ease sharing of sprite hardware and to handle simple cases of sprite usage and movement. It is assumed the programs that use these routines do want to be good citizens in their hearts (i.e., that they will not FreeSprite unless they actually own the sprite).
Virtual Sprite machine may ignore simple sprite machine.

SEE ALSO

sprite.h, GetSprite, ChangeSprite, MoveSprite

FreeSysRequest

NAME

```
FreeSysRequest  --  free up memory used by a call to
                    BuildSysRequest()
```

SYNOPSIS

```
FreeSysRequest(Window)
               A0
```

FUNCTION

This routine frees up all memory allocated by a successful call to the BuildSysRequest() procedure. If BuildSysRequest() returned a pointer to a Window structure, then your program can Wait() for the message port of that window to detect an event that satisfies the requester. When you want to remove the requester, you call this procedure. It ends the requester and deallocates any memory used in the creation of the requester.

NOTE: If BuildSysRequest() did not return a pointer to a window, you should not call FreeSysRequest().

INPUTS

```
Window = a copy of the window pointer returned by a successful
         call to the BuildSysRequest() procedure.
```

RESULT

None

BUGS

None

SEE ALSO

BuildSysRequest(), Wait(), AutoRequest()

FreeTrap

NAME
    FreeTrap -- free a processor trap

SYNOPSIS
    FreeTrap(trapNum)
             D0

FUNCTION
    This function frees a previously allocated trap number for
    reuse. This call must be performed while running in the
    same task in which the trap was allocated.

WARNING
    Traps may not be allocated or freed from exception
    handling code.

INPUTS
    trapNum - the trap number to free {of 0..15}

FreeVPortCopLists

NAME
    FreeVPortCopLists -- deallocate all intermediate Copper lists and
    their headers from a viewport

SYNOPSIS
    FreeVPortCopLists(viewport)

FUNCTION
    Recursively searches display, color, sprite, and user Copper
    lists and calls FreeMem() to deallocate them from memory

INPUTS
    viewport = pointer to ViewPort structure

RESULTS

```
vp->DspIns == NULL; vp->SprIns == NULL; vp->ClrIns == NULL;
vp->UCopIns == NULL;
```

BUGS
    none known

SEE ALSO

```
FreeWBObject

NAME
        FreeWBObject -- free all memory in a Workbench object

SYNOPSIS
        FreeWBObject( obj )
                      A0

FUNCTION
        This routine frees all memory in a Workbench object, and the
        object itself.  It is implemented via FreeFreeList().

        AllocWBObject() takes care of all the initialization required
        to set up the objects free list.

        This routine is intended only for internal users that can
        track changes to the Workbench.

INPUTS
        free -- a pointer to a FreeList structure

RESULTS

EXCEPTIONS

SEE ALSO
        AllocEntry, FreeEntry, AllocWBObject, FreeFreeList

BUGS
```



```
fsubi

NAME

    fsubi -- subtract two floating-point numbers

C USAGE

    fnum3 = fnum1 - fnum2;
            D1      D0

FUNCTION

    Accepts two floating-point numbers and returns the arithmetic
    subtraction of said numbers.  Note that this function is called
    by compiler-generated code, not by a user-generated function call.

INPUTS

    fnum1 - floating-point number
    fnum2 - floating-point number

RESULT

    fnum3 - floating-point number

BUGS

    None

SEE ALSO

    SPSub,
```

ftsti

NAME

ftsti -- compares a fast floating-point number against the value zero (0.0) and sets the appropriate condition codes

C USAGE

```
if (!fnum) {...}
     D1
```

FUNCTION

Accepts a floating-point number and returns the condition codes set to indicate the result of a comparison against the value of zero (0.0). Note that this function is called by compiler generated code, not by a user generated function call.

INPUTS

fnum - floating-point number

RESULT

Condition codes set to reflect the following branches:

```
EQ - fnum =  0.0
NE - fnum != 0.0
PL - fnum >= 0.0
MI - fnum <  0.0
```

BUGS

None

SEE ALSO

SPTst,

GetCC

NAME

GetCC -- get condition codes in a 68010 compatible way.

SYNOPSIS

```
conditions = GetCC()
D0
```

FUNCTION

This function provides a means of obtaining the CPU condition codes in a manner that will make 68010 upgrades transparent.

INPUTS

RESULTS

conditions - the 68000/68010 condition codes

GetCLBuf

NAME

GetCLBuf -- convert a character list to contiguous data

SYNOPSIS

```
length = GetCLBuf(cList, buffer, maxLength)
D0                A0     A1      D1
```

FUNCTION

Move the cList data into the block of memory pointed to by buffer. Exhaust the character list. If a non-destructive peek at the character list is desired, use SubCL. If the cList will no longer be used, remember to FreeCList.

INPUTS

cList -
The clist descriptor used to manage this character list, as returned by AllocCList.

buffer -
A pointer for the byte data from the character list.

maxLength-
The maximum size of buffer.

RESULTS

length -
the number of bytes copied into buffer. This is never greater than maxLength.

EXCEPTIONS

if cList was bigger than maxLength, the cList is not empty.

GetCLChar

NAME

GetCLChar -- get a byte from the beginning of a character list

SYNOPSIS

```
byte = GetCLChar(cList)
D0               A0
```

FUNCTION

Get a byte from the beginning of the character list described by the cList.

INPUTS

cList -
The clist header used to manage this character list, as returned by AllocCList or StrToCL.

RESULTS

byte -
The byte from the beginning of the character list. If no data is available, the upper three bytes are set (longword is -1).

```
GetCLWord

NAME
        GetCLWord -- get a word from the beginning of a character list

SYNOPSIS
        word = GetCLWord(cList)
        D0               A0

FUNCTION
        Get a word from the beginning of the character list described
        by the cList.

INPUTS
        cList -
                The clist header used to manage this character list,
                as returned by AllocCList or StrToCL.

RESULTS
        word    -
                The word from the beginning of the character list.
                If no data is available, the upper two bytes are set
                (longword is -1).  Partial words (1 byte) are not
                returned.
```

```
GetColorMap

NAME
       GetColorMap -- allocate and initialize Colormap


SYNOPSIS
       cm = GetColorMap( entries )
       d0                d0

INPUTS
       entries = number of entries for this colormap

RESULT
       cm = pointer to an initialized ColorMap structure.

       Allocates and initializes the required structures to be attached
       to the ViewPort to save color values.
       Returns 0 if cannot allocate memory for structures

BUGS

SEE ALSO
       SetRGB4 FreeColorMap
```

GetDefPrefs

NAME
    GetDefPrefs -- get a copy of the Intuition default Preferences

SYNOPSIS
```
GetDefPrefs(PrefBuffer, Size)
            A0          D0
```

FUNCTION
    This function gets a copy of the Intuition default Preferences data. It writes the data into the buffer you specify. The number of bytes you want copied is specified by the Size argument.

    The default Preferences are those that Intuition uses when it is first opened. If no Preferences file is found, these are the preferences that are used. These would also be the start-up Preferences in an environment that does not use AmigaDOS.

    It is legal to take a partial copy of the Preferences structure. The more pertinent Preferences variables have been grouped near the top of the structure to facilitate the memory conservation that can be had by taking a copy of only some of the Preferences structure.

INPUTS
    PrefBuffer = pointer to the memory buffer to receive your copy of the Intuition Preferences.
    Size = the number of bytes in your PrefBuffer-the number of bytes you want copied from the system's internal Preference settings.

RESULT
    Returns your Preferences pointer.

BUGS
    None.

SEE ALSO
    GetPrefs()

GetDiskObject

NAME
    GetDiskObject -- read in a Workbench disk object

SYNOPSIS
```
diskobj = GetDiskObject( name )
D0                       A0
```

FUNCTION
    This routine reads in a Workbench disk object in from disk. The name parameter will have a ".info" postpended to it, and the info file of that name will be read. If the call fails, it will return zero. The reason for the failure may be obtained via IoErr().

    This routine is very similar to GetIcon, but it shields the programmer from the worst of the grunginess associated with GetIcon. A FreeList structure is allocated just after the DiskObject structure; FreeDiskObject makes use of this to get rid of the memory that was allocated.

INPUTS
    name -- name of the object

RESULTS
    diskobj -- the Workbench disk object in question

EXCEPTIONS

SEE ALSO
    GetIcon, FreeDiskObject

BUGS

```
GetGBuffers

NAME
   GetGBuffers  --  attempts to allocate ALL the buffers of an entire AnimOb

SYNOPSIS
   GetGBuffers(anOb, RPort, db)   as called by C
               a0    a1     d0

FUNCTION
   For each sequence of each component of the AnimOb, allocates memory for:
       SaveBuffer
       BorderLine
       CollMask and ImageShadow (point to same buffer)
       if db is set (user wants double-buffering) allocate:
           DBufPacket
           BufBuffer

INPUTS
   a1 = pointer to the AnimOb structure
   a2 = pointer to the current RastPort
   d0 = double-buffer indicator (set TRUE for double-buffering)

RESULT
   TRUE if the memory allocations were all successful, else FALSE

BUGS
   None known

SEE ALSO
   Nothing
```

```
GetIcon

NAME
        GetIcon -- read in a DiskObject structure from disk

SYNOPSIS
        status = GetIcon( name, icon, free )
        D0                A0    A1    A2

FUNCTION
        This routine reads in a DiskObject structure and its
        associated information.  All memory will be automatically
        allocated, and stored in the specified FreeList.  The file
        name of the info file will be the name parameter with a
        ".info" postpended to it.  If the call fails, a zero will
        be returned.  The reason for the failure may be obtained
        via IoErr().

        Users are encouraged to use GetDiskObject instead of this
        routine

INPUTS
        name -- name of the object
        icon -- a pointer to a DiskObject
        free -- a pointer to a FreeList

RESULTS
        status -- non-zero if the call succeeded.

EXCEPTIONS

SEE ALSO

BUGS
```

GetMsg

NAME

GetMsg -- get next message from a message port

SYNOPSIS

```
message = GetMsg(port)
D0               A0
```

FUNCTION

This function receives a message from a given message port. It provides a fast, non-copying message receiving mechanism.

The received message is removed from the message port.

This function will not wait. If a message is not present this function will return zero. If a program must wait for a message, it can Wait on the signal specified for the port or use the WaitPort function. There can only be one task waiting for any given port.

Getting the message does not imply that the message is now free to be reused. When the receiver is finished with the message, it may ReplyMsg it.

INPUT

port - a pointer to the receiver message port

RESULT

message - a pointer to the first message available. If there are no messages, return zero.

SEE ALSO

PutMsg, ReplyMsg, WaitPort

GetPrefs

NAME

GetPrefs -- get the current setting of the Intuition Preferences

SYNOPSIS

```
GetPrefs(PrefBuffer, Size)
         A0          D0
```

FUNCTION

This function gets a copy of the current Intuition Preferences data and writes the data into the buffer you specify. The number of bytes you want copied is specified by the Size argument.

It is legal to take a partial copy of the Preferences structure. The more pertinent Preferences variables have been grouped near the top of the structure to facilitate the memory conservation that can be had by taking a copy of only some of the Preferences structure.

INPUTS

PrefBuffer = pointer to the memory buffer to receive your copy of the Intuition Preferences.

Size = the number of bytes in your PrefBuffer-the number of bytes you want copied from the system's internal Preference settings.

RESULT

Returns a copy of your Preferences pointer.

BUGS

None

SEE ALSO

GetDefPrefs()

GetRGB4

NAME

    GetRGB4 -- inquire value of entry in ColorMap

SYNOPSIS

```
value = GetRGB4( colormap, entry )
D0                 A0        D0
```

INPUTS

    colormap = pointer to ColorMap structure
    entry = index into colormap

RESULT

    Returns -1 if no valid entry
    Return UWORD RGB value 4 bits per gun right justified

BUGS

SEE ALSO

    SetRGB4 LoadRGB4 GetColorMap FreeColorMap

GetSprite

NAME

    GetSprite -- attempt to get a sprite for the simple sprite
                 manager.

SYNOPSIS

```
Sprite_Number = GetSprite( sprite, pick )
    d0                       a0      d0
```

FUNCTION

Attempts to allocate one of the eight sprites for private use with the simple sprite manager. This must be done before using further calls to simple sprite machine.

INPUTS

    sprite = ptr to programmers SimpleSprite structure.
    pick   = 0-7
              -1 if programmer just wants the next one.

RESULTS

If pick is 0-7, attempts to allocate the sprite. If the sprite is already allocated, return -1. If pick is -1, allocate the next sprite. If no sprites are available, return -1.

If the sprite is available for allocation, marks it allocated and fill in the 'num' entry of the SimpleSprite structure. If successful, returns the sprite number.

BUGS

SEE ALSO

    sprite.h FreeSprite ChangeSprite MoveSprite GetSprite

GetWBObject

NAME

    GetWBObject -- read in a Workbench object

SYNOPSIS

```
object = GetWBObject( name )
D0                    A0
```

FUNCTION

This routine reads in a Workbench object from disk. The name parameter will have a ".info" postpended to it, and the info file of that name will be read. If the call fails, it will return zero. The reason for the failure may be obtained via IoErr().

This routine is intended only for internal users that can track changes to the Workbench.

INPUTS

    name -- name of the object

RESULTS

    object -- the Workbench object in question

EXCEPTIONS

SEE ALSO

BUGS

IEEEDPAbs

NAME

    IEEEDPAbs -- obtain the absolute value of the IEEE double
                 precision floating-point number

C USAGE

```
fnum1 = IEEEDPAbs(fnum2));
D0/D1             D0/D1
```

FUNCTION

Accepts an IEEE D.P. floating-point number and returns the absolute value of said number.

INPUTS

    fnum2 - IEEE double-precision floating-point number

RESULT

    fnum1 - IEEE double-precision floating-point number

BUGS

    None

SEE ALSO

IEEEDPAdd

NAME

    IEEEDPAdd -- add two IEEE double-precision floating-point numbers

C USAGE

```
fnum1 = IEEEDPAdd(fnum2, fnum3);
D0/D1             D0/D1  D2/D3
```

FUNCTION

Accepts two IEEE D.P. floating-point numbers and returns the arithmetic sum of said numbers.

INPUTS

fnum2 - IEEE double-precision floating-point number
fnum3 - IEEE double-precision floating-point number

RESULT

fnum1 - IEEE double-precision floating-point number

BUGS

None

SEE ALSO

IEEEDPCmp

NAME

    IEEEDPCmp -- compare two IEEE D.P. floating-point numbers and return a relative value indicator

C USAGE

```
if (IEEEDPCmp(fnum1, fnum2)) {...}
              D0/D1  D2/D3
```

FUNCTION

Accepts two IEEE double-precision floating-point numbers and returns the CCR and the integer functional result as an indicator of the result of said comparison.

INPUTS

fnum1 - IEEE double-precision floating-point number
fnum2 - IEEE double-precision floating-point number

RESULT

Condition codes set to reflect the following branches:

```
LT   - fnum1 < fnum2    (Functional Result = -1)
GT   - fnum1 > fnum2    (Functional Result = +1)
ELSE - fnum1 = fnum2    (Functional Result =  0)
```

BUGS

None

SEE ALSO

IEEEDPDiv

NAME

    IEEEDPDiv -- divide two IEEE double-precision floating-point numbers

C USAGE

```
fnum1  = IEEEDPMul(fnum2, fnum3);
D0/D1              D0/D1  D2/D3
```

FUNCTION

    Accepts two IEEE double-precision floating-point numbers and returns the arithmetic division of said numbers.

INPUTS

    fnum2 - IEEE double-precision floating-point number
    fnum3 - IEEE double-precision floating-point number

RESULT

    fnum1 - IEEE double-precision floating-point number

BUGS

    None

SEE ALSO

IEEEDPFlt

NAME

    IEEEDPFlt -- convert integer number to IEEE D.P. floating-point

C USAGE

```
fnum = IEEEDPFlt(inum);
D0/D1            D0
```

FUNCTION

    Accepts an integer and returns the converted IEEE double precision floating-point result of said number.

INPUTS

    inum - signed integer number

RESULT

    fnum - IEEE double-precision floating-point number

BUGS

    None

SEE ALSO

IEEEDPMul

NAME

IEEEDPMul -- multiply two IEEE double-precision floating-point numbers

C USAGE

```
fnum1 = IEEEDPMul(fnum2, fnum3);
D0/D1             D0/D1  D2/D3
```

FUNCTION

Accepts two IEEE D.P. floating-point numbers and returns the arithmetic multiplication of said numbers.

INPUTS

fnum2 - IEEE double-precision floating-point number
fnum3 - IEEE double-precision floating-point number

RESULT

fnum1 - IEEE double-precision floating-point number

BUGS

None

SEE ALSO

IEEEDPNeg

NAME

IEEEDPNeg -- negate the supplied IEEE double-precision floating-point number

C USAGE

```
fnum1 = IEEEDPNeg(fnum2);
D0/D1             D0/D1
```

FUNCTION

Accepts an IEEE D.P. floating-point number and returns the value of said number after having been subtracted from 0.0

INPUTS

fnum2 - IEEE double-precision floating-point number

RESULT

fnum1 - IEEE double-precision floating-point number

BUGS

None

SEE ALSO

IEEEDPSub

NAME

```
    IEEEDPSub -- subtract two IEEE double-precision floating-point
                 numbers
```

C USAGE

```
    fnum1 = IEEEDPSub(fnum2, fnum3);
    D0/D1             D0/D1  D2/D3
```

FUNCTION

Accepts two IEEE D.P. floating-point numbers and returns the arithmetic subtraction of said numbers.

INPUTS

```
    fnum2 - IEEE double-precision floating-point number
    fnum3 - IEEE double-precision floating-point number
```

RESULT

```
    fnum1 - IEEE double-precision floating-point number
```

BUGS

None

SEE ALSO

IEEEDPTst

NAME

```
    IEEEDPTst -- compare an IEEE D.P. floating-point number against
                 the value 0.0 and return a relative value indicator
```

C USAGE

```
    if (IEEEDPTst(fnum)) {...}
                  D0/D1
```

FUNCTION

Accepts an IEEE double-precision floating-point number and returns the CCR and the integer functional result as an indicator of the result of comparison against the value 0.0.

NOTE: Using number directly within parenthesis to generate in-line code is much more efficient.

INPUTS

```
    fnum - IEEE double-precision floating-point number
```

RESULT

Condition codes set to reflect the following branches:

```
        LT   - fnum <  0.0  (Functional Result = -1)
        GT   - fnum >  0.0  (Functional Result = +1)
        ELSE - fnum =  0.0  (Functional Result =  0)
```

BUGS

None

SEE ALSO

IncrCLMark

NAME
    IncrCLMark -- increment a clist mark to the next position

SYNOPSIS
```
    error = IncrCLMark(cList)
    D0                 A0
```

FUNCTION
    Increment a mark for clist operations to mark the next byte in the clist.

INPUTS
```
    cList  -
            a longword descriptor for a clist that can be used
            for clist functions.
```

RESULTS
```
    error  -
            non-zero if the next offset is not in the clist
```

EXCEPTIONS
    if error is non-zero, the request asked to move the mark beyond the end of the clist, and the mark is invalid.

Info

NAME
    Info -- Returns information about the disk.

SYNOPSIS
```
    success = Info( lock, InfoData )
      D0            D1     D2
```

FUNCTION
    Info finds out information about any disk in use. 'lock' refers to the disk, or any file on the disk. Info returns the InfoData structure with information about the size of the disk, number of free blocks and any soft errors. Note that InfoData must be longword aligned.

INPUTS
    lock - BCPL pointer to a lock
    InfoData - address of an InfoData structure

RESULTS
    success - boolean

SPECIAL NOTE:
    Note that InfoData must be longword aligned.

InitArea

NAME

InitArea -- Initialize vector collection matrix

SYNOPSIS

```
InitArea( AreaInfo *, buffer *, max vectors )
                a0          a1          d0
```

FUNCTION

This function provides initialization for the vector collection matrix such that it has a size of (max vectors). The size of the region pointed to by buffer (short pointer) should be five times as large as (max vectors). This size is in bytes. Areafills done by using AreaMove, AreaDraw, and AreaEnd must have enough space allocated in this table to store all the points of the largest fill. If not enough space, the routines will return -1

INPUTS

```
AreaInfo    = pointer to AreaInfo structure
buffer      = pointer to chunk of memory to collect vertices
max vectors = max number of vectors this buffer can hold
```

RESULT

Pointers are set up to begin storage of vectors done by AreaMove and AreaDraw.

NOTE

The underlying graphics routines actually split the table into two parts to save coordinates and flags

BUGS

None known.

SEE ALSO

graph.h AreaEnd AreaMove AreaDraw

InitBitMap

NAME

InitBitMap -- initialize bit map structure with input values

SYNOPSIS

```
InitBitMap( bm, depth, width, height )
            a0   d0     d1      d2
```

FUNCTION

Initializes various elements in the BitMap structure to correctly reflect input depth, width, and height.
Must be used before use of BitMap in other graphics calls.
The Planes[8] are not initialized and need to be set up by the caller. The Planes table was put at the end of the structure so that it may be truncated if needed, as well as extended.

INPUTS

```
bm     = pointer to a BitMap structure (gfx.h)
depth  = number of bitplanes that this bitmap will have
width  = number of bits (columns) wide for this BitMap
height = number of bits (rows) tall for this BitMap
```

BUGS

None known.

SEE ALSO

gfx.h

```
InitCLPool

   NAME
        InitCLPool -- initialize a clist pool

   SYNOPSIS
        error = InitCLPool(cLPool, size)
        D0                 A0      D0

   FUNCTION
        Initialize a block of memory for use as a pool for clist
        nodes.  This involves setting up a header structure and
        building a free list of all the nodes.

   INPUTS
        cLPool  -
                The data area that is to be used as the character list
                pool for the clist operations.
        size    -
                The size of the pool, in bytes.  CList pools are
                limited to 16M bytes.

   RESULTS
        error   -
                If the clist pool provided is so small that not even
                pool management memory will fit, this is set to
                non-zero.
```

```
InitGels

NAME
   InitGels  --  initialize a GEL list; must be called before using GELs

SYNOPSIS
   InitGels(head, tail, GInfo)
            a0    a1    a2

FUNCTION
   Assigns the VSprites as the head and tail of the GEL list in GfxBase
   Links these two GELs together as the keystones of the list
   If the collHandler vector points to some memory array, sets the
   BORDERHIT vector to NULL

INPUTS
   head = pointer to the VSprite structure to be used as the GEL list head
   tail = pointer to the VSprite structure to be used as the GEL list tail
   GInfo = pointer to the GelsInfo structure to be initialized

RESULT
   Nothing

BUGS
   None known

SEE ALSO
   Nothing
```

```
InitGMasks

NAME
   InitGMasks  --  initialize all the masks of an AnimOb

SYNOPSIS
   InitGMasks(anOb)        as called by C
              a0

FUNCTION
   For every sequence of every component, calls InitMasks

INPUTS
   al = pointer to the AnimOb

RESULT
   Nothing

BUGS
   None known

SEE ALSO
   Nothing
```

```
InitLayers

NAME
        InitLayers -- Initialize Layer_Info structure

SYNOPSIS
        InitLayers(li)
                   a0

INPUTS
        li  = pointer to LayerInfo structure

FUNCTION
        Initializes Layer_Info structure in preparation for
        using other layer operations on this list of layers.
        Makes the layers unlocked (open).

SEE ALSO
        layers.h
```

```
InitMasks

NAME
   InitMasks  --  initialize the BorderLine and CollMask masks of a VSprite

SYNOPSIS
   InitMasks(VS)        as called by C
             a0

FUNCTION
   Creates the appropriate BorderLine and CollMask masks of the VSprite
   Correctly detects if the VSprite is actually a Bob definition, handles
   the image data accordingly.

INPUTS
   VS = pointer to the VSprite structure

RESULT
   Nothing

BUGS

SEE ALSO
   Nothing
```

```
InitRastPort

NAME
        InitRastPort -- Initialize raster port structure

SYNOPSIS

        InitRastPort( rp )
                      a1

FUNCTION
        Initializes  a RastPort structure to standard values.

        The struct Rastport describes a control structure for a
        write-able raster.  The RastPort structure describes  how a
        complete single playfield display will be written into.
        A RastPort structure is referenced  whenever any drawing or
        filling operations are to be performed on a section of memory.

        The section of memory that is being used in this way  may or
        may not be presently a part of the current actual on-screen
        display memory.  The name of the actual memory section that
        is linked to the RastPort is referred to here as a "raster" or
        as a bitmap.

        NOTE:   Calling the routine InitRastPort only establishes
        various defaults. It does NOT establish  where, in  memory,
        the rasters are located. To do graphics with this RastPort,
        the user must set up the BitMap pointer in the RastPort.

INPUTS

       rp  = pointer to a RastPort structure.

RESULT
       All entries in RastPort get zeroed out.  Exceptions:
            The following get -1:
                Mask,FgPen,AOLPen,LinePtrn
            DrawMode = JAM2
            The font is set to the standard system font.

BUGS
   None known.

SEE ALSO
   rastport.h
```

```
InitRequester


NAME
    InitRequester  --  initialize a Requester structure

SYNOPSIS
    InitRequester(Requester)
                  A0

FUNCTION
    The original text for this function was:

         This function initializes a requester for general
         use.  After calling InitRequester(), you need fill
         in only those requester values that fit your
         needs.  The other values are set to states that
         Intuition regards as NULL.

    All this routine actually does is fill the specified Requester
    structure with zeros.  There is no requirement to call
    this routine before using a Requester structure.  For the
    sake of backward compatibility, this function call remains,
    but its sole effect is, and is guaranteed to always be, a
    zero, a mystery, an enigma.

INPUTS
    Requester = a pointer to a Requester structure

RESULT
    None

BUGS
    None

SEE ALSO
    None
```



```
InitStruct

NAME
        InitStruct -- initialize memory from a table

SYNOPSIS
        InitStruct(initTable, memory, size);
                   A1         A2      D0-0:16

FUNCTION
        Clear a memory area except those words whose data and offset
        values are provided in the initialization table.  This
        initialization table has byte commands to

             |a    ||byte|       |given||byte|          |once        |
        load |count||word|  into |next ||rptr|  offset, |repetitively|.
                    |long|

        Not all combinations are supported.  The offset, when
        specified, is relative to the memory pointer provided
        (Memory), and is initially zero.  The initialization data
        (InitTable) contains byte commands whose 8 bits are
        interpreted as follows:

        ddssnnnn
            dd  the destination type (and size):
                00  next destination, nnnn is count
                01  next destination, nnnn is repeat
                10  destination offset is next byte, nnnn is count
                11  destination offset is next rptr, nnnn is count
            ss  the size and location of the source:
                00  long, from the next two aligned words
                01  word, from the next aligned word
                10  byte, from the next byte
                11  ERROR - will cause an ALERT (see below)
          nnnn  the count or repeat:
             count  the (number+1) of source items to copy
            repeat  the source is copied (number+1) times.

        initTable commands are always read from the next even byte.
        Given destination offsets are always relative to memory (A2).

        The command 00000000 ends the InitTable stream: use 00010001
        if you really want to copy one longword.

       24 bit APTR not supported for 68020 compatibility -- use long.

INPUTS
        initTable - the beginning of the commands and data to init
                Memory with.  Must be on an even boundary unless only
                byte initialization is done.
        memory - the beginning of the memory to initialize.  Must be
                on an even boundary if size is specified.
        size - the size of memory, which is used to clear it before
                initializing it via the initTable.  If Size is zero,
                memory is not cleared before initializing.  Size is
                rounded down to the nearest even number before use.

---------------------------------------------------------------------
```

```
IMPLEMENTATION
        D0  clear size, command, count and repeat
        D1  destination offset, command type
        A0  current Memory pointer
        A1  current InitTable pointer

        D0,D1,A0,A1 destroyed
```

```
InitTmpRas

NAME
        InitTmpRas --   Initialize area of local memory for usage by
                        areafill, floodfill, text

SYNOPSIS
    InitTmpRas(tmpras *,buffer *, size)
                a0        a1       d0

FUNCTION
        The area of memory pointed to by buffer is set up to be used
        by RastPort routines that may need to get some memory for
        intermediate operations in preparation to putting the graphics
        into the final BitMap.  tmpras is used to control the usage of
        buffer.

INPUTS
        tmpras = pointer to a TmpRas structure to be linked into
                 a RastPort
        buffer = pointer to a contiguous piece of chip memory.
        size   = size in bytes of buffer

RESULT
        Makes buffer available for users of RastPort

BUGS
        None known.  It Would be nice if RastPorts could share one TmpRas.
```

InitView

NAME

InitView -- initialize View structure

SYNOPSIS

```
InitView( view )
          a1
```

FUNCTION

Initializes View structure to default values.

INPUTS

view = pointer to a View structure

RESULT

First, View structure set to all 0s.
Then values are put in DxOffset,DyOffset to properly position
default display about .5 inches from top and left on monitor.
InitView pays no attention to previous contents of view.

BUGS

None known.

SEE ALSO

view.h

InitVPort

NAME

InitVPort -- Initialize ViewPort structure

SYNOPSIS

```
InitVPort( vp )
           a0
```

FUNCTION

Initializes ViewPort structure to default values.

INPUTS

vp = pointer to a ViewPort structure

RESULT

ViewPort structure set to all 0's.

BUGS

None known.

SEE ALSO

view.h

Input

NAME
    Input -- Identifies the program's initial input file handle.

SYNOPSIS
```
file = Input()
 D0
```

RESULTS
    file - BCPL pointer to a file handle

FUNCTION
    To identify the program's initial input file handle, you use Input.
    (To identify the initial output, see Output.)

Insert

NAME
    Insert -- insert a node into a list

SYNOPSIS
```
Insert(list, node, listNode)
       A0    A1    A2
```

FUNCTION
    Insert a node into a doubly linked list AFTER a given
    node position. Insertion at the head of a list is performed
    by passing a zero value for listNode.

INPUTS
    list - a pointer to the target list header
    node - the node to insert
    listNode - the node after which to insert

IntuiTextLength

NAME
    IntuiTextLength -- return the length (pixel width) of an IntuiText

SYNOPSIS
```
IntuiTextLength(IText)
                A0
```

FUNCTION
    This routine accepts a pointer to an instance of an IntuiText structure and returns the length (the pixel width) of the string that is represented by that instance of the structure.

    All of the usual IntuiText rules apply. Most notably, if the Font pointer of the structure is set to NULL, you will get the pixel width of your text in terms of the current default font.

INPUTS
    IText = pointer to an instance of an IntuiText structure

RESULT
    Returns the pixel width of the text specified by the IntuiText data.

BUGS
    None

SEE ALSO
    None

IoErr

NAME
    IoErr -- return extra information from the system

SYNOPSIS
```
error = IoErr()
 D0
```

RESULTS
    error - integer

FUNCTION
    I/O routines return zero to indicate an error. When an error occurs, call this routine to find out more information. Some routines use IoErr(), for example, DeviceProc, to pass back a secondary result.

IsInteractive

NAME
    IsInteractive -- discover whether a file is connected to a
                    virtual terminal

SYNOPSIS
```
bool = IsInteractive ( file )
 D0                     D1
```

FUNCTION
    The function IsInteractive gives a Boolean return. This indicates whether or not the file associated with the file handle 'file' is connected to a virtual terminal.

INPUTS
    file - BCPL pointer to a file handle

RESULTS
    bool - boolean

ItemAddress

NAME
    ItemAddress -- return the address of the specified MenuItem

SYNOPSIS
```
ItemAddress(MenuStrip, MenuNumber)
            A0         D0
```

FUNCTION
    This routine feels through the specified MenuStrip and returns the address of the item specified by the MenuNumber. Typically, you will use this routine to get the address of a MenuItem from a MenuNumber sent to you by Intuition after the user has played with your menus.

    This routine requires that the arguments be well defined. MenuNumber may be equal to MENUNULL, in which case this routine returns NULL. If MenuNumber does not equal MENUNULL, it is presumed to be a valid item number selector for your MenuStrip, which includes a valid menu number and a valid item number. If the item specified by the above two components has a subitem, the MenuNumber may have a subitem component too.

    Note that there must be both a menu number and an item number. Because a subitem specifier is optional, the address returned by this routine may point to either an item or a subitem.

INPUTS
    MenuStrip = a pointer to the first menu in your menu strip.
    MenuNumber = the value that contains the packed data that
        selects the menu and item (and subitem).

RESULT
    If MenuNumber == MENUNULL, this routine returns NULL. Otherwise, this routine returns the address of the MenuItem specified by MenuNumber.

BUGS
    None

SEE ALSO
    The "Menus" chapter in Amiga Intuition Reference Manual

LoadRGB4

NAME
    LoadRGB4 -- load RGB color values from table

SYNOPSIS
```
LoadRGB4( vp, colormap, count )
          a0  al        d0
```

FUNCTION

    Loads the count words of the colormapper from table

INPUTS
```
vp       = pointer to ViewPort whose colors you want to change
colormap = pointer to table of RGB values set up like an array
           of USHORTS
            background--  0x0RGB
            colorl    --  0x0RGB
            color2    --  0x0RGB
            etc.        UWORD per value.
           The colors are interpreted as 15 = maximum intensity.
                                          0 = minimum intensity.
count    =  number of UWORDs in the table to load into the
           colormap starting at color 0 (background) and proceeding
           to the next higher color number
```

RESULTS
    Store the colors in the ViewPorts colormap. This is a
    table gotten from GetColorMap(number of entries).
    This colormap will be initialized from the Default colormap.

BUGS
    None known

SEE ALSO
    view.h

LoadSeg

NAME
    LoadSeg -- load a load module into memory

SYNOPSIS
```
segment = LoadSeg( name )
  D0               Dl
```

FUNCTION
    The file 'name' is a load module produced by the linker. LoadSeg takes this and scatter loads the code segments into memory, chaining the segments together on their first words. It recognizes a zero as indicating the end of the chain.

    If an error occurs, Loadseg unloads any loaded blocks and returns a false (zero) result.

    If all goes well (that is, LoadSeg has loaded the module correctly), Loadseg returns a pointer to the beginning of the list of blocks. Once you have finished with the loaded code, you can unload it with a call to UnLoadSeg. (For using the loaded code, see CreateProc.)

INPUTS
    name - address of first character of a null-terminated string

RESULTS
    segment - BCPL pointer to a segment

LoadView

NAME
    LoadView -- Use a (possibly freshly created) coprocessor instruction list to create the current display.

SYNOPSIS
```
LoadView( View )
          A1
```

FUNCTION
    See NAME field. Coprocessor instruction list has been created by InitVPort, MakeView, and MrgCop.

INPUTS
    View = a pointer to the View structure, which contains the pointer to the constructed coprocessor instructions list

RESULT
    The new View is displayed, according to your instructions. The vertical blank routine will pick this pointer up and direct Copper to start displaying this View.

BUGS

SEE ALSO
    InitVPort, MakeView, MrgCop
    Intuition's RethinkDisplay()

Lock

NAME
    Lock -- lock a directory or file

SYNOPSIS
```
lock = Lock( name, accessMode )
 D0          D1    D2
```

FUNCTION
    Lock returns, if possible, a filing system lock on the file or directory 'name.' If the accessMode is ACCESS_READ, the lock is a shared read lock; if the accessMode is ACCESS_WRITE, it is an exclusive write lock. If LOCK fails (that is, if it cannot obtain a filing system lock on the file or directory) it returns a zero.

    Note that the overhead for doing a Lock is less than that for doing an Open. If you want to test to see if a file exists, you should use Lock. Of course, once you've found that it exists, you have to use Open to open it.

INPUTS
    name - address of first character of a null-terminated string
    accessMode - integer

RESULTS
    lock - BCPL pointer to a lock

```
LockLayer

NAME
       LockLayer -- lock layer to make changes to ClipRects


SYNOPSIS
       LockLayer( li, l )
                  a0  a1

INPUTS
       li  = pointer to LayerInfo structure
       l   = pointer to a layer

FUNCTION
       Makes this layer unavailable for other tasks to use.
       If another task is already using this layer, waits for
       it to complete and then takes the layer.

SEE ALSO
      layers.h
```

```
LockLayerInfo

NAME
       LockLayerInfo -- lock the LayerInfo structure.


SYNOPSIS
       LockLayerInfo( li )
                      a0

INPUTS
       li  = pointer to LayerInfo structure

FUNCTION
        After the operation that required a LockLayerInfo is complete,
        unlocks the LayerInfo structure so that other tasks may
        affect the layers.

SEE ALSO
       layers.h  LockLayerInfo()
```

LockLayerRom

NAME

    LockLayerRom -- lock layer structure by rom(gfx lib) code

SYNOPSIS

```
LockLayerRom( layer )
              a5
```

FUNCTION

Returns when the layer is locked and no other caller may alter the ClipRect structure in the Layer structure.

INPUTS

    layer   = pointer to Layer structure

NOTE

This call does not destroy any registers.
This call nests so that callers in this chain will not lock themselves out.

Caveat: This lock does not prevent another task from calling LockLayerRom() and not blocking.
This is potentially dangerous in the case of ScrollRaster which will resort the list of ClipRects although it does not add any new ClipRects or remove any ClipRects.

SEE ALSO

    layers.h

LockLayers

NAME

    LockLayers -- lock all layers from graphics output

SYNOPSIS

```
LockLayers( li )
            a0
```

INPUTS

    li = pointer to LayerInfo structure

FUNCTION

First, calls LockLayerInfo.
Makes all layers in this layer list locked.

SEE ALSO

    layers.h LockLayer() LockLayerInfo()

MakeLibrary

NAME

    MakeLibrary -- construct a library

SYNOPSIS

```
library = MakeLibrary(vectors, structure, init, dataSize, segList)
D0                    A0       A1         A2    D0        D1
```

FUNCTION

This function is used for constructing a library vector and data area. Space for the library is allocated from the system's free memory pool. The size fields of the library are filled. The data portion of the library is initialized. A library specific entrypoint is called (init) if present.

INPUTS

vectors - pointer to an array of function pointers or function displacements. If the first word of the array is -1, then the array contains relative word displacements (based off of vectors); otherwise, the array contains absolute function pointers.

structure - points to an "InitStruct" data region. If null, then it will not be called.

init - an entry point that will be called before adding the library to the system. If null, it will not be called. When it is called, it will be called with the libAddr in D0, and its result will be the result of this function.

dSize - the size of the library data area, including the standard library node data.

segList - pointer to a memory segment list (used by DOS) This is passed to a library's init code.

RESULT

library - the reference address of the library. This is the address used in references to the library, not the beginning of the memory area allocated.

EXCEPTION

If the library vector table require more system memory than is available, this function will cause a system panic.

SEE ALSO

InitStruct

MakeScreen

NAME

MakeScreen -- do an Intuition-integrated MakeVPort() of a custom screen

SYNOPSIS

```
MakeScreen(Screen)
           A0
```

FUNCTION

This procedure allows you to do a MakeVPort() for the ViewPort of your custom screen in an Intuition-integrated way. This allows you to do your own screen manipulations without worrying about interference with Intuition's usage of the same ViewPort.

After calling this routine, you can call RethinkDisplay() to incorporate the new ViewPort of your custom screen into the Intuition display.

INPUTS

Screen = address of the Screen structure.

RESULT

None

BUGS

None

SEE ALSO

RethinkDisplay(), RemakeDisplay(), MakeVPort()

```
MakeVPort


NAME
        MakeVPort -- generate display Copper list

SYNOPSIS
        MakeVPort( view, viewport )
                a0      a1

FUNCTION
        Using information in the View and ViewPort
        constructs intermediate Copper list for this ViewPort.

INPUTS
        view    = pointer to View structure
        viewport= pointer to ViewPort structure
                  The viewport must have valid ptr to RasInfo

RESULTS
        Constructs intermediate Copper list and puts pointers in
        viewport.DspIns
        If the ColorMap ptr in ViewPort is nil, it uses colors
        from the default color table.
        If DUALPF in Modes, there must be a second RasInfo pointed
        to by the first RasInfo

BUGS

SEE ALSO
        MrgCop() view.h
        Intuition's MakeScreen(), RemakeDisplay(), and RethinkDisplay()
```

```
MarkCList

   NAME
        MarkCList -- mark a position in a clist

   SYNOPSIS
        error = MarkCList(cList, offset)
        D0                A0     D0

   FUNCTION
        Mark the clist for index operations by specifying a byte
        offset into the clist.  Note that only one mark is retained
        by each clist.  If the byte to which the mark refers is
        subsequently manipulated, the mark will become invalid.

   INPUTS
        cList  -
                a longword descriptor for a clist that can be used
                for clist functions.
        offset -
                a byte offset into the clist.  The first byte in the
                clist is at offset zero.  This value should not be
                greater than (SizeCList-1).

   RESULTS
        error  -
                non-zero if the offset is not in the clist

   EXCEPTIONS
        if the offset is more than the length of the clist, the mark
        is invalid.
```

MatchToolValue

NAME
    MatchToolValue -- check a tool type variable for a particular value

SYNOPSIS
```
result = MatchToolValue( typeString, value  )
D0                       A0          A1
```

FUNCTION
    MatchToolValue is useful for parsing a tool type value for a known value. It knows how to parse the syntax for a tool type value (in particular, it knows that '|' separates alternate values).

INPUTS
    typeString - a ToolType value (as returned by FindToolType)
    value - you are interested if value appears in typeString

RESULTS
    result - a one if the value was in typeString

EXCEPTIONS

EXAMPLE
    Assume there are two type strings:
```
    type1 = "text"
    type2 = "a|b|c"

MatchToolValue( type1, "text" ) returns 1
MatchToolValue( type1, "data" ) returns 0
MatchToolValue( type2, "a" ) returns 1
MatchToolValue( type2, "b" ) returns 1
MatchToolValue( type2, "d" ) returns 0
MatchToolValue( type2, "a|b" ) returns 0
```

SEE ALSO
    FindToolType

BUGS

ModifyIDCMP

NAME
    ModifyIDCMP -- modify the state of the window's IDCMP

SYNOPSIS
```
ModifyIDCMP(Window, IDCMPFlags)
            A0      D0
```

FUNCTION
    This routine modifies the state of your window's IDCMP (Intuition Direct Communication Message Port). The state is modified to reflect your desires as described by the flag bits in the value IDCMPFlags. If the IDCMPFlags argument equals NULL, you are asking for the ports to be closed; if they are open, they will be closed. If you set any of the IDCMPFlags, this means that you want the message ports to be open; if not currently open, the ports will be opened.

    The four actions that might be taken are described below:
- o If there is currently no IDCMP in the given window and IDCMPFlags is NULL, nothing happens.
- o If there is currently no IDCMP in the given window and any of the IDCMPFlags are selected (set), the IDCMP of the window is created, including allocating and initializing the message ports and allocating a signal bit for your port. See "Input and Output Methods" in the Amiga Intuition Reference Manual for full details.
- o If the IDCMP for the given window is opened and the IDCMPFlags argument is NULL, Intuition will close the ports, free the buffers, and free your signal bit. The current task must be the same one that was active when this signal bit was allocated.
- o If the IDCMP for the given window is opened and the IDCMPFlags argument is not NULL, this means that you want to change which events will be broadcast to your program through the IDCMP.

    NOTE: You can set up the Window->UserPort to any port of your own before you call ModifyIDCMP(). If IDCMPFlags is non-null but your UserPort is already initialized, Intuition will assume that it is a valid port with task and signal data preset and will not disturb your set-up; Intuition will just allocate the Intuition message port for your window. The converse is true as well; if UserPort is NULL when you call here with IDCMPFlags == NULL, only the Intuition port will be deallocated. This allows you to use a port that you already have allocated:

- o OpenWindow() with IDCMPFlags equal to NULL (open no ports).
- o Set the UserPort variable of your window to any valid port of your own choosing.
- o Call ModifyIDCMP() with IDCMPFlags set to what you want.
- o Then, to clean up later, set UserPort equal to NULL before calling CloseWindow() (leave IDCMPFlags alone).

    A grim, foreboding note: If you are ever rude enough to close an IDCMP without first having Reply()'d to all of the messages sent to the IDCMP port, Intuition will in turn be so rude as to reclaim and deallocate its messages without waiting for your permission.

INPUTS
    Window = pointer to the Window structure containing the IDCMP ports
    IDCMPFlags = the flag bits describing the new desired state of the IDCMP

RESULT
    None

BUGS
    None

SEE ALSO
    OpenWindow()

ModifyProp

NAME
    ModifyProp -- modify the current parameters of a proportional gadget

SYNOPSIS
```
ModifyProp(PropGadget, Pointer, Requester,
           A0          A1       A2
        Flags, HorizPot, VertPot, HorizBody, VertBody)
        D0     D1        D2       D3         D4
```

FUNCTION
    This routine modifies the parameters of the specified proportional gadget. The gadget's internal state is then recalculated and the imagery is redisplayed.

    The Pointer argument can point to either a Window or a Screen structure. Which one it actually points to is decided by examining the SCRGADGET flag of the gadget. If the flag is set, Pointer points to a Screen structure; otherwise, it points to a Window structure.

    The Requester variable can point to a Requester structure. If the gadget has the REQGADGET flag set, the gadget is in a requester and the Pointer must necessarily point to a window. If this is not the gadget of a requester, the Requester argument may be NULL.

INPUTS
    PropGadget = pointer to the structure of a proportional gadget.
    Pointer = pointer to the structure of the "owning" display element of the gadget, which is a window or a screen.
    Requester = pointer to a Requester structure (this may be NULL if this is not a requester gadget).
    Flags = value to be stored in the Flags variable of the PropInfo.
    HorizPot = value to be stored in the HorizPot variable of the PropInfo.
    VertPot = value to be stored in the VertPot variable of the PropInfo.
    HorizBody = value to be stored in the HorizBody variable of the PropInfo.
    VertBody = value to be stored in the VertBody variable of the PropInfo.

RESULT
    None

BUGS
    None

SEE ALSO
    None

Move

*

NAME

    Move -- move graphics pen position

SYNOPSIS

```
Move( rp, x, y)
      a1 d0 d1
```

FUNCTION

    Moves graphics pen position to (x,y) relative to upper left (0,0)
    of RastPort.

    Note: Text uses the same position.

INPUTS

```
rp  =   pointer to a RastPort structure
x,y=    point in the RastPort
```

MoveLayer

NAME

    MoveLayer -- move nonbackdrop layer to new position in BitMap

SYNOPSIS

```
MoveLayer( li, l, dx, dy )
           a0  a1 d0  d1
```

INPUTS

```
li  = pointer to LayerInfo structure
l   = pointer to a nonbackdrop layer
dx  = delta to add to current x position
dy  = delta to add to current y position
```

FUNCTION

    Moves this layer to new position in shared BitMap.
    If any refresh layers become revealed, collects damage and
    sets REFRESH bit in layer Flags.

SEE ALSO

    layers.h

MoveLayerInFrontOf

```
NAME
       MoveLayerInFrontOf -- put layer in front of another layer

SYNOPSIS
       BOOLEAN MoveLayerInFrontOf( layertomove, target )
                                              a0  a1

INPUTS
       layertomove : layer to moved
       target      : move layertomove infront of target

FUNCTION
       Moves this layer in front of target, swapping bits
       in and out of the display with other layers.
       If this is a refresh layer, collects damage list and
       sets bit in Flags if redraw required.
       By clearing the BACKDROP bit in the layers Flags, you may
       bring a Backdrop layer up to the front of all other layers.

RETURNS
       TRUE    if operation successful
       FALSE   if operation unsuccessful (probably out of memory)

SEE ALSO
       layers.h
```

MoveScreen

```
NAME
     MoveScreen  --  attempt to move the screen by the delta amounts

SYNOPSIS
     MoveScreen(Screen, DeltaX, DeltaY)
                A0      D0      D1

FUNCTION
     Attempts to move the specified screen.  This movement must
     follow one constraint (only for the current release of the
     software):  horizontal movements are ignored.

     If the DeltaX and DeltaY variables you specify would move
     the screen in a way that violates the above restriction, the
     screen will be moved as far as possible.

INPUTS
     Screen = pointer to a Screen structure.
     DeltaX = amount to move the screen on the x axis.
     DeltaY = amount to move the screen on the y axis.

RESULT
     None

BUGS
     None

SEE ALSO
     None
```

MoveSprite

NAME
    MoveSprite -- move sprite to a point relative to top of viewport

SYNOPSIS
```
MoveSprite( vp, sprite, x, y )
            a0   a1    d0 d1
```

FUNCTION
    Moves sprite image to new place on display.

INPUTS
```
vp      = pointer to ViewPort structure
        = 0, if sprite positioned relative to View
sprite  = pointer to SimpleSprite structure
x,y     = new position relative to top of viewport
```

RESULTS

BUGS

SEE ALSO
    sprite.h FreeSprite ChangeSprite GetSprite

MoveWindow

NAME
    MoveWindow -- ask Intuition to move a window

SYNOPSIS
```
MoveWindow(Window, DeltaX, DeltaY)
           A0      D0      D1
```

FUNCTION
    This routine sends a request to Intuition asking to move the window the specified distance. The delta arguments describe how far to move the window along the respective axes. Note that the window will not be moved immediately; it will be moved the next time Intuition receives an input event, which happens currently at a minimum rate of ten times per second and a maximum of sixty times a second.

    This routine does no error-checking. If your delta values specify some far corner of the universe, Intuition will attempt to move your window to the far corners of the universe. Because of the distortions in the space-time continuum that can result from this, as predicted by special relativity, the result is generally not a pretty sight.

INPUTS
```
Window = pointer to the structure of the window to be moved.
DeltaX = signed value describing how far to move the window
     on the x axis.
DeltaY = signed value describing how far to move the window
     on the y axis.
```

RESULT
    None

BUGS
    None

SEE ALSO
    SizeWindow(), WindowToFront(), WindowToBack()

MrgCop

NAME
    MrgCop -- Merge together coprocessor instructions.

SYNOPSIS
    MrgCop(View)
            A1

FUNCTION
    Merge together the display, color, sprite and user coprocessor instructions into a single coprocessor instruction stream. This essentially creates a per-display-frame program for the coprocessor. This function MrgCop is used, for example, by the graphics animation routines which effectively add information into an essentially static background display. This changes some of the user or sprite instructions, but not those which have formed the basic display in the first place. When all forms of coprocessor instructions are merged together, you will have a complete per-frame instruction list for the coprocessor.

    Restrictions: Each of the coprocessor instruction lists MUST be internally sorted in min to max Y-X order. The merge routines depend on this! Each list must be terminated using CEND(Copper list)

INPUTS
    View - a pointer to the view structure whose coprocessor instructions are to be merged.

RESULT

    The View structure will now contain a complete, sorted/merged list of instructions for the coprocessor, ready to be used by the display processor. The display processor is told to use this new instruction stream through the instruction LoadView().

BUGS

SEE ALSO
    InitVPort, MrgCop, LoadView
    Intuition's RethinkDisplay()

NewLayerInfo

NAME
    NewLayerInfo -- allocate and Initialize full Layer_Info structure

SYNOPSIS
    NewLayerInfo()

INPUTS
    None

FUNCTION
    Allocates memory required for full Layer_Info structure.
    Initializes Layer_Info structure in preparation to use other layer operations on this list of layers.
    Makes the layers unlocked (open).

RETURNS
    pointer to Layer_Info structure if successful
    NULL if not enough memory

SEE ALSO
    layers.h

```
NewRegion

NAME
       NewRegion -- get a region of size 0

SYNOPSIS
       rgn = (struct Region *)NewRegion()
        d0

Function
        Create a Region structure, initialize it to empty and return
        a pointer it.

INPUTS
        none

BUGS
```

```
OffGadget

NAME
     OffGadget  --   disable the specified gadget

SYNOPSIS
     OffGadget(Gadget, Pointer, Requester)
               A0      A1       A2

FUNCTION
     This command disables the specified gadget.  When a gadget
     is disabled, these things happen:

     o  Its imagery is displayed ghosted.
     o  The GADGDISABLED flag is set.
     o  The gadget cannot be selected by the user.

     The Pointer argument must point to a Window structure.  The
     Requester variable can point to a Requester structure.  If
     the gadget has the REQGADGET flag set, the gadget is in a
     requester and Pointer must necessarily point to the window
     containing that requester.  If this is not the gadget of a
     requester, the Requester argument may be NULL.

     NOTE:  It is never safe to tinker with the gadget list yourself.
     Do not supply some gadget that Intuition has not
     already processed in the usual way.

     NOTE:  If you have specified that this is a gadget of a
     requester, that requester must be currently displayed.

INPUTS
     Gadget = pointer to the structure of the gadget that you
          want disabled.
     Pointer = pointer to a Window structure.
     Requester = pointer to a Requester structure (may be NULL if
          this is not a requester gadget list).

RESULT
     None

BUGS
     None

SEE ALSO
     OnGadget()
```

OffMenu

NAME
    OffMenu -- disable the given menu or menu item

SYNOPSIS
```
    OffMenu(Window, MenuNumber)
            A0      D0
```

FUNCTION
    This command disables a subitem, an item, or a whole menu. If the base of the menu number matches the menu currently revealed, the menu strip is redisplayed.

INPUTS
    Window = pointer to the Window structure.
    MenuNumber = the menu piece to be enabled.

RESULT
    None

BUGS
    None

SEE ALSO
    OnMenu()

OnGadget

NAME
    OnGadget -- enable the specified gadget

SYNOPSIS
```
    OnGadget(Gadget, Pointer, Requester)
             A0      A1       A2
```

FUNCTION
    This command enables the specified gadget. When a gadget is enabled, these things happen:

- o Its imagery is displayed normally (not ghosted).
- o The GADGDISABLED flag is cleared.
- o The gadget can thereafter be selected by the user.

The Pointer argument must point to a Window structure. The Requester variable can point to a Requester structure. If the gadget has the REQGADGET flag set, the gadget is in a requester and Pointer must point to the Window containing the requester. If this is not the gadget of a requester, the requester argument may be NULL.

NOTE: It is never safe to tinker with the gadget list yourself. Do not supply some gadget that Intuition has not already processed in the usual way.

NOTE: If you have specified that this is a gadget of a requester, that requester must be currently displayed.

INPUTS
    Gadget = pointer to the structure of the gadget that you want enabled.
    Pointer = pointer to a Window structure.
    Requester = pointer to a Requester structure (may be NULL if this is not a requester gadget list).

RESULT
    None

BUGS
    None

SEE ALSO
    OffGadget()

OnMenu

NAME
    OnMenu -- enable the given menu or menu item

SYNOPSIS
```
    OnMenu(Window, MenuNumber)
           A0      D0
```

FUNCTION
    This command enables a subitem, an item, or a whole menu.
    If the base of the menu number matches the menu currently
    revealed, the menu strip is redisplayed.

INPUTS
    Window = pointer to the window.
    MenuNumber = the menu piece to be enabled.

RESULT
    None

BUGS
    None

SEE ALSO
    OffMenu()

Open

NAME
    Open -- open a file for input or output

SYNOPSIS
```
    file = Open( name, accessMode )
     D0          D1    D2
```

FUNCTION
    Open opens 'name' and returns a file handle. If the accessMode is MODE_OLDFILE (=1005), OPEN opens an existing file for reading or writing.

    However, Open creates a new file for writing if the value is MODE_NEWFILE (=1006). The 'name' can be a filename (optionally prefaced by a device name), a simple device such as NIL:, a window specification such as CON: or RAW: followed by window parameters, or *, representing the current window.

    For further details on the devices NIL:, CON:, and RAW:, see chapter 1 of the of the AmigaDOS User's Manual. If Open cannot open the file 'name' for some reason, it returns the value zero (0). In this case, a call to the routine IoErr() supplies a secondary error code.

    For testing to see if a file exists, see the entry under Lock.

INPUTS
    name - address of first character of a null-terminated string
    accessMode - integer

RESULTS
    file - BCPL pointer to file handle

OpenDevice

NAME
    OpenDevice -- gain access to a device

SYNOPSIS

```
error = OpenDevice(devName, unitNumber, iORequest, flags)
D0                 A0       D0          A1         D1
```

FUNCTION
    This function opens the named device/unit and initializes the given I/O request block.

INPUTS
    devName - requested device name

    unitNumber - the unit number to open on that device. The format of the unit number is device specific.

    iORequest - the I/O request block to be returned with appropriate fields initialized.

    flags - additional driver specific information. This is sometimes used to request opening a device with exclusive access.

RESULTS
    error - zero if successful, else an error is returned

SEE ALSO
    CloseDevice

OpenDiskFont

NAME
    OpenDiskFont - load and get a pointer to a disk font

SYNOPSIS

```
font = OpenDiskFont(textAttr)
D0                  A0
```

FUNCTION
    This function finds the font with the specified textAttr on disk, loads it into memory, and returns a pointer to the font that can be used in subsequent SetFont() and CloseFont() calls. It is important to match this call with a corresponding CloseFont() call for effective management of font memory.

    If the font is already in memory, the copy in memory is used. The disk copy is not reloaded.

INPUTS
    textAttr = a TextAttr structure that describes the text font attributes desired.

EXCEPTIONS
    D0 is zero if the desired font cannot be found.

OpenFont

NAME

OpenFont -- get a pointer to a system font.

SYNOPSIS

```
font = OpenFont(textAttr), graphicsLib
D0      A0     A6
```

FUNCTION

This function searches the system font space for the graphics text font that best matches the attributes specified. The pointer to the font returned can be used in subsequent SetFont and CloseFont calls. It is important to match this call with a corresponding CloseFont call for effective management of RAM fonts.

INPUTS

textAttr - a TextAttr structure that describes the text font attributes desired

EXCEPTIONS

D0 is zero if the desired font cannot be found. If the named font is found, but the size and style specified are not available, a font with the nearest attributes is returned.

OpenLibrary

NAME

OpenLibrary -- gain access to a library

SYNOPSIS

```
library = OpenLibrary(libName, version)
D0                    A1       D0
```

FUNCTION

This function returns a pointer to a library that was previously installed into the system. If the requested library is exists, and if the library version is greater than or equal to the requested version, then the open will succeed.

INPUTS

libName - the name of the library to open
version - the version of the library required.

RESULTS

library - a library pointer for a successful open, else zero

SEE ALSO

CloseLibrary

OpenResource

NAME
    OpenResource -- gain access to a resource

SYNOPSIS
```
    resource = OpenResource(resName)
    D0                      A1
```

FUNCTION
    This function returns a pointer to a resource that was previously installed into the system.

INPUTS
    resName - the name of the resource requested.

RESULTS
    resource - if successful, a resource pointer, else null

SEE ALSO
    CloseResource

OpenScreen

NAME
    OpenScreen -- open an Intuition screen

SYNOPSIS
```
    OpenScreen(NewScreen)
               A0
```
    where the NewScreen structure is initialized with:
    Left, Top, Width, Height, Depth, DetailPen, BlockPen, ViewModes, Type, Font, DefaultTitle, Gadgets

FUNCTION
    This command opens an Intuition screen according to the specified parameters. It does all the allocations, sets up the screen structure and all substructures completely, and links this screen's ViewPort into Intuition's View of the world.

    Before you call OpenScreen(), you must initialize an instance of a NewScreen structure. NewScreen is a structure that contains all of the arguments needed to open a screen. The NewScreen structure may be discarded immediately after it is used to open the screen.

    The TextAttr pointer that you supply as an argument will be used as the default font for all Intuition-managed text that appears in the screen and its windows. This includes, but is not limited to, the text on the title bars of both the screen and windows.

    The SHOWTITLE flag is set to TRUE by default when a screen is opened. This causes the screen's title bar to be displayed when the screen first opens. To hide the title bar, you must call the routine ShowTitle().

INPUTS
    NewScreen = pointer to an instance of a NewScreen structure, which is initialized with the following information:

    LeftEdge = initial x position of your screen (should be zero for now).
    TopEdge = initial y position of the opening screen.
    Width = the width for this screen's RastPort.
    Height = the height for this screen's RastPort.
    Depth = number of bit-planes.
    DetailPen = pen number for details (such as gadgets or text in the title bar).
    BlockPen = pen number for block fills (such as the title bar).
    Type = screen type (for any screen not created by Intuition, this should be equal to CUSTOMSCREEN). Types currently supported include only CUSTOMSCREEN, which is your own screen.
        You may also set the Type flag CUSTOMBITMAP and then supply your own BitMap for Intuition to use, rather than having Intuition allocate the display memory for

```
        you.
    ViewModes = the appropriate flags for the data type
        ViewPort.Modes.  These might include:
        HIRES for this screen to be HIRES width.
        INTERLACE for the display to switch to interlaced mode.
        SPRITES for this screen to use sprites.
        DUALPF for dual-playfield mode.

    Font = pointer to the default TextAttr structure for this
        screen and all windows that open in this screen.
    DefaultTitle = pointer to a line of text that will be
        displayed along the screen's title bar.  The text will
        be null-terminated.  If this argument is set to NULL,
        no text will be produced.
    Gadgets = this should be set to NULL.
    CustomBitMap = If you're not supplying a custom BitMap, this
        value is ignored.  However, if you have your own
        display memory that you want used for this screen, the
        CustomBitMap argument should point to the BitMap that
        describes your display memory.  See the "Screens"
        chapter in the Amiga Intuition Reference Manual and
        the "Graphics Primitives" chapter in this
        manual for more information about BitMaps.

RESULT
    If all is well, the routine returns the pointer to your new
    screen.  If anything goes wrong, the routine returns NULL.

BUGS
    None

SEE ALSO
    OpenWindow(),  ShowTitle()
```


OpenWindow

```
NAME
    OpenWindow  --  open an Intuition window

SYNOPSIS
    OpenWindow(NewWindow)
               A0
    where the NewWindow structure is initialized with:
    Left, Top, Width, Height, DetailPen, BlockPen, Flags, IDCMPFlags,
    Gadgets, CheckMark, Text, Type, Screen, BitMap,
    MinWidth, MinHeight, MaxWidth, MaxHeight

FUNCTION
    This command opens an Intuition window of the given height,
    width, and depth, including the specified system gadgets as
    well as any of your own.  It allocates everything you need
    to get going.

    Before you call OpenWindow(), you must initialize an
    instance of a NewWindow structure, which contains all of the
    arguments needed to open a window.  The NewWindow structure
    may be discarded immediately after it is used to open the
    window.

    If Type == CUSTOMSCREEN, you must have opened your own
    screen already via a call to OpenScreen().  Then Intuition
    uses your Screen argument for the pertinent information
    needed to get your window going.  On the other hand, if Type
    == one of Intuition's standard screens, your Screen argument
    is ignored.  Instead, Intuition will check to see whether or
    not that screen already exists; if it does not, it will be
    opened first before Intuition opens your window in the standard
    screen.  If the flag SUPER_BITMAP is set, the BitMap
    variable must point to your own BitMap.  The DetailPen and
    the BlockPen are used for system drawing; for instance, the
    title bar is first filled using the BlockPen, and then the
    gadgets and text are drawn using DetailPen.  You can supply
    special pens for your window, or you can use the screen's
    pens instead (by setting either of these arguments to -1).

INPUTS
    NewWindow = pointer to an instance of a NewWindow structure,
        which is initialized with the following data:
    ____________________________________________________

    LeftEdge = the initial x position for your window.
    TopEdge = the initial y position for your window.
    Width = the initial width of this window.
    Height = the initial height of this window.
    DetailPen = pen number (or -1) for the drawing of window
        details (such as gadgets or text in the title bar).
    BlockPen = pen number (or -1) for window block fills (such
        as the title bar)
    Flags = specifiers for your requirements of this window, as
        follows.
        o  System gadgets you want attached to your window:
           o  WINDOWDRAG allows this window to be dragged.
```

- o WINDOWDEPTH lets the user depth-arrange this window.
- o WINDOWCLOSE attaches the standard close gadget.
- o WINDOWSIZING allows this window to be sized. If you ask for the WINDOWSIZING gadget, you must specify one or both of the flags SIZEBRIGHT and SIZEBBOTTOM below; if you do not, the default is SIZEBRIGHT. See the following SIZEBRIGHT and SIZEBBOTTOM items for extra information.
- o SIZEBRIGHT is a special system gadget flag that you set to specify whether or not you want the right border adjusted to account for the physical size of the sizing gadget. The sizing gadget must, after all, take up room in either the right or the bottom border (or both, if you like) of the window. Setting either this or the SIZEBBOTTOM flag selects which edge will take up the slack. This will be particularly useful to applications that want to use the extra space for other gadgets (such as a proportional gadget and two Booleans done up to look like scroll bars) or, for instance, applications that want every possible horizontal bit and are willing to lose lines vertically.
  NOTE: If you select WINDOWSIZING, you must select either SIZEBRIGHT or SIZEBBOTTOM or both. If you select neither, the default is SIZEBRIGHT.
- o SIZEBBOTTOM is a special system gadget flag that you set to specify whether or not you want the bottom border adjusted to account for the physical size of the sizing gadget. For details, refer to SIZEBRIGHT above. NOTE: If you select WINDOWSIZING, you must select either SIZEBRIGHT or SIZEBBOTTOM or both. If you select neither, the default is SIZEBRIGHT.

- o GIMMEZEROZERO produces easy but expensive output.
- o Type of window raster you want:
  - o SIMPLE_REFRESH
  - o SMART_REFRESH
  - o SUPER_BITMAP
- o BACKDROP specifies whether or not you want this window to be one of Intuition's special backdrop windows. See BORDERLESS as well.
- o REPORTMOUSE specifies whether or not you want the program to "listen" to mouse movement events whenever its window is active. If you want to change whether or not your window is listening to the mouse after you have opened your window, you can call ReportMouse(). Whether or not your window is listening to the mouse is also affected by gadgets, because they can cause the program to get mouse movement reports. The reports (either InputEvents or messages on the IDCMP) that you get will have the x,y coordinates of the current mouse position, relative to the upper left corner of your window (GIMMEZEROZERO notwithstanding). This flag can work in conjunction with the IDCMP flag called MOUSEMOVE, which allows your program to listen via the IDCMP.
- o BORDERLESS should be set if you want a window with no default border padding. Your window may have border padding anyway, depending on the gadgetry you have requested for the window, but you will not get the standard border lines and spacing that come with typical windows. This is a good way to take over the entire screen, since you can have a window cover the entire width of the screen using this flag. This will work particularly well in conjunction with the BACKDROP flag (see above), because it allows you to open a window that fills the entire screen.
  NOTE: This is not a flag that you want to set casually, since it may cause visual confusion on the screen. The window borders are the only dependable visual division between various windows and the background screen. Taking away the border takes away that visual cue, so make sure that your design does not need it before you proceed.
- o ACTIVATE is the flag you set if you want this window to automatically become the active window. The active window is the one that receives input from the keyboard and mouse. It is usually a good idea to have the window you open when your application first starts up be an ACTIVATED one, but all others opened later should not be ACTIVATED. (If the user is off doing something with another screen, for instance, your new window will change where the input is going, which would have the effect of yanking the input rug from under the user.) Please use this flag thoughtfully and carefully.
- o RMBTRAP, when set, causes the right mouse button events to be trapped and broadcast as events. Your program can receive these events through either the IDCMP or the console.

IDCMPFlags = IDCMP is the acronym for Intuition Direct Communications Message Port. If any of the IDCMP flags is selected, Intuition will create a pair of message ports and use them for direct communications with the task that is opening this window (as compared with broadcasting information via the console device). See the "Input and Output Methods" chapter of "Amiga Intuition Reference Manual" for complete details.

You request an IDCMP by setting any of these flags. Except for the special "verify" flags, every other flag you set tells Intuition that if a given event occurs that your program wants to know about, Intuition should broadcast the details of that event through the IDCMP rather than via the console device. This allows a program to interface with Intuition directly, rather than going through the console device.

Remember, if you are going to open both an IDCMP and a console, it will be far better to get most of the event messages via the console. Reserve your usage of the IDCMP for special performance cases; that is, when you are not going to open a console for your window and yet you do want to learn about a certain set of events (for instance, CLOSEWINDOW); another example is SIZEVERIFY, which is a function that you get only through the use

of the IDCMP (because the console does not give you any way to talk to Intuition directly).
On the other hand, if the IDCMPFlags argument is equal to zero, no IDCMP is created and the only way you can learn about any window event for this window is via a console opened for this window. For instance, you have no way to SIZEVERIFY.

If you want to change the state of the IDCMP after you have opened the window (including opening or closing the IDCMP), you call the routine ModifyIDCMP().
The flags you can set are explained below:

- REQVERIFY is a flag that, like SIZEVERIFY and MENUVERIFY (see below), specifies that you want to make sure that your graphical state is quiescent before something extraordinary happens, such as the drawing of a rectangle of graphical data in your window. If you are drawing in that window, you probably will wish to make sure that you have ceased drawing before the user is allowed to bring up the DMRequest you have set up. The same goes for when the system has a requester for the user. Set this flag to ask for that verification step.
- REQCLEAR is the flag you set to get notification when the last requester is cleared from your window and it is safe for you to start output again (presuming that you are using REQVERIFY).
- REQSET is a flag that you set to receive a broadcast when the first requester is opened in your window. Compare this with REQCLEAR above. This function is distinct from REQVERIFY. REQSET merely tells your program that a requester has opened, whereas REQVERIFY requires the program to respond before the requester is opened.
- MENUVERIFY is the flag you set to have Intuition stop and wait for your program to finish all graphical output to the window before drawing the menus. Menus are currently drawn in the most memory-efficient way, which involves interrupting output to all windows in the screen before the menus are drawn. If you need to finish your graphical output before this happens, you can set this flag to make sure that you do.
- SIZEVERIFY is used when the program sends output to the window that depends on a knowledge of the current size of the window. If the user wants to resize the window, you may want to make sure that any queued output completes before the sizing takes place (critical text, for instance). To do so, set this flag. Then, when the user wants to size, Intuition will send the program the SIZEVERIFY message and Wait() until the program replies that it is all right to proceed with the sizing.
  NOTE: Saying that Intuition will Wait() until your program replies is really saying that the user will wait until the program replies, which suffers the great negative potential of user-unfriendliness. Remember to use this flag sparingly, and, as always with any IDCMP message your program receives, reply promptly! After the user has sized the window, your program can find out about it by using NEWSIZE.
- NEWSIZE is the flag that tells Intuition to send an IDCMP message after the user has resized your window. At this point, you could examine the size variables in your Window structure to discover the new size of the window.
- REFRESHWINDOW, when set, will cause a message to be sent whenever your window needs refreshing. This flag makes sense only with SIMPLE_REFRESH and SMART_REFRESH windows.
- MOUSEBUTTONS will make sure your program receives reports about mouse-button up/down events. NOTE: Only the events that mean nothing to Intuition are reported. If the user clicks the select button over a gadget, Intuition deals with it without sending any message.
- MOUSEMOVE works only if you set the REPORTMOUSE flag (see above) or if one of your gadgets has the flag FOLLOWMOUSE set. Then all mouse movements will be reported through the IDCMP.
- GADGETDOWN specifies that when the user "selects" a gadget you have created with the GADGIMMEDIATE flag set, the fact will be broadcast through the IDCMP.
- GADGETUP specifies that when the user "releases" a gadget that you have created with the RELVERIFY flag set, the fact will be broadcast through the IDCMP.
- MENUPICK specifies that MenuNumber data be sent to your program.
- CLOSEWINDOW specifies that the CLOSEWINDOW event be broadcasted through the IDCMP rather than the console device.
- RAWKEY specifies that all RAWKEY events be transmitted via the IDCMP. Note that these are absolutely raw keycodes, which you will have to massage before using. Setting this and the MOUSE flags effectively eliminates the need to open a console device to get input from the keyboard and mouse. Of course, in exchange you lose all of the console features, most notably the "cooking" of input data and the systematic output of text to your window.
- VANILLAKEY is the raw keycode RAWKEY event translated into the current default character keymap of the console device. In the USA, the default keymap is ASCII characters. When you set this flag, you will get IntuiMessages where the Code field has a character representing the key struck on the keyboard.
- INTUITICKS gives you simple timer events from Intuition when your window is the active one; it may help you avoid opening and managing the timer device. With this flag set, you will get only one queued-up INTUITICKS message at a time. If Intuition notices that you've been sent an INTUITICKS message and haven't replied to it, another message will not be sent.
  Intuition receives timer events ten times a second (approximately).
- Set ACTIVEWINDOW and INACTIVEWINDOW to discover when your window becomes activated or inactivated.

Gadgets = a pointer to the first of a linked list of your own gadgets that you want attached to this window. Can

be NULL if you have no gadgets of your own.
CheckMark = a pointer to an instance of the Image structure that contains the imagery you want used when any of your MenuItems is to be checkmarked. If you do not want to supply your own imagery and prefer to use Intuition's own checkmark, set this argument to NULL.
Text = a null-terminated line of text that will appear on the title bar of your window (may be NULL if you want no text).
Type = the screen type for this window. If this equals CUSTOMSCREEN, you must have already opened a custom screen (see text above). Types available include:
- o WBENCHSCREEN
- o CUSTOMSCREEN

Screen = if your type is one of Intuition's standard screens, this argument is ignored. However, if type == CUSTOMSCREEN, this must point to the structure of your own screen.
BitMap = if you have specified SUPER_BITMAP as the type of raster you want for this window, this value points to a instance of the BitMap structure. However, if the raster type is not SUPER_BITMAP, this pointer is ignored.
MinWidth, MinHeight, MaxWidth, MaxHeight = the size limits for this window. These must be reasonable values, which is to say that the minimums cannot be greater than the current size, nor can the maximums be smaller than the current size. If they are, they are ignored. Any one of these can be initialized to zero, which means that that limit will be set to the current dimension of that axis. The limits can be changed after the window is opened by calling the WindowLimits() routine. If you have not requested the WINDOWSIZING option, these variables are ignored and you do not have to initialize them.

RESULT
If all is well, this command returns a pointer to the structure of your new window. If anything goes wrong, it returns NULL.

BUGS
ACTIVATE is currently advisory only. The user is able to do things that will prevent your window from becoming the active one when it opens.

SEE ALSO
OpenScreen(), ModifyIDCMP(), SetWindowTitles(), WindowLimits()

OpenWorkBench

NAME
OpenWorkBench -- open the Workbench screen

SYNOPSIS
BOOL OpenWorkBench()

FUNCTION
This routine attempts to reopen the Workbench. If the Workbench screen reopens successfully, this routine returns TRUE; if something goes wrong, it returns FALSE.

Even though this routine does return a BOOL value, you can ignore the return value if you want.

INPUTS
None

RESULT
TRUE if the Workbench screen opened successfully or was already opened.
FALSE if anything went wrong and the Workbench screen is not open.

BUGS
None

SEE ALSO
None

OrRectRegion

NAME

```
OrRectRegion -- perform second OR operation of rectangle
                with region, leaving result in region
```

SYNOPSIS

```
OrRectRegion(region,rectangle)
             a0     a1
```

Function

If any portion of rectangle is not in the region, adds that portion to the region

INPUTS

```
region     = pointer to Region structure
rectangle  = pointer to Rectangle structure
```

BUGS

Output

NAME

Output -- Determine the programs initial output file handle.

SYNOPSIS

```
file = Output()
 D0
```

FUNCTION

To identify the program's initial output file handle, you use Output. (To identify the initial input, see Input.)

RESULTS

file - BCPL pointer to a file handle

OwnBlitter

NAME
    OwnBlitter -- get the blitter for private usage

SYNOPSIS
    OwnBlitter()

FUNCTION
    Returns when the blitter has been locked from others using it and can now be used by this task. Before actually using, the new owner should call WaitBlit, which waits until any previous blit that the blitter may have been doing is actually done.

INPUTS

RETURNS

SEE ALSO
    DisownBlitter

ParentDir

NAME
    ParentDir -- obtain the parent of a directory or file

SYNOPSIS
```
    Lock = ParentDir( lock )
     D0                D1
```

FUNCTION
    This function returns a lock associated with the parent directory of a file or directory. That is, ParentDir takes a lock associated with a file or directory and returns the lock of its parent directory.

    Note: The result of ParentDir may be zero (0) for the root of the current filing system.

INPUTS
    lock - BCPL pointer to a lock

RESULTS
    lock - BCPL pointer to a lock

PeekCLMark

NAME

    PeekCLMark -- peek at the byte in the clist at the mark

SYNOPSIS

```
byte = PeekCLMark(cList)
D0                A0
```

FUNCTION

    Returns the byte value at the mark in the character list
    associated with the mark.

INPUTS

    cList -
            a longword descriptor for a clist that can be used
            for clist functions.

RESULTS

    byte   -
            the byte at the mark in the clist.

Permit

NAME

    Permit -- Permit multi-tasking following a Forbid()

SYNOPSIS

```
Permit();
```

FUNCTION

    Task switching will not necessarily be permitted after this call since
    the Forbid() function nests (only an equal number of Permit's
    following a set of Forbid's finally allows task-switching).

SEE ALSO

    Forbid

PolyDraw

NAME
    PolyDraw   -- draw lines from table of (x,y) values.

SYNOPSIS
```
PolyDraw( rp, count , array )
          a1  d0      a0
```

FUNCTION
    Starting with the first pair, draws connected lines to it and to every succeeding pair.

INPUTS
```
rp      = pointer to RastPort structure
count   = number of points in array (x,y) pairs
array   = pointer to first (x,y) pair
```

BUGS
    none known

SEE ALSO
    Draw()

*

PrintIText

NAME
    PrintIText -- print the text according to the IntuiText argument

SYNOPSIS
```
PrintIText(RastPort, IText, LeftEdge, TopEdge)
           A0        A1     D0        D1
```

FUNCTION
    This routine prints the IntuiText into the specified RastPort. It sets up the RastPort as specified by the IntuiText values, then prints the text into the RastPort at the IntuiText x,y coordinates offset by the left/top arguments.

    This routine does Intuition window-clipping as appropriate. If you print text outside of your window, your characters will be clipped at the window's edge.

    If the NextText field of the IntuiText argument is non-zero, the next IntuiText is drawn as well (return to the top of this FUNCTION section for details).

INPUTS
```
RastPort = pointer to the RastPort destination of the text.
IText = pointer to an IntuiText structure.
LeftEdge = left offset of the IntuiText into the RastPort.
TopEdge = top offset of the IntuiText into the RastPort.
```

RESULT
    None

BUGS
    None

SEE ALSO
    None

```
PutCLBuf

   NAME
        PutCLBuf -- convert contiguous data into a character list

   SYNOPSIS
        error = PutCLBuf(cList, buffer, length)
        D0               A0     A1      D1

   FUNCTION
        Appends the contents of the data buffer to a character list.
        The buffer data remains intact.

   INPUTS
        cList -
                The clist descriptor used to manage this character
                list, as returned by AllocCList.
        buffer  -
                A pointer to byte data used to initialize the character
                list.
        length  -
                The number of bytes of data in the buffer.

   RESULTS
        error   -
                non-zero indicates the number of bytes not added.
```

```
PutCLChar

   NAME
        PutCLChar -- add a byte to the end of a character list

   SYNOPSIS
        error = PutCLChar(cList, byte)
        D0                A0     D0

   FUNCTION
        Adds a byte to the end of the character list described by the
        cList.

   INPUTS
        cList -
                The clist header used to manage this character list,
                as returned by AllocCList or StrToCL.
        byte    -
                The byte to add to the end of the character list

   RESULTS
        error   -
                non-zero indicates the byte could not be added
```

PutCLWord

```
NAME
     PutCLWord -- add a word to the end of a character list

SYNOPSIS
     error = PutCLWord(cList, word)
     D0                A0     D0

FUNCTION
     Add a word to the end of the character list described by the
     cList.

INPUTS
     cList -
             The clist header used to manage this character list,
             as returned by AllocCList or StrToCL.
     word    -
             The word to add to the end of the character list

RESULTS
     error   -
             non-zero indicates the number of bytes not added.
             Partial words are not added, so error is always zero
             or two.
```

PutDiskObject

```
NAME
     PutDiskObject -- write out a DiskObject to disk

SYNOPSIS
     status = PutDiskObject( name, diskobj )
     D0                      A0    A1

FUNCTION
     This routine writes out a DiskObject structure and its
     associated information.  The file name of the info
     file will be the name parameter with a ".info" postpended
     to it.  If the call fails, a zero will be returned.  The
     reason for the failure may be obtained via IoErr().

     PutDiskObject and PutIcon are functionally identical.
     They are both provided so there is a Put/Get/Free triple
     for disk objects.

INPUTS
     name -- name of the object
     diskobj -- a pointer to a DiskObject

RESULTS
     status -- non-zero if the call succeeded

EXCEPTIONS

SEE ALSO
     GetDiskObject, FreeDiskObject, PutIcon

BUGS
```

PutIcon

```
NAME
     PutIcon -- write out a DiskObject to disk

SYNOPSIS
     status = PutIcon( name, icon )
     D0                A0    A1

FUNCTION
     This routine writes out a DiskObject structure and its
     associated information.  The file name of the info
     file will be the name parameter with a ".info" postpended
     to it.  If the call fails, a zero will be returned.  The
     reason for the failure may be obtained via IoErr().

     PutDiskObject and PutIcon are functionally identical.
     They are both provided so there is a Put/Get/Free triple
     for disk objects.

     Users are encouraged to use PutDiskObject instead of this
     routine

INPUTS
     name -- name of the object
     icon -- a pointer to a DiskObject

RESULTS
     status -- non-zero if the call succeeded

EXCEPTIONS

SEE ALSO

BUGS
```

PutMsg

```
NAME
     PutMsg -- put a message to a message port

SYNOPSIS
     PutMsg(port, message)
            A0    A1

FUNCTION
     This function attaches a message to a given message port.
     It provides a fast, non-copying message sending mechanism.

     Messages can be attached to only one port at a time.  The
     message body can be of any size or form.  Because messages
     are not copied, cooperating tasks share the same message
     memory.  The sender task should not recycle the message
     until it has been replied by the receiver.  Of course this
     depends on the message handling conventions setup by the
     involved tasks.  If the ReplyPort field is non-zero, when
     the message is replied by the receiver, it will be sent back
     to that port.

    Any one of the following actions can be set to occur
     when a message is put:
             1. no special action
             2. signal a given task
             3. cause a software interrupt
     3. cause a software interrupt
     The action is selected depending on the value set in
     PB_ACTION of MP_FLAGS.

INPUT
     port - pointer to a message port
     message - pointer to a message

SEE ALSO
     GetMsg, ReplyMsg
```

PutWBObject

NAME

PutWBObject -- write out a Workbench object

SYNOPSIS

```
status = PutWBObject( name, object )
D0                    A0    A1
```

FUNCTION

This routine writes a Workbench object to disk. The name parameter will have a ".info" postpended to it, and that file name will have the disk-resident information written into it. If the call fails, it will return a zero. The reason for the failure may be obtained via IoErr().

This routine is intended only for internal users that can track changes to the Workbench.

INPUTS

name -- name of the object
object -- the Workbench object to be written out

RESULTS

status -- non-zero if the call succeeded.

EXCEPTIONS

SEE ALSO

BUGS

QBlit

NAME

QBlit -- queue up a request for blitter usage

SYNOPSIS

```
QBlit( bp )
       A1
```

FUNCTION

Links a request for the use of the blitter to the end of the current blitter queue. The pointer bp points to a blit structure containing, among other things, the link information and the address of your routine which is to be called when the blitter queue finally gets around to this specific request. When your routine is called, you are in control of the blitter ... it is not busy with anyone else's requests. This means that you can directly specify the register contents and start the blitter. See the description of the blit structure and the uses of QBlit in the "Graphics Primitives" chapter in this manual. The header of a blitter structure is shown in hardware/blit.h

INPUTS

bp = pointer to a blit structure

RESULT

Your routine is called when the blitter is ready for you.

NOTE

In general, requests for blitter usage through this channel are put in front of those who use the blitter via OwnBlitter and DisownBlitter. However, for small blits there is more overhead using the queuer than Own/Disown Blitter.

BUGS

None known

SEE ALSO

QBSBlit blit.h

QBSBlit

NAME

QBSBlit -- synchronize the blitter request with the video beam.

SYNOPSIS

```
QBSBlit( bsp )
         al
```

FUNCTION

Calls a user routine for use of the blitter, enqueued separately from the QBlit queue. Calls the user routine contained in the blit structure when the video beam is located at a specified position onscreen. Useful when you are trying to blit into a visible part of the screen and wish to perform the data move while the beam is not trying to display that same area (prevents showing part of an old display and part of a new display simultaneously). Blitter requests on the QBSBlit queue take precedence over those on the regular blitter queue. The beam position is specified through the blitnode.

INPUTS

bsp = pointer to a blit structure. See description in the Graphics Support section of the manual for more info.

RESULT

User routine is called when the QBSBlit queue reaches this request AND the video beam is in the specified position.

BUGS

SEE ALSO

QBlit

Read

NAME

Read -- read bytes of data from a file

SYNOPSIS

```
actualLength = Read( file, buffer, length )
  D0                 D1    D2       D3
```

FUNCTION

You can copy data with a combination of Read and Write. Read reads bytes of information from an opened file (represented here by the argument 'file') into the memory buffer indicated. Read attempts to read as many bytes as fit into the buffer as indicated by the value of length. You should always make sure that the value you give as the length really does represent the size of the buffer. Read may return a result indicating that it read less bytes than you requested, for example, when reading a line of data that you typed at the terminal.

The value returned is the length of the information actually read. That is to say, when 'actualLength' is greater than zero, the value of 'actualLength' is the the number of characters read. A value of zero means that end-of-file has been reached. Errors are indicated by a value of -1. Read from the console returns a value when a return is found or the buffer is full.

A call to Read also modifies or changes the value of IoErr(). IoErr() gives more information about an error (for example, actualLength equals -1) when it is called.

INPUTS

file - BCPL pointer to a file handle
buffer - address of the first location of a buffer
length - integer

RESULTS

actualLength - integer

```
ReadPixel

NAME
       ReadPixel -- read the pen number value of the pixel at a
                    specified x,y location within a certain RastPort

SYNOPSIS
       penno = (int)ReadPixel( rp,  x,  y )
          D0                   al   D0  D1

FUNCTION
       Combines the bits from each of the bit-planes used to describe
       a particular RastPort into the pen number selector which that
       bit combination normally forms for the system hardware selection
       of pixel color.

INPUTS
       x is the X coordinate within the range of the RastPort size.
       y is the Y coordinate within the range of the RastPort size.
       rp is a pointer to a RastPort structure
       rp is a pointer to a RastPort structure

RESULT
       Pen (0..255) number at that position is returned.
       -1 is returned if cannot read that pixel

BUGS

SEE ALSO
       WritePixel
```

```
RectFill

NAME
       RectFill -- fill a defined rectangular area with
               the current drawing pen color, outline color,
               secondary color, and pattern.


SYNOPSIS
       RectFill( rp, xmin, ymin, xmax, ymax)
                 A1   D0    D1    D2    D3

FUNCTION
       Fills the rectangular region specified by the
       parameters with the chosen pen colors, areafill
       pattern, and drawing mode.

INPUTS
       (xmin,ymin) (xmax,ymax) are the coordinates of the upper
       left corner and the lower right corner, respectively, of the
       rectangle.
       (xmax >= xmin) and (ymax >= ymin)

       rp points to the RastPort which receives the filled rectangle.


SEE ALSO
```

Se ScrollRaster.

RefreshGadgets

NAME
    RefreshGadgets -- refresh (redraws) the gadget display

SYNOPSIS
```
    RefreshGadgets(Gadgets, Pointer, Requester)
                   A0       A1       A2
```

FUNCTION
    This routine refreshes (redraws) all of the gadgets in the gadget list, starting from the specified gadget.

    The Pointer argument points to a Window structure.

    The Requester variable can point to a Requester structure. If the first gadget in the list has the REQGADGET flag set, the gadget list refers to gadgets in a requester and Pointer must necessarily point to a window. If these are not the gadgets of a requester, the Requester argument may be NULL.

    There are two main reasons why you might want to use this routine. First, you have modified the imagery of the gadgets in your display and you want the new imagery to be displayed. Second, if you think that some graphic operation trashed the gadgetry of your display, this routine will refresh the imagery.

    The Gadgets argument can be a copy of the FirstGadget variable in either the Screen or Window structure that you want refreshed; the effect of this will be that all gadgets will be redrawn. However, you can selectively refresh just some of the gadgets by starting the refresh part way into the list-for instance, redrawing your window non-GIMMEZEROZERO gadgets only, which you have conveniently grouped at the end of your gadget list.

    NOTE: It is never safe to tinker with the gadget list yourself. Do not supply some gadget list that Intuition has not already processed in the usual way.

    NOTE: If you have specified that this is the gadget list of a requester, that requester must be currently displayed.

INPUTS
    Gadgets = pointer to the first structure in the list of gadgets wanting refreshment.
    Pointer = pointer to a Window structure.
    Requester = pointer to a Requester structure (may be NULL if this is not a requester gadget list).

RESULT
    None

BUGS
    None

SEE ALSO
    None

RemakeDisplay

NAME
    RemakeDisplay -- remake the entire Intuition display

SYNOPSIS
    RemakeDisplay()

FUNCTION

    This is the big one. This procedure remakes the entire Intuition display. It calls MakeScreen() for every screen in the system and then it calls RethinkDisplay(), which rethinks the relationships of the screens to one another and then rethinks the display Copper lists.

    WARNING: This routine can take several milliseconds to run, so do not use it lightly. RethinkDisplay() (called by this routine) does a Forbid() on entry and a Permit() on exit, which can seriously degrade the performance of the multitasking Executive.

INPUTS
    None

RESULT
    None

BUGS
    None

SEE ALSO
    RethinkDisplay()

```
RemDevice

   NAME
        RemDevice -- remove a device from the system

   SYNOPSIS
        error = RemDevice(device)
        D0                 A1

   FUNCTION
        This function removes an existing device from the system.
        This function deletes the device from the device name list,
        so no new opens can occur.

   INPUTS
        device - pointer to a device node

   RESULTS
        error - zero if successful, else an error is returned

   SEE ALSO
        AddDevice
```

```
RemFont

NAME
    RemFont -- remove a font from the system list

SYNOPSIS
    error = RemFont(textFont), GraphicsLib
    D0      A1     A6

FUNCTION
    This function removes a font from the system, ensuring that
    access to it is restricted to those applications that
    currently have an active pointer to it: i.e., no new GetFont
    requests to this font are satisfied.

INPUTS
    textFont - the TextFont structure to remove.
```

RemHead

NAME
```
        RemHead -- remove the head node from a list
```

SYNOPSIS
```
        node = RemHead(list)
        D0             A0
```

FUNCTION
```
        Get a pointer to the head node and remove it from the list.
```

INPUTS
```
        list - a pointer to the target list header
```

RESULT
```
        node - the node removed or zero when empty list
```

RemIBob

NAME
```
   RemIBob  --  immediately remove a Bob from the GEL list and the RastPort
```

SYNOPSIS
```
   RemIBob(Bob, RPort, VPort)
           a0   a1     a2
```

FUNCTION
```
   Removes a Bob immediately by uncoupling it from the GEL list and erasing
       it from the RastPort
```

INPUTS
```
   Bob = pointer to the Bob to be removed
   RPort = pointer to the RastPort if the Bob is to be erased
   VPort = pointer to the ViewPort for beam-synchronizing
```

RESULT
```
   Nothing
```

BUGS
```
   None known
```

SEE ALSO
```
   RemVSprite
```

```
RemIntServer

   NAME
        RemIntServer -- remove an interrupt server

   SYNOPSIS
        RemIntServer(intNum, interrupt)
                     D0-0:4  Al

   FUNCTION
        This function removes an interrupt server node from
        the given server chain.

        If this server was the last one one the chain interrupts
        will be disabled for intNum.

   INPUTS
        intNum - the Paula interrupt bit (0..14)
        interrupt - pointer to an interrupt server node

   SEE ALSO
        AddIntServer
```

```
RemLibrary

   NAME
        RemLibrary -- remove a library from the system

   SYNOPSIS
        error = RemLibrary(library)
        D0                 Al

   FUNCTION
        This function removes an existing library from the system.
        It will delete it from the system library name list, so no
        new opens may be performed.

   INPUTS
        library - pointer to a library node structure

   RESULTS
        error - zero if successful, else an error number

   SEE ALSO
        AddLibrary
```

Remove

NAME
    Remove -- remove a node from a list

SYNOPSIS
```
Remove(node)
       A1
```

FUNCTION
    Remove a node from a list.

INPUTS
    node - the node to remove

RemoveGadget

NAME
    RemoveGadget -- remove a gadget from a window

SYNOPSIS
```
USHORT RemoveGadget(Pointer, Gadget)
                    A0       A1
```

FUNCTION
    This routine removes the given gadget from the gadget list of the specified window. It returns the ordinal position of the removed gadget. If the gadget pointer points to a gadget that is not in the appropriate list, -1 is returned. If there are no gadgets in the list, -1 is returned. If you remove the 65,535th gadget from the list, -1 is returned.

    NOTE: The gadget's imagery is not erased by this routine.

INPUTS
    Pointer = pointer to the window from which the gadget is to be removed.
    Gadget = pointer to the gadget to be removed. The gadget itself describes whether this gadget should be removed from the window.

RESULT
    Returns the ordinal position of the removed gadget. If the gadget was not found in the appropriate list or if there are no gadgets in the list, -1 is returned.

BUGS
    None

SEE ALSO
    AddGadget()

RemPort

NAME
    RemPort -- remove a message port from the system

SYNOPSIS
```
RemPort(port)
        A1
```

FUNCTION
    This function removes a message port structure from the system's message port list. Subsequent attempts to rendezvous by name with this port will fail.

INPUTS
    port - pointer to a message port

SEE ALSO
    AddPort, FindPort

RemResource

```
NAME
    RemResource -- remove a resource from the system

SYNOPSIS
    RemResource(resource)
                A1

FUNCTION
    This function removes an existing resource from the system.

INPUTS
    resource - pointer to a resource node

SEE ALSO
    AddResource
```

RemTail

```
NAME
     RemTail -- remove the tail node from a list

SYNOPSIS
     node = RemTail(list)
     D0             A0

FUNCTION
     Get a pointer to the tail node and remove it from the list.

INPUTS
     list - a pointer to the target list header

RESULT
     node - the node removed or zero when empty list
```

RemTask

NAME
    RemTask -- remove a task from the system

SYNOPSIS
```
RemTask(task)
        A1
```

FUNCTION
    This function removes a task from the system. Deallocation of resources should have been performed prior to calling this function.

INPUTS
    task - pointer to the task node representing the task to be removed. A zero value indicates self removal, and will cause the next ready task to begin execution.

SEE ALSO
    AddTask

RemVSprite

NAME
    RemVSprite -- remove a VSprite from the current GEL list

SYNOPSIS
```
RemVSprite(VS)
           a0
```

FUNCTION
    Unlinks the VSprite from the current GEL list

INPUTS
    VS = pointer to the VSprite structure to be removed from the GEL list

RESULT
    Nothing

BUGS
    None known

SEE ALSO
    Nothing

```
Rename

NAME
    Rename -- rename a directory or file

SYNOPSIS
    success = Rename( oldName, newName )
        D0                D1       D2

FUNCTION
    Rename attempts to rename the file or directory specified as 'oldName'
    with the name 'newName'. If the file or directory 'newName' exists,
    Rename fails and Rename returns an error.

    Both the 'oldName' and the 'newName' can be complex filenames containing
    a directory specification. In this case, the file will be moved from
    one directory to another. However, the destination directory must
    exist before you do this.

    Note: It is impossible to rename a file from one volume to another.

INPUTS
    oldName - address of first character of a null-terminated string
    newName - address of first character of a null-terminated string

RESULTS
    success - boolean
```

```
ReplyMsg

NAME
    ReplyMsg -- put a message to its reply port

SYNOPSIS
    ReplyMsg(message)
             A1

FUNCTION
    This function sends a message to its reply port.  This is
    usually done when the receiver of a message has finished
    and wants to return it to the sender (so that it can be
    re-used or deallocated, whatever).

INPUT
    message - a pointer to the message

SEE ALSO
    ReplyMsg
```

ReportMouse

NAME
    ReportMouse -- tell Intuition whether or not to report mouse movement

SYNOPSIS
```
ReportMouse(Window, Boolean)
            A0      D0
```

FUNCTION
    This routine tells Intuition whether or not to broadcast mouse movement events to this window when it is active. The Boolean value specifies whether to start or stop broadcasting position information of mouse-movement. If the window is active, mouse-movement reports start coming immediately after this command. This routine will change the current state of the FOLLOWMOUSE function of a currently-selected gadget, too. Note that calling ReportMouse() when a gadget is selected will only temporarily change whether or not mouse movements are reported while the gadget is selected; the next time the gadget is selected, its FOLLOWMOUSE flag is examined anew. Note also that calling ReportMouse() when no gadget is currently selected will change the state of the window's REPORTMOUSE flag but will have no effect on any gadget that may be subsequently selected.

    The ReportMouse() function is first performed when OpenWindow() is first called. If the flag REPORTMOUSE is included among the options, all mouse-movement events are reported to the opening task and will continue to be reported until ReportMouse() is called with a Boolean value of FALSE. If REPORTMOUSE is not set, no mouse-movement reports will be broadcast until ReportMouse() is called with a Boolean value of TRUE.

INPUTS
    Window = pointer to a Window structure associated with this request.
    Boolean = TRUE or FALSE value specifying whether to turn this function on or off.

RESULT
    None

BUGS
    None

SEE ALSO
    None

Request

NAME
    Request -- activate a requester

SYNOPSIS
```
Request(Requester, Window)
        A0         A1
```

FUNCTION
    This routine links in and displays a requester in the specified window. This routine ignores the window's REQVERIFY flag.

INPUTS
    Requester = pointer to the structure of the requester to be displayed.
    Window = pointer to the structure of the window into which this requester goes.

RESULT
    If the requester is successfully opened, TRUE is returned.
    If the requester could not be opened, FALSE is returned.

BUGS
    None

SEE ALSO
    None

RethinkDisplay

NAME
    RethinkDisplay -- the grand manipulator of the entire Intuition display

SYNOPSIS
    RethinkDisplay()

FUNCTION
    This function performs the Intuition global display reconstruction. This includes massaging internal-state data, rethinking all of the ViewPorts and their relationship to one another, and, finally, reconstructing the entire display based on the results of all this rethinking.

    The reconstruction of the display includes calls to the graphics library to perform MrgCop() and LoadView() for all of Intuition's screens.

    You may perform a MakeScreen() on your custom screen before calling this routine. The results will be incorporated in the new display.

    WARNING: This routine can take several milliseconds to run, so do not use it lightly. RethinkDisplay() does a Forbid() on entry and a Permit() on exit, which can seriously degrade the performance of the multitasking Executive.

INPUTS
    None

RESULT
    None

BUGS
    None

SEE ALSO
    MakeScreen(), RemakeDisplay(), MrgCop(), LoadView(), Forbid(), Permit()

ScrollLayer

NAME
    ScrollLayer -- scroll around in a superbitmap

SYNOPSIS
```
ScrollLayer( li, l, dx, dy )
             a0  a1 d0  d1
```

INPUTS
    li = pointer to LayerInfo structure
    l = pointer to a nonbackdrop layer
    dx = delta to add to current x scroll value
    dy = delta to add to current y scroll value

FUNCTION
    Copies bits between layer and superbitmap to reposition layer over different portion of superbitmap.

SEE ALSO
    layers.h

ScreenToBack

```
NAME
     ScreenToBack  --  send the specified screen to the back of
                       the display

SYNOPSIS
     ScreenToBack(Screen)
                  A0

FUNCTION
     This routine sends the specified screen to the back of the
     display.

INPUTS
     Screen = pointer to a Screen structure

RESULT
     None

BUGS
     None

SEE ALSO
     ScreenToFront()
```

ScreenToFront

```
NAME
     ScreenToFront  --  bring the specified screen to the front
                        of the display

SYNOPSIS
     ScreenToFront(Screen)
                   A0

FUNCTION
     This routine brings the specified screen to the front of the
     display.

INPUTS
     Screen = a pointer to a Screen structure

RESULT
     None

BUGS
     None

SEE ALSO
     ScreenToBack()
```

ScrollRaster

NAME

    ScrollRaster -- push bits in rectangle in raster around by
                    dx,dy towards 0,0 inside rectangle

SYNOPSIS

```
ScrollRaster( rp, dx, dy, xmin, ymin, xmax, ymax)
              a1  d0  d1  d2    d3    d4    d5
```

FUNCTION

Moves the bits in the raster by (dx,dy) towards (0,0).
The space vacated is RectFilled with BGPen.
Limits the scroll operation to the rectangle defined
by (xmin,ymin)(xmax,ymax). Bits outside will not be
affected.

INPUTS

rp must be a valid pointer to a RastPort
dx,dy are integers that may be positive, zero, or negative

EXAMPLE

```
ScrollRaster(rp,0,1)    /* shift raster up by one row */
ScrollRaster(rp,-1,-1)  /* shift raster down and to the right by 1 pixel
```

BUGS

Scrolls maximal $400 pixels

= 128 bytes

ScrollVPort

NAME

    ScrollVPort -- push bits in rectangle in vport around by
                   dx,dy towards 0,0 inside rectangle

SYNOPSIS

```
ScrollVPort( vp )
             a0
```

FUNCTION

After the programmer has adjusted the Offset values in
the RasInfo structures of ViewPort, changes the
the Copper lists to reflect the the scroll positions.

INPUTS

vp must be a valid pointer to a ViewPort
that is currently on display

RESULTS

Modifies hardware and intermediate Copper lists to reflect
new RasInfo

NOTE

Changing the BitMap ptr in RasInfo and not changing the
the Offsets will cause a double-buffering affect.

BUGS

Pokes not fast enough to avoid some visible hashing of display

Seek

NAME

    Seek -- move to a logical position in a file

SYNOPSIS

```
    oldPosition = Seek( file, position, mode )
     D0                 D1    D2        D3
```

FUNCTION

Seek sets the read/write cursor for the file 'file' to the position 'position'. Both Read and Write use this position as a place to start reading or writing. If all goes well, the result is the previous position

in the file. If an error occurs, the result is -1. You can then use IoErr() to find out more information about the error.

'mode' can be OFFSET_BEGINNING (=-1), OFFSET_CURRENT (=0) or OFFSET_END (=1). You use it to specify the relative start position. For example, 20 from current is a position twenty bytes forward from current, -20 from end is 20 bytes before the end of the current file.

To find out the current file position without altering it, you call to Seek specifying an offset of zero from the current position.

To move to the end of a file, Seek to end-of-file offset with zero position. Note that you can append information to a file by moving to the end of a file with Seek and then writing. You cannot Seek beyond the end of a file.

INPUTS

    file - BCPL pointer to a file handle
    position - integer
    mode - integer

RESULTS

    oldPosition - integer

SendIO

NAME

    SendIO -- initiate an I/O command

SYNOPSIS

```
    SendIO(iORequest)
           A1
```

FUNCTION

This function requests the device driver to initiate the command specified in the given I/O request. The device will return regardless of whether the I/O has completed.

INPUTS

    iORequest - pointer to an I/O request

SEE ALSO

    DoIO, WaitIO

```
SetAPen

NAME
        SetAPen -- Set primary pen

SYNOPSIS
        SetAPen( rp, pen )
                 a1  d0

FUNCTION
        Sets the primary drawing pen for lines, fills, and text.

INPUTS
        rp      = pointer to RastPort structure.
        pen     = 0-255

RESULT
        Changes the minterms in the RastPort to reflect new primary pen.
        Set line drawer to restart pattern.

BUGS

SEE ALSO
        SetBPen
```

```
SetBPen

NAME
        SetBPen -- Set secondary pen

SYNOPSIS
        SetBPen( rp, pen )
                 a1  d0

FUNCTION
        Sets the secondary drawing pen for lines, fills, and text.

INPUTS
        rp      = pointer to RastPort structure.
        pen     = 0-255

RESULT
        Changes the minterms in the RastPort to reflect new secondary pen.
        Set line drawer to restart pattern.

BUGS

SEE ALSO
        SetAPen
```

SetCollision

NAME
   SetCollision -- sets a pointer to a user collision routine

SYNOPSIS
```
   SetCollision(num, routine, GInfo)
                d0   a0       a1
```

FUNCTION
   Sets entry h in the user's collision vectors table equal to the pointer p

INPUTS
   num = collision vector number
   routine = pointer to the user's collision routine
   GInfo = pointer to a GelsInfo structure

RESULT
   Nothing

BUGS
   None known

SEE ALSO
   Nothing

SetComment

NAME
   SetComment -- set a comment

SYNOPSIS
```
    Success = SetComment( name, comment )
     D0                     D1     D2
```

FUNCTION
   SetComment sets a comment on a file or directory. The comment is a pointer to a null-terminated string of up to 80 characters.

INPUTS
   name - address of first character of a null-terminated string
   comment - address of first character of a null-terminated string

RESULTS
   success - boolean

SetDMRequest

NAME
    SetDMRequest -- set the DMRequest of the window

SYNOPSIS
```
SetDMRequest(Window, DMRequester)
             A0      A1
```

FUNCTION
    This routine attempts to set the DMRequester in the specified window. The DMRequester is the special requester that you attach to the double-click of the menu button, allowing the user to bring up this requester on demand. This routine will not set the DMRequester if it is already set and is currently active (in use by the user). To change the DMRequester after having called SetDMRequest(), you start by calling ClearDMRequest() until it returns a value of TRUE. Then you can call SetDMRequest() with the new DMRequester.

INPUTS
    Window = pointer to the structure of the window into which the DMRequest is to be set.
    DMRequester = a pointer to a Requester structure.

RESULT
    If the current DMRequest was not in use, the DMRequester pointer is set in the window and this routine returns TRUE.

    If the DMRequest was currently in use, this routine does not change the pointer and returns FALSE.

BUGS
    None

SEE ALSO
    ClearDMRequest(), Request(.

SetDrMd

NAME
    SetDrMd -- set drawing mode

SYNOPSIS
```
SetDrMd( rp, mode )
         a1  d0
```

FUNCTION
    Sets the drawing mode for lines, fills and text.

INPUTS
```
rp      = pointer to RastPort structure.
mode    = 0-255

        #define JAM1       0   /* jam 1 color into raster */
        #define JAM2       1   /* jam 2 colors into raster */
        #define COMPLEMENT 2   /* XOR bits into raster */
        #define INVERSVID  4   /* inverse video for drawing modes */
```

    Some combinations may not make much sense.

RESULT
    The mode set is dependent on the bits selected.
    Change minterms to reflect new drawing mode.
    Set line drawerto restart pattern.

BUGS

SEE ALSO
    SetAPen

SetExcept

NAME

SetExcept -- define certain signals to cause exceptions

SYNOPSIS

```
oldSignals = SetExcept(newSignals, signalMask)
D0                     D0          D1
```

FUNCTION

This function defines which of the task's signals will cause an exception. When any of the signals occurs the task's exception handler will be dispatched. If the signal occurred prior to calling SetExcept, the exception will happen immediately.

INPUTS

newSignals - the new values for the signals specified in signalMask.

signalMask - the set of signals to be effected

RESULTS

oldSignals - the prior exception signals

EXAMPLE

Get the current state of all exception signals:

```
SetExcept(0,0)
```

Change a few exception signals:

```
SetExcept($1374,$1074)
```

SEE ALSO

Signal, SetSignal

SetFont

NAME

SetFont -- set the text font and attributes in a RastPort

SYNOPSIS

```
error = SetFont(rastPort, font), graphicsLib
D0              A1        A0     A6
```

FUNCTION

This function sets the font in the RastPort to that described by font and updates the text attributes to reflect that change. If TextAttr is zero, this call leaves the RastPort with no font. This function clears the effect of any previous soft styles.

INPUTS

RastPort - the RastPort in which the text attributes are changed.

font - an open font.

SetFunction

NAME

SetFunction -- change a function vector in a library

SYNOPSIS

```
oldFunc = SetFunction(library, funcOffset, funcEntry)
D0                    A1       A0.W        D0
```

FUNCTION

SetFunction is a functional way of changing those parts of a library that are checksummed. They are changed in such a way that the summing process will never falsely declare a library to be invalid.

INPUTS

library - a pointer to the library to be changed

funcOffset - the offset that FuncEntry should be put at.

funcEntry - pointer to new function

SetIntVector

NAME

SetIntVector -- set a system interrupt vector

SYNOPSIS

```
oldInterrupt = SetIntVector(intNumber, interrupt)
D0                          D0-0:4     A1
```

FUNCTION

This function provides a mechanism for setting the system interrupt vectors. Both the code and data pointers of the vector are set to the new values. A pointer to the old interrupt structure is returned. When the system calls the specified interrupt code the registers are setup as follows:

```
D0 - scratch
D1 - scratch (on entry: active portia interrupts)

A0 - scratch (on entry: pointer to chipbase)
A1 - scratch (on entry: interrupt's data segment)

A5 - jump vector register (scratch on call)
A6 - library base pointer (scratch on call)

all other registers - must be preserved
```

INPUTS

intNum - the Paula interrupt bit number (0..14)

interrupt - a pointer to a node structure containing the handler's entry point and data segment pointer. It is a good idea to give the node a name so that other users may identify who currently has control of the interrupt.

RESULT

A pointer to the prior interrupt node which had control of this interrupt.

SetMenuStrip

NAME
    SetMenuStrip -- attach the menu strip to the window

SYNOPSIS
```
SetMenuStrip(Window, Menu)
             A0      A1
```

FUNCTION
    This routine attaches the menu strip to the window. If the user presses the menu button after this routine is called, this specified menu strip will be displayed and accessible.

    NOTE: You should always design your menu strip changes to be two-way operations; every menu strip you add to your window should be cleared sometime. Even in the simplest case, when you will have just one menu strip for the lifetime of your window, you should always clear the menu strip before closing the window. If you already have a menu strip attached to this window, the correct procedure for changing to a new menu strip involves calling ClearMenuStrip() to clear the old menu strip first. The sequence of events should be:

1. OpenWindow().
2. Zero or more iterations of:
    - o SetMenuStrip().
    - o ClearMenuStrip().
3. CloseWindow().

INPUTS
    Window = pointer to a Window structure.
    Menu = pointer to the first Menu structure in the menu strip.

RESULT
    None

BUGS
    None

SEE ALSO
    ClearMenuStrip()

SetOPen

NAME
    SetOPen -- Set outline pen

SYNOPSIS
```
SetOPen( rp, pen )
         a1  d0
```

FUNCTION
    Set the outline drawing pen for area outlines.

INPUTS
    rp = pointer to RastPort structure.
    pen = 0-255

RESULT
    Changes the minterms in the RastPort to reflect new outline pen.

BUGS

SEE ALSO

SetPointer

NAME
    SetPointer -- set a window with its own pointer

SYNOPSIS
```
    SetPointer(Window, Pointer, Height, Width, XOffset, YOffset)
               A0      A1       D0      D1     D2       D3
```

FUNCTION
    This routine sets up the window with the sprite definition for the pointer. Then, whenever the window is active, the pointer image will change to the sprite's version of the pointer. If the window is active when this routine is called, the change takes place immediately.

    The XOffset and YOffset arguments are used to offset the top left corner of the hardware sprite imagery from what Intuition regards as the current position of the pointer. Another way of describing it is as the offset from the "hot spot" of the pointer to the top left corner of the sprite. For instance, if you specify offsets of zero, zero, then the top-left corner of your sprite image will be placed at the pointer position. On the other hand, if you specify an XOffset of -7 (remember, sprites are 16 pixels wide), your sprite will be centered over the pointer position. If you specify an XOffset of -15, the right edge of the sprite will be over the pointer position.

INPUTS
    Window = pointer to the structure of the window to receive this pointer definition.
    Pointer = pointer to the data definition of a sprite.
    Height = the height of the pointer.
    Width = the width of the sprite (must be less than or equal to 16).
    XOffset = the offset for your sprite from the pointer position.
    YOffset = the offset for your sprite from the pointer position.

RESULT
    None
BUGS
    None
SEE ALSO
    ClearPointer()

SetProtection

NAME
    SetProtection -- set file or directory protection

SYNOPSIS
```
    Success = SetProtection( name, mask )
      D0                     D1    D2
```

INPUTS
    name - address of first character of a null-terminated string
    mask - the protection mask required

RESULTS
    success - boolean

FUNCTION
    SetProtection sets the protection attributes on a file or directory. The lower four bits of the mask are as follows:

    bit 3: if 1 then reads not allowed, else reads allowed.
    bit 2: if 1 then writes not allowed, else writes allowed.
    bit 1: if 1 then execution not allowed, else execution allowed.
    bit 0: if 1 then deletion not allowed, else deletion allowed.

    Bits 31-4 Reserved.

    Only delete is checked for in the current release of AmigaDOS. Rather than referring to bits by number you should use the definitions in "include/libraries/dos.h."

SetRast

NAME
SetRast -- set an entire drawing area to a specified color

SYNOPSIS
```
SetRast( RastPort, pen )
         A1        D0
```

FUNCTION
Sets the entire contents of the specified RastPort to the specified pen.

INPUTS
RastPort is a pointer to the rastPort you wish to use.
Pen is the pen value which you wish to fill into that port. (0-255)

RESULT
The drawing area becomes the selected pen number.

BUGS

SEE ALSO

SetRGB4

NAME
SetRGB4 -- set one color register for this viewport

SYNOPSIS
```
SetRGB4(  vp, n,  r,  g,  b)
          a0  D0  D1  D2  D3
```

INPUTS
vp= ViewPort to affect
n = the color number (range from 0 to 31)

r = red level
g = green level
b = blue level

RESULT
If there is a ColorMap for this ViewPort, store the value in in the structure ColorMap.
The selected color register is changed to match your specs.
If the color value is unused, nothing will happen.

BUGS
If the color value is unused it may affect the color values in the next ViewPorts.

SEE ALSO
LoadRGB4

SetSignal

NAME

SetSignal -- define the state of this task's signals

SYNOPSIS

```
oldSignals = SetSignal(newSignals, signalMask)
D0                     D0          D1
```

FUNCTION

This function defines the states of the task's signals.

This function is considered dangerous.

INPUTS

newSignals - the new values for the signals specified in signalSet.
signalMask - the set of signals to be effected

RESULTS

oldSignals - the prior values for all signals

EXAMPLE

```
Get the current state of all signals:
    SetSignal(0,0)
Clear all signals:
    SetSignal(0,FFFFFFFFH)
```

SEE ALSO

Signal, Wait

SetSoftStyle

NAME

SetSoftStyle -- set the soft style of the current font

SYNOPSIS

```
newStyle = SetSoftStyle(rastPort, style, enable), graphicsLib
                        A1        D0     D1       A6
```

FUNCTION

This function alters the soft style of the current font. Only those bits that are also set in enable are affected. The resulting style is returned, since some style request changes will not be honored when the implicit style of the font precludes changing them.

INPUTS

rastPort - the RastPort from which the font and style are extracted.
style - the new font style to set, subject to enable.
enable - those bits in style to be changed. Any set bits here that would not be set as a result of AskSoftStyle will be ignored, and the newStyle result will not be as expected.

RESULTS

style - the resulting style, both as a result of previous soft style selection, the effect of this function, and the style inherent in the set font.

SetSR

NAME

    SetSR -- get and/or set processor status register

SYNOPSIS

```
oldSR = SetSR(newSR, mask)
D0            D0     D1
```

FUNCTION

This function provides a means of modifying the CPU status register in a "safe" way (well, how safe can a function like this be anyway?). This function will only effect the status register bits specified in the mask parameter. The prior content of the entire status register is returned.

INPUTS

newSR - new values for bits specified in the mask.
    All other bits are not effected.
mask - bits to be changed

RESULTS

oldSR - the entire status register before new bits

EXAMPLES

```
To get the current SR:
    currentSR = SetSR(0,0);
To change the processor interrupt level to 3:
    oldSR = SetSR($0300,$0700);
Set processor interrupts back to prior level:
    SetSR(oldSR,$0700);
```

SetTaskPri

NAME

    SetTaskPri -- get and set the priority of a task

SYNOPSIS

```
oldPriority = SetTaskPri(task, priority)
D0-0:8                   A1    D0-0:8
```

FUNCTION

This function changes the priority of a task regardless of its state. The old priority of the task is returned. A reschedule is performed, and a context switch may result.

INPUTS

task - task to be affected
priority - the new priority for the task

RESULT

oldPriority - the tasks previous priority

```
SetWindowTitles


NAME
     SetWindowTitles  --  set the window's titles for both the
                          window and the screen

SYNOPSIS
     SetWindowTitles(Window, WindowTitle, ScreenTitle)
                     A0      A1           A2

FUNCTION
     This routine allows you to set the text that appears in the
     window and/or screen title bars.  The window title appears
     at all times in the window title bar.  The window's screen
     title appears at the screen title bar whenever this window
     is active.

     When this routine is called, your window title will be
     changed immediately.  If your window is active when this
     routine is called, the screen title will be changed immediately.

     You can specify a value of -1 for either of
     the title pointers.  This designates that you want Intuition
     to leave the current setting of that particular title alone,
     modifying only the other one.  Of course, you could set both
     to -1.

     Furthermore, you can set a value of 0 for either of the
     title pointers.  Doing so specifies that you want no title
     to appear (the title bar will be blank).

INPUTS
     Window = pointer to your Window structure.
     WindowTitle = pointer to a null-terminated text string; this
          pointer can also be set to either -1  or 0.
     ScreenTitle = pointer to a null-terminated text string; this
          pointer can also be set to either -1 or 0.

RESULT
     None

BUGS
     None

SEE ALSO
     OpenWindow(), ShowTitle()
```

```
ShowTitle


NAME
     ShowTitle  --  set the screen title bar display mode

SYNOPSIS
     ShowTitle(Screen, ShowIt)
               A0      D0

FUNCTION
     This routine sets the SHOWTITLE flag of the specified screen
     and then coordinates the redisplay of the screen and its
     windows.

     The screen title bar can appear either in front of or behind
     Backdrop windows.  Non-Backdrop windows always appear in
     front of the screen title bar.  You specify whether you want
     the screen title bar to be in front of or behind the
     screen's Backdrop windows by calling this routine.

     The ShowIt argument should be set to either TRUE or FALSE.
     If TRUE, the screen's title bar will be shown in front of
     Backdrop windows.  If FALSE, the title bar will be located
     behind all windows.  When a screen is first opened, the
     default setting of the SHOWTITLE flag is TRUE.

INPUTS
     Screen = pointer to a Screen structure.
     ShowIt = Boolean TRUE or FALSE describing whether to show or
          hide the screen title bar.

RESULT
     None

BUGS
     None

SEE ALSO
     SetWindowTitles()
```

Signal

NAME
    Signal -- signal a task

SYNOPSIS
```
    Signal(task, signals)
           A1    D0
```

FUNCTION
    This function signals a task with the given signals. If the task is currently waiting for one or more of these signals, it will be made ready and a reschedule will occur. If the task is not waiting for any of these signals, the signals will be posted to the task for possible later use. A signal may be sent to a task regardless of whether it's running, ready, or waiting.

    This function is considered "low level". Its main purpose is to support multiple higher level functions like PutMsg. Generally a user need not perform Signals directly.

INPUT
    task - the task to be signalled
    signals - the signals to be sent

SEE ALSO
    Wait, SetSignal

SizeCList

NAME
    SizeCList -- get the number of bytes in a character list

SYNOPSIS
```
    bytes = SizeCList(cList)
    D0                A0
```

FUNCTION
    Inquires as to the number of characters in cList.

INPUTS
    cList -
        The clist header used to manage this character list, as returned by AllocCList or StrToCL.

RESULTS
    bytes -
        the number of bytes in cList.

SizeLayer

NAME

SizeLayer -- change the size of this nonbackdrop layer.

SYNOPSIS

```
SizeLayer( li, l, dx, dy )
           a0  a1 d0  d1
```

INPUTS

```
li  = pointer to LayerInfo structure
l   = pointer to a nonbackdrop layer
dx  = delta to add to current x size
dy  = delta to add to current y size
```

FUNCTION

Changes the size of this layer by (dx,dy). The lower right hand corner is extended to make room for the larger layer.
If there is SuperBitMap for this layer, copy pixels into or out of the layer depending on whether the layer increases or decreases in size.
Collect damage list for those layers that may need to be refreshed if damage occurred.

NOTE

The current implementation forces layer to front. This is not to be depended upon and may change in future releases of layer.lib.

SEE ALSO

layers.h

SizeWindow

NAME

SizeWindow -- ask Intuition to size a window

SYNOPSIS

```
SizeWindow(Window, DeltaX, DeltaY)
           A0      D0      D1
```

FUNCTION

This routine sends a request to Intuition asking to size the window by the specified amounts. The delta arguments describe how much to size the window along the respective axes.

Note that the window will not be sized immediately. It will be sized the next time Intuition receives an input event, which happens currently at a minimum rate of ten times per second and a maximum of sixty times a second. You can discover when your window has finally been sized by setting the NEWSIZE flag of the IDCMP of your window. See the "Input and Output Methods" chapter in "Amiga Intuition Reference Manual" for a description of the IDCMP.

This routine does no error-checking. If your delta values specify some far corner of the universe, Intuition will attempt to size your window to that far corner.
Because of the distortions in the space-time continuum that can result from this, as predicted by special relativity, the result is generally not desirable.

INPUTS

```
Window = pointer to the structure of the window to be sized.
DeltaX = signed value describing how much to size the window
     on the x axis.
DeltaY = signed value describing how much to size the window
     on the y axis.
```

RESULT

None

BUGS

None

SEE ALSO

MoveWindow(), WindowToFront(), WindowToBack()

```
SortGList

NAME
   SortGList  --  sort the current GEL list according to the y,x coordinates

SYNOPSIS
   SortGList(RPort)     as called by C
             a1

FUNCTION
   Sorts the current GEL list according to the GEL's y,x coordinates
   This sorting is essential before calls to DrawGList or DoCollision

INPUTS
   RPort = pointer to the RastPort structure containing the GelsInfo

RESULT
   Nothing

BUGS
   None known

SEE ALSO
   DoCollision
   DrawGList
```

```
SPAbs

NAME

    SPAbs -- obtain the absolute value of the fast floating-point number

C USAGE

    fnum2 = SPAbs(fnum1);
                  D0

FUNCTION

    Accepts a floating-point number and returns the absolute value of
    said number.

INPUTS

    fnum1 - floating-point number

RESULT

    fnum2 - floating-point absolute value of fnum1

BUGS

    None

SEE ALSO
```

```
SPAcos

NAME

    SPAcos -- obtain the arccosine of the floating-point number

SYNOPSIS

    fnum2 = SPAcos(fnum1);
                   D0

FUNCTION

    Accepts a floating-point number representing the cosine
    of an angle and returns the value of said angle in
    radians

INPUTS

    fnum1 - floating-point number

RESULT

    fnum2 - floating-point number

BUGS

SEE ALSO
```

```
SPAdd

NAME
    SPAdd -- add two floating-point numbers

C USAGE
    fnum3 = SPADD(fnum1, fnum2);
                  D1     D0

FUNCTION
    Accepts two floating-point numbers and returns the arithmetic
    sum of said numbers.

INPUTS

    fnum1 - floating-point number
    fnum2 - floating-point number

RESULT

    fnum3 - floating-point number

BUGS

    None

SEE ALSO
```

SPAsin

NAME
    SPAsin -- obtain the arcsine of the floating-point number

SYNOPSIS

```
    fnum2 = SPAsin(fnum1);
                   D0
```

FUNCTION

    Accepts a floating-point number representing the sine of an angle and returns the value of said angle in radians

INPUTS

    fnum1 - floating-point number

RESULT

    fnum2 - floating-point number

BUGS

    None

SEE ALSO

SPAtan

NAME

    SPAtan -- obtain the arctangent of the floating-point number

SYNOPSIS

```
    fnum2 = SPAtan(fnum1);
                   D0
```

FUNCTION

    Accepts a floating-point number representing the tangent of an angle and returns the value of said angle in radians

INPUTS

    fnum1 - floating-point number

RESULT

    fnum2 - floating-point number

BUGS

    None

SEE ALSO

SPCmp

NAME

    SPCmp -- compare two floating-point numbers and set
            appropriate condition codes

C USAGE

```
if (SPCmp(fnum1, fnum2)) {...}
          D1     D0
```

FUNCTION

Accepts two floating-point numbers and returns the condition codes set to indicate the result of said comparison. Additionally, the integer functional result is returned to indicate the result of said comparison.

INPUTS

fnum1 - floating-point number
fnum2 - floating-point number

RESULT

Condition codes set to reflect the following branches:

```
GT - fnum2 >  fnum1
GE - fnum2 >= fnum1
EQ - fnum2 =  fnum1
NE - fnum2 != fnum1
LT - fnum2 <  fnum1
LE - fnum2 <= fnum1
```

Integer functional result as:

```
+1 => fnum1 > fnum2
-1 => fnum1 < fnum2
 0 => fnum1 = fnum2
```

BUGS

None

SEE ALSO

SPCos

NAME

SPCos -- obtain the cosine of the floating point number

SYNOPSIS

```
fnum2 = SPCos(fnum1);
              D0
```

FUNCTION

Accepts a floating point number representing an angle in radians and returns the cosine of said angle

INPUTS

fnum1 - floating point number

RESULT

fnum2 - floating point number

BUGS

None

SEE ALSO

SPCosh

NAME

    SPCosh -- obtain the hyperbolic cosine of the floating point number

SYNOPSIS

```
fnum2 = SPCosh(fnum1);
                D0
```

FUNCTION

    Accepts a floating point number representing an angle in
    radians and returns the hyperbolic cosine of said angle

INPUTS

    fnum1 - floating point number

RESULT

    fnum2 - floating point number

BUGS

    None

SEE ALSO

SPDiv

NAME

    SPDiv -- divide two floating-point numbers

C USAGE

```
fnum3 = SPDiv(fnum1, fnum2);
              D1     D0
```

FUNCTION

    Accepts two floating-point numbers and returns the arithmetic
    division of said numbers.

INPUTS

    fnum1 - floating-point number
    fnum2 - floating-point number

RESULT

    fnum3 - floating-point number

BUGS

    None

SEE ALSO

SPExp

NAME

    SPExp -- obtain the exponent (e**X) of the floating-point number

SYNOPSIS

```
fnum2 = SPExp(fnum1);
              D0
```

FUNCTION

    Accepts a floating-point number and returns e raised to the
    input numbers power

INPUTS

    fnum1 - floating-point number

RESULT

    fnum2 - floating-point number

BUGS

    None

SEE ALSO

SPFieee

NAME

    SPFieee -- convert an IEEE standard number to FFP format

SYNOPSIS

```
fnum = SPFieee(ieeenum);
               D0
```

FUNCTION

    Accepts an IEEE standard format number and returns
    the same number, only converted into Motorola fast
    floating-point format

INPUTS

    ieeenum - floating-point number (IEEE STD format)

RESULT

    fnum - floating-point number (Motorola FFP format)

BUGS

    None

SEE ALSO

SPFlt

NAME

SPFlt -- convert integer number to fast floating-point

C USAGE

```
fnum = SPFlt(inum);
               D0
```

FUNCTION

Accepts an integer and returns the converted floating-point result of said number.

INPUTS

inum - signed integer number

RESULT

fnum - floating-point number

BUGS

None

SEE ALSO

SplitCList

NAME

SplitCList -- split a clist

SYNOPSIS

```
tailCList = SplitCList(cList)
D0                     A0
```

FUNCTION

Splits a clist into two clists. The original clist will contain the head of the clist up to but not including the mark (obtained via the MarkCList command). A new clist will be created and returned containing the bytes associated with the mark thru the end of the original clist.

INPUTS

cList -
a longword descriptor for a clist that can be used for clist functions.

RESULTS

tailCList-
a longword descriptor for a clist that contains the tail end of the original clist.

EXCEPTIONS

If there is not enough memory to build the new clist or the mark is invalid, tailCList is negative.

SPLog

NAME

    SPLog -- obtain the natural logarithm of the floating-point number

SYNOPSIS

```
fnum2 = SPLog(fnum1);
                D0
```

FUNCTION

    Accepts a floating-point number and returns the natural
    logarithm (base e) of said number

INPUTS

    fnum1 - floating-point number

RESULT

    fnum2 - floating-point number

BUGS

    None

SEE ALSO

SPLog10

NAME

    SPLog10 -- obtain the naparian logarithm (base 10) of the
               floating-point number

SYNOPSIS

```
fnum2 = SPLog10(fnum1);
                  D0
```

FUNCTION

    Accepts a floating-point number and returns the naparian
    logarithm (base 10) of said number

INPUTS

    fnum1 - floating-point number

RESULT

    fnum2 - floating-point number

BUGS

    None

SEE ALSO

SPMul

NAME

    SPMul -- multiply two floating-point numbers

C USAGE

```
fnum3 = SPMul(fnum1, fnum2);
              D1     D0
```

FUNCTION

    Accepts two floating-point numbers and returns the arithmetic
    multiplication of said numbers.

INPUTS

    fnum1 - floating-point number
    fnum2 - floating-point number

RESULT

    fnum3 - floating-point number

BUGS

    None

SEE ALSO

SPNeg

NAME

    SPNeg -- negate the supplied floating-point number

C USAGE

```
fnum2 = SPNeg(fnum1);
              D0
```

FUNCTION

    Accepts a floating-point number and returns the value
    of said number after having been subtracted from 0.0

INPUTS

    fnum1 - floating-point number

RESULT

    fnum2 - floating-point negation of fnum1

BUGS

    None

SEE ALSO

SPPow

NAME

    SPPow -- obtain the exponentiation of two FFP numbers

SYNOPSIS

```
fnum3 = SPPow(fnum1, fnum2);
              D1     D0
```

FUNCTION

    Accepts two (2) floating-point numbers and returns the
    result of fnum1 raised to the fnum2 power

INPUTS

    fnum1 - floating-point number
    fnum2 - floating-point number

RESULT

    fnum3 - floating-point number

BUGS

    None

SEE ALSO

SPSin

NAME

    SPSin -- obtain the sine of the floating-point number

SYNOPSIS

```
fnum2 = SPSin(fnum1);
              D0
```

FUNCTION

    Accepts a floating-point number representing an angle in
    radians and returns the sine of said angle

INPUTS

    fnum1 - floating-point number

RESULT

    fnum2 - floating-point number

BUGS

    None

SEE ALSO

SPSincos

NAME

SPSincos -- obtain the sine & cosine of the FFP number

SYNOPSIS

```
fnum3 = SPSincos(fnum1, &fnum2);
                 D1     D0
```

FUNCTION

Accepts a floating-point number representing an angle in radians and returns both the sine & cosine of said angle

INPUTS

```
fnum1  - floating-point number
&fnum2 - address of cosine result
```

RESULT

```
fnum2 - floating-point number (cosine)
fnum3 - floating-point number (sine)
```

BUGS

None

SEE ALSO

SPSinh

NAME

SPSinh -- obtain the hyperbolic sine of the floating-point number

SYNOPSIS

```
fnum2 = SPSinh(fnum1);
               D0
```

FUNCTION

Accepts a floating-point number representing an angle in radians and returns the hyperbolic sine of said angle

INPUTS

fnum1 - floating-point number

RESULT

fnum2 - floating-point number

BUGS

None

SEE ALSO

SPSqrt

NAME

SPSqrt -- obtain the square root of the floating-point number

SYNOPSIS

```
fnum2 = SPSqrt(fnum1);
               D0
```

FUNCTION

Accepts a floating-point number and returns the square root of said number

INPUTS

fnum1 - floating-point number

RESULT

fnum2 - floating-point number

BUGS

None

SEE ALSO

SPSub

NAME

SPSub -- subtract two floating-point numbers

C USAGE

```
fnum3 = SPSub(fnum1, fnum2);
              D1     D0
```

FUNCTION

Accepts two floating-point numbers and returns the arithmetic subtraction of said numbers.

INPUTS

fnum1 - floating-point number
fnum2 - floating-point number

RESULT

fnum3 - floating-point number

BUGS

None

SEE ALSO

SPTanh

NAME

    SPTanh -- obtain the hyperbolic tangent of the floating-point number

SYNOPSIS

```
fnum2 = SPTanh(fnum1);
               D0
```

FUNCTION

    Accepts a floating-point number representing an angle in
    radians and returns the hyperbolic tangent of said angle

INPUTS

    fnum1 - floating-point number

RESULT

    fnum2 - floating-point number

BUGS

    None

SEE ALSO

SPTieee

NAME

    SPTieee -- convert an FFP number to IEEE standard format

SYNOPSIS

```
ieeenum = SPTieee(fnum);
```

FUNCTION

    Accepts a Motorola fast floating-point number and
    returns the same number, only converted into IEEE
    standard format

INPUTS

    fnum - floating-point number (Motorola FFP format)

RESULT

    ieeenum - floating-point number (IEEE STD format)

BUGS

    None

SEE ALSO

SPTst

NAME

SPTst -- compare a fast floating-point number against the value zero (0.0) and set the appropriate condition codes

C USAGE

```
if (!(SPTst(fnum))) {...}
           D1
```

FUNCTION

Accepts a floating-point number and returns the condition codes set to indicate the result of a comparison against the value of zero (0.0). Additionally, the integer functional result is returned.

INPUTS

fnum - floating-point number

RESULT

Condition codes set to reflect the following branches:

```
EQ - fnum =  0.0
NE - fnum != 0.0
PL - fnum >= 0.0
MI - fnum <  0.0
```

Integer functional result as:

```
+1 => fnum > 0.0
-1 => fnum < 0.0
 0 => fnum = 0.0
```

BUGS

None

SEE ALSO

SubCList

NAME

SubCList -- copy a substring from a clist

SYNOPSIS

```
cList = SubCList(cList, index, length)
D0               A0     D0     D1
```

FUNCTION

Copies a substring of the cList into a new cList created by this operation. Starts at offset index into the character list and copies for length bytes. The source clist is not altered.

INPUTS

cList -
The clist descriptor used to manage this character list, as returned by NewCList or StrToCL.

index -
The offset in the character list to start copying the substring from. An index of 0 is the first character in the clist.

length -
The number of bytes to copy.

RESULTS

cList -
a longword descriptor for a clist that can be used for clist functions.

EXCEPTIONS

If cList is negative, not enough space was available for the new clist.

If the substring does not exist for the index and length specified, the resulting clist will be shorter than expected.

SumLibrary

NAME

SumLibrary -- compute and check the checksum on a library

SYNOPSIS

```
SumLibrary(library)
           A1
```

FUNCTION

SumLibrary computes a new checksum on a library. It can also be used to check an old checksum. If an old checksum does not match and the library has not been marked as changed then the system will alert the user.

INPUTS

library - a pointer to the library to be changed

EXCEPTIONS

An alert will occur if the checksum fails.

SuperState

NAME

SuperState -- enter supervisor state with user stack

SYNOPSIS

```
oldSysStack = SuperState()
D0
```

FUNCTION

Enter supervisor mode while running on the user's stack. The user still has access to user stack variables. Be careful though, the user stack must be large enough to accommodate space for all interrupt data -- this includes all possible nesting of interrupts. This function is a no op when called from supervisor state.

RESULTS

oldSysStack - system stack pointer

Save this. It will come in useful when you return to user state. If the system is already in supervisor mode, oldSysStack is zero.

SEE ALSO

UserState

SwapBitsRastPortClipRect

NAME

SwapBitsRastPortCLipRect -- swap bits between common bitmap and obscured ClipRect

SYNOPSIS

```
SwapBitsRastPortClipRect( rp, cr )
                          a0  a1
```

INPUTS

```
rp   = pointer to rastport
cr   = pointer to cliprect to swap bits with
```

FUNCTION

Support routine useful for those that need to do some operations not done by the layer library. Allows programmer to swap the contents of a small BitMap with a subsection of the display. This is accomplished without using extra memory. The bits in the display RastPort are exchanged with the bits in the ClipRect's BitMap.

SEE ALSO

SyncSBitMap

NAME

SyncSBitMap -- synchronize Super BitMap with whatever is in the standard Layer bounds

SYNOPSIS

```
SyncSBitMap( layer * )
             a0
```

FUNCTION

Copies all bits from ClipRects in Layer into Super BitMap BitMap. This is used for those functions that do not want to deal with the ClipRect structures but do want to be able to work with a SuperBitMap Layer.

INPUTS

layer is a pointer to a Layer that has a SuperBitMap The Layer should already be locked by the caller.

SEE ALSO

CopySBitMap

```
Text

NAME
    Text -- write text characters (no formatting)

SYNOPSIS
    error = Text(RastPort, string, count), gfxLib
    D0           A1        A0      D0-0:16   A6

FUNCTION
    This graphics function writes printable text characters to the
    specified RastPort at the current position.  No control meaning
    is applied to any of the characters, and only text on the
    current line is output.

INPUTS
    RastPort - a pointer to the RastPort which describes where the
        text is to be output
    count - the string length.  If zero, there are no characters
        to be output.
    string - the address of string to output

EXCEPTIONS
    BOUNDS -
        If the characters displayed run past the RastPort boundary,
        the current position is truncated to the boundary, and
        thus does not represent the true position.
```

```
TextLength

NAME
    TextLength -- determine raster length of text data

SYNOPSIS
    length = TextLength(rastPort, string, count)
    D0                  A1        A0      D0-0:16

FUNCTION
    This graphics function determines the length that text data
    would occupy if output to the specified RastPort with the
    current attributes.  The length is specified as the number of
    raster dots: to determine what the current position would be
    after a Write using this string, add the length to cp_x (cp_y
    is unchanged by Write).

INPUTS
    RastPort - a pointer to the RastPort, which describes where the
        text attributes reside.
    string - the address of string to determine the length of
    count - the string length.  If zero, there are no characters
        in the string.

RESULTS
    length - the number of pixels in x this text would occupy, not
        including any negative kerning that may take place at
        the beginning of the text string, nor taking into
        account the effects of any clipping that may take
        place.

BUGS
    A length that would overflow single-word arithmetic is not
    calculated correctly.
```

ThinLayerInfo

NAME
ThinLayerInfo -- convert 1.1 LayerInfo to 1.0 LayerInfo

SYNOPSIS
```
ThinLayerInfo(li)
              a0
```

INPUTS
li = pointer to LayerInfo structure

FUNCTION
Returns the extra memory needed that was allocated with FattenLayerInfo. This must be done prior to freeing the Layer_Info structure itself. V1.1 software should be using DisposeLayerInfo.

SEE ALSO
layers.h
DisposeLayerInfo, FattenLayerInfo

Translate

NAME
Translate -- Converts an English string into phonetics

SYNOPSIS
```
rtnCode = Translate(instring, inlen, outbuf, outlen)
```

FUNCTION
The translate function converts an English string into a string of phonetic codes suitable as input to the narrator device.

INPUTS
```
instring - pointer to English string
inlen    - length of English string
outbuf   - a char array which will hold the phonetic codes
outlen   - the length of the output array
```

RESULTS
Translate will return a zero if no error has occurred. The only error that can occur is overflowing the output buffer. If Translate determines that an overflow will occur, it will stop the translation at a word boundary before the overflow happens. If this occurs, Translate will return a negative number whose absolute value indicates where in the INPUT string Translate stopped. The user can then use the offset -rtnCode from the beginning of the buffer in a subsequent Translate call to continue the translation where s/he left off.

SEE ALSO

```
UnGetCLChar

NAME
       UnGetCLChar -- add a byte to the beginning of a character list

SYNOPSIS
       error = UnGetCLChar(cList, byte)
       D0                  A0     D0

FUNCTION
       Adds a byte to the beginning of the character list described
       by the cList.

INPUTS
       cList -
               The clist header used to manage this character list,
               as returned by AllocCList or StrToCL.
       byte    -
               The byte to add to the beginning of the character list

RESULTS
       error   -
               non-zero indicates the byte could not be added
```

```
UnGetCLWord

NAME
       UnGetCLWord -- add a word to the beginning of a character list

SYNOPSIS
       error = UnGetCLWord(cList, word)
       D0                  A0     D0

FUNCTION
       Adds a word to the beginning of the character list described
       by the cList.

INPUTS
       cList -
               The clist header used to manage this character list,
               as returned by AllocCList or StrToCL.
       word    -
               The word to add to the beginning of the character list

RESULTS
       error   -
               non-zero indicates the number of bytes not added.
               Partial words are not added, so error is always zero
               or two.
```

```
UnLoadSeg

NAME
    UnLoadSeg -- unload a segment previously loaded by LoadSeg

SYNOPSIS
    UnLoadSeg( segment )
               D1

FUNCTION
    UnLoadSeg unloads the segment identifier that was returned by LoadSeg.
    'segment' may be zero.

INPUTS
    segment - BCPL pointer to a segment
```

```
UnLock

NAME
    UnLock -- unlock a directory or file

SYNOPSIS
    UnLock( lock )
            D1

FUNCTION
    UnLock removes a filing system lock obtained from Lock, DupLock, or
    CreateDir.

INPUTS
    lock - BCPL pointer to a lock
```

UnlockLayer

NAME
```
UnlockLayer -- unlock layer and allow graphics routines
               to use it.
```

SYNOPSIS
```
UnlockLayer( l )
             a0
```

INPUTS
```
l   = pointer to a layer
```

FUNCTION

When finished changing the ClipRects or whatever you were doing with this layer, you must unlock it it to allow the other task to proceed with its graphic output.

SEE ALSO

layers.h

UnlockLayerInfo

NAME
```
UnlockLayerInfo -- unlock the LayerInfo structure.
```

SYNOPSIS
```
UnlockLayerInfo( li )
                 a0
```

INPUTS
```
li  = pointer to LayerInfo structure
```

FUNCTION

Before doing an operation that requires the LayerInfo structure, makes sure that no other task is also using the LayerInfo structure. This procedure returns when the LayerInfo belongs to this task. There should be an UnlockLayerInfo for every LockLayerInfo.

All layer routines presently LockLayerInfo when they start-up and UnlockLayerInfo as they exit. Programmers will need to use these Lock/Unlock routines if they wish to do something with the layer structure that is not supported by the layer library.

SEE ALSO

layers.h UnlockLayerInfo()

UnlockLayerRom

NAME
UnlockLayerRom -- unlock Layer structure by rom (gfx.lib) code

SYNOPSIS
```
UnlockLayerRom( layer )
                a5
```

FUNCTION

Decrements lock count and unlocks layer if the result is 0.
Once the layer is really unlocked the, layerlib may then
modify this layer.

INPUTS
layer = pointer to Layer structure

NOTE
There should be an UnlockLayer for every LockLayer.
This call does destroy scratch registers.

SEE ALSO
layers.h, LockLayer()

UnlockLayers

NAME
UnlockLayers -- unlock all layers from graphics output
Restart graphics output to layers that
have been waiting

SYNOPSIS
```
UnlockLayers( li )
              a0
```

INPUTS
li = pointer to LayerInfo structure

FUNCTION
Make all layers in this layer list unlocked.
Then call UnlockLayerInfo.

SEE ALSO
layers.h UnlockLayer()

```
UnPutCLChar

   NAME
        UnPutCLChar -- get a byte from the end of a character list

   SYNOPSIS
        byte = UnPutCLChar(cList)
        D0                 A0

   FUNCTION
        Gets a byte from the end of the character list described by the
        cList.

   INPUTS
        cList -
                The clist header used to manage this character list,
                as returned by AllocCList or StrToCL.

   RESULTS
        byte    -
                The byte from the end of the character list.  If no
                data is available, the upper three bytes are set
                (longword is -1).
```

```
UnPutCLWord

   NAME
        UnPutCLWord -- get a word from the end of a character list

   SYNOPSIS
        word = UnPutCLWord(cList)
        D0                 A0

   FUNCTION
        Gets a word from the end of the character list described by the
        cList.

   INPUTS
        cList -
                The clist header used to manage this character list,
                as returned by AllocCList or StrToCL.

   RESULTS
        word    -
                The word from the beginning of the character list.
                If no data is available, the upper two bytes are set
                (longword is -1).  Partial words (1 byte) are not
                returned.
```

```
UpfrontLayer

NAME
        UpfrontLayer -- put layer in front of all other layers


SYNOPSIS
        BOOLEAN UpfrontLayer( li, l )
                              a0  a1

INPUTS
        li  = pointer to LayerInfo structure
        l   = pointer to a nonbackdrop layer

FUNCTION
        Moves this layer in front of all others, swapping bits
        in and out of the display with other layers.
        If this is a refresh layer, collects damage list and
        sets bit in Flags if redraw required.
        By clearing the BACKDROP bit in the layers Flags, you may
        bring a Backdrop layer up to the front of all other layers.

RETURNS
        TRUE    if operation successful
        FALSE   if operation unsuccessful (probably out of memory)

SEE ALSO
       layers.h
```

```
UserState

   NAME
        UserState -- return to user state with user stack

   SYNOPSIS
        UserState(sysStack)
                  D0

   FUNCTION
        Return to user state with user stack, from supervisor state
        with user stack.  This function is normally used in
        conjunction with the SuperState function above.

        This function must not be called from the user state.

   INPUT
        sysStack - supervisor stack pointer

   SEE ALSO
        SuperState
```

VBeamPos

NAME
    VBeamPos -- get vertical beam position at this instant

SYNOPSIS
```
pos = VBeamPos()
 d0
```

FUNCTION
    Gets the vertical beam position from the hardware.

INPUTS
    None

RESULT
    Interrogates hardware for beam position and returns value.
    valid results in the range of 0-255

BUGS
    Because of hardware constraints, if the vertical beam is
    between 256 and 262, 0 through 6 may be returned.

NOTE
    Because of multitasking, the actual value returned may have
    no use.

ViewAddress

NAME
    ViewAddress -- return the address of the Intuition View
    structure

SYNOPSIS
```
ViewAddress()
```

FUNCTION
    This routine returns the address of the Intuition View
    structure. If you want to use any of the graphics, text, or
    animation primitives in your window and that primitive
    requires a pointer to a View, this routine will return the
    address of the View for you.

INPUTS
    None.

RESULT
    Returns the address of the Intuition View structure.

BUGS
    It would be hard for this routine to have a bug.

SEE ALSO
    All of the graphics, text, and animation primitive.

ViewPortAddress

NAME

```
ViewPortAddress  --  return the address of a window's
                     ViewPort structure
```

SYNOPSIS

```
ViewPortAddress(Window)
                A0
```

FUNCTION

This routine returns the address of the ViewPort structure associated with the specified window. This is actually the ViewPort of the screen within which the window is displayed. If you want to use any of the graphics, text, or animation primitives in your window and that primitive requires a pointer to a ViewPort structure, you can use this call.

INPUTS

Window = pointer to the Window structure for which you want the ViewPort address.

RESULT

Returns the address of the window's ViewPort structure.

BUGS

It would be hard for this routine to have a bug.

SEE ALSO

All of the graphics, text, and animation primitives.

Wait

NAME

Wait -- wait for one or more signals

SYNOPSIS

```
signals = Wait(signalSet)
D0             D0
```

FUNCTION

This function will cause the current task to suspend waiting for one or more signals. When any of the specified signals occurs, the task will return to the ready state. If a signal occurred prior to calling Wait, the wait condition will be immediately satisfied, and the task will continue to run.

This function cannot be called while in supervisor mode!

INPUT

signalSet - the set of signals for which to wait. Each bit represents a particular signal.

RESULTS

WaitBlit

NAME

WaitBlit -- Waits for the blitter to be finished before proceeding with anything else.

SYNOPSIS

```
WaitBlit()
```

FUNCTION

WaitBlit returns when the blitter is idle. This function should normally be used only when dealing with the blitter in a synchronous manner, such as when using OwnBlitter and DisownBlitter. WaitBlit does not wait for all blits queued up using QBlit or QBSBlit.

INPUTS

None

RESULT

Your program waits until the blitter is finished.

BUGS

Because of a bug in Agnus, this code may return too soon when the blitter has in fact not started the blit yet, even though BltSize has been written. This most often occurs in a heavily loaded system with extended memory, HIRES, and 4 bitplanes.

SEE ALSO

OwnBlitter, DisownBlitter

WaitBOVP

NAME

WaitBOVP -- wait till vertical beam reaches bottom of this ViewPort.

SYNOPSIS

```
WaitBOVP( ViewPort )
          a0
```

FUNCTION

Returns when vertical beam reaches bottom of this viewport.

INPUTS

ViewPort = pointer to ViewPort structure

WaitForChar

NAME

    WaitForChar -- determine whether characters arrive at a virtual
                   terminal within a time limit

SYNOPSIS

```
bool = WaitForChar( file, timeout )
 D0                 D1     D2
```

FUNCTION

If a character is available to be read from the file associated with the handle 'file' within a certain time, indicated by 'timeout,' WaitForChar returns -1 (TRUE); otherwise, it returns 0 (FALSE). If a character is available, you can use Read to read it. Note that WaitForChar is only valid when the I/O streams are connected to a virtual terminal device. 'timeout' is specified in microseconds.

INPUTS

file - BCPL pointer to a file handle
timeout - integer

RESULTS

bool - boolean

WaitIO

NAME

WaitIO -- wait for completion of an I/O request

SYNOPSIS

```
error = WaitIO(iORequest)
D0             A1
```

FUNCTION

This function waits for the specified I/O request to complete. If the I/O has already completed, this function will return immediately.

This function should be used with care, as it does not return until the I/O request completes; if the I/O never completes, this function will never return, and your task will hang. If this situation is a possibility, it is safer to use the Wait function, which will return when any particular signal is received. This is how I/O timeouts can be properly handled.

INPUTS

iORequest - pointer to an I/O request block

RESULTS

error - zero if successful, else an error is returned

SEE ALSO

SendIO

WaitPort

NAME
    WaitPort -- wait for a given port to be non-empty

SYNOPSIS
```
message = WaitPort(port)
D0                 A0
```

FUNCTION
    This function waits for the given port to become non-empty. If necessary, the Wait function will be called to wait for the port signal. If a message is already present at the port, this function will return immediately. The return value is always a pointer to the first message queued (but it is not removed from the queue.

INPUT
    port - a pointer to the message port

RETURN
    message - a pointer to the first available message

SEE ALSO
    GetMsg

WaitTOF

NAME
    WaitTOF -- wait for the top of the next video frame

SYNOPSIS
    WaitTOF()

FUNCTION
    Waits for vertical blank to occur and all vertical blank service routines to complete before returning to caller.

BUGS

INPUTS
    none

WBenchToBack

NAME
    WBenchToBack -- send the Workbench screen in back of all
                    screens

SYNOPSIS
    WBenchToBack()

FUNCTION
    This routine causes the Workbench screen, if it is currently
    opened, to go to the background. This does not "move" the
    screen up or down; it affects only the depth arrangement of
    the screen.

    If the Workbench screen was opened, this function returns
    TRUE; otherwise, it returns FALSE.

INPUTS
    None

RESULT
    If the Workbench screen was opened, this function returns
    TRUE; otherwise, it returns FALSE.

BUGS
    Non.

SEE ALSO
    WBenchToFront()

WBenchToFront

NAME
    WBenchToFront -- bring the Workbench screen in front of
                     all screens

SYNOPSIS
    WBenchToFront()

FUNCTION
    This routine causes the Workbench screen, if it is currently
    opened, to come to the foreground. This does not "move" the
    screen up or down; it affects only the depth arrangement of
    the screen.

    If the Workbench screen was opened, this function returns
    TRUE; otherwise, it returns FALSE.

INPUTS
    None

RESULT
    If the Workbench screen was opened, this function returns
    TRUE; otherwise, it returns FALSE.

BUGS
    None

SEE ALSO
    WBenchToBack()

WhichLayer

NAME

    WhichLayer -- in which Layer is this point located?

SYNOPSIS

```
layer = (struct Layer *)WhichLayer( li, x, y )
                                    a0  d0 d1
```

INPUTS

    li   = pointer to LayerInfo structure
    (x,y) = coordinate in the BitMap

FUNCTION

Starting at the topmost layer, checks to see if this point (x,y) occurs in this layer. If it does, returns the pointer to this layer. Returns 0 if there is no layer at this point.

SEE ALSO

    layers.h

WindowLimits

NAME

    WindowLimits -- set the minimum and maximum limits of the window

SYNOPSIS

```
WindowLimits(Window,MinWidth,MinHeight,MaxWidth,MaxHeight)
             A0     D0       D1        D2       D3
```

FUNCTION

This routine allows you to adjust the minimum and maximum limits of the window's size. Until this routine is called, the window's size limits are equal to the initial limits specified by the call to OpenWindow().

If you do not want to change any one of the dimensions, set the limit argument for that dimension to zero. If any limit argument is equal to zero, that argument is ignored and the initial setting of that parameter remains undisturbed.

If any argument is out of range (minimums greater than the current size, maximums less than the current size), that limit will be ignored, though the others will still take effect if they are in range. If any argument is out of range, the return value from this procedure will be FALSE. If all arguments are valid, the return value will be TRUE.

If the user is currently sizing this window, the new limits will not take effect until after the sizing is completed.

INPUTS

Window = pointer to a Window structure.

MinWidth, MinHeight, MaxWidth, MaxHeight = the new limits for the size of this window. If a limit is set to zero, it will be ignored and that setting will be unchanged.

RESULT

Returns TRUE if everything was in order. If a parameter was out of range (minimums greater than current size, maximums less than current size), FALSE is returned, and the errant limit request is not fulfilled (though the valid ones will be).

BUGS

    None

SEE ALSO

    OpenWindow()

WindowToBack

NAME
    WindowToBack -- ask Intuition to send this window to the back

SYNOPSIS

```
WindowToBack(Window)
             A0
```

FUNCTION
    This routine sends a request to Intuition asking to send the window in back of all other windows in the screen. Note that the window will not be depth arranged immediately; it will be arranged the next time Intuition receives an input event, which happens currently at a minimum rate of ten times per second and a maximum of sixty times a second.

    Remember that Backdrop windows cannot be depth-arranged.

INPUTS
    Window = pointer to the structure of the window to be sent to the back.

RESULT
    None

BUGS
    None

SEE ALSO
    MoveWindow(), SizeWindow(), WindowToFront(.

WindowToFront

NAME
    WindowToFront -- ask Intuition to bring this window to the front

SYNOPSIS

```
WindowToFront(Window)
              A0
```

FUNCTION
    This routine sends a request to Intuition asking to bring the window in front of all other windows in the screen.

    Note that the window will not be depth-arranged immediately. It will be arranged the next time Intuition receives an input event, which happens currently at a minimum rate of ten times per second and a maximum of sixty times a second.

    Remember that Backdrop windows cannot be depth arranged.

INPUTS
    Window = pointer to the structure of the window to be brought to front.

RESULT
    None

BUGS
    None

SEE ALSO
    MoveWindow(), SizeWindow(), WindowToBack()

Write

NAME
    Write -- write bytes of data to a file.

SYNOPSIS
```
returnedLength = Write( file, buffer, length)
 D0                     D1    D2      D3
```

FUNCTION
    You can copy data with a combination of Read and Write. Write writes bytes of data to the opened file 'file.' 'length' refers to the actual length of data to be transferred; 'buffer' refers to the buffer size.

    Write returns a value that indicates the length of information actually written. That is to say, when 'length' is greater than zero, the value of 'length' is the number of characters written. A value of -1 indicates an error. The user of this call must always check for an error return which may, for example, indicate that the disk is full.

INPUTS
    file - BCPL pointer to a file handle
    buffer - address of the first position in the buffer
    length - integer

RESULTS
    returnedLength - integer

WritePixel

NAME
    WritePixel -- change the pen number of one specific pixel in a specified RasterPort.

SYNOPSIS
```
WritePixel(  rp, x,  y)
             a1 D0  D1
```

FUNCTION
    Changes the pen number of the selected pixel in the specified RastPort to that currently specified by PenA, the primary drawing pen. Obeys DrawModes and minterms in RastPort.

INPUTS
    x - the X coordinate within the RastPort at which the selected pixel is located.
    y - the Y coordinate.
    rp - a pointer to the RastPort to use.

RESULT
    The pixel is changed.

BUGS

SEE ALSO
    ReadPixel

XorRectRegion

NAME

```
XorRectRegion -- perform second XOR operation of rectangle
                 with region, leaving result in region
```

SYNOPSIS

```
XorRectRegion(region,rectangle)
              a0     a1
```

Function

Clips away any portion of the region that exists outside of the rectangle. Leaves the result in region.

INPUTS

```
region      = pointer to Region structure
rectangle   = pointer to Rectangle structure
```

BUGS

This one does not work yet.

Appendix B

Device Summaries

This appendix contains UNIX-like summaries for the commands that may be applied to ROM-resident (or Kickstart-resident) devices, as well as summaries of routines in disk-loadable devices. These documentation files are organized by device. Following this introduction is a listing of each command, followed by the library in which it is located. Note that there are no summaries for the trackdisk device; see the "Trackdisk Device" chapter for information about this device.

The tutorial sections of this manual give you information about how these device commands relate to each other and the prerequisites for calling them. To use any of the device commands, you must first open the device. The correct calling sequence for opening each device is shown in the device tutorial chapter itself. This introduction lists the names of the current set of devices that are included with the system.

If the device is disk-resident, it is loaded and initialized. The **OpenDevice()** call fills in the **io_Device** and **io_Unit** fields of your I/O request block, thereby tying that request block to a specific device. When you say **DoIO(IORequest)**, the **DoIO()** routine, among others, looks in the **IORequest** to find out which device is to be used. This prevents your needing to have a complete (duplicate) set of I/O transmit and control functions for each device.

The following is a list of the names of the devices that are currently a part of the Amiga software. All of these are to be treated as null-terminated strings, which are given to the **OpenDevice()** function. For example:

error = OpenDevice("keyboard.device",0,IORequest,0);

See **OpenDevice()** in the "Routine Summaries" appendix for the meaning of the various fields of this command.

Device Names

audio.device
clipboard.device
console.device
gameport.device
input.device
keyboard.device
narrator.device
parallel.device
printer.device
serial.device
timer.device
trackdisk.device

When you have finished using a device, at the end of your program you should close it, using the **CloseDevice()** function as follows:

CloseDevice(IORequest);

You must also free whatever memory you may have dedicated to device communication before your program ends. Note that you must make sure that the device has responded to all of your I/O requests by returning your **IORequest** blocks before you attempt to close the device or deallocate the memory.

If the system is running out of memory and needs to free up space, it can check the accessors field for various devices. If you have closed the device, it decrements its accessors count. For those devices whose accessors value is zero, the system can retrieve the memory that the device was using.

Certain devices—the timer and console devices—have routines associated with them. These devices can almost be treated as libraries. To access these routines, you must, as with a library, provide a value to a specific base variable name:

Device	**Base Address Name**
timer	TimerBase
console	ConsoleDevice

To get this base address, you must open the device, then copy the **io_Device** field from your **IORequest** block as the base address for this "library" routine. Note that unlike when you are using libraries, you need not issue a **CloseLibrary()** command after using the device routines. The **CloseDevice()** function call is sufficient.

An example showing how to obtain the base address for the timer device is shown in the "Timer Device" chapter in this manual.

Contents

OpenDevice	console.device
OpenDevice	console.device
PERVOL	audio.device
Post	clipboard.device
PrtCommand	printer.device
Query	serial.device
Query	parallel.device
RawKeyConvert	console.device
RawKeyConvert	console.device
RawWrite	printer.device
READ	audio.device
Read	serial.device
Read	console.device
Read	console.device
Read	narrator.device
Read	parallel.device
Read	clipboard.device
ReadEvent	gameport.device
ReadEvent	keyboard.device
ReadMatrix	keyboard.device
RemHandler	input.device
RemResetHandler	keyboard.device
RESET	audio.device
Reset	input.device
Reset	serial.device
Reset	printer.device
Reset	keyboard.device
Reset	narrator.device
Reset	parallel.device
Reset	clipboard.device
ResetHandlerDone	keyboard.device
SetCType	gameport.device
SetMPort	input.device
SetMTrig	input.device
SetMType	input.device
SetParams	serial.device
SetParams	parallel.device
SetPeriod	input.device
SETPREC	audio.device
SetThresh	input.device
SetTrigger	gameport.device
START	audio.device
Start	input.device
Start	serial.device
Start	printer.device
Start	narrator.device
Start	parallel.device
STOP	audio.device
Stop	serial.device
Stop	printer.device
Stop	parallel.device
SubTime	timer.device
TR_ADDREQUEST	timer.device
TR_GETSYSTIME	timer.device
TR_SETSYSTIME	timer.device
UPDATE	audio.device
Update	clipboard.device
WAITCYCLE	audio.device
WRITE	audio.device
Write	serial.device

Write	console.device
Write	console.device
Write	printer.device
Write	narrator.device
Write	parallel.device
Write	clipboard.device
WriteEvent	input.device

Contents

```
audio.device/AbortIO

   NAME
       AbortIO - abort a device command

   SYNOPSIS
       AbortIO(iORequest);
                  A1

   FUNCTION
       AbortIO tries to abort a device command.  It is allowed to be
       unsuccessful.  If the Abort is successful, the io_Error field of the
       iORequest contains an indication that IO was aborted.

   INPUTS
       iORequest -- pointer to the I/O Request for the command to abort
```

audio.device/BeginIO

NAME
    BeginIO - dispatch a device command

SYNOPSIS
```
BeginIO(iORequest);
        A1
```

FUNCTION
    BeginIO has the responsibility of dispatching all device commands. Immediate commands are always called directly, and all other commands are queued to make them single threaded.

INPUTS
    iORequest -- pointer to the I/O Request for this command

audio.device/BeginIO/ADCMD_ALLOCATE

NAME
    ADCMD_ALLOCATE -- allocate a set of audio channels

FUNCTION
    ADCMD_ALLOCATE is a command that allocates multiple audio channels. ADCMD_ALLOCATE takes an array of possible channel combinations (ioa_Data) and an allocation precedence (ln_Pri) and tries to allocate one of the combinations of channels.

If the channel combination array is zero length (ioa_Length), the allocation succeeds; otherwise, ADCMD_ALLOCATE checks each combination, one at a time, in the specified order, to find one combination that does not require ADCMD_ALLOCATE to steal allocated channels.

If it must steal allocated channels, it uses the channel combination that steals the lowest precedence channels. ADCMD_ALLOCATE cannot steal a channel of equal or greater precedence than the allocation precedence (ln_Pri).

If it fails to allocate any channel combination and the no-wait flag (ADIOF_NOWAIT) is set ADCMD_ALLOCATE returns a zero in the unit field of the I/O request (io_Unit) and an error (IOERR_ALLOCFAILED). If the no-wait flag is clear, it places the I/O request in a list that tries to allocate again whenever ADCMD_FREE frees channels or ADCMD_SETPREC lowers the channels' precedences.

If the allocation is successful, ADCMD_ALLOCATE checks if any channels are locked (ADCMD_LOCK) and if so, replies (ReplyMsg) the lock I/O request with an error (ADIOERR_CHANNELSTOLEN). Then it places the allocation I/O request in a list waiting for the locked channels to be freed. When all the allocated channels are unlocked, ADCMD_ALLOCATE:
- . resets (CMD_RESET) the allocated channels,
- . generates a new allocation key (ioa_AllocKey), if it is zero,
- . copies the allocation key into each of the allocated channels
- . copies the allocation precedence into each of the allocated channels, and
- . copies the channel bit map into the unit field of the I/O request.

If channels are allocated with a non-zero allocation key, ADCMD_ALLOCATE allocates with that same key; otherwise, it generates a new and unique key.

ADCMD_ALLOCATE is synchronous:
- . if the allocation succeeds and there are no locked channels to be stolen, or
- . if the allocation fails and the no-wait flag is set.

In either case, ADCMD_ALLOCATE replies only (mn_ReplyPort) if the quick flag (IOF_QUICK) is clear; otherwise, the allocation is asynchronous, so it clears the quick flag and replies the I/O request after the allocation is finished. If channels are stolen, all audio device commands return an error (IOERR_NOALLOCATION) when the former user tries to use them again. Do not use ADCMD_ALLOCATE in interrupt code.

If you decide to store directly to the audio hardware registers, you must either lock the channels you've allocated or set the precedence

```
    to maximum (ADALLOC_MAXPREC) to prevent the channels from being
    stolen.

    Under all circumstances, unless channels are stolen, you must free
    (ADCMD_FREE) all allocated channels when you are finished using them.

INPUTS
    ln_Pri       - allocation precedence (-128 thru 127)
    mn_ReplyPort- pointer to message port that receives I/O request after
                  the allocation completes is asynchronous or quick flag
                  (ADIOF_QUICK) is set
    io_Device    - pointer to device node, must be set by (or copied from
                  I/O block set by) OpenDevice function
    io_Command   - command number for ADCMD_ALLOCATE
    io_Flags     - flags, must be cleared if not used:
                  IOF_QUICK     - (CLEAR) reply I/O request
                                  (SET) only reply I/O request only if
                                        asynchronous (see above text)
                  ADIOF_NOWAIT- (CLEAR) if allocation fails, wait till is
                                          succeeds
                                (SET) if allocation fails, return error
                                        (ADIOERR_ALLOCFAILED)
    ioa_AllocKey- allocation key, zero to generate new key; otherwise,
                  it must be set by (or copied from I/O block set by)
                  OpenDevice function or previous ADCMD_ALLOCATE command
    ioa_Data     - pointer to channel combination options (byte array, bits
                  0 thru 3 correspond to channels 0 thru 3)
    ioa_Length   - length of the channel combination option array
                  (0 thru 16, 0 always succeeds)

OUTPUTS
    io_Unit      - bit map of successfully allocated channels (bits 0 thru
                  3 correspond to channels 0 thru 3)
    io_Flags     - IOF_QUICK flag cleared if asynchronous (see above text)
    io_Error     - error number:
                  0                    - no error
                  ADIOERR_ALLOCFAILED - allocation failed
```



```
audio.device/BeginIO/ADCMD_FINISH

   NAME
       ADCMD_FINISH -- abort writes in progress to audio channels

   FUNCTION
       ADCMD_FINISH is a command for multiple audio channels.  For each
       selected channel (io_Unit), if the allocation key (ioa_AllocKey) is
       correct and there is a write (CMD_WRITE)in progress, ADCMD_FINISH
       aborts the current write immediately or at the end of the current
       cycle depending on the sync flag (ADIOF_SYNCCYCLE).  If the allocation
       key is incorrect ADCMD_FINISH returns an error (ADIOERR_NOALLOCATION).
       ADCMD_FINISH is synchronous and replies only (mn_ReplyPort) if the
       quick flag (IOF_QUICK) is clear.  Do not use ADCMD_FINISH in interrupt
       code at interrupt level 5 or higher.

   INPUTS
       mn_ReplyPort- pointer to message port that receives I/O request
                     if the quick flag (IOF_QUICK) is clear
       io_Device   - pointer to device node, must be set by (or copied from
                     I/O block set by) OpenDevice function
       io_Unit     - bit map of channels to finish (bits 0 thru 3 correspond
                     to channels 0 thru 3)
       io_Command  - command number for ADCMD_FINISH
       io_Flags    - flags, must be cleared if not used:
                     IOF_QUICK      - (CLEAR) reply I/O request
                     ADIOF_SYNCCYCLE- (CLEAR) finish immediately
                                      (SET) finish at the end of current
                                            cycle

       ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                     set by) OpenDevice function or ADCMD_ALLOCATE command

   OUTPUTS
       io_Unit     - bit map of channels successfully finished (bits 0 thru 3
                     correspond to channels 0 thru 3)
       io_Error    - error number:
                     0                     - no error
                     ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                             does not match key for channel
```

```
audio.device/BeginIO/ADCMD_FREE

   NAME
       ADCMD_FREE -- free audio channels for allocation

   FUNCTION
       ADCMD_FREE is a command for multiple audio channels.  For each
       selected channel (io_Unit), if the allocation key (ioa_AllocKey) is
       correct, ADCMD_FREE does the following:
         . restores the channel to a known state (CMD_RESET),
         . changes the channels allocation key, and
         . makes the channel available for reallocation.
         . If the channel is locked (ADCMD_LOCK) ADCMD_FREE unlocks it and
           clears the bit for the channel (io_Unit) in the lock I/O request.
           If the lock I/O request has no channel bits set ADCMD_FREE replies
           the lock I/O request, and
         . checks if there are allocation requests (ADCMD_ALLOCATE) waiting
           for the channel.

       Otherwise, ADCMD_FREE returns an error (ADIOERR_NOALLOCATION).
       ADCMD_FREE is synchronous and replies only (mn_ReplyPort) if the quick
       flag (IOF_QUICK) is clear.  Do not use ADCMD_FREE in interrupt code.

   INPUTS
       mn_ReplyPort- pointer to message port that receives I/O request
                     if the quick flag (IOF_QUICK) is clear
       io_Device   - pointer to device node, must be set by (or copied from
                     I/O block set by) OpenDevice function
       io_Unit     - bit map of channels to free (bits 0 thru 3 correspond to
                     channels 0 thru 3)
       io_Command  - command number for ADCMD_FREE
       io_Flags    - flags, must be cleared if not used:
                     IOF_QUICK - (CLEAR) reply I/O request
       ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                     set by) OpenDevice function or ADCMD_ALLOCATE command

   OUTPUTS
       io_Unit     - bit map of channels successfully freed (bits 0 thru 3
                     correspond to channels 0 thru 3)
       io_Error    - error number:
                     0                   - no error
                     ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                           does not match key for channel
```

```
audio.device/BeginIO/ADCMD_LOCK

   NAME
       ADCMD_LOCK -- prevent audio channels from being stolen

   FUNCTION
       ADCMD_LOCK is a command for multiple audio channels.  For each
       selected channel (io_Unit), if the allocation key (ioa_AllocKey) is
       correct, ADCMD_LOCK locks the channel, preventing subsequent
       allocations (ADCMD_ALLOCATE or OpenDevice) from stealing the channel.
       Otherwise, ADCMD_LOCK returns an error (ADIOERR_NOALLOCATION) and will
       not lock any channels.

       Unlike setting the precedence (ADCMD_SETPREC, ADCMD_ALLOCATE or
       OpenDevice) to maximum (ADALLOC_MAXPREC) which would cause all
       subsequent allocations to fail, ADCMD_LOCK causes all higher
       precedence allocations, even no-wait (ADIOF_NOWAIT) allocations, to
       wait until the channels are unlocked.

       Locked channels can be unlocked only by freeing them (ADCMD_FREE),
       which clears the channel select bits (io_Unit).  ADCMD_LOCK does not
       reply the I/O request (mn_ReplyPort) until all the channels it locks
       are freed, unless a higher precedence allocation attempts to steal one
       the locked channels. If a steal occurs, ADCMD_LOCK replies and returns
       an error (ADIOERR_CHANNELSTOLEN).  If the lock is replied
       (mn_ReplyPort) with this error, the channels should be freed as soon
       as possible.  To avoid a possible deadlock, never make the freeing of
       stolen channels dependent on another allocations completion.

       ADCMD_LOCK is asynchronous only if the allocation key is correct, in
       which case it clears the quick flag (IOF_QUICK); otherwise, it is
       synchronous and replies only if the quick flag (IOF_QUICK) is clear.
       Do not use ADCMD_LOCK in interrupt code.

   INPUTS
       mn_ReplyPort- pointer to message port that receives I/O request
                     if the quick flag (IOF_QUICK) is clear
       io_Device   - pointer to device node, must be set by (or copied from
                     I/O block set by) OpenDevice function
       io_Unit     - bit map of channels to lock (bits 0 thru 3 correspond to
                     channels 0 thru 3)
       io_Command  - command number for ADCMD_LOCK
       io_Flags    - flags, must be cleared
       ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                     set by) OpenDevice function or ADCMD_ALLOCATE command

   OUTPUTS
       io_Unit     - bit map of successfully locked channels (bits 0 thru 3
                     correspond to channels 0 thru 3) not freed (ADCMD_FREE)
       io_Flags    - IOF_QUICK flag cleared if the allocation key is correct
                     (no ADIOERR_NOALLOCATION error)
       io_Error    - error number:
                     0                    - no error
                     ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                            does not match key for channel
                     ADIOERR_CHANNELSTOLEN- allocation attempting to steal
                                            locked channel
```

```
audio.device/BeginIO/ADCMD_PERVOL

    NAME
        ADCMD_PERVOL -- change the period and volume for writes in progress to
                        audio channels

    FUNCTION
        ADCMD_PERVOL is a command for multiple audio channels.  For each
        selected channel (io_Unit), if the allocation key (ioa_AllocKey) is
        correct and there is a write (CMD_WRITE) in progress, ADCMD_PERVOL
        loads a new volume and period immediately or at the end of the current
        cycle, depending on the sync flag (ADIOF_SYNCCYCLE).  If the allocation
        key is incorrect, ADCMD_PERVOL returns an error (ADIOERR_NOALLOCATION).
        ADCMD_PERVOL is synchronous and replies (mn_ReplyPort) only if the
        quick flag (IOF_QUICK) is clear.  Do not use ADCMD_PERVOL in interrupt
        code at interrupt level 5 or higher.

    INPUTS
        mn_ReplyPort- pointer to message port that receives I/O request
                      if the quick flag (IOF_QUICK) is clear
        io_Device   - pointer to device node, must be set by (or copied from
                      I/O block set by) OpenDevice function
        io_Unit     - bit map of channels to load period and volume (bits 0
                      thru 3 correspond to channels 0 thru 3)
        io_Command  - command number for ADCMD_PERVOL
        io_Flags    - flags, must be cleared if not used:
                      IOF_QUICK       - (CLEAR) reply I/O request
                      ADIOF_SYNCCYCLE- (CLEAR) finish immediately
                                       (SET) finish at the end of current
                                             cycle
        ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                      set by) OpenDevice function or ADCMD_ALLOCATE command
        ioa_Period  - new sample period in 279.365 ns increments (127 thru
                      65536, anti-aliasing filter works below 300 to 500
                      depending on waveform)
        ioa_Volume  - new volume (0 thru 64, linear)

    OUTPUTS
        io_Unit     - bit map of channels that successfully loaded period and
                      volume (bits 0 thru 3 correspond to channels 0 thru 3)
        io_Error    - error number:
                      0                    - no error
                      ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                             does not match key for channel
```

```
audio.device/BeginIO/ADCMD_SETPREC

    NAME
        ADCMD_SETPREC -- set the allocation precedence for audio channels

    FUNCTION
        ADCMD_SETPREC is a command for multiple audio channels.  For each
        selected channel (io_Unit), if the allocation key (ioa_AllocKey) is
        correct, ADCMD_SETPREC sets the allocation precedence to a new value
        (ln_Pri) and checks if there are higher-precedence allocation requests
        (ADCMD_ALLOCATE) waiting for the channel; otherwise, ADCMD_SETPREC
        returns an error (ADIOERR_NOALLOCATION).  ADCMD_SETPREC is synchronous
        and replies (mn_ReplyPort) only if the quick flag (IOF_QUICK) is clear.
        Do not use ADCMD_SETPREC in interrupt code.

    INPUTS
        ln_Pri      - new allocation precedence (-128 thru 127)
        mn_ReplyPort- pointer to message port that receives I/O request
                      if the quick flag (IOF_QUICK) is clear
        io_Device   - pointer to device node, must be set by (or copied from
                      I/O block set by) OpenDevice function
        io_Unit     - bit map of channels to set precedence (bits 0 thru 3
                      correspond to channels 0 thru 3)
        io_Command  - command number for ADCMD_SETPREC
        io_Flags    - flags, must be cleared if not used:
                      IOF_QUICK - (CLEAR) reply I/O request
        ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                      set by) OpenDevice function or ADCMD_ALLOCATE command

    OUTPUTS
        io_Unit     - bit map of channels that successfully set precedence
                      (bits 0 thru 3 correspond to channels 0 thru 3)
        io_Error    - error number:
                      0                    - no error
                      ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                             does not match key for channel
```

```
audio.device/BeginIO/ADCMD_WAITCYCLE

   NAME
       ADCMD_WAITCYCLE -- wait for an audio channel to complete the current
                          cycle of a write

   FUNCTION
       ADCMD_WAITCYCLE is a command for a single audio channel (io_Unit).
       If the allocation key (ioa_AllocKey) is correct and there is a write
       (CMD_WRITE) in progress on selected channel, ADCMD_WAITCYCLE does not
       reply (mn_ReplyPort) until the end of the current cycle.  If there is
       no write is progress, ADCMD_WAITCYCLE replies immediately.  If the
       allocation key is incorrect, ADCMD_WAITCYCLE returns an error
       (ADIOERR_NOALLOCATION).  ADCMD_WAITCYCLE returns an error
       (IOERR_ABORTED) if it is canceled (AbortIO) or the channel is stolen
       (ADCMD_ALLOCATE).  ADCMD_WAITCYCLE is asynchronous only if it is
       waiting for a cycle to complete, in which case it clears the quick
       flag (IOF_QUICK); otherwise, it is synchronous and replies only if the
       quick flag (IOF_QUICK) is clear.  Do not use ADCMD_WAITCYCLE in
       interrupt code at interrupt level 5 or higher.

   INPUTS
       mn_ReplyPort- pointer to message port that receives I/O request, if
                     the quick flag (IOF_QUICK) is clear, or if a write is in
                     progress on the selected channel and a cycle has
                     completed
       io_Device   - pointer to device node, must be set by (or copied from
                     I/O block set by) OpenDevice function
       io_Unit     - bit map of channel to wait for cycle (bits 0 thru 3
                     correspond to channels 0 thru 3).  If more than one bit
                     is set, lowest bit number channel is used.
       io_Command  - command number for CMD_WAITCYCLE
       io_Flags    - flags, must be cleared if not used:
                     IOF_QUICK - (CLEAR) reply I/O request
                                 (SET) reply I/O request only if a write is
                                       in progress on the selected channel
                                       and a cycle has completed
       ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                     set by) OpenDevice function or ADCMD_ALLOCATE command

   OUTPUTS
       io_Unit     - bit map of channel that successfully waited for cycle
                     (bits 0 thru 3 correspond to channels 0 thru 3)
       io_Flags    - IOF_QUICK flag cleared if a write is in progress on the
                     selected channel
       io_Error    - error number:
                     0                    - no error
                     IOERR_ABORTED        - canceled (AbortIO) or channel
                                            stolen
                     ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                            does not match key for channel
```

```
audio.device/BeginIO/CMD_CLEAR

   NAME
       CMD_CLEAR -- throw away internal caches

   FUNCTION
       CMD_CLEAR is a standard command for multiple audio channels.  For each
       selected channel (io_Unit), if the allocation key (ioa_AllocKey) is
       correct, CMD_CLEAR does nothing; otherwise, CMD_CLEAR returns an error
       (ADIOERR_NOALLOCATION).  CMD_CLEAR is synchronous and replies
       (mn_ReplyPort) only if the quick flag (IOF_QUICK) is clear.

   INPUTS
       mn_ReplyPort- pointer to message port that receives I/O request after
                     if the quick flag (IOF_QUICK) is clear
       io_Device   - pointer to device node, must be set by (or copied from
                     I/O block set by) OpenDevice function
       io_Unit     - bit map of channels to clear (bits 0 thru 3 correspond
                     to channels 0 thru 3)
       io_Command  - command number for CMD_CLEAR
       io_Flags    - flags, must be cleared if not used:
                     IOF_QUICK - (CLEAR) reply I/O request
       ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                     set by) OpenDevice function or ADCMD_ALLOCATE command

   OUTPUTS
       io_Unit     - bit map of channels successfully cleared (bits 0 thru 3
                     correspond to channels 0 thru 3)
       io_Error    - error number:
                     0                    - no error
                     ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                            does not match key for channel
```

```
audio.device/BeginIO/CMD_FLUSH

   NAME
       CMD_FLUSH -- cancel all pending I/O

   FUNCTION
       CMD_FLUSH is a standard command for multiple audio channels.  For each
       selected channel (io_Unit), if the allocation key (ioa_AllocKey) is
       correct, CMD_FLUSH aborts all writes (CMD_WRITE) in progress or queued
       and any I/O requests waiting to synchronize with the end of the cycle
       (ADCMD_WAITCYCLE); otherwise, CMD_FLUSH returns an error
       (ADIOERR_NOALLOCATION).  CMD_FLUSH is synchronous and replies
       (mn_ReplyPort) only if the quick flag (IOF_QUICK) is clear.  Do not
       use CMD_FLUSH in interrupt code at interrupt level 5 or higher.

   INPUTS
       mn_ReplyPort- pointer to message port that receives I/O request
                     if the quick flag (IOF_QUICK) is clear
       io_Device   - pointer to device node, must be set by (or copied from
                     I/O block set by) OpenDevice function
       io_Unit     - bit map of channels to flush (bits 0 thru 3 correspond
                     to channels 0 thru 3)
       io_Command  - command number for CMD_FLUSH
       io_Flags    - flags, must be cleared if not used:
                     IOF_QUICK - (CLEAR) reply I/O request
       ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                     set by) OpenDevice function or ADCMD_ALLOCATE command

   OUTPUTS
       io_Unit     - bit map of channels successfully flushed (bits 0 thru 3
                     correspond to channels 0 thru 3)
       io_Error    - error number:
                     0                    - no error
                     ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                            does not match key for channel
```

```
audio.device/BeginIO/CMD_READ

   NAME
       CMD_READ -- normal I/O entry point

   FUNCTION
       CMD_READ is a standard command for a single audio channel (io_Unit).
       If the allocation key (ioa_AllocKey) is correct, CMD_READ returns a
       pointer (io_Data) to the I/O block currently writing (CMD_WRITE) on
       the selected channel; otherwise, CMD_READ returns an error
       (ADIOERR_NOALLOCATION).  If there is no write in progress, CMD_READ
       returns zero.  CMD_READ is synchronous and replies (mn_ReplyPort)
       only if the quick bit (IOF_QUICK) is clear.

   INPUTS
       mn_ReplyPort- pointer to message port that receives I/O request after
                     if the quick flag (IOF_QUICK) is clear
       io_Device   - pointer to device node, must be set by (or copied from
                     I/O block set by) OpenDevice function
       io_Unit     - bit map of channel to read (bit 0 thru 3 corresponds to
                     channel 0 thru 3).  If more than one bit is set, lowest
                     bit number channel read.
       io_Command  - command number for CMD_READ
       io_Flags    - flags, must be cleared if not used:
                     IOF_QUICK - (CLEAR) reply I/O request
       ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                     set by) OpenDevice function or ADCMD_ALLOCATE command

   OUTPUTS
       io_Unit     - bit map of channel successfully read (bit 0 thru 3
                     corresponds to channel 0 thru 3)
       io_Error    - error number:
                     0                    - no error
                     ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                            does not match key for channel
       ioa_Data    - pointer to I/O block for current write, zero if none is
                     progress
```

```
audio.device/BeginIO/CMD_RESET

    NAME
        CMD_RESET -- restore device to a known state

    FUNCTION
        CMD_RESET is a standard command for multiple audio channels.  For each
        selected channel (io_Unit), if the allocation key (ioa_AllocKey) is
        correct, CMD_RESET:
          . clears the hardware audio registers and attach bits,
          . sets the audio interrupt vector,
          . cancels all pending I/O (CMD_FLUSH), and
          . unstops the channel if it is stopped (CMD_STOP),

        Otherwise, CMD_RESET returns an error (ADIOERR_NOALLOCATION).
        CMD_RESET is synchronous and replies (mn_ReplyPort) only if the quick
        flag (IOF_QUICK) is clear.  Do not use CMD_RESET in interrupt code at
        interrupt level 5 or higher.

    INPUTS
        mn_ReplyPort- pointer to message port that receives I/O request
                      if the quick flag (IOF_QUICK) is clear
        io_Device   - pointer to device node, must be set by (or copied from
                      I/O block set by) OpenDevice function
        io_Unit     - bit map of channels to reset (bits 0 thru 3 correspond
                      to channels 0 thru 3)
        io_Command  - command number for CMD_RESET
        io_Flags    - flags, must be cleared if not used:
                      IOF_QUICK - (CLEAR) reply I/O request
        ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                      set by) OpenDevice function or ADCMD_ALLOCATE command

    OUTPUTS
        io_Unit     - bit map of channels to successfully reset (bits 0 thru 3
                      correspond to channels 0 thru 3)
        io_Error    - error number:
                      0                   - no error
                      ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                            does not match key for channel
```

```
audio.device/BeginIO/CMD_START

    NAME
        CMD_START -- start device processing (like ^Q)

    FUNCTION
        CMD_START is a standard command for multiple audio channels.  For each
        selected channel (io_Unit), if the allocation key (ioa_AllocKey) is
        correct and the channel was previously stopped (CMD_STOP), CMP_START
        immediately starts all writes (CMD_WRITE) to the channel.  If the
        allocation key is incorrect, CMD_START returns an error
        (ADIOERR_NOALLOCATION).  CMD_START starts multiple channels
        simultaneously to minimize distortion if the channels are playing the
        same waveform and their outputs are mixed. CMD_START is synchronous and
        replies (mn_ReplyPort) only if the quick flag (IOF_QUICK) is clear.
        Do not use CMD_START in interrupt code at interrupt level 5 or higher.

    INPUTS
        mn_ReplyPort- pointer to message port that receives I/O request after
                      if the quick flag (IOF_QUICK) is clear
        io_Device   - pointer to device node, must be set by (or copied from
                      I/O block set by) OpenDevice function
        io_Unit     - bit map of channels to start (bits 0 thru 3 correspond
                      to channels 0 thru 3)
        io_Command  - command number for CMD_START
        io_Flags    - flags, must be cleared if not used:
                      IOF_QUICK - (CLEAR) reply I/O request
        ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                      set by) OpenDevice function or ADCMD_ALLOCATE command

    OUTPUTS
        io_Unit     - bit map of channels successfully started (bits 0 thru 3
                      correspond to channels 0 thru 3)
        io_Error    - error number:
                      0                   - no error
                      ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                            does not match key for channel
```

```
audio.device/BeginIO/CMD_STOP

   NAME
       CMD_STOP -- stop device processing (like ^S)

   FUNCTION
       CMD_STOP is a standard command for multiple audio channels.  For each
       selected channel (io_Unit), if the allocation key (ioa_AllocKey) is
       correct, CMD_STOP immediately stops any writes (CMD_WRITE) in
       progress; otherwise, CMD_STOP returns an error (ADIOERR_NOALLOCATION).
       CMD_WRITE queues up writes to a stopped channel until CMD_START starts
       the channel or CMD_RESET resets the channel. CMD_STOP is synchronous
       and replies (mn_ReplyPort) only if the quick flag (IOF_QUICK) is
       clear.  Do not use CMD_STOP in interrupt code at interrupt level 5 or
       higher.

   INPUTS
       mn_ReplyPort- pointer to message port that receives I/O request after
                     if the quick flag (IOF_QUICK) is clear
       io_Device   - pointer to device node, must be set by (or copied from
                     I/O block set by) OpenDevice function
       io_Unit     - bit map of channels to stop (bits 0 thru 3 correspond to
                     channels 0 thru 3)
       io_Command  - command number for CMD_STOP
       io_Flags    - flags, must be cleared if not used:
                     IOF_QUICK - (CLEAR) reply I/O request
       ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                     set by) OpenDevice function or ADCMD_ALLOCATE command

   OUTPUTS
       io_Unit     - bit map of channels successfully stopped (bits 0 thru 3
                     correspond to channels 0 thru 3)
       io_Error    - error number:
                     0                   - no error
                     ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                           does not match key for channel
```

```
audio.device/BeginIO/CMD_UPDATE

   NAME
       CMD_UPDATE -- force dirty buffers out

   FUNCTION
       CMD_UPDATE is a standard command for multiple audio channels.  For
       each selected channel (io_Unit), if the allocation key (ioa_AllocKey)
       is correct, CMD_UPDATE does nothing; otherwise, CMD_UPDATE returns an
       error (ADIOERR_NOALLOCATION).  CMD_UPDATE is synchronous and
       replies (mn_ReplyPort) only if the quick flag (IOF_QUICK) is clear.

   INPUTS
       mn_ReplyPort- pointer to message port that receives I/O request after
                     if the quick flag (IOF_QUICK) is clear
       io_Device   - pointer to device node, must be set by (or copied from
                     I/O block set by) OpenDevice function
       io_Unit     - bit map of channels to update (bits 0 thru 3 correspond
                     to channels 0 thru 3)
       io_Command  - command number for CMD_UPDATE
       io_Flags    - flags, must be cleared if not used:
                     IOF_QUICK - (CLEAR) reply I/O request
       ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                     set by) OpenDevice function or ADCMD_ALLOCATE command

   OUTPUTS
       io_Unit     - bit map of channels successfully updated (bits 0 thru 3
                     correspond to channels 0 thru 3)
       io_Error    - error number:
                     0                   - no error
                     ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                           does not match key for channel
```

```
audio.device/BeginIO/CMD_WRITE

   NAME
       CMD_WRITE -- normal I/O entry point

   FUNCTION
       CMD_WRITE is a standard command for a single audio channel (io_Unit).
       If the allocation key (ioa_AllocKey) is correct, CMD_WRITE plays a
       sound using the selected channel; otherwise, it returns an error
       (ADIOERR_NOALLOCATION).  CMD_WRITE queues up requests if there is
       another write in progress or if the channel is stopped (CMD_STOP).
       When the write actually starts; if the ADIOF_PERVOL flag is set,
       CMD_WRITE loads volume (ioa_Volume) and period (ioa_Period), and if
       the ADIOF_WRITEMESSAGE flag is set, CMD_WRITE replies the write
       message (ioa_WriteMsg).  CMD_WRITE returns an error (IOERR_ABORTED) if
       it is canceled (AbortIO) or the channel is stolen (ADCMD_ALLOCATE).
       CMD_WRITE is asynchronous only if there is no error, in which case it
       clears the quick flag (IOF_QUICK) and replies the I/O request
       (mn_ReplyPort) after it finishes writting; otherwise, it is synchronous
       and replies only if the quick flag (IOF_QUICK) is clear.  Do not use
       CMD_WRITE in interrupt code at interrupt level 5 or higher.

   INPUTS
       mn_ReplyPort- pointer to message port that receives I/O request after
                     the write completes
       io_Device   - pointer to device node, must be set by (or copied from
                     I/O block set by) OpenDevice function
       io_Unit     - bit map of channel to write (bit 0 thru 3 corresponds to
                     channel 0 thru 3).  If more than one bit is set, lowest
                     bit number channel is written.
       io_Command  - command number for CMD_WRITE
       io_Flags    - flags, must be cleared if not used:
                     ADIOF_PERVOL       - (SET) load volume and period
                     ADIOF_WRITEMESSAGE - (SET) reply message at write start
       ioa_AllocKey- allocation key, must be set by (or copied from I/O block
                     set by) OpenDevice function or ADCMD_ALLOCATE command
       ioa_Data    - pointer to waveform array (signed bytes (-128 thru 127)
                     in custom chip addressable RAM and word-aligned)
       ioa_Length  - length of the wave array in bytes (2 thru 131072, must
                     be even number)
       ioa_Period  - sample period in 279.365 ns increments (127 thru 65536,
                     anti-aliasing filter works below 300 to 500 depending on
                     waveform), if enabled by ADIOF_PERVOL
       ioa_Volume  - volume (0 thru 64, linear), if enabled by ADIOF_PERVOL
       ioa_Cycles  - number of times to repeat array (0 thru 65535, 0 for
                     infinite)
       ioa_WriteMsg- message replied at start of write,  if enabled by
                     ADIOF_WRITEMESSAGE

   OUTPUTS
       io_Unit     - bit map of channel successfully written (bit 0 thru 3
                     corresponds to channel 0 thru 3)
       io_Flags    - IOF_QUICK flag cleared if there is no error
       io_Error    - error number:
                     0                    - no error
                     IOERR_ABORTED        - canceled (AbortIO) or channel
                                            stolen
                     ADIOERR_NOALLOCATION - allocation key (ioa_AllocKey)
                                            does not match key for channel

   BUGS
       If CMD_WRITE starts the write immediately after stopping a previous
       write, you must set the ADIOF_PERVOL flag or the new data pointer
       (ioa_Data) and length (ioa_Length) may not be loaded.
```

```
audio.device/CloseDevice

   NAME
       CloseDevice - terminate access to the audio device

   SYNOPSIS
       CloseDevice(iORequest);
                   A1

   FUNCTION
       The CloseDevice routine notifies the audio device that it will no
       longer be used.  It takes an I/O audio request block (IOAudio) and
       clears the device pointer (io_Device).  If there are any channels
       allocated with the same allocation key (ioa_AllocKey), CloseDevice
       frees (ADCMD_FREE) them. CloseDevice decrements the open count, and if
       it falls to zero and an expunge (Expunge) is pending, the device is
       expunged.

   INPUTS
       iORequest   - pointer to audio request block (struct IOAudio)
               io_Device   - pointer to device node, must be set by (or
                             copied from I/O block set by) open (OpenDevice)
               io_Unit     - bit map of channels to free (ADCMD_FREE) (bits 0
                             thru 3 correspond to channels 0 thru 3)
               ioa_AllocKey- allocation key, used to free channels

   OUTPUTS
       iORequest - pointer to audio request block (struct IOAudio)
               io_Device   - set to -1
               io_Unit     - set to zero
```

```
audio.device/Expunge

   NAME
       EXPUNGE - indicate a desire to remove the Audio device

   FUNCTION
       The Expunge routine is called when a user issues a RemDevice call.  By
       the time it is called, the device has already been removed from the
       device list, so no new opens will succeed.  The existence of any other
       users of the device, as determined by the device open count being
       non-zero, will cause the Expunge to be deferred.  When the device is
       not in use, or no longer in use, the Expunge is actually performed.
```

```
audio.device/OpenDevice

   NAME
       OpenDevice - open the audio device

   SYNOPSIS
       error = OpenDevice("audio.device", unitNumber, iORequest, flags);

   FUNCTION
       The OpenDevice routine grants access to the audio device.  It takes an
       I/O audio request block (iORequest), and if it can successfully open
       the audio device, it loads the device pointer (io_Device) and the
       allocation key (ioa_AllocKey); otherwise, it returns an error
       (IOERR_OPENFAIL).  OpenDevice increments the open count keeping the
       device from being expunged (Expunge).  If the length (ioa_Length) is
       non-zero, OpenDevice tries to allocate (ADCMD_ALLOCATE) audio channels
       from a array of channel combination options (ioa_Data). If the
       allocation succeeds, the allocated channel combination is loaded into
       the unit field (ioa_Unit); otherwise, OpenDevice returns an error
       (ADIOERR_ALLOCFAILED).  OpenDevice does not wait for allocation to
       succeed and closes (CloseDevice) the audio device if it fails.  To
       allocate channels, OpenDevice also requires a properly initialized
       reply port (mn_ReplyPort) with an allocated signal bit.

   INPUTS
       unitNumber- not used
       iORequest - pointer to audio request block (struct IOAudio)
               ln_Pri      - allocation precedence (-128 thru 127), only
                             necessary for allocation (non-zero length)
               mn_ReplyPort- pointer to message port for allocation, only
                             necessary for allocation (non-zero length)
               ioa_Data    - pointer to channel combination options (byte
                             array, bits 0 thru 3 correspond to channels 0
                             thru 3), only necessary for allocation (non-zero
                             length)
               ioa_Length  - length of the channel combination option array
                             (0 thru 16), zero for no allocation
       flags     - not used

   OUTPUTS
       iORequest - pointer to audio request block (struct IOAudio)
               io_Device   - pointer to device node if OpenDevice succeeds,
                             otherwise -1
               io_Unit     - bit map of successfully allocated channels (bits
                             0 thru 3 correspond to channels 0 thru 3) if
                             allocation, otherwise 0
               io_Error    - error number:
                             0                   - no error
                             IOERR_OPENFAIL      - open failed
                             ADIOERR_ALLOCFAILED - allocation failed, no open
                ioa_AllocKey- unique allocation key, if OpenDevice succeeds
       error     - copy of io_Error
```

Contents
----

clipboard.device/BeginIO

NAME
    BeginIO - initiate clipboard device IO

SYNOPSIS
    SendIO(iORequest)
    DoIO(iORequest)

FUNCTION
    BeginIO is the workhorse device function used to initiate device commands. It can be called directly or via the Exec library functions SendIO() and DoIO().

clipboard.device/Close

NAME
    CloseDevice - terminate access to the clipboard device

SYNOPSIS
    CloseDevice(iORequest)

FUNCTION
    This routine notifies the clipboard device that the iORequest will no longer be used.

clipboard.device/CLIPREADID

```
NAME
     CLIPREADID - determine the current read identifier

FUNCTION
     CLIPREADID fills the io_ClipID with a clip identifier that
     can be compared with that of a post command:  if greater than
     the post identifier, the post data held privately by an
     application is not valid for its own pasting.

IO REQUEST
     io_Message      mn_ReplyPort set up
     io_Device       preset by OpenDevice
     io_Unit         preset by OpenDevice
     io_Command      CMD_CLIPREADID

     io_ClipID       the ClipID of the current write is set
```

clipboard.device/CLIPWRITEID

```
NAME
     CLIPWRITEID - determine the current write identifier

FUNCTION
     CLIPWRITEID fills the io_ClipID with a clip identifier that
     can be compared with that of a post command:  if greater than
     the post identifier, the post is obsolete and need never
     be satisfied.

IO REQUEST
     io_Message      mn_ReplyPort set up
     io_Device       preset by OpenDevice
     io_Unit         preset by OpenDevice
     io_Command      CMD_CLIPWRITEID

     io_ClipID       the ClipID of the current write is set
```

```
clipboard.device/EXPUNGE

   NAME
        Expunge - indicate a desire to remove the clipboard device

   SYNOPSIS
        <Expunge is not generally called by application programs>

   FUNCTION
        The Expunge routine is called when the system needs the memory
        used by the clipboard device, and the clipboard device has no
        open units.  The clipboard device is removed from memory until
        next needed (i.e., until the next OpenDevice("clipboard.device", ...).
```

```
clipboard.device/OpenDevice

   NAME
        OpenDevice - open the clipboard device

   SYNOPSIS
        OpenDevice("clipboard.device", unit, iORequest, 0)

   FUNCTION
        The open routine grants access to a device.  There are two
        fields in the iORequest block that will be filled in:
        io_Device and io_Unit.

        A successful OpenDevice() call must be matched by a CloseDevice()
        call when access to the device is no longer needed.

   RESULTS
        If the open was unsuccessful, returns a non-zero
        result and the iORequest is not valid.
```

```
clipboard.device/POST

   NAME
        POST - post clip to clipboard

   FUNCTION
        Indicate to the clipboard device that data is available for
        use by accessors of the clipboard.  This is intended to be
        used when a cut is large, in a private data format, and/or
        changing frequently, and it thus makes sense to avoid
        converting it to an IFF form and writing it to the clipboard
        unless another application wants it.  The post provides a
        message port to which the clipboard device will send a satisfy
        message if the data is required.

        If the satisfy message is received, the write associated with
        the post must be performed.  The act of writing the clip
        indicates that the message has been received: it may then be
        re-used by the clipboard device, and so must actually be
        removed from the satisfy message port so that the port is not
        corrupted.

        If the application wishes to determine if a post it has
        performed is still the current clip, it should check the
        post's io_ClipID with that returned by the CLIPREADID
        command.  If CLIPREADID is greater, the clip is not still
        current.

        If an application has a pending post and wishes to determine
        if it should satisfy it (e.g., before it exits), it should
        check the post's io_ClipID with that returned by the
        CLIPWRITEID command.  If CLIPWRITEID is greater, there
        is no need to satisfy the post.

   IO REQUEST
        io_Message      mn_ReplyPort set up
        io_Device       preset by OpenDevice
        io_Unit         preset by OpenDevice
        io_Command      CBD_POST
        io_Data         pointer to satisfy message port
        io_ClipID       zero

   RESULTS
        io_Error        non-zero if an error occurred
        io_ClipID       the clip ID assigned to this post, to be used
                        in the write command if this is satisfied
```

```
clipboard.device/READ

   NAME
        READ - read clip from clipboard

   FUNCTION
        The read function serves two purposes.

        When io_Offset is within the clip, it acts as a normal read
        request, and io_Data is filled with data from the clipboard.
        The first read request should have a zero io_ClipID, which
        will be filled with the ID assigned for this read.  Normal
        sequential access from the beginning of the clip is achieved
        by setting io_Offset to zero for the first read, then leaving
        it untouched for subsequent reads.  If io_Data is null, then
        io_Offset is incremented by io_Actual as if io_Length bytes
        had been read.  This is useful for skipping to the end-of-file
        by using a huge io_Length.

        When io_Offset is beyond the end of the clip, this acts as a
        signal to the clipboard device that the application is
        through reading this clip.  Be aware that while an application
        is in the middle of reading a clip, any attempts to write new
        data to the clipboard are held off.  This read past the end
        of file indicates that those operations may now be initiated.

   IO REQUEST
        io_Message      mn_ReplyPort set up
        io_Device       preset by OpenDevice
        io_Unit         preset by OpenDevice
        io_Command      CMD_READ
        io_Length       number of bytes to put in data buffer
        io_Data         pointer to buffer of data to fill, or null to
                        skip over data
        io_Offset       byte offset of data to read
        io_ClipID       zero if this is the initial read

   RESULTS
        io_Error        non-zero if an error occurred
        io_Actual       filled with the actual number of bytes read
        io_Data         (the buffer now has io_Actual bytes of data)
        io_Offset       updated to next read position, which is
                        beyond EOF if io_Actual != io_Length
        io_ClipID       the clip ID assigned to this read: do not
                        alter for subsequent reads
```

```
clipboard.device/RESET

   NAME
        RESET - reset the clipboard

   FUNCTION
        Resets the clipboard device without destroying handles
        to the open device.

   IO REQUEST
        io_Message       mn_ReplyPort set up
        io_Device        preset by OpenDevice
        io_Command       CMD_RESET
        io_Flags         IOB_QUICK set if quick I/O is possible
```

```
clipboard.device/UPDATE

   NAME
        UPDATE - terminate the writing of a cut to the clipboard

   FUNCTION
        Indicate to the clipboard that the previous write commands are
        complete and can be used for any pending pastes (reads).  This
        command cannot be issued while any of the write commands are
        pending.

   IO REQUEST
        io_Message       mn_ReplyPort set up
        io_Device        preset by OpenDevice
        io_Unit          preset by OpenDevice
        io_Command       CMD_UPDATE
        io_ClipID        the ClipID of the write

   RESULTS
        io_Error         non-zero if an error occurred
```

```
clipboard.device/WRITE

   NAME
        WRITE - write clip to clipboard

   FUNCTION
        This command writes data to the clipboard.  This data can be
        provided sequentially by clearing io_Offset for the initial
        write, and using the incremented value unaltered for
        subsequent writes.  If io_Offset is ever beyond the current
        clip size, the clip is padded with zeros.

        If this write is in response to a SatisfyMsg for a pending
        post, the io_ClipID returned by the Post command must
        be used.  Otherwise, a new ID is obtained by clearing the
        io_ClipID for the first write.  Subsequent writes must not
        alter the io_ClipID.

   IO REQUEST
        io_Message      mn_ReplyPort set up
        io_Device       preset by OpenDevice
        io_Unit         preset by OpenDevice
        io_Command      CMD_WRITE
        io_Length       number of bytes from io_Data to write
        io_Data         pointer to block of data to write
        io_Offset       usually zero if this is the initial write
        io_ClipID       zero if this is the initial write, ClipID of
                        the Post if this is to satisfy a post

   RESULTS
        io_Error        non-zero if an error occurred
        io_Actual       filled with the actual number of bytes written
        io_Offset       updated to next write position
        io_ClipID       the clip ID assigned to this write: do not
                        alter for subsequent writes
```

Contents

```
console.device/CDAskKeyMap

   NAME
        AskKeyMap - get the current key map structure for this console

   FUNCTION
        Fills the IO_DATA buffer with the current KeyMap structure in
        use by this console unit.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Unit         preset by the call to OpenDevice
        io_Command      CD_ASKKEYMAP
        io_Flags        IOF_QUICK if quick I/O possible, else zero
        io_Length       sizeof(*keyMap)
        io_Data         struct KeyMap *keyMap
                        eight longwords to describe the raw keycode
                        to byte stream conversion.

   RESULTS
        This function sets the error field in the iORequest, and fills
        the structure at IO_DATA with the current key map.
```

```
console.device/CDInputHandler

   NAME
        CDInputHandler - handle an input event for the console device

   SYNOPSIS
        CDInputHandler(events, consoleDev)
                       A0      A1

   FUNCTION
        Accepts input events from the producer, which is usually the
        ROM input.task.

   NOTES
        This function is different from standard device commands in
        that it is a function in the console device library vectors.
        The "OpenLibrary" call for the console device is to
        OpenDevice("console.device", -1, iORequest, 0) and then grab
        the io_Device field out of the iORequest as the library
        vector.
```

console.device/CDSetKeyMap

```
NAME
     SetKeyMap - set the current key map structure for this console

FUNCTION
     Sets the current KeyMap structure used by this console unit to
     the structure pointed to by IO_DATA

IO REQUEST
     io_Message      mn_ReplyPort set if quick I/O is not possible
     io_Device       preset by the call to OpenDevice
     io_Unit         preset by the call to OpenDevice
     io_Command      CD_SETKEYMAP
     io_Flags        IOF_QUICK if quick I/O possible, else zero
     io_Length       sizeof(*keyMap)
     io_Data         struct KeyMap *keyMap
                     eight longwords that describe the raw keycode
                     to byte stream conversion.

RESULTS
     This function sets the error field in the iORequest and fills
     the current key map from IO_DATA.
```

console.device/Clear

```
NAME
     Clear - clear console input buffer

FUNCTION
     Remove from the input buffer any reports waiting to satisfy
     read requests.

IO REQUEST
     io_Message      mn_ReplyPort set if quick I/O is not possible
     io_Device       preset by the call to OpenDevice
     io_Unit         preset by the call to OpenDevice
     io_Command      CMD_CLEAR
     io_Flags        IOB_QUICK set if quick I/O is possible
```

```
console.device/OpenDevice

   NAME
        OpenDevice - a request to open a console device

   SYNOPSIS
        OpenDevice("console.device", unit, iORequest, 0)

   FUNCTION
        The open routine grants access to a device.  There are two
        fields in the iORequest block that may be filled in:  the
        IO_DEVICE field and possibly the IO_UNIT field.

        This open command differs from most other device open commands
        in that it requires some information to be supplied in the
        IO_DATA field of the iORequest block.  This initialization
        information supplies the window that is used by the console
        device for output.

        The unit number that is a standard parameter for an open call
        is used specially by this device.  A unit of -1 indicates that
        no actual console is to be opened; this is used to get a
        pointer to the device library vector.  A unit of zero binds
        the supplied window to a unique console.  Sharing a console
        must be done at a level higher than the device.  There are no
        other valid unit numbers.

   IO REQUEST
        io_Data         struct Window *window
                        This is the window that will be used for this
                        console.  It must be supplied if the unit in
                        the OpenDevice call is 0 (see above).  The
                        RPort of this window is potentially in use by
                        the console whenever there is an outstanding
                        write command.
```

```
console.device/RawKeyConvert

   NAME
        RawKeyConvert - decode raw input classes

   SYNOPSIS
        actual = RawKeyConvert(event, buffer, length, keyMap), consoleDev
        D0                     A0     A1      D1      A2       A6

   FUNCTION
        This console function converts input events of type
        IECLASS_RAWKEY to ANSI bytes, based on the keyMap, and
        places the result into the buffer.

   INPUTS
        event - an InputEvent structure pointer.
        buffer - a byte buffer large enough to hold all anticipated
                characters generated by this conversion.
        length - maximum anticipation, i.e. the buffer size in bytes.
        keyMap - a KeyMap structure pointer, or null if the default
                console device key map is to be used.
        consoleDev - the io_Device of the console device.

   RESULTS
        actual - the number of characters in the buffer, or -1 if
                a buffer overflow was about to occur.

   ERRORS
        if actual is -1, a buffer overflow condition was detected.
        Not all of the characters in the buffer are valid.

   NOTES
        This function is different from standard device commands in
        that it is a function in the console device library vectors.
        The "OpenLibrary" call for the console device is to
        OpenDevice("console.device", -1, iORequest, 0), and then grab
        the io_Device field out of the iORequest as the library
        vector.
```

```
console.device/Read

   NAME
        Read - return the next input from the keyboard

   FUNCTION
        Reads the next input, generally from the keyboard.  The form of
        this input is as an ANSI byte stream:  i.e., either ASCII text
        or control sequences.  Raw input events received by the
        console device can be selectively filtered via the SRE and RRE
        control sequences (see the write command).  Keys are converted
        via the keymap associated with the unit, which is modified
        with AskKeyMap and SetKeyMap

        If, for example, raw keycodes had been enabled by writing
        <CSI>1s to the console (where <CSI> is $9B or Esc[), keys
        would return raw keycode reports with the information from
        the input event itself, in the form:
        <CSI>1;0;<keycode>;<qualifiers>;0;0;<seconds>;<microseconds>q

        If there is no pending input, this command will not be
        satisfied; if there is some input, but not as much as can
        fill IO_LENGTH, the request will be satisfied with the input
        currently available.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Unit         preset by the call to OpenDevice
        io_Command      CMD_READ
        io_Flags        IOF_QUICK if quick I/O possible, else zero
        io_Length       sizeof(*buffer)
        io_Data         char buffer[]
                        The destination for the characters to read
                        from the keyboard.

   RESULTS
        This function sets the error field in the ioRequest, and fills
        the ioRequest IO_DATA area with the next input, and IO_ACTUAL
        with the number of bytes read.
```



```
console.device/Write

   NAME
        Write - write text to the display

   FUNCTION
        Write a text record to the display.  Note that the RPort of
        the console window is in use while this write command is
        pending.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Unit         preset by the call to OpenDevice
        io_Command      CMD_WRITE
        io_Flags        IOF_QUICK if quick I/O possible, else zero
        io_Length       sizeof(*buffer)
        io_Data         char buffer[]
                        a buffer containing the ANSI text to write to
                        the console device.

   ANSI CODES SUPPORTED

        Independent Control Functions (no introducer) --
        Code    Name    Definition
        -----   ---     ----------------------------------------------
        00/ 8   BS      BACKSPACE
        00/10   LF      LINE FEED
        00/11   VT      VERTICAL TAB
        00/12   FF      FORM FEED
        00/13   CR      CARRIAGE RETURN
        00/14   SO      SHIFT OUT
        00/15   SI      SHIFT IN
        01/11   ESC     ESCAPE

        Code or Esc Name Definition
        -----   --- ---- ---------------------------------------------
        08/ 4   D   IND  INDEX: move the active position down one line
        08/ 5   E   NEL  NEXT LINE:
        08/13   M   RI   REVERSE INDEX:
        09/11   [   CSI  CONTROL SEQUENCE INTRODUCER: see next list

        ISO-compatible Escape Sequences (introduced by Esc) --
        Esc   Name Definition
        ----- ---- -------------------------------------------------
        a     INT  INTERRUPT (will not be supported later)
        c     RIS  RESET TO INITIAL STATE

        Control Sequences (introduced by CSI, i.e., $9B or Esc[) with
        parameters: "1" is an optional numeric parameter.   "2" is two
        numeric parameters; e.g., '14;94'.    "3" is any number of
        numeric parameters.  Numeric parameters are separated by semicolons.
        Esc[    Name Definition
        ------- ---- ------------------------------------------------
        1@      ICH  INSERT CHARACTER
        1A      CUU  CURSOR UP
        1B      CUD  CURSOR DOWN
        1C      CUF  CURSOR FORWARD
        1D      CUB  CURSOR BACKWARD
```

```
1E      CNL  CURSOR NEXT LINE
1F      CPL  CURSOR PRECEEDING LINE
2H      CUP  CURSOR POSITION
1J      ED   ERASE IN DISPLAY (only to end of display)
1K      EL   ERASE IN LINE (only to end of line)
1L      IL   INSERT LINE
1M      DL   DELETE LINE
1P      DCH  DELETE CHARACTER
2R      CPR  CURSOR POSITION REPORT (in Read stream only)
1S      SU   SCROLL UP
1T      SD   SCROLL DOWN
3h      SM   SET MODE
3l      RM   RESET MODE
3m      SGR  SELECT GRAPHIC RENDITION
1n      DSR  DEVICE STATUS REPORT
1t      aSLPP SET PAGE LENGTH (private Amiga sequence)
1u      aSLL SET LINE LENGTH (private Amiga sequence)
1x      aSLO SET LEFT OFFSET (private Amiga sequence)
1y      aSTO SET TOP OFFSET (private Amiga sequence)
3{      aSRE SET RAW EVENTS (private Amiga sequence)
8|      aIER INPUT EVENT REPORT (private Amiga Read sequence)
3}      aRRE RESET RAW EVENTS (private Amiga sequence)
1~      aSKR SPECIAL KEY REPORT (private Amiga Read sequence)
1 p     aSCR SET CURSOR RENDITION (private Amiga sequence)
0 q     aWSR WINDOW STATUS REQUEST (private Amiga sequence)
4 r     aWBR WINDOW BOUNDS REPORT (private Amiga Read sequence)
```

Contents
----

gameport.device/AskCType

```
NAME
     AskCType - inquire the current gameport controller type

FUNCTION
     This command identifies the type of controller at the game
     port, so that the signals at the port may be properly
     interpreted.  The controller type has been set by a previous
     SetCType.

     This command always executes immediately.

IO REQUEST
     io_Message      mn_ReplyPort set if quick I/O is not possible
     io_Device       preset by the call to OpenDevice
     io_Unit         preset by the call to OpenDevice
     io_Command      GPD_ASKCTYPE
     io_Flags        IOB_QUICK set if quick I/O is possible
     io_Length       at least 1
     io_Data         the address of the byte variable for the
                     result
```

gameport.device/AskTrigger

```
NAME
     AskTrigger - inquire the conditions for a gameport report

FUNCTION
     This command inquires what conditions must be met by a game
     port unit before a pending Read request will be satisfied.
     These conditions, called triggers, are independent -- that
     any one occurs is sufficient to queue a gameport report to
     the Read queue.  These conditions are set by SetTrigger.

     This command always executes immediately.

IO REQUEST
     io_Message      mn_ReplyPort set if quick I/O is not possible
     io_Device       preset by the call to OpenDevice
     io_Unit         preset by the call to OpenDevice
     io_Command      GPD_ASKTRIGGER
     io_Flags        IOB_QUICK set if quick I/O is possible
     io_Length       sizeof(gameportTrigger)
     io_Data         a structure of type GameportTrigger, which
                     has the following elements
         gpt_Keys -
                 GPTB_DOWNKEYS set if button down transitions
                 trigger a report, and GPTB_UPKEYS set if button up
                 transitions trigger a report
         gpt_Timeout -
                 a time which, if exceeded, triggers a report;
                 measured in vertical blank units (60/sec)
         gpt_XDelta  -
                 a distance in x which, if exceeded, triggers a
                 report
         gpt_YDelta  -
                 a distance in x which, if exceeded, triggers a
                 report
```

```
gameport.device/Clear

   NAME
        Clear - clear gameport input buffer

   FUNCTION
        Removes from the input buffer any gameport reports waiting to
        satisfy read requests.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Unit         preset by the call to OpenDevice
        io_Command      CMD_CLEAR
        io_Flags        IOB_QUICK set if quick I/O is possible
```

```
gameport.device/Open

   NAME
        Open - a request to open the GamePort device

   SYNOPSIS
        OpenDevice("gameport.device", unit, iORequest, 0)

   FUNCTION
        The open routine grants access to a device.  Two
        fields in the iORequest block will be filled in: the
        IO_DEVICE field and the IO_UNIT field.

        The device open count will be incremented.  The device cannot
        be expunged unless this open is matched by a Close device.

   INPUTS
        unit  -
                0   unit associated with left gameport controller
                1   unit associated with right gameport controller

   RESULTS
        If the open was unsuccessful, IO_ERROR will be set, IO_UNIT
        and IO_DEVICE will not be valid.
```

gameport.device/ReadEvent

NAME
    ReadEvent - return the next gameport event.

FUNCTION
    Reads gameport events from the gameport and puts them in the data area of the iORequest. If there are no pending gameport events, this command will not be satisfied, but if there are some events, but not as many as can fill IO_LENGTH, the request will be satisfied with those currently available.

IO REQUEST

```
io_Message      mn_ReplyPort set if quick I/O is not possible
io_Device       preset by the call to OpenDevice
io_Unit         preset by the call to OpenDevice
io_Command      GPD_READEVENT
io_Flags        IOB_QUICK set if quick I/O is possible
io_Length       the size of the io_Data area in bytes: there
                are sizeof(inputEvent) bytes per input event.
io_Data         a buffer area to fill with input events.  The
                fields of the input event are:
    ie_NextEvent
                links the events returned
    ie_Class
                is IECLASS_RAWMOUSE
    ie_SubClass
                is 0 for the left, 1 for the right gameport
    ie_Code
                contains any gameport button reports.  No
                report is indicated by the value 0xff.
    ie_Qualifier
                only the relative and button bits are set
    ie_X, ie_Y
                the x and y values for this report, in either
                relative or absolute device dependent units.
    ie_TimeStamp
                the delta time since the last report, given
                not as a standard timestamp, but as the frame
                count in the TV_SECS field.
```

RESULTS
    This function sets the error field in the iORequest and fills the iORequest with the next gameport events (but not partial events).

SEE ALSO
    gameport.device/SetCType, gameport.device/SetTrigger

gameport.device/SetCType

NAME
    SetCType - set the current gameport controller type

FUNCTION
    This command sets the type of device at the gameport, so that the signals at the port may be properly interpreted. The port can also be turned off, so that no reports are generated.

    This command always executes immediately.

IO REQUEST

```
io_Message      mn_ReplyPort set if quick I/O is not possible
io_Device       preset by the call to OpenDevice
io_Unit         preset by the call to OpenDevice
io_Command      GPD_SETCTYPE
io_Flags        IOB_QUICK set if quick I/O is possible
io_Length       1
io_Data         the address of the byte variable describing
                the controller type, as per the equates in
                the gameport include file
```

```
gameport.device/SetTrigger

    NAME
        SetTrigger - set the conditions for a gameport report

    FUNCTION
        This command sets what conditions must be met by a game
        port unit before a pending Read request will be satisfied.
        These conditions, called triggers, are independent -- that
        any one occurs is sufficient to queue a gameport report to
        the Read queue.  These conditions are inquired with
        AskTrigger.

        This command always executes immediately.

    IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Unit         preset by the call to OpenDevice
        io_Command      GPD_SETTRIGGER
        io_Flags        IOB_QUICK set if quick I/O is possible
        io_Length       sizeof(gameportTrigger)
        io_Data         a structure of type GameportTrigger, which
                        has the following elements
            gpt_Keys -
                    GPTB_DOWNKEYS set if button down transitions
                    trigger a report, and GPTB_UPKEYS set if button up
                    transitions trigger a report
            gpt_Timeout -
                    a time which, if exceeded, triggers a report;
                    measured in vertical blank units (60/sec)
            gpt_XDelta  -
                    a distance in x which, if exceeded, triggers a
                    report
            gpt_YDelta  -
                    a distance in x which, if exceeded, triggers a
                    report
```

Contents

```
input.device/AddHandler

   NAME
        AddHandler - add an input handler to the device

   FUNCTION
        Adds a function to the list of functions called to handle
        input events generated by this device.  The function is called
        as
            newInputEvents = Handler(inputEvents, handlerData);
            D0                         A0           A1

   IO REQUEST
        io_Message      mn_ReplyPort set
        io_Device       preset by OpenDevice
        io_Unit         preset by OpenDevice
        io_Command      IND_ADDHANDLER
        io_Data         a pointer to an interrupt structure.
            is_Data     the handlerData pointer described above
            is_Code     the Handler function address

   NOTES
        The interrupt structure is kept by the input device until a
        RemHandler command is satisfied for it.
```

```
input.device/Clear

   NAME
        Clear - clear input buffer

   FUNCTION
        Removes from input buffers any input reports waiting to
        satisfy read requests.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Unit         preset by the call to OpenDevice
        io_Command      CMD_CLEAR
        io_Flags        IOB_QUICK set if quick I/O is possible
```

```
input.device/Open

   NAME
        Open - a request to open the input device

   SYNOPSIS
        OpenDevice("input.device", 0, iORequest, 0)

   FUNCTION
        The open routine grants access to a device.  Two
        fields in the iORequest block will be filled in:  the
        IO_DEVICE field and the IO_UNIT field.

        The device open count will be incremented.  The device cannot
        be expunged unless this open is matched by a CloseDevice.

   RESULTS
        If the open was unsuccessful, IO_ERROR will be set, IO_UNIT
        and IO_DEVICE will not be valid.
```

```
input.device/RemHandler

   NAME
        RemHandler - remove an input handler from the device

   FUNCTION
        Removes a function previously added to the list of handler
        functions.

   IO REQUEST
        io_Message      mn_ReplyPort set
        io_Device       preset by OpenDevice
        io_Unit         preset by OpenDevice
        io_Command      IND_REMHANDLER
        io_Data         a pointer to the interrupt structure.

   NOTES
        This command is not immediate
```

input.device/Reset

NAME
    Reset - reset the input

FUNCTION
    Reset resets the keyboard device without destroying handles
    to the open device.

IO REQUEST

io_Message	mn_ReplyPort set if quick I/O is not possible
io_Device	preset by the call to OpenDevice
io_Unit	preset by the call to OpenDevice
io_Command	CMD_RESET
io_Flags	IOB_QUICK set if quick I/O is possible

input.device/SetMPort

NAME
    SetMPort - set the current mouse port

FUNCTION
    This command sets the gameport port at which the mouse is
    connected.

IO REQUEST

io_Message	mn_ReplyPort set if quick I/O is not possible
io_Device	preset by the call to OpenDevice
io_Unit	preset by the call to OpenDevice
io_Command	IND_SETMPORT
io_Flags	IOB_QUICK set if quick I/O is possible
io_Length	1
io_Data	a pointer to a byte that is either 0 or 1, indicating that mouse input should be obtained from either the left or right controller port, respectively.

```
input.device/SetMTrig

   NAME
        SetMTrig - set the conditions for a mouse port report

   FUNCTION
        This command sets what conditions must be met by a mouse
        before a pending Read request will be satisfied.  The trigger
        specification is that used by the gameport device.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Unit         preset by the call to OpenDevice
        io_Command      IND_SETTRIGGER
        io_Flags        IOB_QUICK set if quick I/O is possible
        io_Length       sizeof(gameportTrigger)
        io_Data         a structure of type GameportTrigger, which
                        has the following elements
            gpt_Keys -
                    GPTB_DOWNKEYS set if button-down transitions
                    trigger a report, and GPTB_UPKEYS set if button up
                    transitions trigger a report
            gpt_Timeout -
                    a time which, if exceeded, triggers a report;
                    measured in vertical blank units (60/sec)
            gpt_XDelta  -
                    a distance in x which, if exceeded, triggers a
                    report
            gpt_YDelta  -
                    a distance in x which, if exceeded, triggers a
                    report
```

```
input.device/SetMType

   NAME
        SetMType - set the current mouse port controller type

   FUNCTION
        This command sets the type of device at the mouse port, so
        the signals at the port may be properly interpreted.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Unit         preset by the call to OpenDevice
        io_Command      IND_SETMTYPE
        io_Flags        IOB_QUICK set if quick I/O is possible
        io_Length       1
        io_Data         the address of the byte variable describing
                        the controller type, as per the equates in
                        the gameport include file
```

```
input.device/SetPeriod

   NAME
        SetPeriod - set the key repeat period

   FUNCTION
        This command sets the period at which a repeating key repeats.
        This command always executes immediately.

   IO REQUEST - a timerequest
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Unit         preset by the call to OpenDevice
        io_Command      IND_SETPERIOD
        io_Flags        IOB_QUICK set if quick I/O is possible
        io_tv_Secs      the repeat period seconds
        io_tv_Micro     the repeat period microseconds
```

```
input.device/SetThresh

   NAME
        SetThresh - set the key repeat threshold

   FUNCTION
        This command sets the time that a key must be held down before
        it can repeat.  The repeatability of a key may be restricted
        (as, for example, are the shift keys).

        This command always executes immediately.

   IO REQUEST - a timerequest
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Unit         preset by the call to OpenDevice
        io_Command      IND_SETTHRESH
        io_Flags        IOB_QUICK set if quick I/O is possible
        io_tv_Secs      the threshold seconds
        io_tv_Micro     the threshold microseconds
```

```
input.device/Start

   NAME
        Start - restart after stop

   FUNCTION
        Start restarts the unit after a stop command.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Unit         preset by the call to OpenDevice
        io_Command      CMD_START
        io_Flags        IOB_QUICK set if quick I/O is possible
```

```
input.device/WriteEvent

   NAME
        WriteEvent - propagate input event(s) to all handlers

   FUNCTION

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Unit         preset by the call to OpenDevice
        io_Command      IND_WRITEEVENT
        io_Flags        IOB_QUICK set if quick I/O is possible
        io_Length       the size of the io_Data area in bytes: there
                        are sizeof(inputEvent) bytes per input event.
        io_Data         a buffer area with input events(s).  The
                        fields of the input event are:
            ie_NextEvent
                        links the events together, the last event
                        has a zero ie_NextEvent.
            ie_Class
            ie_SubClass
            ie_Code
            ie_Qualifier
            ie_X, ie_Y
            ie_TimeStamp
                        as desired

   NOTES
        The contents of the input event(s) are destroyed.
```

Contents
----

keyboard.device/AddResetHandler

```
   NAME
        AddResetHandler - add a reset handler to the device

   FUNCTION
        Adds a function to the list of functions called to clean up
        before a hard reset:

            Handler(handlerData);
                    A1

   IO REQUEST
        io_Message      mn_ReplyPort set
        io_Device       preset by OpenDevice
        io_Unit         preset by OpenDevice
        io_Command      KBD_ADDRESETHANDLER
        io_Data         a pointer to an interrupt structure.
            is_Data     the handlerData pointer described above
            is_Code     the Handler function address

   NOTES
        The interrupt structure is kept by the keyboard device until a
        RemResetHandler command is satisfied for it.
```

```
keyboard.device/Clear


   NAME
        Clear - clear keyboard input buffer

   FUNCTION
        Removes from the input buffer any keys transitions waiting to
        satisfy read requests.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Command      CMD_CLEAR
        io_Flags        IOB_QUICK set if quick I/O is possible
```

```
keyboard.device/ReadEvent


   NAME
        ReadEvent - return the next keyboard event.

   FUNCTION
        Read raw keyboard events from the keyboard and put them in the
        data area of the iORequest.  If there are no pending keyboard
        events, this command will not be satisfied.  If there are
        some events, but not as many as can fill IO_LENGTH, the
        request will be satisfied with those currently available.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Command      KBD_READEVENT
        io_Flags        IOB_QUICK set if quick I/O is possible
        io_Length       the size of the io_Data area in bytes: there
                        are sizeof(inputEvent) bytes per input event.
        io_Data         a buffer area to fill with input events.  The
                        fields of the input event are:
            ie_NextEvent
                        links the events returned
            ie_Class
                        is IECLASS_RAWKEY
            ie_Code
                        contains the next key up/down reports
            ie_Qualifier
                        only the shift and numeric pad bits are set
            ie_SubClass, ie_X, ie_Y, ie_TimeStamp
                        are not used, and set to zero

   RESULTS
        This function sets the error field in the IORequest and fills
        the IORequest with the next keyboard events (but not partial
        events).
```

keyboard.device/ReadMatrix

```
NAME
     ReadMatrix - read the current keyboard key matrix

FUNCTION
     This function reads the up/down state of every key in the
     key matrix.

IO REQUEST
     io_Message      mn_ReplyPort set if quick I/O is not possible
     io_Device       preset by the call to OpenDevice
     io_Command      KBD_READMATRIX
     io_Flags        IOB_QUICK set if quick I/O is possible
     io_Length       the size of the io_Data area in bytes: this
                     must be big enough to hold the key matrix.
     io_Data         a buffer area to fill with the key matrix:
                     an array of bytes whose component bits reflect
                     each keys state: the state of the key for
                     keycode n is at bit (n MOD 8) in byte
                     (n DIV 8) of this matrix.

RESULTS
     This function sets the error field in the IORequest and sets
     matrix to the current key matrix.
```

keyboard.device/RemResetHandler

```
NAME
     RemResetHandler - remove a reset handler from the device

FUNCTION
     Removes a function previously added to the list of handler
     functions.

IO REQUEST
     io_Message      mn_ReplyPort set
     io_Device       preset by OpenDevice
     io_Unit         preset by OpenDevice
     io_Command      KBD_REMRESETHANDLER
     io_Data         a pointer to the handler interrupt structure.
```

keyboard.device/Reset

NAME
    Reset - reset the keyboard

FUNCTION
    Reset resets the keyboard device without destroying handles
    to the open device.

IO REQUEST

io_Message	mn_ReplyPort set if quick I/O is not possible
io_Device	preset by the call to OpenDevice
io_Command	CMD_RESET
io_Flags	IOB_QUICK set if quick I/O is possible

keyboard.device/ResetHandlerDone

NAME
    ResetHandlerDone - indicate that reset can occur

FUNCTION
    Indicates that reset clean-up associated with the handler has
    completed.

IO REQUEST

io_Message	mn_ReplyPort set
io_Device	preset by OpenDevice
io_Unit	preset by OpenDevice
io_Command	KBD_RESETHANDLERDONE
io_Data	a pointer to the handler interrupt structure.

Contents
----

narrator.device/AbortIO

NAME
    AbortIO - abort an IO request

SYNOPSIS
    AbortIO(IORequest)

FUNCTION
    Aborts a speech IO request. The request may be in the queue
   or currently active.

INPUTS
    IORB of request to abort.

RESULTS
    io_Error field of IORB set to IOERR_ABORTED

SEE ALSO

```
narrator.device/CloseDevice

   NAME
        CloseDevice - terminate access to the narrator device

   SYNOPSIS
        CloseDevice(IORequest)

   FUNCTION
        Close invalidates the IO_UNIT and IO_DEVICE fields in the
        IORB, preventing subsequent IO until another OpenDevice.
        CloseDevice also reduces the open count.  If the count
        goes to 0 and the expunge bit is set, the device is
        expunged.  If the open count goes to zero and the delayed
        expunge bit is not set, CloseDevice sets the expunge bit.

   INPUTS
        IORequest block

   RESULTS
        IORequest block with unit and device pointers invalidated.

   SEE ALSO
```

```
narrator.device/Flush

   NAME
        Flush - abort all in-progress and queued requests

   SYNOPSIS
        Standard device command.  See DoIO()/SendIO().

   FUNCTION
        Aborts all in-progress and queued speech requests.

   INPUTS
        io_Command - CMD_FLUSH

   RESULTS

   SEE ALSO
```

```
narrator.device/Open

   NAME
        OpenDevice - open the narrator device

   SYNOPSIS
        error = OpenDevie("narrator.device", 0, IORequest, 0);

   FUNCTION
        The OpenDevice routine grants access to the narrator device.
        OpenDevice checks the unit number, and if non-zero, returns
        an error (ND_UnitErr).  If this is the first time the driver
        has been opened, OpenDevice will attempt to open the audio
        device and allocate the driver's static buffers.  If either
        of these operations fail, an error is returned (see the .h and .i
        files for possible error return codes).  Next, OpenDevice
        (done for all opens, not just the first one) initializes the
        user's IORequest block (IORB).  Default values for sex, rate,
        pitch, pitch mode, sampling frequency, and mouths are set in
        the appropriate fields of the IORB.  Note that if users wish
        to use non-default values for these parms, the values must
        be set after the open is done.  OpenDevice then assigns a
        pseudo-unit number to the IORB for use in synchronizing read
        and write requests.  See the read command for more details.
        Finally, OpenDevice stores the device node pointer in the
        IORB and clears the delayed expunge bit.

   INPUTS
        deviceName - must be "narrator.device"
        unitNumber - must be 0
        IORequest  - the user's IORB (need not be initialized)
        flags      - not used

   RESULTS
        IORB fields set:
           rate     - 150 words/minute
           pitch    - 110 Hz
           mode     - Natural
           sex      - Male
           mouths   - Off
           sampfreq - 22200
           volume   - 64 (max)

        error - same as io_Error field of IORB

   SEE ALSO
```



```
narrator.device/Read

   NAME
        Read - return the next different mouth shape from an
               associated write

   SYNOPSIS
        Standard device command.  See DoIO/SendIO.

   FUNCTION
        The read command of the narrator device returns mouth
        shapes to the user.  The shape returned is guaranteed
        to be different from the previously returned shape
        (allowing updating to be done only when something has
        changed).  Each read request is associated with a
        write request by the pseudo-unit number assigned by
        the OpenDevice call.  Since the first structure in
        the read-mouth IORB is a narrator (write) IORB, this
        association is easily made by copying the narrator
        IORB into the narrate_rb field fo the read IORB.
        See the .hi files.  If there is no write in progress
        or in the device input queue with the same pseudo-
        unit number as the read request, the read will be
        returned to the user with an error.  This is also
        how the user knows that the write request has
        finished and that s/he should not issue any more
        reads.  Note that in this case the mouth shapes may
        not be different from previously returned values.

   INPUTS
        IORB with the narrator_rb structure copied from the
        associated write request execpt for:
           io_Message - message port for read request
           io_Command - CMD_READ
           io_Error   - 0
           width      - 0
           height     - 0

   RESULTS
        IORB fields set:
           width  - mouth width in millimeters/3.67
                    (division done for scaling)
           height - mouth height in millimeters
           shape  - compressed form of mouth shapes
                    (internal use only)

   SEE ALSO
        Write command.
```

```
narrator.device/Reset

   NAME
        Reset - reset the device to a known state

   SYNOPSIS
        Standard device command.  See DoIO()/SendIO().

   FUNCTION
        Resets the device as though it has just be initialized.
        Aborts all read/write requests whether they are active or enqueued.
        Restarts device if it has been stopped.

   INPUTS
        io_Command = CMD_RESET

   RESULTS

   SEE ALSO
```

```
narrator.device/Start/Stop

   NAME
        Stop  - stops the device
        Start - restarts the device after Stop

   SYNOPSIS
        Standard device commands.  See DoIO()/SendIO().

   FUNCTION
        Stop halts the currently active speech (if any) and
        prevents any queued requests from starting.

        Start restarts the currently active speech (if any)
        and allows queued request to start.

   INPUTS
        io_Command = CMD_STOP or CMD_START

   RESULTS

   SEE ALSO
```

```
narrator.device/Write

   NAME
        Write - send speech request to the narrator device

   SYNOPSIS
        Standard device command.  See DoIO()/SendIO().

   FUNCTION
        Performs the speech request.  If there is an
        associated read request on the device input queue,
        write will remove it and return an initial mouth
        shape to the user.  Note that if you are going
        to be doing reads, the mouths parameter must be
        set to 1.

   INPUTS
        Narrator IORB
           ch_masks - array of audio channel selection masks
                      (see audio device documentation for
                       description of this field)
           nm_masks - number of audio channel selection masks
           mouths   - 0 if no mouths are desired
                      1 if mouths are to be read
           rate     - speaking rate
           pitch    - pitch
           mode     - pitch mode
                      0 if natural mode
                      1 if robotic mode
           sex      - 0 if male
                    - 1 if female
           io_Message - message port
           io_Command - CMD_WRITE
           io_Data    - input string
           io_Length  - length of input string

   RESULTS
        The function sets the io_Error field of the IORB.  The
        io_Actual field is set to the length of the input string
        that was actually processed.  If the return code indicates
        a phoneme error (ND_PhonErr), io_Actual is the position in
        the input string where the error occurred.

   SEE ALSO
        Read command.
        Audio device documentation.
```

Contents

```
parallel.device/AbortIO

   NAME
       AbortIO -- abort the specified I/O request

   FUNCTION
       This function aborts the specified read or write request. If the
       request is active, it is stopped immediately. If the request is
       queued, it is painlessly removed.

   INPUTS
       iORequest  -- pointer to the IORqst Block that is to be aborted.

   RESULTS
       Error -- if the Abort succeeded, Error will be #IOERR_ABORTED
       (-2) and the request will be flagged as aborted (bit 5 of io_Flags
       set). If the Abort failed, the Error will be zero.
```

```
parallel.device/BeginIO

   NAME
       BeginIO -- start up an I/O process

   FUNCTION
       This function initiates a I/O request made to the parallel
       device. Other than read or write, the functions are performed
       synchronously and do not depend on any interrupt handling
       logic (or its associated discontinuities).  If so selected,
       the function can be performed as IO_QUICK.  Reads and writes are
       merely initiated by BeginIO, and thus return to the caller as begun,
       not completed. Completion is signaled via the standard ReplyMsg
       routine. A valid read or write request is performed asynchronously,
       never as IO_QUICK.  Multiple requests are handled via FIFO
       queuing.

   INPUTS
       iORequest  -- pointer to an I/O Request Block of size
           io_ExtParSize (see parallel.i for size/definition),
           containing a valid function in io_Command to process,
           as well as the function's other required parameters.
       deviceNode -- pointer to the "parallel.device" node built at
           init, and put into io_Device at Open.

   RESULTS
       Error -- if the BeginIO succeeded, Error will be null.
           If the BeginIO failed, the Error will be non-zero.
           Most I/O errors won't be reported until the ReplyMsg.
```

```
parallel.device/Clear

   NAME
       Clear -- clear the parallel port buffer

   FUNCTION
       This function just RTS's (no buffer to clear).

   IO REQUEST
       io_Message      mn_ReplyPort initialized
       io_Device       set by OpenDevice
       io_Unit         set by OpenDevice
       io_Command      CMD_CLEAR

   RESULTS
       Error -- none
```

```
parallel.device/Close

   NAME
       Close -- close the parallel port

   SYNOPSIS
       CloseDevice(deviceNode)

   FUNCTION
       This function closes software access to the parallel device.

   INPUTS
       deviceNode - pointer to the device node, set by Open

   SEE ALSO
       parallel.device/Open
```

```
parallel.device/Flush

   NAME
       Flush -- clear all queued I/O requests for the parallel port

   FUNCTION
       This function purges the read and write request queues for the
       parallel device.

   IO REQUEST
       io_Message      mn_ReplyPort initialized
       io_Device       set by OpenDevice
       io_Unit         set by OpenDevice
       io_Command      CMD_FLUSH

   RESULTS
       Error -- if the Flush succeeded, Error will be null.
           If the Flush failed, the Error will be non-zero.
```

```
parallel.device/Open

   NAME
       Open -- a request to open the parallel port

   SYNOPSIS
       OpenDevice(parname, unit, ioRequest, flags)

   FUNCTION
       This function allows the requester software access to the parallel
       device.  Unless the shared-access bit (bit 5 of io_ParFlags) is
       set, exclusive use is granted and no other access is allowed
       until the owner closes the device.

       OpenDevice initializes the io_Device and io_Unit fields to 0,
       because there is only one parallel device/unit.

   INPUTS
       parname   - pointer to literal string "parallel.device"
       unit      - ignored
       ioRequest - pointer to an ioRequest block of size io_ExtParSize
                   (see parallel.i for size/definition) to be initialized
                   by the Open routine.
                   NOTE use of io_ParFlags (see FUNCTION above)

       IMPORTANT !!! ioRequest block MUST (!!) be of size io_ExtParSize !!!
       ---------
       flags     - ignored

   RESULTS
       D0 -- pointer to the device node
       Error -- if the Open succeeded, Error will be null.
           If the Open failed, then the Error will be non-zero.
```

```
parallel.device/Query

   NAME
       Query -- query parallel port/line status

   FUNCTION
       This function return the status of the parallel port lines and
       registers.

   IO REQUEST
       io_Message      mn_ReplyPort initialized
       io_Device       set by OpenDevice
       io_Unit         set by OpenDevice
       io_Command      PDCMD_QUERY (0A)

   RESULTS
       io_Status        BIT  ACTIVE  FUNCTION

                         0     low    printer selected
                         1     low    paper out
                         2     low    printer in busy toggle
                         3      -     read=0,write=1
                       4-7            reserved
```

```
parallel.device/Read

   NAME
       Read -- read input from parallel port

   FUNCTION
       This function causes a stream of characters to be read from the
       parallel I/O register. The number of characters is specified in
       io_Length, unless -1 is used, in which case input is read until
       an EOF is read (currently 0x00). If no read request has been
       made, pending input (i.e. handshake request) is not acknowledged.

   IO REQUEST
       io_Message      mn_ReplyPort initialized
       io_Device       set by OpenDevice
       io_Unit         set by OpenDevice
       io_Command      CMD_READ
       io_Flags        IOF_QUICK if quick I/O possible and desired
       io_Length       number of characters to receive, or if set
                       to -1 receive until EOF read in
       io_Data         pointer where to put the data.

   RESULTS
       Error -- if the Read succeeded, Error will be null.
           If the Read failed, the Error will be non-zero.

   SEE ALSO
       parallel.device/BeginIO, parallel.device/SetParams
```

```
parallel.device/Reset

   NAME
       Reset -- reinitialize the parallel port

   FUNCTION
       This function resets the parallel port to its freshly initialized
       condition. It aborts all I/O requests both queued and current and
       sets the port's flags and parameters to their boot-up time
       default values.

   IO REQUEST
       io_Message      mn_ReplyPort initialized
       io_Device       set by OpenDevice
       io_Unit         set by OpenDevice
       io_Command      CMD_RESET

   RESULTS
       Error -- if the Reset succeeded, Error will be null.
           If the Reset failed, the Error will be non-zero.
```

```
parallel.device/SetParams

   NAME
       SetParams -- change parameters for the parallel port

   FUNCTION
       This function allows the caller to change parameters for the
       parallel port. It will disallow changes if any reads or writes
       are active or queued. The EofMode bit of io_SerFlags can be
       set/reset without a call to Setparams. The Shared bit of
       io_SerFlags pertains to OpenDevice calls only. ALL OTHER PARA-
       METERS CAN BE CHANGED ONLY BY THE SETPARAMS FUNCTION. (!!!!)

   IO REQUEST
       io_Message      mn_ReplyPort initialized
       io_Device       set by OpenDevice
       io_Unit         set by OpenDevice
       io_Command      PDCMD_SETPARAMS (09)
             NOTE:  the following fields are filled by Open
                    to reflect the parallel device's current
                    configuration.
       io_PExtFlags    not used in V1.1 (MUST be set to zero)
       io_ParFlags     see definition in parallel.i or parallel.h
             NOTE:  x00 yields exclusive access, termarray
                    inactive.
       io_PTermArray   ASCII descending-ordered 8-byte array of
                       termination characters. If less than 8 chars
                       used, fill out array w/lowest valid value.
                       Terminators are used only if EOFMODE bit of
                       io_Parflags is set. (e.g. x512F040303030303 )
                       This field is filled on OpenDevice only if the
                       EOFMODE bit is set.

   RESULTS
       Error -- if the SetParams succeeded, Error will be null.
           If the SetParams failed, the Error will be non-zero.
```

```
parallel.device/Start

   NAME
       Start -- restart I/O that has paused on the parallel port

   FUNCTION
       This function restarts the current I/O activity on the parallel
       port by reactivating the handshaking sequence.

   IO REQUEST
       io_Message      mn_ReplyPort initialized
       io_Device       set by OpenDevice
       io_Unit         set by OpenDevice
       io_Command      CMD_START

   RESULTS
       Error -- if the Start succeeded, Error will be null.
           If the Start failed, the Error will be non-zero.

   SEE ALSO
       parallel.device/Stop
```

```
parallel.device/Stop

   NAME
       Stop -- pause current activity on the parallel port

   FUNCTION
       This function halts the current I/O activity on the parallel
       device by discontinuing the handshaking sequence.

   IO REQUEST
       io_Message      mn_ReplyPort initialized
       io_Device       set by OpenDevice
       io_Unit         set by OpenDevice
       io_Command      CMD_STOP

   RESULTS
       Error -- if the Stop succeeded, Error will be null.
           If the Stop failed, the Error will be non-zero.

   SEE ALSO
       parallel.device/Start
```

```
parallel.device/Write

    NAME
        Write -- send output to parallel port

    FUNCTION
        This function causes a stream of characters to be written to the
        parallel output register. The number of characters is specified in
        io_Length, unless -1 is used, in which case output is sent until
        an EOF is encountered (currently 0x00).

    IO REQUEST
        io_Message      mn_ReplyPort initialized
        io_Device       set by OpenDevice
        io_Unit         set by OpenDevice
        io_Command      CMD_WRITE
        io_Flags        IOF_QUICK if quick I/O is possible and desired
        io_Length       number of characters to transmit, or if set
                        to -1 send until EOF encountered
        io_Data         pointer to block of data to transmit

    RESULTS
        Error -- if the Write succeeded, Error will be null.
            If the Write failed, the Error will be non-zero.

    SEE ALSO
        parallel.device/BeginIO, parallel.device/SetParams
```

Contents

```
printer.device/DumpRPort

   NAME
        DumpRPort - dump the specified RastPort to a graphics printer

   FUNCTION
        Prints a rendition of the supplied RastPort, using the supplied
        ColorMap, position and scaling information, as specified in
        the printer Preferences

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Command      PRD_DUMPRPORT
        io_Flags        IOB_QUICK set if quick I/O is possible
         io_RastPort     ptr to a RastPort.
         io_ColorMap     ptr to a ColorMap.
         io_Modes        the 'modes' flag as from a ViewPort structure
                         the upper word is reserved and should be zero
         io_SrcX         the x offset into the RastPort
         io_SrcY         the y offset into the RastPort
         io_SrcWidth     the x size in the RastPort to be printed
         io_SrcHeight    the y size in the RastPort to be printed
         io_DestCols     ...
         io_DestRows     these two parameters describe the size of the
                         area to print to on the printer, as described
                         below.
         io_Special a) interpretation of Dest parameters:
                        If SPECIAL_MIL is set, then the associated
                        parameter is specified in thousandths of
                        an inch on the printer.
                        If SPECIAL_FULL is set, then the dimension
                        is set to the maximum possible (as
                        determined by the printer limits or the
                        configuration limits, whichever is less).
                        If SPECIAL_FRAC is set, the parameter is
                        taken to be a longword binary fraction
                        of the maximum for that dimension.
                        If ASPECT is set, one of the dimensions
                        may be reduced to preserve the aspect
                        ratio of the print.
                        If all bits for a dimension are clear, the
                        parameter is specified in printer pixels.
                        If SPECIAL_DENSITY(1-4) is set, the
                        printer-specific driver has the option of
                        selecting a different dots per inch density
                        (dpi) than the default one. As of this writing,
                        the printer-specific modules supporting this
                        feature are the HP_LASERJET and the
                        HP_LASERJET_PLUS.  For these two printers, the
                        densities are 75, 100, 150 & 300 dpi,
                        respectively. The HP_LASERJET
                        always defaults to 75 dpi. The HP_LASERJET_PLUS
                        defaults to 100 dpi if the preferences is set to
                        DRAFT quality and 150 dpi with LETTER quality.
                        if SPECIAL_CENTER is set, then the picture will be
                        centered on the paper.

         There exist rules for the interpretation of io_DestRows and
        io_DestCols that may produce unexpected results when they are
        not greater than zero and io_Special is zero.  They have been
        retained for compatability.  The user will not trigger these
        other rules with well formed usage of io_Special.

        The special rules for io_DestRows and io_DestCols
        (WHICH TAKE EFFECT ONLY IF IO_SPECIAL IS 0) are:
                a) DestCols>0 & DestRows>0 - use as absolute values.
                   i.e., DestCols=320 & DestRows=200 means that the picture
                   will appear on the printer as 320x200 dots.
                b) DestCols=0 & DestRows>0 - use the printer's maximum number
                   of columns and print DestRows lines, i.e., if DestCols=0
                   and DestRows=200 than the picture will appear on the
                   printer as wide as it can be and 200 dots high.
                c) DestCols=0 & DestRows=0 - same as above except the driver
                   determines the proper number of lines to print based on
                   the aspect ratio of the printer.  This results in the
                   largest picture possible that is not distorted or inverted
                   Note: As of this writing, this is the call made by such
                   program as DeluxePaint, GraphicCraft, and AegisImages.
                d) DestCols>0 &DestRows=0 - use the specified width and the
                   driver determines the proper number of lines to print based
                   on the aspect ratio of the printer, i.e., if you desire a
                   picture that is 500 pixels wide and aspect ratio correct,
                   use DestCols=500 and DestRows=0.
                e) DestCols<0 or DestRows>0 - the final picture is either a
                   reduction or expansion based on the fraction
                   |DestCols| / DestRows in the proper aspect ratio.
                   Some examples:
                   1) if DestCols=-2 & DestRows=1 then the printed picture
                      will be 2x the AMIGA picture and in the proper aspect
                      ratio.  (2x is derived from |-2| / 1 which gives 2.0)
                   2) if DestCols=-1 & DestRows=2 then the printed picture
                      will be 1/2x the AMIGA picture in the proper aspect
                      ratio.  (1/2x is derived from |-1| / 2 which gives 0.5)

   HINTS
        The printer selected in preferences must have graphics
        capability to use this command.
        Color printers may not be able to print black and white or
        grey-scale pictures -- specifically, the Okimate 20 cannot
        print these with a color ribbon: use a black one.
        If the printer has an input buffer option, use it.
        If the printer can be uni- or bidirectional, select
        unidirectional; this produces a much cleaner picture and
        in some cases a faster printout.
        Please note that the width and height of the printable area on
        the printer is in terms of pixels and bounded by the folllowing:
         a) WIDTH = (RIGHT_MARGIN - LEFT_MARGIN + 1) / CHARACTERS_PER_INCH
         b) HEIGHT = LENGTH / LINES_PER_INCH
        For RGB printer support, the YMC values in the printer-specific
        render.c functions equate to RGB respectively, i.e., yellow is red,
        magenta is green, and cyan is blue.
```

```
printer.device/Flush

   NAME
        Flush - abort all I/O requests (immediate)

   FUNCTION
        Flush aborts all stopped I/O at the unit.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Command      CMD_FLUSH
        io_Flags        IOB_QUICK set if quick I/O is possible
```

```
printer.device/Invalid

   NAME
        Invalid - invalid command

   FUNCTION
        Invalid is always an invalid command and sets the device
        error appropriately.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Command      CMD_INVALID
        io_Flags        IOB_QUICK set if quick I/O is possible
```

printer.device/PrtCommand

```
NAME
    PCPrtCommand -- send a command to the printer

FUNCTION
   This function sends a command to either the parallel or serial
   device.  The printer device maps this command to the control
   code set of the current printer.  The commands supported can
   be found with the printer.device/Write command.  All printers
   may not support all functions.

IO REQUEST IOPrtCmdReq
    io_Message      mn_ReplyPort set
    io_Device       preset by OpenDevice
    io_Unit         preset by OpenDevice
    io_Command      PRD_PRTCOMMAND
    io_PrtCommand   the actual command number
    io_Parm0        parameter for the command
    io_Parm1        parameter for the command
    io_Parm2        parameter for the command
    io_Parm3        parameter for the command

RESULTS
    Errors: if the PCPrtCommand succeeded, Error will be zero.
        Otherwise, the Error will be non-zero.

SEE ALSO
    printer.device/Write printer.h, parallel.device, Preferences
```

printer.device/RawWrite

```
NAME
     RawWrite - transparent write command

FUNCTION
     This is a nonstandard write command that performs no
     processing on the data passed to it.

IO REQUEST
     io_Message      mn_ReplyPort set if quick I/O is not possible
     io_Command      PRD_RAWWRITE
     io_Flags        IOB_QUICK set if quick I/O is possible
     io_Length       the number of bytes in io_Data
     io_Data         the raw bytes to write to the printer
```

```
printer.device/Reset


   NAME
        Reset - reset the printer

   FUNCTION
        Reset resets the printer device without destroying handles
        to the open device.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Command      CMD_RESET
        io_Flags        IOB_QUICK set if quick I/O is possible
```

```
printer.device/Start


   NAME
        Start - restart after stop (immediate)

   FUNCTION
        Start restarts the unit after a stop command.

   IO REQUEST
        io_Message      mn_ReplyPort set if quick I/O is not possible
        io_Device       preset by the call to OpenDevice
        io_Command      CMD_START
        io_Flags        IOB_QUICK set if quick I/O is possible
```

printer.device/Stop

NAME
    Stop - pause current and queued I/O requests (immediate)

FUNCTION
    Stop pauses all queued requests for the unit and tries to pause the current I/O request. The only commands that will be allowed to be performed subsequently are immediate I/O requests, which include those to start, flush, and finish the I/O after the stop command.

IO REQUEST

io_Message	mn_ReplyPort set if quick I/O is not possible
io_Device	preset by the call to OpenDevice
io_Command	CMD_STOP
io_Flags	IOB_QUICK set if quick I/O is possible

printer.device/Write

NAME
    PCWrite -- send output to the printer

FUNCTION
    This function causes a buffer of characters to be written to the either the parallel or serial device. The number of characters is specified in io_Length, unless -1 is used, in which case output is send until a 0x00 is encountered. The printer device, like the console device, maps ANSI X3.64 style 7-bit printer control codes to the control code set of the current printer. The ANSI codes supported can be found below. All printers may not support all functions.

IO REQUEST

io_Message	mn_ReplyPort set
io_Device	preset by OpenDevice
io_Unit	preset by OpenDevice
io_Command	CMD_WRITE
io_Length	number of characters to process, or if -1, process until EOF encountered
io_Data	pointer to block of data to process

RESULTS
    Errors: if the PCWrite succeeded, Error will be zero.
        Otherwise, the Error will be non-zero.

SEE ALSO
    printer.h, parallel.device, serial.device, Preferences

ANSI X3.64 style COMMANDS

aRIS	ESCc	reset
aRIN	ESC#1	initialize
aIND	ESCD	lf
aNEL	ESCE	return,lf
aRI	ESCM	reverse lf
aSGR0	ESC[0m	normal char set
aSGR3	ESC[3m	italics on
aSGR23	ESC[23m	italics off
aSGR4	ESC[4m	underline on
aSGR24	ESC[24m	underline off
aSGR1	ESC[1m	boldface on
aSGR22	ESC[22m	boldface off
aSFC	SGR30-39	set foreground color
aSBC	SGR40-49	set background color
aSHORP0	ESC[0w	normal pitch
aSHORP2	ESC[2w	elite on
aSHORP1	ESC[1w	elite off
aSHORP4	ESC[4w	condensed fine on
aSHORP3	ESC[3w	condensed off
aSHORP6	ESC[6w	enlarged on
aSHORP5	ESC[5w	enlarged off

aDEN6	ESC[6"z	shadow print on
aDEN5	ESC[5"z	shadow print off
aDEN4	ESC[4"z	doublestrike on
aDEN3	ESC[3"z	doublestrike off
aDEN2	ESC[2"z	NLQ on
aDEN1	ESC[1"z	NLQ off
aSUS2	ESC[2v	superscript on
aSUS1	ESC[1v	superscript off
aSUS4	ESC[4v	subscript on
aSUS3	ESC[3v	subscript off
aSUS0	ESC[0v	normalize the line
aPLU	ESCL	partial line up
aPLD	ESCK	partial line down
aFNT0	ESC(B	US char set
aFNT1	ESC(R	French char set
aFNT2	ESC(K	German char set
aFNT3	ESC(A	UK char set
aFNT4	ESC(E	Danish I char set
aFNT5	ESC(H	Sweden char set
aFNT6	ESC(Y	Italian char set
aFNT7	ESC(Z	Spanish char set
aFNT8	ESC(J	Japanese char set
aFNT9	ESC(6	Norwegian char set
aFNT10	ESC(C	Danish II char set
aPROP2	ESC[2p	proportional on
aPROP1	ESC[1p	proportional off
aPROP0	ESC[0p	proportional clear
aTSS	ESC[n E	set proportional offset
aJFY5	ESC[5 F	auto left justify
aJFY7	ESC[7 F	auto right justify
aJFY6	ESC[6 F	auto full justify
aJFY0	ESC[0 F	auto justify off
aJFY3	ESC[3 F	letter space (justify)
aJFY1	ESC[1 F	word fill(auto center)
aVERP0	ESC[0z	1/8" line spacing
aVERP1	ESC[1z	1/6" line spacing
aSLPP	ESC[nt	set form length n
aPERF	ESC[nq	perf skip n (n>0)
aPERF0	ESC[0q	perf skip off
aLMS	ESC#9	Left margin set
aRMS	ESC#0	Right margin set
aTMS	ESC#8	Top margin set
aBMS	ESC#2	Bottom marg set
aSTBM	ESC[Pn1;Pn2r	T&B margins
aSLRM	ESC[Pn1;Pn2s	L&R margin
aCAM	ESC#3	Clear margins
aHTS	ESCH	Set horiz tab
aVTS	ESCJ	Set vertical tabs
aTBC0	ESC[0g	Clr horiz tab
aTBC3	ESC[3g	Clear all h tab
aTBC1	ESC[1g	Clr vertical tabs
aTBC4	ESC[4g	Clr all v tabs
aTBCALL	ESC#4	Clr all h & v tabs
aTBSALL	ESC#5	Set default tabs
aEXTEND	ESC[Pn"x	extended commands

Contents
----

serial.device/AbortIO

```
NAME
    AbortIO -- abort the specified I/O request

FUNCTION
    This function aborts the specified read or write request. If the
    request is active, it is stopped immediately. If the request is
    queued, it is painlessly removed.

INPUTS
    iORequest  -- pointer to the IORqst Block that is to be aborted.

RESULTS
    Error -- if the Abort succeeded, Error will be #IOERR_ABORTED
        (-2) and the request will be flagged as aborted (set bit 5 of
        io_Flags). If the Abort failed, the Error will be zero.
```

```
serial.device/BeginIO

NAME
    BeginIO -- start up an I/O process

FUNCTION
    This function initiates a I/O request made to the serial
    device. Other than read or write, the functions are performed
    synchronously and do not depend on any interrupt-handling
    logic (or its associated discontinuities). Hence, if so
    selected, the functions can be performed as IO_QUICK.
    With one exception, reads and writes are merely initiated by
    BeginIO and thus return to the caller as begun, not completed.
    Completion is signaled via the standard ReplyMsg routine.
    Multiple requests are handled via FIFO queuing.
    The only exception to this non-QUICK handling of reads and writes
    is for READS when:
      - IO_QUICK bit is set
      - There are no pending read requests
      - There is already enough data in the input buffer to satisfy
        this I/O Request immediately.
    In this case, the IO_QUICK flag is not cleared and the request
    is completed by the time it returns to the caller. There is no
    ReplyMsg or signal bit activity in this case.

INPUTS
    ioRequest  -- pointer to an I/O Request Block of size
        io_ExtSerSize (see serial.i for size/definition),
        containing a valid command in io_Command to process,
        as well as the command's other required parameters.
    deviceNode -- pointer to the "serial.device" node built at
        init, and put into io_Device at Open.

RESULTS
    Error -- if the BeginIO succeeded, Error will be null.
        If the BeginIO failed, the Error will be non-zero.
        Most I/O errors won't be reported until the ReplyMsg.
```



```
serial.device/Break

NAME
    Break -- send a break signal over the serial line

FUNCTION
    This function sends a break signal (serial line held low
    for an extended period) out the serial port. This is accomplished
    by setting the UARTBRK bit of reg ADKCON. After a
    duration (user-specifiable via setparams, default 250000
    microseconds), the bit is reset and the signal discontinued. If
    If the QUEUEDBRK bit of io_SerFlags is set in the io_Request
    block, the request is placed at the back of the write-request
    queue and executed in turn. If the QUEUEDBRK bit is not set,
    the break is started immediately, control returns to the
    caller, and the timer discontinues the signal after the
    duration is completed. It is up to the caller to coordinate
    his/her intentions with the proper commands such as ABORT,
    FLUSH, STOP, START, etc.

IO REQUEST
    io_Message      mn_ReplyPort initialized
    io_Device       set by OpenDevice
    io_Unit         set by OpenDevice
    io_Command      SDCMD_BREAK
    io_Flags        set/reset IO_QUICK per above description

RESULTS
    Error -- if the Break succeeded, Error will be null.
        If the Break failed, the Error will be non-zero.
```

```
serial.device/Clear

    NAME
        Clear -- clear the serial port buffers

    FUNCTION
        This function resets the serial port's read buffer pointers.

    IO REQUEST
        io_Message      mn_ReplyPort initialized
        io_Device       set by OpenDevice
        io_Unit         set by OpenDevice
        io_Command      CMD_CLEAR

    RESULTS
        Error -- if the Clear succeeded, Error will be null.
            If the Clear failed, the Error will be non-zero.
```

```
serial.device/Close

    NAME
        Close -- close the serial port

    SYNOPSIS
        CloseDevice(deviceNode)

    FUNCTION
        This function closes software access to the serial device. Upon
        closing, the device's input buffer is freed.

    INPUTS
        deviceNode - pointer the device node, set by Open

    SEE ALSO
        serial.device/Open
```

```
serial.device/Flush


   NAME
       Flush -- clear all queued I/O requests for the serial port

   FUNCTION
       This function purges the read and write request queues for the
       serial device. Flush will not affect active requests.

   IO REQUEST
       io_Message      mn_ReplyPort initialized
       io_Device       set by OpenDevice
       io_Unit         set by OpenDevice
       io_Command      CMD_FLUSH

   RESULTS
       Error -- if the Flush succeeded, Error will be null.
           If the Flush failed, the Error will be non-zero.
```

```
serial.device/Open


   NAME
       Open -- a request to open the serial port

   SYNOPSIS
       OpenDevice(sername, unit, ioRequest, flags)

   FUNCTION
       This function allows the requester software access to the serial
       device. Unless the shared-access bit (bit 5 of io_SerFlags) is
       set, exclusive use is granted and no other access is allowed
       until the owner closes the device. All serial-specific fields
       are initialized to their most recent values (or default, if the
       first time open). OpenDevice initializes the io_Device and
       io_Unit fields to 0, since there is only one serial device/unit.
       If the user wants to support 7-wire handshaking (i.e. RS232-C
       CTS/RTS protocol), he should set the 7WIRE bit before opening.

   INPUTS
       sername   - pointer to literal string "serial.device"
       unit      - ignored
       ioRequest - pointer to an ioRequest block of size io_ExtSerSize
                   (see serial.i,h for size/definition) to be initialized
                   by the OpenDevice routine.
                   NOTE use of io_SerFlags (see FUNCTION above)
#@&%!  IMPORTANT !!! ioRequest block MUST (!!) be of size io_ExtSerSize !!!
       flags     - ignored

   RESULTS
       D0 -- pointer to the device node
       Error -- if the Open succeeded, Error will be null.
           If the Open failed, the Error will be non-zero.
```

serial.device/Query

```
NAME
    Query -- query serial port/line status

FUNCTION
    This function returns the status of the serial port lines and
    registers. The number of unread bytes in the serial device's
    read buffer is shown in io_Actual.

IO REQUEST
    io_Message      mn_ReplyPort initialized
    io_Device       set by OpenDevice
    io_Unit         set by OpenDevice
    io_Command      SDCMD_QUERY (0A)

RESULTS
    io_Status        BIT  ACTIVE  FUNCTION

           LSB        0   low    reserved
                      1   low    reserved
                      2   low    reserved
                      3   low    Data Set Ready
                      4   low    Clear To Send
                      5   low    Carrier Detect
                      6   low    Ready To Send
                      7   low    Data Terminal Ready
           MSB        8   high   read buffer overflow
                      9   high   break sent (most recent output)
                     10   high   break received (as latest input)
                     11   high   transmit x-OFFed
                     12   high   receive x-OFFed
                  13-15          reserved

    io_Actual       set to count of unread input characters

    Error -- if the Query succeeded, Error will be null.
        If the Flush failed, the Error will be non-zero.
```

serial.device/Read

```
NAME
    Read -- read input from serial port

FUNCTION
    This function causes a stream of characters to be read in the
    serial port. The number of characters is specified in io_Length,
    unless -1 is used, in which case input is read until an null(0x00)
    is received. Input for which there is no request is stored in the
    input buffer until it can be dispatched to a requester.

IO REQUEST
    io_Message      mn_ReplyPort initialized
    io_Device       set by OpenDevice
    io_Unit         set by OpenDevice
    io_Command      CMD_READ
    io_Flags        IOF_QUICK if quick I/O possible and desired
    io_Length       number of characters to receive, or if set
                    to -1 receive until null(0x00) read in
    io_Data         pointer to read buffer

RESULTS
    Error -- if the Read succeeded, Error will be null.
        If the Read failed, the Error will be non-zero.
```

serial.device/Reset

```
NAME
    Reset -- reinitialize the serial port

FUNCTION
    This function resets the serial port to its freshly initialized
    condition. It aborts all I/O requests both queued and current,
    relinquishes the current buffer, obtains a new default sized
    buffer, and sets the port's flags and parameters to their
    boot-up time default values. The functions places the reset
    parameter values in the ioRequest block.

IO REQUEST
    io_Message      mn_ReplyPort initialized
    io_Device       set by OpenDevice
    io_Unit         set by OpenDevice
    io_Command      CMD_RESET

RESULTS
    Error -- if the Reset succeeded, Error will be null.
        If the Reset failed, the Error will be non-zero.
```


serial.device/SetParams

```
NAME
    SetParams -- change parameters for the serial port

FUNCTION
    This function allows the caller to change parameters for the
    serial device. Except for xON-xOFF enable/disable, it will
    reject a setparams call if any reads or writes are active
    or pending.
       Note specifically:

 1. Valid input for io_Baud is between 112 and 292000 baud inclusive;
    asynchronous I/O above 32KB (especially on a busy system) may
    be ambitious.
 2. The EOFMODE and QUEUEDBRK bits of io_SerFlags can be set/reset
    in the io_Rqst block without a call to SetParams. The SHARED
    and 7WIRE bits of io_SerFlags are used in OpenDevice calls.
    ALL OTHER PARAMETERS CAN BE CHANGED ONLY BY THE SetParams
    COMMAND. (!!!!)
 3. RBufLen must be at least 512.
 4. io_ExtFlags is not used in V1.1 and MUST be set to zero to
    assure upward compatibility.
 5. xON-xOFF is by default enabled. The XDISABLED bit is the only
    parameter that can be changed via a SetParams call while the
    device is active.  Note that this will return the value
    SerErr_DevBusy in the io_Error field.
 6. If you are trying to run MIDI, it is suggested to set the RAD_BOOGIE
    bit of io_SerFlags to bypass unneeded overhead. Specifically, this
    skips checks for parity, x-OFF handling, character lengths other than
    8 bits, and testing for a break signal. Setting RAD_BOOGIE will
    also set the XDISABLED bit.
    Note that writing data (that's already in MIDI format) at MIDI rates
    is easily accomplished. Using this driver alone for MIDI reads may,
    however, be inappropriate, because of  MIDI time-stamping requirements
    and the possibility of overruns in a busy multitasking and/or
    display-intensive environment.

IO REQUEST
    io_Message      mn_ReplyPort initialized
    io_Device       set by OpenDevice
    io_Unit         set by OpenDevice
    io_Command      SDCMD_SETPARAMS (0x0B)
    NOTE:  the following fields are filled in by Open
           to reflect the serial device's current configuration.
    io_CtlChar      a longword containing byte values for the
                    xON,xOFF,INQ,ACK fields (respectively)
                    (INQ/ACK not used at this time)
    io_RBufLen      length in bytes of input buffer
    io_ExtFlags     (not used)
    NOTE:  any change in buffer size causes the
           current buffer to be deallocated and a new,
           correctly sized one to be allocated. Thus,
           the CONTENTS OF THE OLD BUFFER ARE LOST.
    io_Baud         baud rate for reads AND writes. (See 1 above)
    io_BrkTime      duration of break signal in MICROseconds
    io_TermArray    ASCII descending-ordered 8-byte array of
```

```
                termination characters. If less than 8 chars
                used, fill out array w/lowest valid value.
                Terminators are checked only if EOFMODE bit of
                io_Serflags is set. (e.g., x512F040303030303 )
io_ReadLen      number of bits in read word (1-8) not including parity
io_WriteLen     number of bits in write word (1-8) "      "       "
io_StopBits     number of stop bits (1 normal, 2 can be
                specified for reads if ReadLen <= 7)
io_SerFlags     see serial.i,h for bit equates, NOTE that x00
                yields exclusive access, xON/OFF-enabled, no
                parity checking, 3-wire protocol and TermArray
                inactive.
```

RESULTS
    Error -- if the SetParams succeeded, Error will be null.
        If the SetParams failed, the Error will be non-zero.

NAME
    Start -- restart paused I/O over the serial port

FUNCTION
    This function restarts all current I/O on the serial port by
    sending an xON to the "other side," and submitting a "logical
    xON" to "our side," if/when appropriate to current activity.

IO REQUEST

```
io_Message      mn_ReplyPort initialized
io_Device       set by OpenDevice
io_Unit         set by OpenDevice
io_Command      CMD_START
```

RESULTS
    Error -- if the Start succeeded, Error will be null.
        If the Start failed, the Error will be non-zero.

SEE ALSO
    serial.device/Stop

```
serial.device/Stop


   NAME
       Stop -- pause all current I/O over the serial port

   FUNCTION
       This function halts all current I/O on the serial port by
       sending an xOFF to the "other side," and submitting a "logical
       xOFF" to "our side," if/when appropriate to current activity.

   IO REQUEST
       io_Message      mn_ReplyPort initialized
       io_Device       set by OpenDevice
       io_Unit         set by OpenDevice
       io_Command      CMD_STOP

   RESULTS
       Error -- if the Stop succeeded, Error will be null.
           If the Stop failed, the Error will be non-zero.

   SEE ALSO
       serial.device/Start
```

```
serial.device/Write


   NAME
       Write -- send output to serial port

   FUNCTION
       This function causes a stream of characters to be written out
       the serial port. The number of characters is specified in
       io_Length, unless -1 is used, in which case output is sent until
       a null(0x00) is encountered.

   IO REQUEST
       io_Message      mn_ReplyPort initialized
       io_Device       set by OpenDevice
       io_Unit         set by OpenDevice
       io_Command      CMD_WRITE
       io_Flags        IOF_QUICK set if quick I/O possible and desired
       io_Length       number of characters to transmit, or if set
                       to -1 transmit until null encountered in buffer
       io_Data         pointer to block of data to transmit

   RESULTS
       Error -- if the Write succeeded, Error will be null.
           If the Write failed, the Error will be non-zero.

   SEE ALSO
       serial.device/BeginIO, serial.device/setParams
```

Contents

timer.device/AddTime

```
NAME
     AddTime - add one time request to another

SYNOPSIS
     AddTime( Dest, Source ), timer.device
              A0    A1         A6

FUNCTION
     This routine adds one timeval structure to another.  The
     results are stored in the destination (Dest + Source -> Dest)

     A0 and A1 will be left unchanged.

INPUTS
     Dest, Source -- pointers to timeval structures.

EXCEPTIONS

SEE ALSO

BUGS
```

timer.device/background

```
TIMER REQUEST
    A time request is a nonstandard IO Request.  It has an IORequest
    followed by a timeval structure.

TIMEVAL
    A timeval structure consists of two longwords.  The first is
    the number of seconds, the latter is the fractional number
    of microseconds.  The microseconds must always be "normalized;"
    e.g., the longword must be between 0 and one million.

UNITS
    The timer contains two units -- one that is precise but
    inaccurate, the other that has little system overhead,
    is very stable over time, but has only limited resolution.

UNIT_MICROHZ
    This unit uses a programmable timer in the 8520 to keep
    track of its time.  It has precision down to about 2
    microseconds, but will drift as system load increases.
    The timer is typically accurate to within five percent.

UNIT_VBLANK
    This unit is driven by the vertical blank interrupt.  It
    is very stable over time, but has a resolution of only
    16667 microseconds (or 20000 microseconds in PAL land).
    The timer is cheap to use, and should be used by
    those who are waiting for long periods of time (typically
    1/2 second or more).

LIBRARY
     In addition to the normal device calls, the timer also supports
     three direct, library-like calls.  They are for manipulating
     timeval structures.  Addition, subtraction, and comparison
     are supported.
```

timer.device/CmpTime

```
NAME
     CmpTime - compare two timeval structures

SYNOPSIS
     result = CmpTime( Dest, Source ), timer.device
                       A0    A1        A6

FUNCTION
     This routine compares two timeval structures.

     A0 and A1 will be left unchanged.

INPUTS
     Dest, Source -- pointers to timeval structures.

RESULTS
     result =  0     if Dest has the same time as Source
     result = -1     if Dest has less time than Source
     result = +1     if Dest has more time than Source

EXCEPTIONS

SEE ALSO

BUGS
```

```
timer.device/SubTime


   NAME
        SubTime - subtract one time request from another

   SYNOPSIS
        SubTime( Dest, Source ), timer.device
                 A0    A1        A6

   FUNCTION
        This routine subtracts one timeval structure from another.  The
        results are stored in the destination (Dest - Source -> Dest)

        A0 and A1 will be left unchanged.

   INPUTS
        Dest, Source -- pointers to timeval structures.

   EXCEPTIONS

   SEE ALSO

   BUGS
```

```
timer.device/TR_ADDREQUEST

   NAME
       TR_ADDREQUEST -- submit a request to time time

   FUNCTION
       Asks the timer to count off a specified amount of time.
       The timer will chain this request with its other
       requests and will reply the message back to the
       user when the timer counts down to zero.

   TIMER REQUEST
       io_Message      mn_ReplyPort initialized
       io_Device       preset by timer in OpenDevice
       io_Unit         preset by timer in OpenDevice
       io_Command      TR_ADDREQUEST
       io_Flags        IOF_QUICK allowable
       tr_time         a timeval structure specify how long until
                           the driver will reply

   RESULTS
       tr_time         will contain junk
```

timer.device/TR_GETSYSTIME

```
NAME
    TR_GETSYSTIME -- get the system time

FUNCTION
    Asks the timer what time it is.  The system time starts
    at zero at power-on but may be initialized via the
    TR_SETSYSTIME call.

    System time is monotonically increasing and guaranteed
    to be unique (except if someone sets the time backwards).
    The time is incremented every vertical blank by the
    vertical blanking interval.  In addition, it is changed
    every time someone asks what time it is.  In this way,
    the return value of the system time is unique and unrepeating.

TIMER REQUEST
    io_Message      mn_ReplyPort initialized
    io_Device       preset by timer in OpenDevice
    io_Unit         preset by timer in OpenDevice
    io_Command      TR_ADDREQUEST
    io_Flags        IOF_QUICK allowable

RESULTS
    tr_time         the timeval structure will be filled in with
                        the current system time
```

timer.device/TR_SETSYSTIME

```
NAME
    TR_SETSYSTIME -- set the system time

FUNCTION
    Sets the system's idea of what time it is.  The system
    starts out at time "zero" so it is safe to set it
    forward to the "real" time.  However, care should be taken
    when setting the time backwards.  System time
    is specified as being monotonically increasing.

TIMER REQUEST
    io_Message      mn_ReplyPort initialized
    io_Device       preset by timer in OpenDevice
    io_Unit         preset by timer in OpenDevice
    io_Command      TR_ADDREQUEST
    io_Flags        IOF_QUICK allowable
    tr_time         a timeval structure with the current system
                        time

RESULTS
    none
```

Appendix C

Resource Summaries

This appendix contains summaries for system resource routines. Resources are software entities in the Amiga kernel software that enable cooperating tasks to gain exclusive access to certain parts of the Amiga hardware. There are four resources in the Amiga system:

disk allows access to one of four possible disk units.

cia allows you to access specific bits in each of the Complex Interface Adapters.

There are two cia resources: ciaa.resource and ciab.resource, corresponding to the first and second 8520 in the system. See the software memory map in *Amiga ROM Kernel Reference Manual: Exec* for the definition of the bits controlled by each cia.

potgo manages the bits of the POTGO register.

misc manages the serial and parallel port register bits.

Each routine for resource management is outlined in the summary sections that follow.

Note: Resources need be used only if you are attempting to use the associated hardware directly. The system software routines use these resources internally when they perform hardware operations. Tasks that also use these software resource controls will be compatible with Exec and the system software.

To use the routines listed for the resources, you must first open the resource and assign the value returned to a specific base pointer name. Here is a list of the resource names and their associated base pointer names. Like names for libraries, their names are null-terminated strings:

Resource Name	**Base Pointer Name**
potgo.resource	PotgoBase
disk.resource	None provided, for assembly-language programmers only
misc.resource	None provided, for assembly-language programmers only
ciaa.resource	<user-defined>
ciab.resource	<user-defined>

Some examples follow.

```
struct Library *PotgoBase;
PotgoBase = (struct Library *)OpenResource("potgo.resource");
/* then use the routines provided */



/* <user-defined> example */
struct Library *myCiaPointerA;

myCiaPointerA = (struct Library *)OpenResource("ciaa.resource");

/* then utilize myCiaPointerA as one of the explicit parameters
 * for the C language calls to the resource routines. */
```

Contents

```
NAME
    AbleICR -- enable/disable ICR interrupts

SYNOPSIS
    oldMask = AbleICR(Resource, mask)
    D0                 A6        D0

FUNCTION
    This function provides a means of enabling and disabling
    8520 CIA interrupt control registers.
    In addition, it returns the previous enable mask.

INPUTS
     mask - a bit mask indicating which interrupts to be
        modified.  If bit 7 is clear the mask indicates
        interrupts to be disabled.  If bit 7 is set, the
        mask indicates interrupts to be enabled.
        Bit positions are identical to those in 8520 ICR.

     resource - pointer to ciaa.resource or ciab.resource as
           obtained from the call to OpenResource

RESULTS
    oldMask - the previous enable mask before the requested
        changes.  To get the current mask without making
        changes, call the function with a null parameter.

EXAMPLES
    Get the current mask:
        mask = AbleICR(0)
    Enable both timer interrupts:
        AbleICR(0x83)
    Disable serial port interrupt:
        AbleICR(0x08)

EXCEPTIONS
    Enabling the mask for a pending interrupt will cause
    an immediate processor interrupt (that is, if everything
    else is enabled).  You may want to clear the pending
    interrupts with SetICRx prior to enabling them.

SEE ALSO
    SetICR
```

cia.resource/AddICRVector

```
NAME
     AddICRVector -- attach an interrupt handler to a CIA bit

SYNOPSYS
     interrupt = AddICRVector(resrouce, iCRBit, interrupt)
     D0                       A6        D0      A1

FUNCTION
     Assign interrupt processing code to a particular interrupt
     bit of the CIA ICR.  If the interrupt bit has already been
     assigned, this function will fail, and return a pointer
     to the owner interrupt.  If it succeeds, a null is returned.

     This function will also enable the CIA interrupt for the given
     ICR bit.

INPUTS
     iCRBit - bit number to set (0..4)
     interrupt - pointer to interrupt structure
     resource - pointer to ciaa.resource or ciab.resource as
                obtained from the call to OpenResource
RESULT
     interrupt - zero if successful, otherwise returns a pointer
             to the current owner interrupt structure.

SEE ALSO
     RemICRVector
```

cia.resource/RemICRVector

```
NAME
     RemICRVector -- detach an interrupt handler from a CIA bit

SYNOPSYS
     RemICRVector(resource, iCRBit, interrupt)
                  A6        D0      A1

FUNCTION
     Disconnect interrupt processing code for a particular interrupt
     bit of the CIA ICR.

     This function will also disable the CIA interrupt for the given
     ICR bit.

INPUTS
     iCRBit - bit number to set (0..4)
     interrupt - pointer to interrupt structure
     resource - pointer to ciaa.resource or ciab.resource as
                obtained from the call to OpenResource

RESULT

SEE ALSO
     AddICRVector
```

```
cia.resource/SetICR


    NAME
        SetICR -- cause, clear, and sample ICR interrupts

    SYNOPSIS
        oldMask = SetICR(resource, mask)
        D0               A6        D0

    FUNCTION
        This function provides a means of resetting, causing, and
        sampling 8520 CIA interrupt control registers.

    INPUTS
         mask - a bit mask indicating which interrupts to be
                    caused.  If bit 7 is clear the mask indicates
                    interrupts to be reset.  If bit 7 is set, the
                    mask indicates interrupts to be caused.
                    Bit positions are identical to those in 8520 ICR.
         resource - pointer to ciaa.resource or ciab.resource as
                    obtained from the call to OpenResource

    RESULTS
        oldMask - the previous interrupt register status before
            making the requested changes.  To sample current
            status without making changes,  call the function
            with a null parameter.

    EXAMPLES
        Get the interrupt mask:
            mask = SetICR(0)
        Clear serial port interrupt:
            SetICR(0x08)

    EXCEPTIONS
        Setting an interrupt bit for an enabled interrupt will cause
         an immediate interrupt.

    SEE ALSO
        AbleICR
```



```
disk.resource/AllocUnit


    NAME
        AllocUnit - allocate a unit of the disk

    SYNOPSIS
        Success = AllocUnit( unitNum ), DRResource
         D0                   D0         A6

    FUNCTION
         This routine allocates one of the units of the disk.  It should
         be called before trying to use the disk (via GetUnit).

    INPUTS
         unitNum -- a legal unit number (zero through three)

    RESULTS
         Success -- nonzero if successful, zero on failure

    EXCEPTIONS

    SEE ALSO

    BUGS
```

```
disk.resource/FreeUnit


   NAME
       FreeUnit - deallocate the disk

   SYNOPSIS
       FreeUnit( unitNum ), DRResource
                 D0         A6

   FUNCTION
        This routine deallocates one of the units of the disk.  It should
        be called when done with the disk.  Do not call it if you did
        no successfully allocate the disk (there is no protection -- you
        will probably crash the disk system).

   INPUTS
        unitNum -- a legal unit number (zero through three)

   RESULTS

   EXCEPTIONS

   SEE ALSO

   BUGS
```



```
disk.resource/GetUnit


   NAME
       GetUnit - allocate the disk for a driver

   SYNOPSIS
       lastDriver = GetUnit( unitPointer ), DRResource
       D0                    A1             A6

   FUNCTION
        This routine allocates the disk to a driver.  It is either
        immediately available, or the request is saved until the disk
        is available.  When it is available, your unitPointer is
        sent back to you (via ReplyMsg).  You may then reattempt the
        GetUnit.

        Allocating the disk allows you to use the disk's resources.
        Remember however that there are four units to the disk; you are
        only one of them.  Please be polite to the other units (by never
        selecting them, and by not leaving interrupts enabled, etc.).

        When you are done, please leave the disk in the following state:
            dmacon dma bit ON
            dsklen dma bit OFF (write a #DSKDMAOFF to dsklen)
            adkcon disk bits -- any way you want
            entena:disk sync and disk block interrupts -- Both DISABLED
            CIA resource index interrupt -- DISABLED
            8520 outputs -- doesn't matter, because all bits will be
                set to inactive by the resource.
            8520 data direction regs -- restore to original state.

   INPUTS
        unitPtr - a pointer to your disk resource unit structure.
                Note that the message filed of the structure MUST
                be a valid message, ready to be replied to.

   RESULTS
        lastDriver - if the disk is not busy, then the last unit
                to use the disk is returned.  This may be used to
                see if a driver needs to reset device registers.
                (If you were the last user, then no one has changed
                any of the registers.  If someone else has used it,
                then any allowable changes may have been made).  If the
                disk is busy, then a null is returned.

   EXCEPTIONS

   SEE ALSO

   BUGS
```

disk.resource/GetUnitID

NAME
    GetUnitID - find out what type of disk is out there

SYNOPSIS
```
idtype = GetUnitID( unitNum ), DRResource
 D0                  D0          A6
```

FUNCTION

INPUTS

RESULTS
    idtype -- the type of the disk drive. Standard types are
            defined in the resource include file.

EXCEPTIONS

SEE ALSO

BUGS

disk.resource/GiveUnit

NAME
    GiveUnit - Free the disk

SYNOPSIS
```
GiveUnit(), DRResource
             A6
```

FUNCTION
    This routine frees the disk after a driver is done with it.
    If others are waiting, it will notify them.

INPUTS

RESULTS

EXCEPTIONS

SEE ALSO

BUGS

```
misc.resource/FreeMiscResource

    NAME
        FreeMiscResource - make a resource available for reallocation

    SYNOPSIS
        FreeMiscResource( unitNum ), DRResource
                          D0         A6

    FUNCTION
         This routine frees one of the resources allocated
         by AllocMiscResource.  The resource is made available
         for reuse.

         This routine may not be called from an interrupt routine

    INPUTS
         unitNum - the number of the miscellaneous resource to be freed.

    RESULTS

    EXCEPTIONS

    SEE ALSO

    BUGS
```

```
misc.resource/GetMiscResource

    NAME
        GetMiscResource - allocate one of the misc resources

    SYNOPSIS
        CurrentUser = GetMiscResource( unitNum, name ), DRResource
        D0                             D0       A1      A6

    FUNCTION
         This routine allocates one of the miscellaneous resources.
         If the resource is currently allocated, an error is returned.
         If you do get it, your name is associated with the resource
         (so a user can see who has it allocated).

         This routine may not be called from an interrupt routine

    INPUTS
         unitNum - the number of the resource you want to allocate
         name - a mnenonic name that will help the user figure out
                 what piece of software is hogging a resource.
                 (havoc breaks out if a name of null is passed in...)

    RESULTS
         CurrentUser - if the resource is busy, then the name of
                 the current user is returned.  If the resource is
                 free, then null is returned.

    EXCEPTIONS

    SEE ALSO

    BUGS
```

potgo.resource/AllocPotBits

```
NAME
     AllocPotBits - allocate bits in the potgo register

SYNOPSIS
     allocated = AllocPotBits(bits), potgoResource
     D0                       D0     A6

FUNCTION
     The AllocPotBits routine allocates bits in the hardware potgo
     register that the application wishes to manipulate via
     WritePotgo.  The request may be for more than one bit.  A
     user trying to allocate bits may find that they are
     unavailable because they are already allocated, or because
     the start bit itself (bit 0) has been allocated, or if
     requesting the start bit, because input bits have been
     allocated.  A user can block itself from allocation: i.e.,
     it should FreePotgoBits the bits it has and re-AllocPotBits if
     it is trying to change an allocation involving the start bit.

INPUTS
     bits - a description of the hardware bits that the application
            wishes to manipulate, loosely based on the register
            description itself:
         START (bit 0) - set if you wish to use start (i.e., start
                the proportional controller counters) with the
                input ports you allocate (below).  You must
                allocate all the DATxx ports you want to apply
                START to in this same call, with the OUTxx bit clear.
         DATLX (bit 8) - set if you wish to use the port associated
                with the left (0) controller, pin 5.
         OUTLX (bit 9) - set if you promise to use the LX port in
                output mode only.  The port is not set to output
                for you at this time -- this bit set indicates
                that you don't mind if STARTs are initiated at any
                time by others, since ports that are enabled for
                output are unaffected by START.
         DATLY (bit 10) - same as DATLX but for the left (0) controller,
                pin 9.
         OUTLY (bit 11) - same as OUTLX but for LY.
         DATRX (bit 12) - the right (1) controller, pin 5.
         OUTRX (bit 13) - OUT for RX.
         DATRY (bit 14) - the right (1) controller, pin 9.
         OUTRY (bit 15) - OUT for RY.

RESULTS
     allocated - the START and DATxx bits of those requested that
            were granted.  The OUTxx bits are don't cares.
```

potgo.resource/FreePotBits

```
NAME
     FreePotBits - free allocated bits in the potgo register

SYNOPSIS
     FreePotBits(allocated), potgoResource
                 D0          A6

FUNCTION
     The FreePotBits routine frees previously allocated bits in the
     hardware potgo register that the application had allocated via
     AllocPotBits and no longer wishes to use.  It accepts the
     return value from AllocPotBits as its argument.
```

potgo.resource/WritePotgo

```
NAME
     WritePotgo - write to the hardware potgo register

SYNOPSIS
     WritePotgo(word, mask), potgoResource
                D0    D1     A6

FUNCTION
     The WritePotgo routine sets and clears bits in the hardware
     potgo register.  Only those bits specified by the mask are
     affected -- it is improper to set bits in the mask that you
     have not successfully allocated.  The bits in the high byte
     are saved to be maintained when other users write to the
     potgo register.  The START bit is not saved, it is written
     only explicitly as the result of a call to this routine with
     the START bit set: other users will not restart it.

INPUTS
     word - the data to write to the hardware potgo register and
            save for further use, except the START bit, which is
            not saved.
     mask - those bits in word that are to be written.  Other
            bits may have been provided by previous calls to
            this routine, and default to zero.
```

Appendix D

Include Files

This appendix has separate sections for the C and assembly-language include files. At the beginning of each section of files there is a cross-reference showing all the defined constants, data structures, and data structure terms in each file. These names are listed alphabetically, followed by file and line-number references.

C Include Files—".h" Files

The first portion of this appendix contains the C-language include files that define the system data structures used by the ROM (or kickstart) routines and the disk-loadable libraries. These include files are organized on a functional basis. For example, files pertinent to graphics are listed under "graphics/graphicsitem.h."

This appendix is a hard copy of the "SYS:includes" directory on the Amiga C (Lattice C) disk.

Assembly-language Include Files—".i" Files

The second portion of this appendix contains the assembly language include files that define the system data structures used by the ROM (or kickstart) routines and the disk-loadable libraries. These include files are organized on a functional basis. For example, files pertinent to graphics are listed under "graphics/graphicsitem.i."

This appendix is a hard copy of the "SYS:includes" directory on the Amiga Macro Assembler disk.

File numbers for cross-reference listing:

1:adkbits.i	2:audio.i	3:blit.i	4:bootblock.i
5:cia.i	6:ciabase.i	7:clip.i	8:clipboard.i
9:console.i	10:copper.i	11:custom.i	12:disk.i
13:diskfont.i	14:display.i	15:dmabits.i	16:dos.i
17:dos_lib.i	18:dosextens.i	19:gameport.i	20:gels.i
21:gfx.i	22:gfxbase.i	23:icon.i	24:input.i
25:inputevent.i	26:intbits.i	27:intuition.i	28:intuitionbase.i
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Contents

```
         IFND  DEVICES_AUDIO_I
DEVICES_AUDIO_I      SET   1
*******************************************************************
*               Commodore-Amiga, Inc.                             *
*               audio.i                                           *
*******************************************************************

         IFND  EXEC_IO_I
         INCLUDE  "exec/io.i"
         ENDC

AUDIONAME      MACRO
         DC.B  'audio.device',0
         ENDM

ADHARD_CHANNELS      EQU   4

ADALLOC_MINPREC      EQU   -128
ADALLOC_MAXPREC      EQU   127

ADCMD_FREE           EQU   CMD_NONSTD+0
ADCMD_SETPREC        EQU   CMD_NONSTD+1
ADCMD_FINISH         EQU   CMD_NONSTD+2
ADCMD_PERVOL         EQU   CMD_NONSTD+3
ADCMD_LOCK           EQU   CMD_NONSTD+4
ADCMD_WAITCYCLE      EQU   CMD_NONSTD+5
ADCMDB_NOUNIT        EQU   5
ADCMDF_NOUNIT        EQU   1<<5
ADCMD_ALLOCATE       EQU   ADCMDF_NOUNIT+0

ADIOB_PERVOL         EQU   4
ADIOF_PERVOL         EQU   1<<4
ADIOB_SYNCCYCLE      EQU   5
ADIOF_SYNCCYCLE      EQU   1<<5
ADIOB_NOWAIT         EQU   6
ADIOF_NOWAIT         EQU   1<<6
ADIOB_WRITEMESSAGE   EQU   7
ADIOF_WRITEMESSAGE   EQU   1<<7

ADIOERR_NOALLOCATION EQU   -10
ADIOERR_ALLOCFAILED  EQU   -11
ADIOERR_CHANNELSTOLEN EQU  -12

   STRUCTURE   IOAudio,IO_SIZE
   WORD     ioa_AllocKey
   APTR     ioa_Data
   ULONG    ioa_Length
   UWORD    ioa_Period
   UWORD    ioa_Volume
   UWORD    ioa_Cycles
   STRUCT   ioa_WriteMsg,MN_SIZE
   LABEL    ioa_SIZEOF

   ENDC
```

```
*********************************************************************
*              Commodore-Amiga, Inc.                                *
*              bootblock.i                                          *
*********************************************************************
**************************************************************************
*
* Source Control
* ------ -------
*
* $Header: bootblock.i,v 27.1 85/06/24 13:15:16 neil Exp $
*
* $Locker:  $
*
* $Log:  bootblock.i,v $
* Revision 27.1  85/06/24  13:15:16  neil
* *** empty log message ***
*
* Revision 26.2  85/06/18  23:55:38  neil
* Added BBNAME definitions
*
* Revision 26.1  85/06/17  20:08:25  neil
* *** empty log message ***
*
*
**************************************************************************

******* BootBlock definition:

 STRUCTURE BB,0
   STRUCT   BB_ID,4             * 4 character identifier
   LONG     BB_CHKSUM           * boot block checksum (balance)
   LONG     BB_DOSBLOCK         * reserved for DOS patch
   LABEL    BB_ENTRY            * bootstrap entry point
   LABEL    BB_SIZE

BOOTSECTS    equu   2           * 1K bootstrap

BBID_DOS macro                  * something that is bootable
            dc.b  'DOS',0
      endm

BBID_KICK   macro               * firmware image disk
            dc.b  'KICK'
      endm


BBNAME_DOS  EQU   (('D'<<24)!('O'<<16)!('S'<<8))
BBNAME_KICK EQU   (('K'<<24)!('I'<<16)!('C'<<8)!('K'))
```

```
   IFND     DEVICES_CLIPBOARD_I
DEVICES_CLIPBOARD_I  EQU   1
*********************************************************************
*              Commodore-Amiga, Inc.                                *
*              clipboard.i                                          *
*********************************************************************
*********************************************************************
*
*  clipboard device command definitions
*
*********************************************************************

   IFND     EXEC_NODES_I
   INCLUDE     "exec/nodes.i"
   ENDC
   IFND     EXEC_LISTS_I
   INCLUDE     "exec/lists.i"
   ENDC
   IFND     EXEC_PORTS_I
   INCLUDE     "exec/ports.i"
   ENDC
   IFND     EXEC_IO_I
   INCLUDE     "exec/io.i"
   ENDC

   DEVINIT

   DEVCMD   CBD_POST
   DEVCMD   CBD_CURRENTREADID
   DEVCMD   CBD_CURRENTWRITEID

CBERR_OBSOLETEID  EQU   1


 STRUCTURE  ClipboardUnitPartial,0
    STRUCT  cu_Node,LN_SIZE;     ; list of units
    ULONG   cu_UnitNum;        ; unit number for this unit
    ; the remaining unit data is private to the device


 STRUCTURE  IOClipReq,0
    STRUCT  io_Message,MN_SIZE
    APTR    io_Device          ; device node pointer
    APTR    io_Unit            ; unit (driver private)
    UWORD   io_Command         ; device command
    UBYTE   io_Flags           ; including QUICK and SATISFY
    BYTE    io_Error           ; error or warning num
    ULONG   io_Actual          ; number of bytes transferred
    ULONG   io_Length          ; number of bytes requested
    APTR    io_Data            ; either clip stream or post port
    ULONG   io_Offset          ; offset in clip stream
    LONG    io_ClipID          ; ordinal clip identifier
    LABEL   iocr_SIZEOF



PRIMARY_CLIP   EQU   0         ; primary clip unit

 STRUCTURE  SatisfyMsg,0
```

```
     STRUCT  sm_Msg,MN_SIZE     ; the length will be 6
     UWORD   sm_Unit            ; which clip unit this is
     LONG    sm_ClipID          ; the clip identifier of the post
     LABEL   satisfyMsg_SIZEOF

    ENDC
```

```
   IFND  DEVICES_CONSOLE_I
DEVICES_CONSOLE_I SET   1
********************************************************************
*               Commodore-Amiga, Inc.                              *
*               console.i                                          *
********************************************************************
********************************************************************
*
*  Console device command definitions
*
*   Source Control
*   --------------
*   $Header: console.i,v 1.4 85/11/13 15:13:21 kodiak Exp $
*
*   $Locker:  $
*
*********************************************************************

   IFND  EXEC_IO_I
   INCLUDE  "exec/io.i"
   ENDC

******* Console commands *******
   DEVINIT

   DEVCMD         CD_ASKKEYMAP
   DEVCMD         CD_SETKEYMAP


******* SGR parameters

SGR_PRIMARY       EQU   0
SGR_BOLD          EQU   1
SGR_ITALIC        EQU   3
SGR_UNDERSCORE    EQU   4
SGR_NEGATIVE      EQU   7

*  these names refer to the ANSI standard, not the implementation
SGR_BLACK         EQU   30
SGR_RED           EQU   31
SGR_GREEN         EQU   32
SGR_YELLOW        EQU   33
SGR_BLUE          EQU   34
SGR_MAGENTA       EQU   35
SGR_CYAN          EQU   36
SGR_WHITE         EQU   37
SGR_DEFAULT       EQU   39

SGR_BLACKBG       EQU   40
SGR_REDBG         EQU   41
SGR_GREENBG       EQU   42
SGR_YELLOWBG      EQU   43
SGR_BLUEBG        EQU   44
SGR_MAGENTABG     EQU   45
SGR_CYANBG        EQU   46
SGR_WHITEBG       EQU   47
SGR_DEFAULTBG     EQU   49

*  these names refer to the implementation, they are the preferred
```

```
* names for use with the Amiga console device.
SGR_CLR0          EQU   30
SGR_CLR1          EQU   31
SGR_CLR2          EQU   32
SGR_CLR3          EQU   33
SGR_CLR4          EQU   34
SGR_CLR5          EQU   35
SGR_CLR6          EQU   36
SGR_CLR7          EQU   37

SGR_CLR0BG        EQU   40
SGR_CLR1BG        EQU   41
SGR_CLR2BG        EQU   42
SGR_CLR3BG        EQU   43
SGR_CLR4BG        EQU   44
SGR_CLR5BG        EQU   45
SGR_CLR6BG        EQU   46
SGR_CLR7BG        EQU   47


******   DSR parameters

DSR_CPR           EQU   6

******   CTC parameters
CTC_HSETTAB       EQU   0
CTC_HCLRTAB       EQU   2
CTC_HCLRTABSALL   EQU   5

******   TBC parameters
TBC_HCLRTAB       EQU   0
TBC_HCLRTABSALL   EQU   3

******   SM and RM parameters
M_LNM             EQU   20    ; linefeed newline mode
M_ASM    MACRO
      DC.B  '>1'              ; auto scroll mode
      ENDM
M_AWM    MACRO
      DC.B  '?7'              ; auto wrap mode
      ENDM

   ENDC
```

```
   IFND  DEVICES_GAMEPORT_I
DEVICES_GAMEPORT_I   SET   1
*******************************************************************
*               Commodore-Amiga, Inc.                             *
*               gameport.i                                        *
*******************************************************************
*******************************************************************
*
*  Game Port device command definitions
*
*******************************************************************

   IFND  EXEC_IO_I
   INCLUDE  "exec/io.i"
   ENDC


******* GamePort commands *******
   DEVINIT

   DEVCMD   GPD_READEVENT
   DEVCMD   GPD_ASKCTYPE
   DEVCMD   GPD_SETCTYPE
   DEVCMD   GPD_ASKTRIGGER
   DEVCMD   GPD_SETTRIGGER

******* GamePort structures *******

*  gpt_Keys
   BITDEF       GPT,DOWNKEYS,0
   BITDEF       GPT,UPKEYS,1

 STRUCTURE  GamePortTrigger,0
       UWORD   gpt_Keys          ;key transition triggers
       UWORD   gpt_Timeout       ;time trigger (vertical blank units)
       UWORD   gpt_XDelta        ;X distance trigger
       UWORD   gpt_YDelta        ;Y distance trigger
       LABEL   gpt_SIZEOF

******* Controller Types ******
GPCT_ALLOCATED     EQU   -1      ; allocated by another user
GPCT_NOCONTROLLER EQU   0

GPCT_MOUSE         EQU   1
GPCT_RELJOYSTICK   EQU   2
GPCT_ABSJOYSTICK   EQU   3


******* Errors ******
GPDERR_SETCTYPE    EQU   1       ; this controller not valid at this time

   ENDC
```

```
   IFND  DEVICES_INPUT_I
DEVICES_INPUT_I   SET   1
*******************************************************************
*              Commodore-Amiga, Inc.                              *
*              input.i                                            *
*******************************************************************
*********************************************************************
*
*  input device command definitions
*
*********************************************************************

   IFND     EXEC_IO_I
   INCLUDE     "exec/io.i"
   ENDC

   DEVINIT

   DEVCMD      IND_ADDHANDLER
   DEVCMD      IND_REMHANDLER
   DEVCMD      IND_WRITEEVENT
   DEVCMD      IND_SETTHRESH
   DEVCMD      IND_SETPERIOD
   DEVCMD      IND_SETMPORT
   DEVCMD      IND_SETMTYPE
   DEVCMD      IND_SETMTRIG

   ENDC
```

```
   IFND  DEVICES_INPUTEVENT_I
DEVICES_INPUTEVENT_I SET   1
*******************************************************************
*              Commodore-Amiga, Inc.                              *
*              inputevent.i                                       *
*******************************************************************
*******************************************************************
*
*  input event definitions
*
*******************************************************************

   IFND  DEVICES_TIMER_I
   INCLUDE  "devices/timer.i"
   ENDC

*------ constants --------------------------------------------------

*   --- InputEvent.ie_Class ---
* A NOP input event
IECLASS_NULL            EQU   $00
* A raw keycode from the keyboard device
IECLASS_RAWKEY          EQU   $01
* A raw mouse report from the game port device
IECLASS_RAWMOUSE        EQU   $02
* A private console event
IECLASS_EVENT           EQU   $03
* A Pointer Position report
IECLASS_POINTERPOS      EQU   $04
* A timer event
IECLASS_TIMER           EQU   $06
* select button pressed down over a Gadget (address in ie_EventAddress)
IECLASS_GADGETDOWN      EQU $07
* select button released over the same Gadget (address in ie_EventAddress)
IECLASS_GADGETUP        EQU   $08
* some Requester activity has taken place.  See Codes REQCLEAR and REQSET
IECLASS_REQUESTER       EQU   $09
* this is a Menu Number transmission (Menu number is in ie_Code)
IECLASS_MENULIST        EQU   $0A
* User has selected the active Window's Close Gadget
IECLASS_CLOSEWINDOW     EQU   $0B
* this Window has a new size
IECLASS_SIZEWINDOW      EQU   $0C
* the Window pointed to by ie_EventAddress needs to be refreshed
IECLASS_REFRESHWINDOW   EQU   $0D
* new preferences are available
IECLASS_NEWPREFS        EQU   $0E
* the disk has been removed
IECLASS_DISKREMOVED     EQU   $0F
* the disk has been inserted
IECLASS_DISKINSERTED    EQU   $10
* the window is about to be been made active
IECLASS_ACTIVEWINDOW    EQU   $11
* the window is about to be made inactive
IECLASS_INACTIVEWINDOW  EQU   $12

* the last class
IECLASS_MAX             EQU   $12
```

```
*   --- InputEvent.ie_Code ---
*  IECLASS_RAWKEY
IECODE_UP_PREFIX        EQU   $80
IECODEB_UP_PREFIX       EQU   7
IECODE_KEY_CODE_FIRST   EQU   $00
IECODE_KEY_CODE_LAST    EQU   $77
IECODE_COMM_CODE_FIRST  EQU   $78
IECODE_COMM_CODE_LAST   EQU   $7F

*  IECLASS_ANSI
IECODE_C0_FIRST         EQU   $00
IECODE_C0_LAST          EQU   $1F
IECODE_ASCII_FIRST      EQU   $20
IECODE_ASCII_LAST       EQU   $7E
IECODE_ASCII_DEL        EQU   $7F
IECODE_C1_FIRST         EQU   $80
IECODE_C1_LAST          EQU   $9F
IECODE_LATIN1_FIRST     EQU   $A0
IECODE_LATIN1_LAST      EQU   $FF

*  IECLASS_RAWMOUSE
IECODE_LBUTTON          EQU   $68  ; also uses IECODE_UP_PREFIX
IECODE_RBUTTON          EQU   $69  ;
IECODE_MBUTTON          EQU   $6A  ;
IECODE_NOBUTTON         EQU   $FF

*  IECLASS_EVENT
IECODE_NEWACTIVE        EQU   $01  ; active input window changed

*  IECLASS_REQUESTER Codes
* REQSET is broadcast when the first Requester (not subsequent ones) opens
* in the Window
IECODE_REQSET           EQU   $01
* REQCLEAR is broadcast when the last Requester clears out of the Window
IECODE_REQCLEAR         EQU   $00


*   --- InputEvent.ie_Qualifier ---
IEQUALIFIER_LSHIFT      EQU   $0001
IEQUALIFIERB_LSHIFT     EQU   0
IEQUALIFIER_RSHIFT      EQU   $0002
IEQUALIFIERB_RSHIFT     EQU   1
IEQUALIFIER_CAPSLOCK    EQU   $0004
IEQUALIFIERB_CAPSLOCK   EQU   2
IEQUALIFIER_CONTROL     EQU   $0008
IEQUALIFIERB_CONTROL    EQU   3
IEQUALIFIER_LALT        EQU   $0010
IEQUALIFIERB_LALT       EQU   4
IEQUALIFIER_RALT        EQU   $0020
IEQUALIFIERB_RALT       EQU   5
IEQUALIFIER_LCOMMAND    EQU   $0040
IEQUALIFIERB_LCOMMAND   EQU   6
IEQUALIFIER_RCOMMAND    EQU   $0080
IEQUALIFIERB_RCOMMAND   EQU   7
IEQUALIFIER_NUMERICPAD  EQU   $0100
IEQUALIFIERB_NUMERICPAD EQU   8
IEQUALIFIER_REPEAT      EQU   $0200
IEQUALIFIERB_REPEAT     EQU   9
IEQUALIFIER_INTERRUPT   EQU   $0400
IEQUALIFIERB_INTERRUPT  EQU   10
IEQUALIFIER_MULTIBROADCAST    EQU   $0800
IEQUALIFIERB_MULTIBROADCAST   EQU   11
IEQUALIFIER_LBUTTON     EQU   $1000
IEQUALIFIERB_LBUTTON    EQU   12
IEQUALIFIER_RBUTTON     EQU   $2000
IEQUALIFIERB_RBUTTON    EQU   13
IEQUALIFIER_MBUTTON     EQU   $4000
IEQUALIFIERB_MBUTTON    EQU   14
IEQUALIFIER_RELATIVEMOUSE     EQU   $8000
IEQUALIFIERB_RELATIVEMOUSE    EQU   15

*------ InputEvent -----------------------------------------------------

 STRUCTURE  InputEvent,0
   APTR  ie_NextEvent           ; the chronologically next event
   UBYTE   ie_Class             ; the input event class
   UBYTE   ie_SubClass          ; optional subclass of the class
   UWORD   ie_Code              ; the input event code
   UWORD   ie_Qualifier         ; qualifiers in effect for the event
   LABEL ie_EventAddress        ; a pointer parameter for an event
   WORD    ie_X                 ; the pointer position for the event,
   WORD    ie_Y                 ;   usually in canvas relative coords
   STRUCT  ie_TimeStamp,TV_SIZE  ; the system tick at the event
   LABEL   ie_SIZEOF

   ENDC
```

```
   IFND  DEVICES_KEYBOARD_I
DEVICES_KEYBOARD_I   SET   1
********************************************************************
*              Commodore-Amiga, Inc.                               *
*              keyboard.i                                          *
********************************************************************
********************************************************************
*
*  Keyboard device command definitions
*
********************************************************************

   IFND      EXEC_IO_I
   INCLUDE      "exec/io.i"
   ENDC

   DEVINIT

   DEVCMD       KBD_READEVENT
   DEVCMD       KBD_READMATRIX
   DEVCMD       KBD_ADDRESETHANDLER
   DEVCMD       KBD_REMRESETHANDLER
   DEVCMD       KBD_RESETHANDLERDONE

   ENDC
```

```
   IFND  DEVICES_KEYMAP_I
DEVICES_KEYMAP_I  SET   1
********************************************************************
*              Commodore-Amiga, Inc.                               *
*              keymap.i                                            *
********************************************************************
**********************************************************************
*
*  console.device key map definitions
*
**********************************************************************

 STRUCTURE  KeyMap,0
   APTR  km_LoKeyMapTypes
   APTR  km_LoKeyMap
   APTR  km_LoCapsable
   APTR  km_LoRepeatable
   APTR  km_HiKeyMapTypes
   APTR  km_HiKeyMap
   APTR  km_HiCapsable
   APTR  km_HiRepeatable
   LABEL km_SIZEOF


KCB_NOP      EQU   7
KCF_NOP      EQU   $80

KC_NOQUAL    EQU   0
KC_VANILLA   EQU   7           ; note that SHIFT+ALT+CTRL is VANILLA
KCF_SHIFT    EQU   $01
KCF_ALT      EQU   $02
KCB_CONTROL  EQU   2
KCF_CONTROL  EQU   $04
KCB_DOWNUP   EQU   3
KCF_DOWNUP   EQU   $08

KCB_STRING   EQU   6
KCF_STRING   EQU   $40

   ENDC
```

```
   IFND  DEVICES_NARRATOR_I
DEVICES_NARRATOR_I   SET   1
*********************************************************************
*                Commodore-Amiga, Inc.                               *
*                narrator.i                                          *
*********************************************************************

   IFND    EXEC_IO_I
   INCLUDE "exec/io.i"
   ENDC

*-------- DEFAULT VALUES, USER PARMS, AND GENERAL CONSTANTS

DEFPITCH   EQU      110              ;DEFAULT PITCH
DEFRATE    EQU      150              ;DEFAULT RATE
DEFVOL     EQU      64               ;DEFAULT VOLUME (FULL)
DEFFREQ    EQU      22200            ;DEFAULT SAMPLING FREQUENCY
NATURALF0  EQU      0                ;NATURAL F0 CONTOURS
ROBOTICF0  EQU      1                ;MONOTONE F0
MALE       EQU      0                ;MALE SPEAKER
FEMALE     EQU      1                ;FEMALE SPEAKER
DEFSEX     EQU      MALE             ;DEFAULT SEX
DEFMODE    EQU      NATURALF0        ;DEFAULT MODE

*     Parameter bounds

MINRATE    EQU      40               ;MINIMUM SPEAKING RATE
MAXRATE    EQU      400              ;MAXIMUM SPEAKING RATE
MINPITCH   EQU      65               ;MINIMUM PITCH
MAXPITCH   EQU      320              ;MAXIMUM PITCH
MINFREQ    EQU      5000             ;MINIMUM SAMPLING FREQUENCY
MAXFREQ    EQU      28000            ;MAXIMUM SAMPLING FREQUENCY
MINVOL     EQU      0                ;MINIMUM VOLUME
MAXVOL     EQU      64               ;MAXIMUM VOLUME

*     Driver error codes

ND_NotUsed   EQU   -1                ;
ND_NoMem     EQU   -2                ;Can't allocate memory
ND_NoAudLib  EQU   -3                ;Can't open audio device
ND_MakeBad   EQU   -4                ;Error in MakeLibrary call
ND_UnitErr   EQU   -5                ;Unit other than 0
ND_CantAlloc EQU   -6                ;Can't allocate the audio channel
ND_Unimpl    EQU   -7                ;Unimplemented command
ND_NoWrite   EQU   -8                ;Read for mouth shape without write
ND_Expunged  EQU   -9                ;Can't open, deferred expunge bit set
ND_PhonErr   EQU   -20               ;Phoneme code spelling error
ND_RateErr   EQU   -21               ;Rate out of bounds
ND_PitchErr  EQU   -22               ;Pitch out of bounds
ND_SexErr    EQU   -23               ;Sex not valid
ND_ModeErr   EQU   -24               ;Mode not valid
ND_FreqErr   EQU   -25               ;Sampling freq out of bounds
ND_VolErr    EQU   -26               ;Volume out of bounds



*     ;------ Write IORequest block
 STRUCTURE NDI,IOSTD_SIZE
   UWORD NDI_RATE                    ;Speaking rate in words/minute
   UWORD NDI_PITCH                   ;Baseline pitch in Hertz
   UWORD NDI_MODE                    ;F0 mode
   UWORD NDI_SEX                     ;Speaker sex
   APTR  NDI_CHMASKS                 ;Pointer to audio channel masks
   UWORD NDI_NUMMASKS                ;Size of channel masks array
   UWORD NDI_VOLUME                  ;Channel volume
   UWORD NDI_SAMPFREQ                ;Sampling frequency
   UBYTE NDI_MOUTHS                  ;Generate mouths? (Boolean value)
   UBYTE NDI_CHANMASK                ;Actual channel mask used (internal use)
   UBYTE NDI_NUMCHAN                 ;Number of channels used (internal use)
   UBYTE NDI_PAD                     ;For alignment
   LABEL   NDI_SIZE                  ;Size of Narrator IORequest block


*     ;------  Mouth read IORB
 STRUCTURE MRB,NDI_SIZE
   UBYTE MRB_WIDTH                   ;Mouth width
   UBYTE MRB_HEIGHT                  ;Mouth height
   UBYTE MRB_SHAPE                   ;Compressed shape (height/width)
   UBYTE MRB_PAD                     ;Alignment
   LABEL MRB_SIZE


   ENDC

```

```
*******************************************************************
*              Commodore-Amiga, Inc.                              *
*              parallel.i                                         *
*******************************************************************
*******************************************************************
*
* external declarations for Parallel Port Driver
*
* SOURCE CONTROL
* ------ -------
* $Header: parallel.i,v 25.0 85/03/27 19:14:15 tomp Exp $
*
* $Locker:  $
*
*******************************************************************

    IFND     DEVICES_PARALLEL_I
DEVICES_PARALLEL_I SET 1

    IFND     EXEC_STRINGS_I
    include 'exec/strings.i'


    IFND     EXEC_IO_I
    include 'exec/io.i'


*-----------------------------------------------------------------
*
* Driver error definitions
*
*-----------------------------------------------------------------

ParErr_DevBusy          EQU   1
ParErr_BufTooBig        EQU   2
ParErr_InvParam         EQU   3
ParErr_LineErr          EQU   4
ParErr_NotOpen          EQU   5
ParErr_PortReset        EQU   6
ParErr_InitErr          EQU   7

*-----------------------------------------------------------------
*
* Useful constants
*
*-----------------------------------------------------------------
*
PDCMD_QUERY             EQU   CMD_NONSTD
PDCMD_SETPARAMS         EQU   CMD_NONSTD+1
Par_DEVFINISH           EQU   10     ; number of device comands
*
*-----------------------------------------------------------------
*
* Driver Specific Commands
*
*-----------------------------------------------------------------

*-- PARALLELNAME is a generic macro to get the name of the driver.  This
*-- way if the name is ever changed you will pick up the change
*-- automatically.
*--
*-- Normal usage would be:
*--
*-- internalName: PARALLELNAME
*--

PARALLELNAME:  MACRO
      STRING   'parallel.device'
      ENDM

      BITDEF   PAR,SHARED,5       ; PARFLAGS non-exclusive access
      BITDEF   PAR,RAD_BOOGIE,3   ;    "     (not yet implemented)
      BITDEF   PAR,EOFMODE,1      ;    "     EOF mode enabled bit
      BITDEF   IOPAR,QUEUED,6     ; IO_FLAGS rqst-queued bit
      BITDEF   IOPAR,ABORT,5      ;    "     rqst-aborted bit
      BITDEF   IOPAR,ACTIVE,4     ;    "     rqst-qued-or-current bit
      BITDEF   IOPT,RWDIR,3       ; IO_STATUS read=0,write=1
      BITDEF   IOPT,PBUSY,2       ;    "     printer in busy toggle
      BITDEF   IOPT,PAPEROUT,1    ;    "     paper out
      BITDEF   IOPT,PSEL,0        ;    "     printer selected
*
*
*******************************************************************

 STRUCTURE PTERMARRAY,0
        ULONG    PTERMARRAY_0
        ULONG    PTERMARRAY_1
        LABEL    PTERMARRAY_SIZE

*******************************************************************
*  CAUTION !!!  IF YOU ACCESS the parallel.device, you MUST (!!!!) use an
*  IOEXTPAR-sized structure or you may overlay innocent memory, okay ?!
*******************************************************************

 STRUCTURE IOEXTPAR,IOSTD_SIZE

*      STRUCT   MsgNode
*   0    APTR     Succ
*   4    APTR     Pred
*   8    UBYTE    Type
*   9    UBYTE    Pri
*   A    APTR     Name
*   E    APTR     ReplyPort
*  12    UWORD    MNLength
*      STRUCT   IOExt
*  14    APTR     IO_DEVICE
*  18    APTR     IO_UNIT
*  1C    UWORD    IO_COMMAND
*  1E    UBYTE    IO_FLAGS
*  1F    UBYTE    IO_ERROR
*      STRUCT   IOStdExt
*  20    ULONG    IO_ACTUAL
*  24    ULONG    IO_LENGTH
*  28    APTR     IO_DATA
*  2C    ULONG    IO_OFFSET
*
*
*  30
      ULONG    IO_PEXTFLAGS        ; (not used) flag extension area
```

```
	UBYTE	IO_PARSTATUS		; device status (see bit defs above)
	UBYTE	IO_PARFLAGS		; see PARFLAGS bit definitions above
	STRUCT	IO_PTERMARRAY,PTERMARRAY_SIZE ; termination char array
	LABEL	IOEXTPar_SIZE
```

```
   IFND  DEVICES_PRINTER_I
DEVICES_PRINTER_I EQU   1
*******************************************************************
*               Commodore-Amiga, Inc.                             *
*               printer.i                                         *
*******************************************************************
*******************************************************************
*
*  printer device command definitions
*
*   Source Control
*   --------------
*   $Header: printer.i,v 1.2 85/10/09 16:16:27 kodiak Exp $
*
*   $Locker:  $
*
*******************************************************************

   IFND  EXEC_NODES_I
   INCLUDE  "exec/nodes.i"
   ENDC

   IFND  EXEC_LISTS_I
   INCLUDE  "exec/lists.i"
   ENDC

   IFND  EXEC_PORTS_I
   INCLUDE  "exec/ports.i"
   ENDC

   IFND  EXEC_IO_I
   INCLUDE  "exec/io.i"
   ENDC

   DEVINIT

   DEVCMD   PRD_RAWWRITE
   DEVCMD   PRD_PRTCOMMAND
   DEVCMD   PRD_DUMPRPORT

;****** printer definitions
aRIS     EQU    0 ; ESCc  reset                          ISO
aRIN     EQU    1 ; ESC#1 initialize                     +++
aIND     EQU    2 ; ESCD  lf                             ISO
aNEL     EQU    3 ; ESCE  return,lf                      ISO
aRI      EQU    4 ; ESCM  reverse lf                     ISO

aSGR0    EQU    5 ; ESC[0m normal char set               ISO
aSGR3    EQU    6 ; ESC[3m italics on                    ISO
aSGR23   EQU    7 ; ESC[23m italics off                  ISO
aSGR4    EQU    8 ; ESC[4m underline on                  ISO
aSGR24   EQU    9 ; ESC[24m underline off                ISO
aSGR1    EQU   10 ; ESC[1m boldface on                   ISO
aSGR22   EQU   11 ; ESC[22m boldface off                 ISO
aSFC     EQU   12 ; SGR30-39  set foreground color       ISO
aSBC     EQU   13 ; SGR40-49  set background color       ISO

aSHORP0  EQU   14 ; ESC[0w normal pitch                  DEC
aSHORP2  EQU   15 ; ESC[2w elite on                      DEC
```

```
aSHORP1  EQU   16 ; ESC[1w elite off              DEC
aSHORP4  EQU   17 ; ESC[4w condensed fine on      DEC
aSHORP3  EQU   18 ; ESC[3w condensed off          DEC
aSHORP6  EQU   19 ; ESC[6w enlarged on            DEC
aSHORP5  EQU   20 ; ESC[5w enlarged off           DEC

aDEN6    EQU   21 ; ESC[6"z shadow print on       DEC (sort of)
aDEN5    EQU   22 ; ESC[5"z shadow print off      DEC
aDEN4    EQU   23 ; ESC[4"z doublestrike on       DEC
aDEN3    EQU   24 ; ESC[3"z doublestrike off      DEC
aDEN2    EQU   25 ; ESC[2"z  NLQ on               DEC
aDEN1    EQU   26 ; ESC[1"z  NLQ off              DEC

aSUS2    EQU   27 ; ESC[2v superscript on         +++
aSUS1    EQU   28 ; ESC[1v superscript off        +++
aSUS4    EQU   29 ; ESC[4v subscript on           +++
aSUS3    EQU   30 ; ESC[3v subscript off          +++
aSUS0    EQU   31 ; ESC[0v normalize the line     +++
aPLU     EQU   32 ; ESCL  partial line up         ISO
aPLD     EQU   33 ; ESCK  partial line down       ISO

aFNT0    EQU   34 ; ESC(B US char set             DEC
aFNT1    EQU   35 ; ESC(R French char set         DEC
aFNT2    EQU   36 ; ESC(K German char set         DEC
aFNT3    EQU   37 ; ESC(A UK char set             DEC
aFNT4    EQU   38 ; ESC(E Danish I char set       DEC
aFNT5    EQU   39 ; ESC(H Sweden char set         DEC
aFNT6    EQU   40 ; ESC(Y Italian char set        DEC
aFNT7    EQU   41 ; ESC(Z Spanish char set        DEC
aFNT8    EQU   42 ; ESC(J Japanese char set       +++
aFNT9    EQU   43 ; ESC(6 Norweign char set       DEC
aFNT10   EQU   44 ; ESC(C Danish II char set      +++

aPROP2   EQU   45 ; ESC[2p  proportional on       +++
aPROP1   EQU   46 ; ESC[1p  proportional off      +++
aPROP0   EQU   47 ; ESC[0p  proportional clear    +++
aTSS     EQU   48 ; ESC[n E set proportional offset  ISO
aJFY5    EQU   49 ; ESC[5 F auto left justify     ISO
aJFY7    EQU   50 ; ESC[7 F auto right justiy     ISO
aJFY6    EQU   51 ; ESC[6 F auto full justify     ISO
aJFY0    EQU   52 ; ESC[0 F auto justify off      ISO
aJFY2    EQU   53 ; ESC[2 F  word space(auto center)  ISO (special)
aJFY3    EQU   54 ; ESC[3 F letter space (justify)    ISO (special)

aVERP0   EQU   55 ; ESC[0z  1/8" line spacing     +++
aVERP1   EQU   56 ; ESC[1z  1/6" line spacing     +++
aSLPP    EQU   57 ; ESC[nt  set form length n     DEC
aPERF    EQU   58 ; ESC[nq  perf skip n (n>0)     +++
aPERF0   EQU   59 ; ESC[0q  perf skip off         +++

aLMS     EQU   60 ; ESC#9  Left margin set        +++
aRMS     EQU   61 ; ESC#0  Right margin set       +++
aTMS     EQU   62 ; ESC#8  Top margin set         +++
aBMS     EQU   63 ; ESC#2  Bottom marg set        +++
aSTBM    EQU   64 ; ESC[Pn1;Pn2r  T&B margins     DEC
aSLRM    EQU   65 ; ESC[Pn1;Pn2s  L&R margin      DEC
aCAM     EQU   66 ; ESC#3  Clear margins          +++

aHTS     EQU   67 ; ESCH    Set horiz tab         ISO
aVTS     EQU   68 ; ESCJ    Set vertical tabs     ISO
aTBC0    EQU   69 ; ESC[0g  Clr horiz tab         ISO
aTBC3    EQU   70 ; ESC[3g  Clear all h tab       ISO
aTBC1    EQU   71 ; ESC[1g  Clr vertical tabs     ISO
aTBC4    EQU   72 ; ESC[4g  Clr all v tabs        ISO
aTBCALL  EQU   73 ; ESC#4   Clr all h & v tabs    +++
aTBSALL  EQU   74 ; ESC#5   Set default tabs      +++
aEXTEND  EQU   75 ; ESC[Pn"x extended commands    +++


 STRUCTURE IOPrtCmdReq,IO_SIZE
    UWORD  io_PrtCommand  ; printer command
    UBYTE  io_Parm0    ; first command parameter
    UBYTE  io_Parm1    ; second command parameter
    UBYTE  io_Parm2    ; third command parameter
    UBYTE  io_Parm3    ; fourth command parameter
    LABEL  iopcr_SIZEOF

 STRUCTURE  IODRPReq,IO_SIZE
    APTR   io_RastPort     ; raster port
    APTR   io_ColorMap     ; color map
    ULONG  io_Modes        ; graphics viewport modes
    UWORD  io_SrcX         ; source x origin
    UWORD  io_SrcY         ; source y origin
    UWORD  io_SrcWidth     ; source x width
    UWORD  io_SrcHeight    ; source x height
    LONG   io_DestCols     ; destination x width
    LONG   io_DestRows     ; destination y height
    UWORD  io_Special      ; option flags
    LABEL  iodrpr_SIZEOF

SPECIAL_MILCOLS       EQU  $01   ; DestCols specified in 1/1000"
SPECIAL_MILROWS       EQU  $02   ; DestRows specified in 1/1000"
SPECIAL_FULLCOLS      EQU  $04   ; make DestCols maximum possible
SPECIAL_FULLROWS      EQU  $08   ; make DestRows maximum possible
SPECIAL_FRACCOLS      EQU  $10   ; DestCols is fraction of FULLCOLS
SPECIAL_FRACROWS      EQU  $20   ; DestRows is fraction of FULLROWS
SPECIAL_ASPECT        EQU  $80   ; ensure correct aspect ratio
SPECIAL_DENSITYMASK   EQU  $F00  ; masks out density bits
SPECIAL_DENSITY1      EQU  $100  ; lowest res
SPECIAL_DENSITY2      EQU  $200  ; next res
SPECIAL_DENSITY3      EQU  $300  ; next res
SPECIAL_DENSITY4      EQU  $400  ; highest res

PDERR_CANCEL          EQU  1  ; user canceled a printer timeout
PDERR_NOTGRAPHICS     EQU  2  ; printer cannot output graphics
PDERR_INVERTHAM       EQU  3  ; cannot invert hold & modify print
PDERR_BADDIMENSION    EQU  4  ; print dimensions illegal
PDERR_DIMENSIONOVFLOW EQU  5  ; print dimensions too large
PDERR_INTERNALMEMORY  EQU  6  ; no memory for internal variables
PDERR_BUFFERMEMORY    EQU  7  ; no memory for print buffer

   ENDC
```

```
**********************************************************************
*               Commodore-Amiga, Inc.                                *
*               prtbase.i                                            *
**********************************************************************
**********************************************************************
*
*  printer device data definition
*
**********************************************************************

   IFND  DEVICES_PRTBASE_I
DEVICES_PRTBASE_I EQU   1

   IFND  EXEC_NODES_I
   INCLUDE  "exec/nodes.i"
   ENDC
   IFND  EXEC_LISTS_I
   INCLUDE  "exec/lists.i"
   ENDC
   IFND  EXEC_PORTS_I
   INCLUDE  "exec/ports.i"
   ENDC
   IFND  EXEC_LIBRARIES_I
   INCLUDE  "exec/libraries.i"
   ENDC
   IFND  EXEC_TASKS_I
   INCLUDE  "exec/tasks.i"
   ENDC

   IFND  DEVICES_PARALLEL_I
   INCLUDE  "devices/parallel.i"
   ENDC
   IFND  DEVICES_SERIAL_I
   INCLUDE  "devices/serial.i"
   ENDC
   IFND  DEVICES_TIMER_I
   INCLUDE  "devices/timer.i"
   ENDC
   IFND  LIBRARIES_DOSEXTENS_I
   INCLUDE  "libraries/dosextens.i"
   ENDC
   IFND  INTUITION_INTUITION_I
   INCLUDE  "intuition/intuition.i"
   ENDC


 STRUCTURE  DeviceData,LIB_SIZE
    APTR dd_Segment           ; A0 when initialized
    APTR dd_ExecBase          ; A6 for exec
    APTR dd_CmdVectors        ; command table for device commands
    APTR dd_CmdBytes          ; bytes describing which command queue
    UWORD   dd_NumCommands    ; the number of commands supported
    LABEL   dd_SIZEOF


*------
*------ device driver private variables ------------------------------
*------
du_Flags EQU   LN_PRI         ; various unit flags

;------ IO_FLAGS
    BITDEF  IO,QUEUED,4       ; command is queued to be performed
    BITDEF  IO,CURRENT,5      ; command is being performed
    BITDEF  IO,SERVICING,6    ; command is being actively performed
    BITDEF  IO,DONE,7         ; command is done

;------ du_Flags
    BITDEF  DU,STOPPED,0      ; commands are not to be performed


*------ Constants ---------------------------------------------------
P_PRIORITY  EQU        0
P_STKSIZE   EQU        $800

*------ pd_Flags ------
   BITDEF   P,IOR0,0          ; IOR0 is in use
   BITDEF   P,IOR1,1          ; IOR1 is in use
   BITDEF   P,EXPUNGED,7      ; device to be expunged when all closed

 STRUCTURE  PrinterData,dd_SIZEOF
    STRUCT  pd_Unit,MP_SIZE   ; the one and only unit
    BPTR pd_PrinterSegment    ; the printer specific segment
    UWORD   pd_PrinterType    ; the segment printer type
    APTR pd_SegmentData       ; the segment data structure
    APTR pd_PrintBuf          ; the raster print buffer
    APTR pd_PWrite            ; the parallel write function
    APTR pd_PBothReady        ; the parallel write function's done

    IFGT IOEXTPar_SIZE-IOEXTSER_SIZE
    STRUCT  pd_IOR0,IOEXTPar_SIZE   ; port I/O request 0
    STRUCT  pd_IOR1,IOEXTPar_SIZE   ;   and 1 for double buffering
    ENDC

    IFLE IOEXTPar_SIZE-IOEXTSER_SIZE
    STRUCT  pd_IOR0,IOEXTSER_SIZE   ; port I/O request 0
    STRUCT  pd_IOR1,IOEXTSER_SIZE   ;   and 1 for double buffering
    ENDC

    STRUCT  pd_TIOR,IOTV_SIZE       ; timer I/O request
    STRUCT  pd_IORPort,MP_SIZE      ;   and message reply port
    STRUCT  pd_TC,TC_SIZE           ; write task
    STRUCT  pd_Stk,P_STKSIZE        ;   and stack space
    UBYTE   pd_Flags                ; device flags
    UBYTE   pd_pad
    STRUCT  pd_Preferences,pf_SIZEOF ; the latest preferences
    UBYTE      pd_PWaitEnabled      ; wait function switch
    LABEL   pd_SIZEOF               ; warning! this may be odd

    BITDEF  PPC,GFX,0
    BITDEF  PPC,COLOR,1

PPC_BWALPHA    EQU   0
PPC_BWGFX      EQU   1
PPC_COLORGFX   EQU   3

PCC_BW         EQU   1
PCC_YMC        EQU   2
PCC_YMC_BW     EQU   3
PCC_YMCB       EQU   4
```

```

STRUCTURE  PrinterExtendedData,0
   APTR    ped_PrinterName    ; printer name, null terminated
   APTR    ped_Init           ; called after LoadSeg
   APTR    ped_Expunge        ; called before UnLoadSeg
   APTR    ped_Open           ; called at OpenDevice
   APTR    ped_Close          ; called at CloseDevice
   UBYTE   ped_PrinterClass   ; printer class
   UBYTE   ped_ColorClass     ; color class
   UBYTE   ped_MaxColumns     ; number of print columns available
   UBYTE   ped_NumCharSets    ; number of character sets
   UWORD   ped_NumRows        ; number of raster rows in a raster dump
   ULONG   ped_MaxXDots       ; number of dots maximum in a raster dump
   ULONG   ped_MaxYDots       ; number of dots maximum in a raster dump
   UWORD   ped_XDotsInch      ; horizontal dot density
   UWORD   ped_YDotsInch      ; vertical dot density
   APTR    ped_Commands       ; printer text command table
   APTR    ped_DoSpecial      ; special command handler
   APTR    ped_Render         ; raster render function
   LONG    ped_TimeoutSecs    ; good write timeout
   LABEL   ped_SIZEOF

STRUCTURE  PrinterSegment,0
   ULONG   ps_NextSegment     ; (actually a BPTR)
   ULONG   ps_runAlert        ; MOVEQ #0,D0 : RTS
   UWORD   ps_Version         ; segment version
   UWORD   ps_Revision        ; segment revision
   LABEL   ps_PED             ; printer extended data

  ENDC
```



```
*********************************************************************
*               Commodore-Amiga, Inc.                               *
*               serial.i                                            *
*********************************************************************
*********************************************************************
*
* external declarations for Serial Port Driver
*
* SOURCE CONTROL
* ------ -------
* $Header: serial.i,v 25.0 85/03/27 19:14:15 tomp Exp $
*
* $Locker:  $
*
*********************************************************************

    IFND    DEVICES_SERIAL_I
DEVICES_SERIAL_I SET 1

    IFND     EXEC_STRINGS_I
    include 'exec/strings.i'


    IFND     EXEC_IO_I
    include 'exec/io.i'


*---------------------------------------------------------------------
*
* Useful constants
*
*---------------------------------------------------------------------
*
SER_CTL        EQU     $11130000 ; default char's for xON,Xoff,reserved,rsvd.
SER_DBAUD      EQU     9600      ; default baud

*
*---------------------------------------------------------------------
*
* Driver Specific Commands

SDCMD_QUERY      EQU     CMD_NONSTD
SDCMD_BREAK      EQU     CMD_NONSTD+1
SDCMD_SETPARAMS  EQU     CMD_NONSTD+2

SER_DEVFINISH    EQU     CMD_NONSTD+2 ; number of device comands

*---------------------------------------------------------------------

*-- SERIALNAME is a generic macro to get the name of the driver.  This
*-- way if the name is ever changed you will pick up the change
*-- automatically.
*--
*-- Normal usage would be:
*--
*-- internalName: SERIALNAME
*--

SERIALNAME: MACRO
```

```
      STRING   'serial.device'
      ENDM

        BITDEF  SER,XDISABLED,7  ; SERFLAGS xOn-xOff feature disabled bit
        BITDEF SER,EOFMODE,6     ;    "     EOF mode enabled bit
        BITDEF SER,SHARED,5      ;    "     non-exclusive access
        BITDEF  SER,RAD_BOOGIE,4 ;    "     high-speed mode active
        BITDEF SER,QUEUEDBRK,3   ;    "     queue this Break ioRqst
        BITDEF  SER,7WIRE,2      ;    "     RS232 7-wire protocol
        BITDEF SER,PARTY_ODD,1   ;    "     parity feature enabled bit
        BITDEF SER,PARTY_ON,0    ;    "     parity-enabled bit
        BITDEF IOSER,QUEUED,6    ; IO_FLAGS rqst-queued bit
        BITDEF IOSER,ABORT,5     ;     "    rqst-aborted bit
        BITDEF IOSER,ACTIVE,4    ;     "    rqst-qued-or-current bit
        BITDEF IOST,XOFFREAD,4   ; IOST_HOB receive currently xOFF'ed
        BITDEF IOST,XOFFWRITE,3  ;     "    transmit currently xOFF'ed
        BITDEF IOST,READBREAK,2  ;     "    break was latest input
        BITDEF IOST,WROTEBREAK,1 ;     "    break was latest output
        BITDEF IOST,OVERRUN,0    ;     "    status word RBF overrun
*
*****************************************************************************
 STRUCTURE TERMARRAY,0
        ULONG    TERMARRAY_0
        ULONG    TERMARRAY_1
        LABEL    TERMARRAY_SIZE

*****************************************************************
* CAUTION !!  IF YOU ACCESS the serial.device, you MUST (!!!!) use an
* IOEXTSER-sized structure or you may overlay innocent memory, okay ?!
*****************************************************************

 STRUCTURE IOEXTSER,IOSTD_SIZE

*     STRUCT   MsgNode
*   0   APTR     Succ
*   4   APTR     Pred
*   8   UBYTE    Type
*   9   UBYTE    Pri
*   A   APTR     Name
*   E   APTR     ReplyPort
*  12   UWORD    MNLength
*     STRUCT   IOExt
*  14   APTR     IO_DEVICE
*  18   APTR     IO_UNIT
*  1C   UWORD    IO_COMMAND
*  1E   UBYTE    IO_FLAGS
*  1F   UBYTE    IO_ERROR
*     STRUCT   IOStdExt
*  20   ULONG    IO_ACTUAL
*  24   ULONG    IO_LENGTH
*  28   APTR     IO_DATA
*  2C   ULONG    IO_OFFSET
*
*  30
   ULONG   IO_CTLCHAR      ; control char's (order = xON,xOFF,rsvd,rsvd)
   ULONG   IO_RBUFLEN      ; length in bytes of serial port's read buffer
   ULONG   IO_EXTFLAGS     ; (not used) flag extension area
   ULONG   IO_BAUD         ; baud rate requested (true baud)
   ULONG   IO_BRKTIME      ; duration of break signal in MICROseconds
   STRUCT  IO_TERMARRAY,TERMARRAY_SIZE ; termination character array
   UBYTE   IO_READLEN      ; bits per read char (bit count)
   UBYTE   IO_WRITELEN     ; bits per write char (bit count)
   UBYTE   IO_STOPBITS     ; stopbits for read (count)
   UBYTE   IO_SERFLAGS     ; see SERFLAGS bit definitions above
   UWORD   IO_STATUS       ; status of serial port, as follows:
*
*               BIT  ACTIVE  FUNCTION
*                0    low    busy
*                1    low    paper out
*                2    low    select
*                3    low    Data Set Ready
*                4    low    Clear To Send
*                5    low    Carrier Detect
*                6    low    Ready To Send
*                7    low    Data Terminal Ready
*                8    high   read overrun
*                9    high   break sent
*               10    high   break received
*               11    high   transmit x-OFFed
*               12    high   receive x-OFFed
*            13-15    (not)  reserved
*
        LABEL   IOEXTSER_SIZE

*****************************************************************************

*-----------------------------------------------------------------------
*
* Driver error definitions
*
*-----------------------------------------------------------------------

SerErr_DevBusy          EQU     1
SerErr_BaudMismatch     EQU     2
SerErr_InvBaud          EQU     3
SerErr_BufErr           EQU     4
SerErr_InvParam         EQU     5
SerErr_LineErr          EQU     6
SerErr_NotOpen          EQU     7
SerErr_PortReset        EQU     8
SerErr_ParityErr        EQU     9
SerErr_InitErr          EQU    10
SerErr_TimerErr         EQU    11
SerErr_BufOverflow      EQU    12
SerErr_NoDSR            EQU    13
SerErr_NoCTS            EQU    14
SerErr_DetectedBreak    EQU    15
```

```
*********************************************************************
*               Commodore-Amiga, Inc.                               *
*               timer.i                                             *
*********************************************************************
*********************************************************************
*
* SOURCE CONTROL
* ------ -------
* $Header: timer.i,v 27.1 85/06/24 13:32:40 neil Exp $
*
* $Locker:  $
*
*********************************************************************


   IFND  DEVICES_TIMER_I
DEVICES_TIMER_I   SET   1

   IFND  EXEC_IO_I
   INCLUDE "exec/io.i"


* unit defintions
UNIT_MICROHZ   EQU   0
UNIT_VBLANK EQU   1

TIMERNAME   MACRO
      DC.B  'timer.device',0
      DS.W  0
      ENDM

 STRUCTURE TIMEVAL,0
   ULONG TV_SECS
   ULONG TV_MICRO
   LABEL TV_SIZE

 STRUCTURE TIMEREQUEST,IO_SIZE
   STRUCT   IOTV_TIME,TV_SIZE
   LABEL IOTV_SIZE

* IO_COMMAND to use for adding a timer
   DEVINIT
   DEVCMD   TR_ADDREQUEST
   DEVCMD   TR_GETSYSTIME
   DEVCMD   TR_SETSYSTIME

   ENDC
```

```
*********************************************************************
*               Commodore-Amiga, Inc.                               *
*               trackdisk.i                                         *
*********************************************************************
*********************************************************************
*
* trackdisk.i
*
* Source Control
* ------ -------
*
* $Header: trackdisk.i,v 27.2 85/07/12 23:16:27 neil Exp $
*
* $Locker:  $
*
**********************************************************************

   IFND  DEVICES_TRACKDISK_I
DEVICES_TRACKDISK_I  SET   1

   IFND  EXEC_IO_I
   INCLUDE  "exec/io.i"


*--------------------------------------------------------------------
*
* Physical drive constants
*
*--------------------------------------------------------------------


NUMCYLS     EQU   80          ; normal # of cylinders
MAXCYLS     EQU   NUMCYLS+20  ; max # of cyls to look for
*                             ;  during a calibrate
NUMSECS     EQU   11
NUMHEADS    EQU   2
MAXRETRY    EQU   10
NUMTRACKS   EQU   NUMCYLS*NUMHEADS
NUMUNITS    EQU   4

*--------------------------------------------------------------------
*
* Useful constants
*
*--------------------------------------------------------------------


*-- sizes before mfm encoding
TD_SECTOR    EQU   512
TD_SECSHIFT EQU   9        ; log TD_SECTOR
*                          ;    2


*--------------------------------------------------------------------
*
* Driver Specific Commands
*
*--------------------------------------------------------------------

```

```
*-- TD_NAME is a generic macro to get the name of the driver.  This
*-- way if the name is ever changed you will pick up the change
*-- automatically.
*--
*-- Normal usage would be:
*--
*-- internalName: TD_NAME
*--

TD_NAME: MACRO
      DC.B  'trackdisk.device',0
      DS.W  0
      ENDM

   BITDEF   TD,EXTCOM,15

   DEVINIT
   DEVCMD   TD_MOTOR           ; control the disk's motor
   DEVCMD   TD_SEEK            ; explicit seek (for testing)
   DEVCMD   TD_FORMAT          ; format disk
   DEVCMD   TD_REMOVE          ; notify when disk changes
   DEVCMD   TD_CHANGENUM       ; number of disk changes
   DEVCMD   TD_CHANGESTATE     ; is there a disk in the drive?
   DEVCMD   TD_PROTSTATUS      ; is the disk write protected?

TD_LASTCOMM EQU   TD_PROTSTATUS

*
*
* The disk driver has an "extended command" facility.  These commands
* take a superset of the normal IO Request block.
*
ETD_WRITE   EQU   (CMD_WRITE!TDF_EXTCOM)
ETD_READ    EQU   (CMD_READ!TDF_EXTCOM)
ETD_MOTOR   EQU   (TD_MOTOR!TDF_EXTCOM)
ETD_SEEK    EQU   (TD_SEEK!TDF_EXTCOM)
ETD_FORMAT  EQU   (TD_FORMAT!TDF_EXTCOM)
ETD_UPDATE  EQU   (CMD_UPDATE!TDF_EXTCOM)
ETD_CLEAR   EQU   (CMD_CLEAR!TDF_EXTCOM)


*
* extended IO has a larger than normal io request block.
*

 STRUCTURE IOEXTTD,IOSTD_SIZE
   ULONG IOTD_COUNT            ; removal/insertion count
   ULONG IOTD_SECLABEL         ; sector label data region
   LABEL IOTD_SIZE

* labels are TD_LABELSIZE bytes per sector

TD_LABELSIZE         EQU   16

*-------------------------------------------------------------------
*
* Driver error defines
*
*-------------------------------------------------------------------

TDERR_NotSpecified    EQU   20
TDERR_NoSecHdr        EQU   21
TDERR_BadSecPreamble  EQU   22
TDERR_BadSecID        EQU   23
TDERR_BadHdrSum       EQU   24
TDERR_BadSecSum       EQU   25
TDERR_TooFewSecs      EQU   26
TDERR_BadSecHdr       EQU   27
TDERR_WriteProt       EQU   28
TDERR_DiskChanged     EQU   29
TDERR_SeekError       EQU   30
TDERR_NoMem           EQU   31
TDERR_BadUnitNum      EQU   32
TDERR_BadDriveType    EQU   33
TDERR_DriveInUse      EQU   34
```

Contents
----

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graphics/copper.i
graphics/display.i
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graphics/gfxbase.i
graphics/layers.i
graphics/rastport.i
graphics/regions.i
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graphics/view.i

```
    IFND    GRAPHICS_CLIP_I
GRAPHICS_CLIP_I SET 1
**********************************************************************
*               Commodore-Amiga, Inc.                                *
*               clip.i                                               *
**********************************************************************

    IFND    GRAPHICS_GFX_I
    include 'graphics/gfx.i'
    ENDC
    IFND    EXEC_PORTS_I
    include 'exec/ports.i'
    ENDC

 STRUCTURE  Layer,0
    LONG    lr_Front
    LONG    lr_Back
    LONG    lr_ClipRect
    LONG    lr_RastPort
    WORD    lr_MinX
    WORD    lr_MinY
    WORD    lr_MaxX
    WORD    lr_MaxY
    BYTE    lr_Lock
    BYTE    lr_LockCount
    BYTE    lr_LayerLockCount
    BYTE    lr_reserved
    WORD    lr_reserved1
    WORD    lr_Flags
    LONG    lr_SuperBitMap
    LONG    lr_SuperClipRect
    LONG    lr_Window
    WORD    lr_Scroll_X
    WORD    lr_Scroll_Y
    STRUCT  lr_LockPort,MP_SIZE
    STRUCT  lr_LockMessage,MN_SIZE
    STRUCT  lr_ReplyPort,MP_SIZE
    STRUCT  lr_1_LockMessage,MN_SIZE
    APTR    lr_DamageList
    APTR    lr__cliprects
    APTR    lr_LayerInfo
    APTR    lr_LayerLocker
    APTR    lr_SuperSaverClipRects
    APTR    lr_cr
    APTR    lr_cr2
    APTR    lr_crnew
    APTR    lr__p1
    LABEL   lr_SIZEOF

 STRUCTURE  ClipRect,0
    LONG    cr_Next
    LONG    cr_Prev
    LONG    cr_LObs
    LONG    cr_BitMap
    WORD    cr_MinX
    WORD    cr_MinY
    WORD    cr_MaxX
    WORD    cr_MaxY
    APTR    cr__p1
```

```
    APTR    cr__p2
    LONG    cr_reserved
    LONG    cr_Flags
 LABEL      cr_SIZEOF

* defines for clipping
ISLESSX equ 1
ISLESSY equ 2
ISGRTRX equ 4
ISGRTRY equ 8

    ENDC
```

```
   IFND  GRAPHICS_COPPER_I
GRAPHICS_COPPER_I SET   1
*********************************************************************
*               Commodore-Amiga, Inc.                               *
*               copper.i                                            *
*********************************************************************

COPPER_MOVE equu 0       /* pseude opcode for move #XXXX,dir */
COPPER_WAIT equ 1        /* pseudo opcode for wait y,x */
CPRNXTBUF   equ 2        /* continue processing with next buffer */
CPR_NT_LOF  equ $8000  /* copper instruction only for short frames */
CPR_NT_SHT  equ $4000   /* copper instruction only for long frames */

   STRUCTURE   CopIns,0
      WORD  ci_OpCode      * 0 = move, 1 = wait */
      STRUCT   ci_nxtlist,0   * UNION
      STRUCT   ci_VWaitPos,0
      STRUCT   ci_DestAddr,2

      STRUCT   ci_HWaitPos,0
      STRUCT   ci_DestData,2

   LABEL ci_SIZEOF

* structure of cprlist that points to list that hardware actually executes */
   STRUCTURE   cprlist,0
      APTR  crl_Next
      APTR  crl_start
      WORD  crl_max
   LABEL crl_SIZEOF

   STRUCTURE   CopList,0
      APTR  cl_Next  /* next block for this copper list */
      APTR  cl__CopList  /* system use */
      APTR  cl_ ViewPort *_ViewPort    /* system use */
      APTR  cl_CopIns /* start of this block */
      APTR  cl_CopPtr /* intermediate ptr */
      APTR  cl_CopLStart   /* mrgcop fills this in for Long Frame*/
      APTR  cl_CopSStart   /* mrgcop fills this in for Short Frame*/
      WORD  cl_Count       /* intermediate counter */
      WORD  cl_MaxCount   /* max # of copins for this block */
      WORD  cl_DyOffset    /* offset this copper list vertical waits */
   LABEL cl_SIZEOF

   STRUCTURE   UCopList,0
      APTR     ucl_Next
      APTR     ucl_FirstCopList /* head node of this copper list */
      APTR     ucl_CopList /* node in use */
   LABEL ucl_SIZEOF

*  private graphics data structure
   STRUCTURE   copinit,0
      STRUCT   copinit_diagstrt,8
      STRUCT   copinit_sprstrtup,2*((2*8*2)+2+(2*2)+2)
      STRUCT   copinit_sprstop,4
   LABEL copinit_SIZEOF

   ENDC
```

```
   IFND  GRAPHICS_DISPLAY_I
GRAPHICS_DISPLAY_I   SET   1
****** display.i ****************************************************/
*                                                                   */
*                Commodore-Amiga, Inc.                              */
*                                                                   */
*                   Modification History                            */
*  date    :   author :    Comments                                 */
*  -------     ------      ------------------------------------     */
*  8-24-84     Dale        added this header file                   */
*                                                                   */
*********************************************************************/

* include define file for display control registers */
* bplcon0 defines */
MODE_640     equ   $8000
PLNCNTMSK    equ   $7                * how many bit planes? */
                                     * 0 = none, 1->6 = 1->6, 7 = reserved */
PLNCNTSHFT   equ   12                * bits to shift for bplcon0 */
PF2PRI       equ   $40               * bplcon2 bit */
COLORON      equ   $0200             * disable color burst */
DBLPF        equ   $400
HOLDNMODIFY equ    $800
INTERLACE    equ   4                 * interlace mode for 400 */

* bplcon1 defines */
PFA_FINE_SCROLL        equ   $F
PFB_FINE_SCROLL_SHIFT equ    4
PF_FINE_SCROLL_MASK    equ   $F

* display window start and stop defines */
DIW_HORIZ_POS          equ   $7F     * horizontal start/stop */
DIW_VRTCL_POS          equ   $1FF    * vertical start/stop */
DIW_VRTCL_POS_SHIFT    equ   7

* Data fetch start/stop horizontal position */
DFTCH_MASK             equ   $FF

* vposr bits */
VPOSRLOF               equ   $8000

   ENDC
```

```
    IFND    GRAPHICS_GELS_I
GRAPHICS_GELS_I SET 1
*******************************************************************
*                Commodore-Amiga, Inc.                            *
*      Graphics Library : Gels Definitions                        *
*                                                                 *
*******************************************************************


*------ VS_vSflags ------------------------------------------------

*    ;-- user-set vSprite flags --
SUSERFLAGS  EQU $00FF           ; mask of all user-settable vSprite-flags
    BITDEF  VS,VSPRITE,0        ; set if vSprite, clear if bob
    BITDEF  VS,SAVEBACK,1       ; set if background is to be saved/restored
    BITDEF  VS,OVERLAY,2        ; set to mask image of bob onto background
    BITDEF  VS,MUSTDRAW,3       ; set if vSprite absolutely must be drawn
*    ;-- system-set vSprite flags --
    BITDEF  VS,BACKSAVED,8      ; this bob's background has been saved
    BITDEF  VS,BOBUPDATE,9      ; temporary flag, useless to outside world
    BITDEF  VS,GELGONE,10       ; set if gel is completely clipped (offscreen)
    BITDEF  VS,VSOVERFLOW,11    ; vSprite overflow (if MUSTDRAW set we draw!)


*------ B_flags ---------------------------------------------------
*    ;-- these are the user flag bits --
BUSERFLAGS  EQU $00FF           ; mask of all user-settable bob-flags
    BITDEF  B,SAVEBOB,0         ; set to not erase bob
    BITDEF  B,BOBISCOMP,1       ; set to identify bob as animComp
*    ;-- these are the system flag bits --
    BITDEF  B,BWAITING,8        ; set while bob is waiting on 'after'
    BITDEF  B,BDRAWN,9          ; set when bob is drawn this DrawG pass
    BITDEF  B,BOBSAWAY,10       ; set to initiate removal of bob
    BITDEF  B,BOBNIX,11         ; set when bob is completely removed
    BITDEF  B,SAVEPRESERVE,12 ; for back-restore during double-buffer
    BITDEF  B,OUTSTEP,13        ; for double-clearing if double-buffer


*------ defines for the animation procedures ----------------------

ANFRACSIZE  EQU 6
ANIMHALF    EQU $0020
RINGTRIGGER EQU $0001

*------ macros -----------------------------------------------------
* these are GEL functions that are currently simple enough to exist as a
* definition.  It should not be assumed that this will always be the case

InitAnimate MACRO    * &animKey
       CLR.L   \1
       ENDM


RemBob      MACRO   * &b
       OR.W    #BF_BOBSAWAY,b_BobFlags+\1
       ENDM

*------ VS : vSprite -----------------------------------------------
 STRUCTURE  VS,0    ; vSprite
```

```
*    -- SYSTEM VARIABLES --
*    GEL linked list forward/backward pointers sorted by y,x value
     APTR    vs_NextVSprite    ; struct *vSprite
     APTR    vs_PrevVSprite    ; struct *vSprite
*    GEL draw list constructed in the order the bobs are actually drawn, then
*    list is copied to clear list
*    must be here in vSprite for system boundary detection
     APTR    vs_DrawPath       ; struct *vSprite: pointer of overlay drawing
     APTR    vs_ClearPath      ; struct *vSprite: pointer for overlay clearing
*    the vSprite positions are defined in (y,x) order to make sorting
*    sorting easier, since (y,x) as a long integer
     WORD    vs_Oldy           ; previous position
     WORD    vs_Oldx           ;
*    -- COMMON VARIABLES --
     WORD    vs_VSFlags        ; vSprite flags
*    -- USER VARIABLES --
*     the vSprite positions are defined in (y,x) order to make sorting
*     easier, since (y,x) as a long integer
     WORD    vs_Y              ; screen position
     WORD    vs_X
     WORD    vs_Height
     WORD    vs_Width          ; number of words per row of image data
     WORD    vs_Depth          ; number of planes of data
     WORD    vs_MeMask         ; which types can collide with this vSprite
     WORD    vs_HitMask        ; which types this vSprite can collide with
     APTR    vs_ImageData      ; *WORD pointer to vSprite image
*     borderLine is the one-dimensional logical OR of all
*     the vSprite bits, used for fast collision detection of edge
     APTR    vs_BorderLine     ; *WORD: logical OR of all vSprite bits
     APTR    vs_CollMask       ; *WORD: similar to above except this is a
*     matrix pointer to this vSprite's color definitions (not used by bobs)
     APTR    vs_SprColors      ; *WORD
     APTR    vs_VSBob          ; struct *bob: points home if this vSprite is
                               ;  part of a bob
*     planePick flag:  set bit selects a plane from image, clear bit selects
*         use of shadow mask for that plane
*     OnOff flag: if using shadow mask to fill plane, this bit (corresponding
*          to bit in planePick) describes whether to fill with 0's or 1's
*     There are two uses for these flags:
*               - if this is the vSprite of a bob, these flags describe how
*                 the bob is to be drawn into memory
*               - if this is a simple vSprite and the user intends on setting
*                 the MUSTDRAW flag of the vSprite, these flags must be set
*                 too to describe which color registers the user wants for
*                 the image
     BYTE    vs_PlanePick
     BYTE    vs_PlaneOnOff
     LABEL   vs_SUserExt       ; user definable
     LABEL   vs_SIZEOF


*------ BOB : bob -----------------------------------------------------

 STRUCTURE  BOB,0     ; bob: blitter object
*    -- COMMON VARIABLES --
     APTR    bob_SavePlanes    ; * *WORD for each plane in RastPort
     WORD    bob_BobFlags      ; general purpose flags (see definitions below)
*    -- USER VARIABLES --
     APTR    bob_SaveBuffer    ; *WORD pointer to the buffer for background
*     save used by bobs for "cookie-cutting" and multi-plane masking
     APTR    bob_ImageShadow   ; *WORD
*     pointer to BOBs for sequenced drawing of bobs
*       for correct overlaying of multiple component animations
     APTR    bob_Before          ; struct *bob: draw this bob before bob pointed
                                 ; to by before
     APTR    bob_After           ; struct *bob: draw this bob after bob pointed
                                 ; to by after
     APTR    bob_BobVSprite      ; struct *vSprite: this bob's vSprite definitio
     APTR    bob_BobComp         ; struct *animComp: pointer to this bob's
                                 ; animComp def
     APTR    bob_DBuffer         ; struct dBufPacket: pointer to this bob's
                                 ; dBuf packet
     LABEL   bob_BUserExt        ; bob user extension
     LABEL   bob_SIZEOF

*------ AC : animComp ---------------------------------------------

 STRUCTURE  AC,0    ; animComp
*    -- COMMON VARIABLES --
     WORD    ac_CompFlags      ; animComp flags for system & user
*     timer defines how long to keep this component active:
*       if set non-zero, timer decrements to zero then switches to nextSeq
*       if set to zero, animComp never switches
     WORD    ac_Timer
*    -- USER VARIABLES --
*     initial value for timer when the animComp is activated by the system
     WORD    ac_TimeSet
*     pointer to next and previous components of animation object
     APTR    ac_NextComp         ; struct *animComp
     APTR    ac_PrevComp         ; struct *animComp
*     pointer to component component definition of next image in sequence
     APTR    ac_NextSeq          ; struct *animComp
     APTR    ac_PrevSeq          ; struct *animComp
     APTR    ac_AnimCRoutine     ; address of special animation procedure
     WORD    ac_YTrans           ; initial y translation (if this is a component
     WORD    ac_XTrans           ; initial x translation (if this is a component
     APTR    ac_HeadOb           ; struct *animOb
     APTR    ac_AnimBob          ; struct *bob
     LABEL   ac_SIZE

*------ AO : animOb ---------------------------------------------

 STRUCTURE  AO,0    ; animOb
*    -- SYSTEM VARIABLES --
     APTR    ao_NextOb           ; struct *animOb
     APTR    ao_PrevOb           ; struct *animOb
*     number of calls to Animate this animOb has endured
     LONG    ao_Clock
     WORD    ao_AnOldY           ; old y,x coordinates
     WORD    ao_AnOldX           ;
*    -- COMMON VARIABLES --
     WORD    ao_AnY              ; y,x coordinates of the animOb
     WORD    ao_AnX              ;
*    -- USER VARIABLES --
     WORD    ao_YVel             ; velocities of this object
     WORD    ao_XVel             ;
     WORD    ao_XAccel           ; accelerations of this object
     WORD    ao_YAccel           ;   !!! backwards !!!
     WORD    ao_RingYTrans       ; ring translation values
     WORD    ao_RingXTrans       ;
```

```
    APTR    ao_AnimORoutine   ; address of special animation procedure
    APTR    ao_HeadComp       ; struct *animComp: pointer to first component
    LABEL   ao_AUserExt       ; animOb user extension
    LABEL   ao_SIZEOF


*------ DBP : dBufPacket -------------------------------------------
* dBufPacket defines the values needed to be saved across buffer to buffer
*   when in double-buffer mode

 STRUCTURE  DBP,0             ; dBufPacket
    WORD    dbp_BufY          ; save the other buffers screen coordinates
    WORD    dbp_BufX          ;
    APTR    dbp_BufPath       ; struct *vSprite: carry the draw path over
                              ; the gap
*    these pointers must be filled in by the user
*    pointer to other buffer's background save buffer
    APTR    dbp_BufBuffer     ; *WORD
*    pointer to other buffer's background plane pointers
    APTR    dbp_BufPlanes     ; **WORD
    LABEL   dbp_SIZEOF

    ENDC
```

```
********************************************************************
*                                                                  *
*               Commodore-Amiga, Inc.                              *
*               gfx.i                                              *
*                                                                  *
********************************************************************
    IFND    GRAPHICS_GFX_I
GRAPHICS_GFX_I  SET 1

BITSET      equ $8000
BITCLR      equ 0
AGNUS       equ 1
DENISE      equ 1

    STRUCTURE   BitMap,0
    WORD    bm_BytesPerRow
    WORD    bm_Rows
    BYTE    bm_Flags
    BYTE    bm_Depth
    WORD    bm_Pad
    STRUCT  bm_Planes,8*4
    LABEL   bm_SIZEOF

   STRUCTURE   Rectangle,0
      WORD  ra_MinX
      WORD  ra_MinY
      WORD  ra_MaxX
      WORD  ra_MaxY
   LABEL    ra_SIZEOF

    ENDC
```

```
****** gfxbase.i *****************************************************
*                                                                    *
*               Commodore-Amiga, Inc.                                *
*                                                                    *
**********************************************************************
    IFND    GRAPHICS_GFXBASE_I
GRAPHICS_GFXBASE_I  SET 1

    IFND    EXEC_LISTS_I
    include 'exec/lists.i'
    ENDC
    IFND    EXEC_LIBRARIES_I
    include 'exec/libraries.i'
    ENDC
    IFND    EXEC_INTERRUPTS_I
    include 'exec/interrupts.i'
    ENDC

 STRUCTURE  GfxBase,LIB_SIZE
    APTR    gb_ActiView        ; struct *View
    APTR    gb_copinit         ; struct *copinit  ; ptr to copper start up list
    APTR    gb_cia             ; for 6526 resource use
    APTR    gb_blitter         ; for blitter resource use
    APTR    gb_LOFlist         ; current copper list being run
    APTR    gb_SHFlist         ; current copper list being run
    APTR    gb_blthd           ; struct *bltnode
    APTR    gb_bltt1           ;
    APTR    gb_bsblthd         ;
    APTR    gb_bsbltt1         ;
    STRUCT  gb_vbsrv,IS_SIZE
    STRUCT  gb_timsrv,IS_SIZE
    STRUCT  gb_bltsrv,IS_SIZE
    STRUCT  gb_TextFonts,LH_SIZE
    APTR    gb_DefaultFont
    UWORD   gb_Modes           ; copy of bltcon0
    BYTE    gb_VBlank
    BYTE    gb_Debug
    UWORD   gb_BeamSync
    WORD    gb_system_bplcon0
    BYTE    gb_SpriteReserved
    BYTE    gb_bytereserved

    WORD    gb_Flags
    WORD    gb_BlitLock
    WORD    gb_BlitNest
    STRUCT  gb_BlitWaitQ,LH_SIZE
    APTR    gb_BlitOwner
    STRUCT  gb_TOF_WaitQ,LH_SIZE
    WORD    gb_DisplayFlags
    STRUCT  gb_reserved,8      ; 8 bytes reserved for future use
    LABEL   gb_SIZE

* bits for dalestuff, which may go away when blitter becomes a resource
OWNBLITTERn equ 0   * blitter owned bit
QBOWNERn    equ 1   * blitter owned by blit queuer
QBOWNER     equ 1<<QBOWNERn

    ENDC
```

```
*               Commodore-Amiga, Inc.
*               layers.i
*
    IFND    GRAPHICS_LAYERS_I
GRAPHICS_LAYERS_I   SET 1

    IFND    EXEC_PORTS_I
      include 'exec/ports.i'
    ENDC

    IFND  EXEC_LISTS_I
      include  'exec/lists.i'
    ENDC

   STRUCTURE   LayerInfo_extra,0
   STRUCT      lie_env,13*4
   STRUCT      lie_mem,LH_SIZE
   APTR        lie_FreeClipRects
   APTR        lie_blitbuff
   LABEL       lie_SIZEOF

LMN_REGION  equ -1

   STRUCTURE   mem_node,0
   APTR     memnode_succ
   APTR     memnode_pred
   APTR     memnode_where
   LONG     memnode_how_big
   LABEL    memnode_SIZEOF

    STRUCTURE  Layer_Info,0
    APTR       li_top_layer
    APTR       li_check_lp
    APTR       li_obs
    STRUCT     li_RP_ReplyPort,MP_SIZE
    STRUCT     li_LockPort,MP_SIZE
    BYTE       li_Lock
    BYTE       li_broadcast
    BYTE       li_locknest
    BYTE       li_pad
    APTR       li_Locker
    STRUCT     li_bytereserved,2
    STRUCT     li_wordreserved,4
    STRUCT     li_longreserved,4
    APTR       li_LayerInfo_extra
    LABEL      li_SIZEOF

NEWLAYERINFO_CALLED  equ 1

    ENDC
```

```
****** rastport.i *************************************************
*
*               Commodore-Amiga, Inc.
*
*******************************************************************
    IFND    GRAPHICS_RASTPORT_I
GRAPHICS_RASTPORT_I SET 1

    IFND    GRAPHICS_GFX_I
       include 'graphics/gfx.i'
    ENDC

*------ TR : TmpRas --------------------------------------------------

 STRUCTURE  TmpRas,0
   APTR     tr_RasPtr          ; *WORD
   LONG     tr_Size
   LABEL    tr_SIZEOF

*------ GelsInfo

   STRUCTURE   GelsInfo,0
   BYTE     gi_sprRsrvd        * flag of which sprites to reserve from
                               * vsprite system
   BYTE     gi_Flags           * reserved for system use
   APTR     gi_gelHead
   APTR     gi_gelTail         * dummy vSprites for list management
* pointer to array of 8 WORDS for sprite available lines
   APTR     gi_nextLine
* pointer to array of 8 pointers for color-last-assigned to vSprites
   APTR     gi_lastColor
   APTR     gi_collHandler     * addresses of collision routines
   SHORT    gi_leftmost
   SHORT    gi_rightmost
   SHORT    gi_topmost
   SHORT    gi_bottommost
   APTR     gi_firstBlissObj
   APTR     gi_lastBlissObj    * system use only
   LABEL    gi_SIZEOF

*------ RP_Flags ------
   BITDEF   RP,FRST_DOT,0      ; draw the first dot of this line ?
   BITDEF   RP,ONE_DOT,1       ; use one dot mode for drawing lines
   BITDEF   RP,DBUFFER,2       ; flag set when RastPorts are double-buffered
*                              ;   (only used for bobs)
   BITDEF   RP,AREAOUTLINE,3   ; used by areafiller
   BITDEF   RP,NOCROSSFILL,5   ; used by areafiller

*------ RP_DrawMode ------
RP_JAM1         EQU 0
RP_JAM2         EQU 1
RP_COMPLEMENT   EQU 2
RP_INVERSVID    EQU 4          ; inverse video for drawing modes

*------ RP_TxFlags ------
   BITDEF  RP,TXSCALE,0

 STRUCTURE  RastPort,0
0  LONG     rp_Layer
4  LONG     rp_BitMap
8  LONG     rp_AreaPtrn
12 LONG     rp_TmpRas
16 LONG     rp_AreaInfo
20 LONG     rp_GelsInfo
24 BYTE     rp_Mask
25 BYTE     rp_FgPen
26 BYTE     rp_BgPen
27 BYTE     rp_AOLPen
28 BYTE     rp_DrawMode
29 BYTE     rp_AreaPtSz
30 BYTE     rp_Dummy
31 BYTE     rp_linpatcnt
32 WORD     rp_Flags
34 WORD     rp_LinePtrn
36 WORD     rp_cp_x
38 WORD     rp_cp_y
   STRUCT   rp_minterms,8
   WORD     rp_PenWidth
   WORD     rp_PenHeight
   LONG     rp_Font
   BYTE     rp_AlgoStyle
   BYTE     rp_TxFlags
   WORD     rp_TxHeight
   WORD     rp_TxWidth
   WORD     rp_TxBaseline
   WORD     rp_TxSpacing
   APTR     rp_RP_User
   STRUCT   rp_wordreserved,14
   STRUCT   rp_longreserved,8
   STRUCT   rp_reserved,8
   LABEL    rp_SIZEOF

 STRUCTURE  AreaInfo,0
   LONG     ai_VctrTbl
   LONG     ai_VctrPtr
   LONG     ai_FlagTbl
   LONG     ai_FlagPtr
   WORD     ai_Count
   WORD     ai_MaxCount
   WORD     ai_FirstX
   WORD     ai_FirstY
   LABEL    ai_SIZEOF

ONE_DOTn    equu    1
ONE_DOT     equ     $2      * 1<<ONE_DOTn
FRST_DOTn   equ     0
FRST_DOT    equ     1       * 1<<FRST_DOTn

     ENDC
```

```
    IFND    GRAPHICS_REGIONS_I
GRAPHICS_REGIONS_I  SET 1
********************************************************************
*                Commodore-Amiga, Inc.                             *
*                regions.i                                         *
********************************************************************

   IFND  GRAPHICS_GFX_I
   include  'graphics/gfx.i'
   ENDC

    STRUCTURE   Region,0
      STRUCT   rg_bounds,ra_SIZEOF
      APTR  rg_RegionRectangle
   LABEL    rg_SIZEOF

   STRUCTURE   RegionRectangle,0
      APTR  rr_Next
      APTR  rr_Prev
      STRUCT   rr_bounds,ra_SIZEOF
   LABEL    rr_SIZEOF

    ENDC
```

```
    IFND    GRAPHICS_SPRITE_I
GRAPHICS_SPRITE_I  SET 1
********************************************************************
*                Commodore-Amiga, Inc.                             *
*                sprite.h                                          *
********************************************************************

   STRUCTURE   SimpleSprite,0
   APTR        ss_posctldata
   WORD        ss_height
   WORD        ss_x
   WORD        ss_y
   WORD        ss_num
   LABEL       ss_SIZEOF

   ENDC
```

```
   IFND  GRAPHICS_TEXT_I
GRAPHICS_TEXT_I      SET   1
*******************************************************************
*              Commodore-Amiga, Inc.                              *
*              text.i                                             *
*******************************************************************
*******************************************************************
*
*  graphics library text structures
*
*******************************************************************

   IFND     EXEC_PORTS_I
   INCLUDE  "exec/ports.i"
   ENDC

*------ Font Styles ------------------------------------------------
FS_NORMAL   EQU 0              ;normal text (no style attributes set)
   BITDEF   FS,EXTENDED,3      ;extended face (must be designed)
   BITDEF   FS,ITALIC,2        ;italic (slanted 1:2 right)
   BITDEF   FS,BOLD,1          ;bold face text (ORed w/ shifted right 1)
   BITDEF   FS,UNDERLINED,0    ;underlined (under baseline)

*------ Font Flags -------------------------------------------------
   BITDEF   FP,ROMFONT,0       ;font is in rom
   BITDEF   FP,DISKFONT,1      ;font is from diskfont.library
   BITDEF   FP,REVPATH,2       ;designed path is reversed (e.g. left)
   BITDEF   FP,TALLDOT,3       ;designed for hires non-interlaced
   BITDEF   FP,WIDEDOT,4       ;designed for lores interlaced
   BITDEF   FP,PROPORTIONAL,5  ;character sizes can vary from nominal
   BITDEF   FP,DESIGNED,6      ;size is "designed", not constructed
   BITDEF   FP,REMOVED,7       ; the font has been removed


******* TextAttr node **********************************************
 STRUCTURE  TextAttr,0
   APTR     ta_Name            ;name of the desired font
   UWORD    ta_YSize           ;size of the desired font
   UBYTE    ta_Style           ;desired font style
   UBYTE    ta_Flags           ;font preferences
   LABEL    ta_SIZEOF


******* TextFont node **********************************************
 STRUCTURE  TextFont,MN_SIZE
 *                             ;font name in LN        \ used in this
20 UWORD    tf_YSize           ;font height            | order to best
22 UBYTE    tf_Style           ;font style             | match a font
23 UBYTE    tf_Flags           ;preference attributes  / request.
24 UWORD    tf_XSize           ;nominal font width
26 UWORD    tf_Baseline        ;distance from the top of char to baseline
28 UWORD    tf_BoldSmear       ;smear to affect a bold enhancement

30 UWORD    tf_Accessors       ;access count

32 UBYTE    tf_LoChar          ;the first character described here
33 UBYTE    tf_HiChar          ;the last character described here
34 APTR     tf_CharData        ;the bit character data

38 UWORD    tf_Modulo          ;the row modulo for the strike font data
40 APTR     tf_CharLoc         ;ptr to location data for the strike font
 *                             ;  2 words: bit offset then size
44 APTR     tf_CharSpace       ;ptr to words of proportional spacing data
   APTR     tf_CharKern        ;ptr to words of kerning data
   LABEL    tf_SIZEOF

   ENDC
```

```
    IFND    GRAPHICS_VIEW_I
GRAPHICS_VIEW_I SET 1
*********************************************************************
*               Commodore-Amiga, Inc.                               *
*               view.i                                              *
*********************************************************************

    IFND    GRAPHICS_GFX_I
    include 'graphics/gfx.i'
    ENDC

V_PFBA      EQU     $40
V_DUALPF    EQU     $400
V_HIRES     EQU     $8000
V_LACE      EQU     4
V_HAM       EQU     $800
V_SPRITES   EQU     $4000
GENLOCK_VIDEO   EQU 2

   STRUCTURE   ColorMap,0
      BYTE  cm_Flags
      BYTE  cm_Type
      WORD  cm_Count
      APTR  cm_ColorTable
   LABEL cm_SIZEOF


   STRUCTURE      ViewPort,0
   LONG    vp_Next
   LONG    vp_ColorMap
   LONG    vp_DspIns
   LONG    vp_SprIns
   LONG    vp_ClrIns
   LONG    vp_UCopIns
   WORD    vp_DWidth
   WORD    vp_DHeight
   WORD    vp_DxOffset
   WORD    vp_DyOffset
   WORD    vp_Modes
   WORD    vp_reserved
   APTR    vp_RasInfo
   LABEL   vp_SIZEOF


   STRUCTURE View,0
   LONG    v_ViewPort
   LONG    v_LOFCprList
   LONG    v_SHFCprList
   WORD    v_DyOffset
   WORD    v_DxOffset
   WORD    v_Modes
   LABEL   v_SIZEOF


   STRUCTURE  collTable,0
   LONG    cp_collPtrs,16
   LABEL   cp_SIZEOF


   STRUCTURE  RasInfo,0
   APTR    ri_Next
   LONG    ri_BitMap
   WORD    ri_RxOffset
   WORD    ri_RyOffset
   LABEL   ri_SIZEOF

    ENDC
```

Contents

```
**********************************************************************
* adkbits.i -- bit definitions for adkcon register
*
* Commodore-Amiga, Inc.
*
* $Header: adkbits.i,v 27.1 85/06/24 14:42:37 neil Exp $
*
* $Locker:  $
*
**********************************************************************

   IFND  HARDWARE_ADKBITS_I
HARDWARE_ADKBITS_I SET  1

ADKB_SETCLR     EQU   15 ; standard set/clear bit
ADKB_PRECOMP1   EQU   14 ; two bits of precompensation
ADKB_PRECOMP0   EQU   13
ADKB_MFMPREC    EQU   12 ; use mfm style precompensation
ADKB_UARTBRK    EQU   11 ; force uart output to zero
ADKB_WORDSYNC   EQU   10 ; enable DSKSYNC register matching
ADKB_MSBSYNC    EQU   9  ; (Apple GCR Only) sync on MSB for reading
ADKB_FAST       EQU   8  ; 1 -> 2 us/bit (mfm), 2 -> 4 us/bit (gcr)
ADKB_USE3PN     EQU   7  ; use aud chan 3 to modulate period of ??
ADKB_USE2P3     EQU   6  ; use aud chan 2 to modulate period of 3
ADKB_USE1P2     EQU   5  ; use aud chan 1 to modulate period of 2
ADKB_USE0P1     EQU   4  ; use aud chan 0 to modulate period of 1
ADKB_USE3VN     EQU   3  ; use aud chan 3 to modulate volume of ??
ADKB_USE2V3     EQU   2  ; use aud chan 2 to modulate volume of 3
ADKB_USE1V2     EQU   1  ; use aud chan 1 to modulate volume of 2
ADKB_USE0V1     EQU   0  ; use aud chan 0 to modulate volume of 1

ADKF_SETCLR     EQU   (1<<15)
ADKF_PRECOMP1   EQU   (1<<14)
ADKF_PRECOMP0   EQU   (1<<13)
ADKF_MFMPREC    EQU   (1<<12)
ADKF_UARTBRK    EQU   (1<<11)
ADKF_WORDSYNC   EQU   (1<<10)
ADKF_MSBSYNC    EQU   (1<<9)
ADKF_FAST       EQU   (1<<8)
ADKF_USE3PN     EQU   (1<<7)
ADKF_USE2P3     EQU   (1<<6)
ADKF_USE1P2     EQU   (1<<5)
ADKF_USE0P1     EQU   (1<<4)
ADKF_USE3VN     EQU   (1<<3)
ADKF_USE2V3     EQU   (1<<2)
ADKF_USE1V2     EQU   (1<<1)
ADKF_USE0V1     EQU   (1<<0)

ADKF_PRE000NS   EQU   0                            ; 000 ns of precomp
ADKF_PRE140NS   EQU   (ADKF_PRECOMP0)              ; 140 ns of precomp
ADKF_PRE280NS   EQU   (ADKF_PRECOMP1)              ; 280 ns of precomp
ADKF_PRE560NS   EQU   (ADKF_PRECOMP0!ADKF_PRECOMP1) ; 560 ns of precomp
```

```
**********************************************************************
* Commodore-Amiga, Inc.
* blit.i
*
* $Header: blit.i,v 27.1 85/06/24 14:42:42 neil Exp $
*
* $Locker:  $
*
**********************************************************************

   IFND  HARDWARE_BLIT_I
HARDWARE_BLIT_I   SET   1

   STRUCTURE bltnode,0
   LONG  bn_n
   LONG  bn_function
   BYTE  bn_stat
   BYTE  bn_dummy
   WORD  bn_blitsize
   WORD  bn_beamsync
   LONG  bn_cleanup
   LABEL bn_SIZEOF

* bit defines used by blit queuer
CLEANMEn     equ 6
CLEANME      equ 1<<CLEANMEn

* include file for blitter */
HSIZEBITS    equ   6
VSIZEBITS    equ   16-HSIZEBITS
HSIZEMASK    equ   $3f        /* 2^6 -- 1 */
VSIZEMASK    equ   $3FF       /* 2^10 - 1 */

MAXBYTESPERROW EQU   128

* definitions for blitter control register 0 */

ABC          equ   $80
ABNC         equ   $40
ANBC         equ   $20
ANBNC        equ   $10
NABC         equ   $8
NABNC        equ   $4
NANBC        equ   $2
NANBNC       equ   $1

BC0B_DEST    equ     8
BC0B_SRCC    equ     9
BC0B_SRCB    equ    10
BC0B_SRCA    equ    11
BC0F_DEST    equ   $100
BC0F_SRCC    equ   $200
BC0F_SRCB    equ   $400
BC0F_SRCA    equ   $800

BC1F_DESC    equ 2

DEST         equ   $100
SRCC         equ   $200
SRCB         equ   $400
SRCA         equ   $800

ASHIFTSHIFT equ   12 /* bits to right align ashift value */
BSHIFTSHIFT equ   12 /* bits to right align bshift value */

* definations for blitter control register 1 */
LINEMODE     equ   $1
FILL_OR      equ   $8
FILL_XOR     equ   $10
FILL_CARRYIN   equ   $4
ONEDOT       equ   $2
OVFLAG       equ   $20
SIGNFLAG     equ   $40
BLITREVERSE  equ   $2

SUD          equ   $10
SUL          equ   $8
AUL          equ   $4

OCTANT8      equ   24
OCTANT7      equ   4
OCTANT6      equ   12
OCTANT5      equ   28
OCTANT4      equ   20
OCTANT3      equ   8
OCTANT2      equ   0
OCTANT1      equ   16
```

```
***********************************************************************
* Commodore-Amiga, Inc.
* cia.i -- definitions for the registers and bits in the
  Complex Interface
* Adapter (CIA) chip
* $Header: cia.i,v 27.1 85/06/24 14:42:49 neil Exp $
* $Locker:  $
*
***********************************************************************
   IFND  HARDWARE_CIA_I
HARDWARE_CIA_I SET   1
*
* _ciaa is on an ODD address (e.g. the low byte) -- $bfe001
* _ciab is on an EVEN address (e.g. the high byte) -- $bfd000
*
* do this to get the definitions:
*    XREF _ciaa
*    XREF _ciab
*
* cia register offsets
ciapra           EQU    $0000
ciaprb           EQU    $0100
ciaddra          EQU    $0200
ciaddrb          EQU    $0300
ciatalo          EQU    $0400
ciatahi          EQU    $0500
ciatblo          EQU    $0600
ciatbhi          EQU    $0700
ciatodlow        EQU    $0800
ciatodmid        EQU    $0900
ciatodhi         EQU    $0A00
ciasdr           EQU    $0C00
ciaicr           EQU    $0D00
ciacra           EQU    $0E00
ciacrb           EQU    $0F00

* interrupt control register bit numbers
CIAICRB_TA       EQU    0
CIAICRB_TB       EQU    1
CIAICRB_ALRM     EQU    2
CIAICRB_SP       EQU    3
CIAICRB_FLG      EQU    4
CIAICRB_IR       EQU    7
CIAICRB_SETCLR   EQU    7

* control register A bit numbers
CIACRAB_START    EQU    0
CIACRAB_PBON     EQU    1
CIACRAB_OUTMODE  EQU    2
CIACRAB_RUNMODE  EQU    3
CIACRAB_LOAD     EQU    4
CIACRAB_INMODE   EQU    5
CIACRAB_SPMODE   EQU    6
CIACRAB_TODIN    EQU    7

* control register B bit numbers
CIACRBB_START    EQU    0
CIACRBB_PBON     EQU    1
CIACRBB_OUTMODE  EQU    2
CIACRBB_RUNMODE  EQU    3
CIACRBB_LOAD     EQU    4
CIACRBB_INMODE0  EQU    5
CIACRBB_INMODE1  EQU    6
CIACRBB_ALARM    EQU    7

* interrupt control register bit masks
CIAICRF_TA       EQU    (1<<0)
CIAICRF_TB       EQU    (1<<1)
CIAICRF_ALRM     EQU    (1<<2)
CIAICRF_SP       EQU    (1<<3)
CIAICRF_FLG      EQU    (1<<4)
CIAICRF_IR       EQU    (1<<7)
CIAICRF_SETCLR   EQU    (1<<7)

* control register A bit masks
CIACRAF_START    EQU    (1<<0)
CIACRAF_PBON     EQU    (1<<1)
CIACRAF_OUTMODE  EQU    (1<<2)
CIACRAF_RUNMODE  EQU    (1<<3)
CIACRAF_LOAD     EQU    (1<<4)
CIACRAF_INMODE   EQU    (1<<5)
CIACRAF_SPMODE   EQU    (1<<6)
CIACRAF_TODIN    EQU    (1<<7)

* control register B bit masks
CIACRBF_START    EQU    (1<<0)
CIACRBF_PBON     EQU    (1<<1)
CIACRBF_OUTMODE  EQU    (1<<2)
CIACRBF_RUNMODE  EQU    (1<<3)
CIACRBF_LOAD     EQU    (1<<4)
CIACRBF_INMODE0  EQU    (1<<5)
CIACRBF_INMODE1  EQU    (1<<6)
CIACRBF_ALARM    EQU    (1<<7)

* control register B INMODE masks
CIACRBF_IN_PHI2  EQU    0
CIACRBF_IN_CNT   EQU    (CIACRBF_INMODE0)
CIACRBF_IN_TA    EQU    (CIACRBF_INMODE1)
CIACRBF_IN_CNT_TA EQU   (CIACRBF_INMODE0!CIACRBF_INMODE1)

*
* Port definitions -- what each bit in a cia peripheral
  register is tied to
*

* ciaa port A (0xbfe001)
CIAB_GAMEPORT1   EQU   (7)   * gameport 1, pin 6 (fire
  button*)
CIAB_GAMEPORT0   EQU   (6)   * gameport 0, pin 6 (fire
  button*)
CIAB_DSKRDY      EQU   (5)   * disk ready*
CIAB_DSKTRACK0   EQU   (4)   * disk on track 00*
CIAB_DSKPROT     EQU   (3)   * disk write protect*
CIAB_DSKCHANGE   EQU   (2)   * disk change*
CIAB_LED         EQU   (1)   * led light control (0==>bright)
CIAB_OVERLAY     EQU   (0)   * memory overlay bit

* ciaa port B (0xbfe101) -- parallel port

```

```
* ciab port A (0xbfd000) -- serial and printer control
CIAB_COMDTR       EQU   (7)    * serial Data Terminal Ready*
CIAB_COMRTS       EQU   (6)    * serial Request to Send*
CIAB_COMCD        EQU   (5)    * serial Carrier Detect*
CIAB_COMCTS       EQU   (4)    * serial Clear to Send*
CIAB_COMDSR       EQU   (3)    * serial Data Set Ready*
CIAB_PRTRSEL      EQU   (2)    * printer SELECT
CIAB_PRTRPOUT     EQU   (1)    * printer paper out
CIAB_PRTRBUSY     EQU   (0)    * printer busy

* ciab port B (0xbfd100) -- disk control
CIAB_DSKMOTOR     EQU   (7)    * disk motorr*
CIAB_DSKSEL3      EQU   (6)    * disk select unit 3*
CIAB_DSKSEL2      EQU   (5)    * disk select unit 2*
CIAB_DSKSEL1      EQU   (4)    * disk select unit 1*
CIAB_DSKSEL0      EQU   (3)    * disk select unit 0*
CIAB_DSKSIDE      EQU   (2)    * disk side select*
CIAB_DSKDIREC     EQU   (1)    * disk direction of seek*
CIAB_DSKSTEP      EQU   (0)    * disk step heads*

* ciaa port A (0xbfe001)
CIAF_GAMEPORT1    EQU   (1<<7)
CIAF_GAMEPORT0    EQU   (1<<6)
CIAF_DSKRDY       EQU   (1<<5)
CIAF_DSKTRACK0    EQU   (1<<4)
CIAF_DSKPROT      EQU   (1<<3)
CIAF_DSKCHANGE    EQU   (1<<2)
CIAF_LED          EQU   (1<<1)
CIAF_OVERLAY      EQU   (1<<0)

* ciaa port B (0xbfe101) -- parallel port

* ciab port A (0xbfd000) -- serial and printer control
CIAF_COMDTR       EQU   (1<<7)
CIAF_COMRTS       EQU   (1<<6)
CIAF_COMCD        EQU   (1<<5)
CIAF_COMCTS       EQU   (1<<4)
CIAF_COMDSR       EQU   (1<<3)
CIAF_PRTRSEL      EQU   (1<<2)
CIAF_PRTRPOUT     EQU   (1<<1)
CIAF_PRTRBUSY     EQU   (1<<0)

* ciab port B (0xbfd100) -- disk control
CIAF_DSKMOTOR     EQU   (1<<7)
CIAF_DSKSEL3      EQU   (1<<6)
CIAF_DSKSEL2      EQU   (1<<5)
CIAF_DSKSEL1      EQU   (1<<4)
CIAF_DSKSEL0      EQU   (1<<3)
CIAF_DSKSIDE      EQU   (1<<2)
CIAF_DSKDIREC     EQU   (1<<1)
CIAF_DSKSTEP      EQU   (1<<0)

   ENDC  !HARDWARE_CIA_I
```

```
**********************************************************************
* Commodore-Amiga, Inc.
* custom.i
* $Header: custom.i,v 27.1 85/06/24 14:42:56 neil Exp $
* $Locker:  $
*
**********************************************************************
   IFND  HARDWARE_CUSTOM_I
HARDWARE_CUSTOM_I SET   1
*
* do this to get base of custom registers:
*  XREF _custom;
*

bltddat     EQU   $000
dmaconr     EQU   $002
vposr       EQU   $004
vhposr      EQU   $006
dskdatr     EQU   $008
joy0dat     EQU   $00A
joy1dat     EQU   $00C
clxdat      EQU   $00E

adkconr     EQU   $010
pot0dat     EQU   $012
pot1dat     EQU   $014
potinp      EQU   $016
serdatr     EQU   $018
dskbytr     EQU   $01A
intenar     EQU   $01C
intreqr     EQU   $01E

dskpt       EQU   $020
dsklen      EQU   $024
dskdat      EQU   $026
refptr      EQU   $028
vposw       EQU   $02A
vhposw      EQU   $02C
copcon      EQU   $02E
serdat      EQU   $030
serper      EQU   $032
potgo       EQU   $034
joytest     EQU   $036
strequ      EQU   $038
strvbl      EQU   $03A
strhor      EQU   $03C
strlong     EQU   $03E

bltcon0     EQU   $040
bltcon1     EQU   $042
bltafwm     EQU   $044
bltalwm     EQU   $046
bltcpt      EQU   $048
bltbpt      EQU   $04C
bltapt      EQU   $050
bltdpt      EQU   $054
bltsize     EQU   $058

bltcmod     EQU   $060
```

```
bltbmod     EQU   $062
bltamod     EQU   $064
bltdmod     EQU   $066

bltcdat     EQU   $070
bltbdat     EQU   $072
bltadat     EQU   $074

dsksync     EQU   $07E

copllc      EQU   $080
cop2lc      EQU   $084
copjmpl     EQU   $088
copjmp2     EQU   $08A
copins      EQU   $08C
diwstrt     EQU   $08E
diwstop     EQU   $090
ddfstrt     EQU   $092
ddfstop     EQU   $094
dmacon      EQU   $096
clxcon      EQU   $098
intena      EQU   $09A
intreq      EQU   $09C
adkcon      EQU   $09E

aud         EQU   $0A0
aud0        EQU   $0A0
aud1        EQU   $0B0
aud2        EQU   $0C0
aud3        EQU   $0D0

* STRUCTURE AudChannel,0
ac_ptr      EQU   $00    ; ptr to start of waveform data
ac_len      EQU   $04    ; length of waveform in words
ac_per      EQU   $06    ; sample period
ac_vol      EQU   $08    ; volume
ac_dat      EQU   $0A    ; sample pair
ac_SIZEOF   EQU   $10

bplpt       EQU   $0E0

bplcon0     EQU   $100
bplcon1     EQU   $102
bplcon2     EQU   $104
bpl1mod     EQU   $108
bpl2mod     EQU   $10A

bpldat      EQU   $110

sprpt       EQU   $120

spr         EQU   $140
* STRUCTURE SpriteDef
sd_pos      EQU   $00
sd_ctl      EQU   $02
sd_dataa    EQU   $04
sd_datab    EQU   $08

color       EQU   $180
```

```
**********************************************************************
* Commodore-Amiga, Inc.
* dmabits.i
*
* $Header: dmabits.i,v 27.1 85/06/24 14:43:02 neil Exp $
*
* $Locker:  $
*
**********************************************************************

   IFND  HARDWARE_DMABITS_I
HARDWARE_DMABITS_I SET  1


* include file for defining dma control stuff */

* write definitions for dmaconw */
DMAF_SETCLR     EQU   $8000
DMAF_AUDIO      EQU   $000F /* 4 bit mask */
DMAF_AUD0       EQU   $0001
DMAF_AUD1       EQU   $0002
DMAF_AUD2       EQU   $0004
DMAF_AUD3       EQU   $0008
DMAF_DISK       EQU   $0010
DMAF_SPRITE     EQU   $0020
DMAF_BLITTER    EQU   $0040
DMAF_COPPER     EQU   $0080
DMAF_RASTER     EQU   $0100
DMAF_MASTER     EQU   $0200
DMAF_BLITHOG    EQU   $0400
DMAF_ALL        EQU   $01FF /* all dma channels */

* read definitions for dmaconr */
* bits 0-8 correspnd to dmaconw definitions */
DMAF_BLTDONE    EQU   $4000
DMAF_BLTNZERO   EQU   $2000

DMAB_SETCLR     EQU   15
DMAB_AUD0       EQU   0
DMAB_AUD1       EQU   1
DMAB_AUD2       EQU   2
DMAB_AUD3       EQU   3
DMAB_DISK       EQU   4
DMAB_SPRITE     EQU   5
DMAB_BLITTER    EQU   6
DMAB_COPPER     EQU   7
DMAB_RASTER     EQU   8
DMAB_MASTER     EQU   9
DMAB_BLITHOG    EQU   10
DMAB_BLTDONE    EQU   14
DMAB_BLTNZERO   EQU   13
```

```
***********************************************************************
* Commodore-Amiga, Inc.
* intenabits.i -- definitions for the bits in the interrupt enable
* (and interrupt request) register
*
* $Header: intbits.i,v 27.1 85/06/24 14:43:07 neil Exp $
*
* $Locker:  $
*
***********************************************************************/

   IFND  HARDWARE_INTBITS_I
HARDWARE_INTBITS_I SET  1


INTB_SETCLR     EQU   (15)  ;Set/Clear control bit. Determines if bits
                            ;written with a 1 get set or cleared. Bits
                            ;written with a zero are allways unchanged.
INTB_INTEN      EQU   (14)  ;Master interrupt (enable only )
INTB_EXTER      EQU   (13)  ;External interrupt
INTB_DSKSYNC    EQU   (12)  ;Disk re-SYNChronized
INTB_RBF        EQU   (11)  ;serial port Receive Buffer Full
INTB_AUD3       EQU   (10)  ;Audio channel 3 block finished
INTB_AUD2       EQU   (9)   ;Audio channel 2 block finished
INTB_AUD1       EQU   (8)   ;Audio channel 1 block finished
INTB_AUD0       EQU   (7)   ;Audio channel 0 block finished
INTB_BLIT       EQU   (6)   ;Blitter finished
INTB_VERTB      EQU   (5)   ;start of Vertical Blank
INTB_COPER      EQU   (4)   ;Coprocessor
INTB_PORTS      EQU   (3)   ;I/O Ports and timers
INTB_SOFTINT    EQU   (2)   ;software interrupt request
INTB_DSKBLK     EQU   (1)   ;Disk Block done
INTB_TBE        EQU   (0)   ;serial port Transmit Buffer Empty



INTF_SETCLR     EQU   (1<<15)
INTF_INTEN      EQU   (1<<14)
INTF_EXTER      EQU   (1<<13)
INTF_DSKSYNC    EQU   (1<<12)
INTF_RBF        EQU   (1<<11)
INTF_AUD3       EQU   (1<<10)
INTF_AUD2       EQU   (1<<9)
INTF_AUD1       EQU   (1<<8)
INTF_AUD0       EQU   (1<<7)
INTF_BLIT       EQU   (1<<6)
INTF_VERTB      EQU   (1<<5)
INTF_COPER      EQU   (1<<4)
INTF_PORTS      EQU   (1<<3)
INTF_SOFTINT    EQU   (1<<2)
INTF_DSKBLK     EQU   (1<<1)
INTF_TBE        EQU   (1<<0)
```

Contents

```
   IFND  INTUITION_INTUITION_I
INTUITION_INTUITION_I   SET   1

;** intuition.i ******************************************************************
;*  Commodore-Amiga, Inc.
;*
;*  intuition.i main include file for assembly-language programmers
;*
;*          Modification History
;*      date    :  author :    Comments
;*     ------      ------     -------------------------------------
;*     1-30-85     -=RJ=-  created this file!
;*     6-12-85      Dale and Carl translated this from the c version
;*     6-13-85      =VoodooDrRj= added back the comments
;*
;**************************************************************************/

   IFND  GRAPHICS_GFX_I
   include  'graphics/gfx.i'
   ENDC

   IFND  GRAPHICS_CLIP_I
   include  'graphics/clip.i'
   ENDC

   IFND  GRAPHICS_VIEW_I
   include  'graphics/view.i'
   ENDC

   IFND  GRAPHICS_RASTPORT_I
   include  'graphics/rastport.i'
   ENDC

   IFND  GRAPHICS_LAYERS_I
   include  'graphics/layers.i'
   ENDC

   IFND  GRAPHICS_TEXT_I
   include 'graphics/text.i'
   ENDC

   IFND EXEC_PORTS_I
   include 'exec/ports.i'
   ENDC

   IFND  DEVICES_TIMER_I
   include  'devices/timer.i'
   ENDC

   IFND  DEVICES_INPUTEVENT_I
   include 'devices/inputevent.i'
   ENDC


; ==================================================================;
; === Menu =========================================================;
; ======================================================================;
 STRUCTURE Menu,0

    APTR  mu_NextMenu   ; menu pointer, same level
    WORD mu_LeftEdge    ; dimensions of the select box;
    WORD mu_TopEdge  ; dimensions of the select box;
    WORD mu_Width ; dimensions of the select box;
    WORD mu_Height   ; dimensions of the select box;
    WORD mu_Flags ; see flag definitions below;
    APTR mu_MenuName ; text for this Menu header
    APTR  mu_FirstItem  ; pointer to first in chain;

    ; these mysteriously-named variables are for internal use only
    WORD mu_JazzX
    WORD mu_JazzY
    WORD mu_BeatX
    WORD mu_BeatY

    LABEL mu_SIZEOF

; FLAGS SET BY BOTH THE APPLIPROG AND INTUITION
MENUENABLED equ $0001   ; whether or not this menu is enabled;

; FLAGS SET BY INTUITION;
MIDRAWN equ $0100 ; this menu's items are currently drawn;





; ======================================================================;
; === MenuItem =========================================================;
; ======================================================================;
 STRUCTURE MenuItem,0

    APTR mi_NextItem ; pointer to next in chained list
    WORD mi_LeftEdge ; dimensions of the select box
    WORD mi_TopEdge  ; dimensions of the select box
    WORD mi_Width ; dimensions of the select box
    WORD mi_Height   ; dimensions of the select box
    WORD mi_Flags ; see the defines below

    LONG mi_MutualExclude ; set bits mean this item excludes that item

    APTR mi_ItemFill ; points to Image, IntuiText, or NULL

    ; when this item is pointed to by the cursor and the items highlight
    ; mode HIGHIMAGE is selected, this alternate image will be displayed
    APTR mi_SelectFill  ; points to Image, IntuiText, or NULL

    BYTE mi_Command  ; only if appliprog sets the COMMSEQ flag

    ; The following variable is strictly from Kludge-City, where some people
```

```
    ; still live.  It is included solely because our types.i macros aren't
    ; smart enough to do the right thing, which would be the automatic
    ; word-alignment to these references as it SHOULD be in order to duplicate
    ; the way alignments are adjusted in the c-language.  And instead of
    ; correcting the problem, I am obliged to kludge up my include.i files.
    ; So here it is!
    BYTE mi_KludgeFill00 ; defined as a BYTE because this does

    APTR mi_SubItem  ; if non-zero, DrawMenu shows "->"

   ; The NextSelect field represents the menu number of next selected
   ; item (when user has drag-selected several items)
    WORD mi_NextSelect

    LABEL  mi_SIZEOF

; --- FLAGS SET BY THE APPLIPROG -------------------------------------------
CHECKIT     equ $0001   ; whether to check this item if selected
ITEMTEXT equ $0002   ; set if textual, clear if graphical item
COMMSEQ     equ $0004   ; set if there's an command sequence
MENUTOGGLE  equ $0008   ; set to toggle the check of a menu item
ITEMENABLED equ $0010   ; set if this item is enabled

; these are the SPECIAL HIGHLIGHT FLAG state meanings
HIGHFLAGS   equ $00C0   ; see definitions below for these bits
HIGHIMAGE   equ $0000   ; use the user's "select image"
HIGHCOMP equ $0040   ; highlight by complementing the select box
HIGHBOX     equ $0080   ; highlight by drawing a box around the image
HIGHNONE equ $00C0   ; don't highlight

; --- FLAGS SET BY BOTH APPLIPROG AND INTUITION ----------------------------
CHECKED equ $0100    ; if CHECKIT, then set this when selected


; --- FLAGS SET BY INTUITION -----------------------------------------------
ISDRAWN     equ $1000   ; this item's subs are currently drawn
HIGHITEM equ $2000   ; this item is currently highlighted
MENUTOGGLED equ $4000   ; this item was already toggled







; ========================================================================
; === Requester ==========================================================
; ========================================================================
 STRUCTURE Requester,0

    ; the ClipRect and BitMap and used for rendering the requester
    APTR  rq_OlderRequest
    WORD rq_LeftEdge    ; dimensions of the entire box
    WORD rq_TopEdge     ; dimensions of the entire box
    WORD rq_Width    ; dimensions of the entire box
    WORD rq_Height      ; dimensions of the entire box

    WORD rq_RelLeft     ; get POINTREL Pointer relativity offsets
    WORD rq_RelTop      ; get POINTREL Pointer relativity offsets

    APTR  rq_ReqGadget        ; pointer to the first of a list of gadgets
    APTR  rq_ReqBorder     ; the box's border
    APTR  rq_ReqText    ; the box's text

    USHORT rq_Flags     ; see definitions below

    UBYTE rq_BackFill      ; pen number for back-plane fill before draws

    ; The following variable is strictly from Kludge-City, where some people
    ; still live.  It is included solely because our types.i macros aren't
    ; smart enough to do the right thing, which would be the automatic
    ; word-alignment to these references as it SHOULD be in order to duplicate
    ; the way alignments are adjusted in the c-language.  And instead of
    ; correcting the problem, I am obliged to kludge up my include.i files.
    ; So here it is!
    BYTE rq_KludgeFill00   ; defined as a BYTE because this does

    APTR rq_ReqLayer    ; layer in which requester rendered
    STRUCT rq_ReqPad1,32   ; for backwards compatibility (reserved)

    ; If the BitMap plane pointers are non-zero, this tells the system
    ; that the image comes pre-drawn (if the appliprog wants to define
    ; it's own box, in any shape or size it wants!); this is OK by
    ; Intuition as long as there's a good correspondence between the image
    ; and the specified Gadgets
    APTR  rq_ReqBMap    ; points to the BitMap of PREDRAWN imagery

    APTR  rq_RWindow    ; points back to requester's window
```

```
    STRUCT rq_ReqPad2,36    ; for backwards compatibility
  (reserved)

    LABEL rq_SIZEOF

; FLAGS SET BY THE APPLIPROG
POINTREL equ $0001  ; if POINTREL set, TopLeft is relative
  to pointer
PREDRAWN equ $0002  ; if ReqBMap points to predrawn Requester
  imagery

; FLAGS SET BY INTUITION;
REQOFFWINDOW    equ $1000    ; part of one of the Gadgets
  was offwindow
REQACTIVE    equ $2000    ; this requester is active
SYSREQUEST   equ $4000    ; this requester caused by system
DEFERREFRESH    equ $8000    ; this Requester stops a Refresh
  broadcast






; =====================================================================
; === Gadget ==========================================================
; =====================================================================
 STRUCTURE Gadget,0

0   APTR gg_NextGadget      ; next gadget in the list

4   WORD gg_LeftEdge     ; "hit box" of gadget
6   WORD gg_TopEdge      ; "hit box" of gadget
8   WORD gg_Width    ; "hit box" of gadget
10  WORD gg_Height       ; "hit box" of gadget

12  WORD gg_Flags        ; see below for list of defines

14  WORD gg_Activation      ; see below for list of defines

16  WORD gg_GadgetType      ; see below for defines

    ; appliprog can specify that the Gadget be rendered
  as either as Border
    ; or an Image.  This variable points to which (or equals
  NULL if there's
    ; nothing to be rendered about this Gadget)
18  APTR gg_GadgetRender

    ; appliprog can specify "highlighted" imagery rather
  than algorithmic
    ; this can point to either Border or Image data
22  APTR gg_SelectRender

26  APTR gg_GadgetText      ; text for this gadget;

    ; by using the MutualExclude word, the appliprog can
  describe
    ; which gadgets mutually-exclude which other ones.
  The bits in
    ; MutualExclude correspond to the gadgets in object
  containing
    ; the gadget list.  If this gadget is selected and a
  bit is set
    ; in this gadget's MutualExclude and the gadget corresponding
  to
    ; that bit is currently selected (e.g. bit 2 set and
  gadget 2
    ; is currently selected) that gadget must be unselected.
   Intuition
    ; does the visual unselecting (with checkmarks) and
  leaves it up
    ; to the program to unselect internally
    LONG gg_MutualExclude  ; set bits mean this gadget excludes
  that

    ; pointer to a structure of special data required by
  Proportional, String
    ; and Integer Gadgets
    APTR gg_SpecialInfo

    WORD gg_GadgetID ; user-definable ID field
    APTR  gg_UserData   ; ptr to general purpose User data
  (ignored by Intuit)

    LABEL gg_SIZEOF

; --- FLAGS SET BY THE APPLIPROG ------------------------------------------
; combinations in these bits describe the highlight technique
  to be used
GADGHIGHBITS   equ $0003
GADGHCOMP    equ $0000   ; Complement the select box
GADGHBOX equ $0001   ; Draw a box around the image
GADGHIMAGE  equ $0002   ; Blast in this alternate image
GADGHNONE    equ $0003   ; don't highlight

; set this flag if the GadgetRender and SelectRender point
  to Image imagery,
; clear if it's a Border
GADGIMAGE    equ $0004

; combinations in these next two bits specify to which corner
  the gadget's
; Left & Top coordinates are relative.  If relative to Top/Left,
; these are "normal" coordinates (everything is relative
  to something in
; this universe)
GRELBOTTOM  equ $0008   ; set if rel to bottom, clear if
  rel top
GRELRIGHT    equ $0010   ; set if rel to right, clear if
  to left
; set the RELWIDTH bit to spec that Width is relative to
  width of screen
GRELWIDTH    equ $0020
; set the RELHEIGHT bit to spec that Height is rel to height
  of screen
GRELHEIGHT  equ $0040

; the SELECTED flag is initialized by you and set by Intuition.
   It
; specifies whether or not this Gadget is currently selected/highlighted
```

```
SELECTED equ $0080

; the GADGDISABLED flag is initialized by you and later set by Intuition
; according to your calls to On/OffGadget().  It specifies whether or not
; this Gadget is currently disabled from being selected
GADGDISABLED   equ $0100

; --- These are the Activation flag bits ----------------------------------
; RELVERIFY is set if you want to verify that the pointer was still over
; the gadget when the select button was released
RELVERIFY   equ $0001

; the flag GADGIMMEDIATE, when set, informs the caller that the gadget
; was activated when it was activated.  this flag works in conjunction with
; the RELVERIFY flag
GADGIMMEDIATE  equ $0002

; the flag ENDGADGET, when set, tells the system that this gadget, when
; selected, causes the Requester or AbsMessage to be ended.  Requesters or
; AbsMessages that are ended are erased and unlinked from the system
ENDGADGET   equ $0004

; the FOLLOWMOUSE flag, when set, specifies that you want to receive
; reports on mouse movements (ie, you want the REPORTMOUSE function for
; your Window).  When the Gadget is deselected (immediately if you have
; no RELVERIFY) the previous state of the REPORTMOUSE flag is restored
; You probably want to set the GADGIMMEDIATE flag when using FOLLOWMOUSE,
; since that's the only reasonable way you have of learning why Intuition
; is suddenly sending you a stream of mouse movement events.  If you don't
; set RELVERIFY, you'll get at least one Mouse Position event.
FOLLOWMOUSE equ $0008

; if any of the BORDER flags are set in a Gadget that's included in the
; Gadget list when a Window is opened, the corresponding Border will
; be adjusted to make room for the Gadget
RIGHTBORDER equ $0010
LEFTBORDER  equ $0020
TOPBORDER   equ $0040
BOTTOMBORDER   equ $0080

TOGGLESELECT   equ $0100   ; this bit for toggle-select mode

STRINGCENTER   equ $0200   ; center the String
STRINGRIGHT equ $0400   ; right-justify the String

LONGINT     equ $0800   ; This String Gadget is a Long Integer

ALTKEYMAP   equ $1000   ; This String has an alternate keymapping


; --- GADGET TYPES ---------------------------------------------------------
; These are the Gaget Type definitions for the variable GadgetType.
; Gadget number type MUST start from one.  NO TYPES OF ZERO ALLOWED.
; first comes the mask for Gadget flags reserved for Gadget typing
GADGETTYPE  equ $FC00   ; all Gadget Global Type flags (padded)
SYSGADGET   equ $8000   ; 1 = SysGadget, 0 = AppliGadget
SCRGADGET   equ $4000   ; 1 = ScreenGadget, 0 = WindowGadget
GZZGADGET   equ $2000   ; 1 = Gadget for GIMMEZEROZERO borders
REQGADGET   equ $1000   ; 1 = this is a Requester Gadget
; system gadgets
SIZING      equ $0010
WDRAGGING   equ $0020
SDRAGGING   equ $0030
WUPFRONT equ $0040
SUPFRONT equ $0050
WDOWNBACK   equ $0060
SDOWNBACK   equ $0070
CLOSE    equ $0080
; application gadgets
BOOLGADGET  equ $0001
GADGET0002  equ $0002
PROPGADGET  equ $0003
STRGADGET   equ $0004






; ========================================================================
; === PropInfo ===========================================================
; ========================================================================
; this is the special data required by the proportional Gadget
; typically, this data will be pointed to by the Gadget variable SpecialInfo
 STRUCTURE PropInfo,0

    WORD pi_Flags ; general purpose flag bits (see defines below)

    ; You initialize the Pot variables before the Gadget is added to
    ; the system.  Then you can look here for the current settings
    ; any time, even while User is playing with this Gadget.
```

```
 To
   ; adjust these after the Gadget is added to the System,
 use
   ; ModifyProp(); The Pots are the actual proportional
 settings,
   ; where a value of zero means zero and a value of MAXPOT
 means
   ; that the Gadget is set to its maximum setting.
   WORD pi_HorizPot ; 16-bit FixedPoint horizontal quantity
 percentage;
   WORD pi_VertPot  ; 16-bit FixedPoint vertical quantity
 percentage;

   ; the 16-bit FixedPoint Body variables describe what
 percentage
   ; of the entire body of stuff referred to by this Gadget
 is
   ; actually shown at one time.  This is used with the
 AUTOKNOB
   ; routines, to adjust the size of the AUTOKNOB according
 to how
   ; much of the data can be seen.  This is also used to
 decide how
   ; far to advance the Pots when User hits the Container
 of the Gadget.
   ; For instance, if you were controlling the display
 of a 5-line
   ; Window of text with this Gadget, and there was a total
 of 15
   ; lines that could be displayed, you would set the VertBody
 value to
   ;    (MAXBODY / (TotalLines / DisplayLines)) = MAXBODY
 / 3.
   ; Therefore, the AUTOKNOB would fill 1/3 of the container,
 and if
   ; User hits the Cotainer outside of the knob, the pot
 would advance
   ; 1/3 (plus or minus) If there's no body to show, or
 the total
   ; amount of displayable info is less than the display
 area, set the
   ; Body variables to the MAX.  To adjust these after
 the Gadget is
   ; added to the System, use ModifyProp().
   WORD pi_HorizBody   ; horizontal Body
   WORD pi_VertBody ; vertical Body

   ; these are the variables that Intuition sets and maintains
   WORD pi_CWidth   ; Container width (with any relativity
 absoluted)
   WORD pi_CHeight  ; Container height (with any relativity
 absoluted)
   WORD pi_HPotRes  ; pot increments
   WORD pi_VPotRes  ; pot increments
   WORD pi_LeftBorder  ; Container borders
   WORD pi_TopBorder   ; Container borders
   LABEL  pi_SIZEOF

; --- FLAG BITS ------------------------------------------------------------
AUTOKNOB equ $0001   ; this flag sez:  gimme that old auto-knob
FREEHORIZ   equ $0002   ; if set, the knob can move horizontally
FREEVERT equ $0004   ; if set, the knob can move vertically
PROPBORDERLESS equ $0008   ; if set, no border will be rendered
KNOBHIT     equ $0100   ; set when this Knob is hit


KNOBHMIN equ 6    ; minimum horizontal size of the knob
KNOBVMIN     equ 4    ; minimum vertical size of the knob
MAXBODY      equ $FFFF   ; maximum body value
MAXPOT       equ $FFFF   ; maximum pot value







; ==========================================================================
; === StringInfo ===========================================================
; ==========================================================================
; this is the special data required by the string Gadget
; typically, this data will be pointed to by the Gadget
  variable SpecialInfo
 STRUCTURE StringInfo,0

    ; you initialize these variables, and then Intuition
  maintains them
    APTR  si_Buffer  ; the buffer containing the start and
  final string
    APTR  si_UndoBuffer ; optional buffer for undoing current
  entry
    WORD si_BufferPos   ; character position in Buffer
    WORD si_MaxChars ; max number of chars in Buffer (including
  NULL)
    WORD si_DispPos  ; Buffer position of first displayed
  character

    ; Intuition initializes and maintains these variables
  for you
    WORD si_UndoPos  ; character position in the undo buffer
    WORD si_NumChars ; number of characters currently in
  Buffer
    WORD si_DispCount   ; number of whole characters visible
  in Container
    WORD si_CLeft ; topleft offset of the container
    WORD si_CTop  ; topleft offset of the container
    APTR  si_LayerPtr   ; the RastPort containing this Gadget

    ; you can initialize this variable before the gadget
  is submitted to
    ; Intuition, and then examine it later to discover what
  integer
    ; the user has entered (if the user never plays with
  the gadget,
    ; the value will be unchanged from your initial setting)
    LONG  si_LongInt ; the LONG return value of a LONGINT
  String Gadget

    ; If you want this Gadget to use your own Console keymapping,
  you
    ; set the ALTKEYMAP bit in the Activation flags of the
```

```
Gadget, and then
  ; set this variable to point to your keymap.  If you
don't set the
  ; ALTKEYMAP, you'll get the standard ASCII keymapping.
  APTR si_AltKeyMap

  LABEL si_SIZEOF




; ======================================================================
; === IntuiText ========================================================
; ======================================================================
; IntuiText is a series of strings that start with a screen
  location
; (always relative to the upper-left corner of something)
  and then the
; text of the string.  The text is null-terminated.
 STRUCTURE IntuiText,0

  UBYTE it_FrontPen      ; the pens for rendering the
text
  UBYTE it_BackPen    ; the pens for rendering the text

  UBYTE it_DrawMode      ; the mode for rendering the
text

  ; The following variable is strictly from Kludge-City,
where some people
  ; still live.  It is included solely because our types.i
macros aren't
  ; smart enough to do the right thing, which would be
the automatic
  ; word-alignment to these references as it SHOULD be
in order to duplicate
  ; the way alignments are adjusted in the c-language.
 And instead of
  ; correcting the problem, I am obliged to kludge up
my include.i files.
  ; So here it is!
  BYTE it_KludgeFill00   ; defined as a BYTE because this
does

  WORD it_LeftEdge    ; relative start location for the
text
  WORD it_TopEdge     ; relative start location for the
text

  APTR  it_ITextFont     ; if NULL, you accept the defaults

  APTR it_IText    ; pointer to null-terminated text

  APTR  it_NextText      ; continuation to TxWrite another
text

  LABEL it_SIZEOF






; ======================================================================
; === Border ===========================================================
; ======================================================================
; Data type Border, used for drawing a series of lines which
  is intended for
; use as a border drawing, but which may, in fact, be used
  to render any
; arbitrary vector shape.
; The routine DrawBorder sets up the RastPort with the appropriate
; variables, then does a Move to the first coordinate, then
  does Draws
; to the subsequent coordinates.
; After all the Draws are done, if NextBorder is non-zero
  we call DrawBorder
; recursively
 STRUCTURE Border,0

   WORD bd_LeftEdge    ; initial offsets from the origin
   WORD bd_TopEdge     ; initial offsets from the origin
   UBYTE bd_FrontPen      ; pen number for rendering
   UBYTE bd_BackPen    ; pen number for rendering
   UBYTE bd_DrawMode      ; mode for rendering
   BYTE  bd_Count      ; number of XY pairs
   APTR  bd_XY         ; vector coordinate pairs rel to
 LeftTop
   APTR  bd_NextBorder    ; pointer to any other Border
 too

   LABEL bd_SIZEOF



; ======================================================================

; === Image ============================================================

; ======================================================================

; This is a brief image structure for very simple transfers
  of
; image data to a RastPort
 STRUCTURE Image,0

   WORD ig_LeftEdge    ; starting offset relative to something

   WORD ig_TopEdge     ; starting offset relative to something

   WORD ig_Width    ; pixel size (though data is word-aligned)
   WORD ig_Height      ; pixel size
   WORD ig_Depth    ; pixel size
   APTR ig_ImageData      ; pointer to the actual image
 bits

   ; the PlanePick and PlaneOnOff variables work much the
 same way as the
   ; equivalent GELS Bob variables.  It's a space-saving

   ; mechanism for image data.  Rather than defining the
 image data
```

```
    ; for every plane of the RastPort, you need define data only for planes
    ; that are not entirely zero or one.  As you define your Imagery, you will
    ; often find that most of the planes ARE just as color selectors.  For
    ; instance, if you're designing a two-color Gadget to use colors two and
    ; three, and the Gadget will reside in a five-plane display, plane zero
    ; of your imagery would be all ones, bit plane one would have data that
    ; describes the imagery, and bit planes two through four would be
    ; all zeroes.  Using these flags allows you to avoid wasting all that
    ; memory in this way:
    ; first, you specify which planes you want your data to appear
    ; in using the PlanePick variable.  For each bit set in the variable, the
    ; next "plane" of your image data is blitted to the display.  For each bit
    ; clear in this variable, the corresponding bit in PlaneOnOff is examined.
    ; If that bit is clear, a "plane" of zeroes will be used.  If the bit is
    ; set, ones will go out instead.  So, for our example:
    ;   Gadget.PlanePick = 0x02;
    ;   Gadget.PlaneOnOff = 0x01;
    ; Note that this also allows for generic Gadgets, like the System Gadgets,
    ; which will work in any number of bit planes
    ; Note also that if you want an Image that is only a filled rectangle,
    ; you can get this by setting PlanePick to zero (pick no planes of data)
    ; and set PlaneOnOff to describe the pen color of the rectangle.
    BYTE ig_PlanePick
    BYTE ig_PlaneOnOff

    ; if the NextImage variable is not NULL, Intuition presumes that
    ; it points to another Image structure with another Image to be
    ; rendered
    APTR ig_NextImage


    LABEL ig_SIZEOF




; ==========================================================================

; === IntuiMessage =========================================================

; ==========================================================================

STRUCTURE IntuiMessage,0

   STRUCT im_ExecMessage,MN_SIZE

   ; the Class bits correspond directly with the IDCMP Flags, except for the
   ; special bit LONELYMESSAGE (defined below)
   ULONG im_Class

   ; the Code field is for special values like MENU number

   WORD im_Code

   ; the Qualifier field is a copy of the current InputEvent's Qualifier
   WORD im_Qualifier

   ; IAddress contains particular addresses for Intuition functions, like
   ; the pointer to the Gadget or the Screen
   APTR im_IAddress

   ; when getting mouse movement reports, any event you get will have the
   ; the mouse coordinates in these variables.  the coordinates are relative
   ; to the upper-left corner of your Window (GIMMEZEROZERO notwithstanding)
   WORD im_MouseX
   WORD im_MouseY

   ; the time values are copies of the current system clock time.  Micros
   ; are in units of microseconds, Seconds in seconds.
   LONG im_Seconds
   LONG im_Micros

   ; the IDCMPWindow variable will always have the address of the Window of
   ; this IDCMP
   APTR im_IDCMPWindow

   ; system-use variable
   APTR im_SpecialLink

   LABEL  im_SIZEOF



; --- IDCMP Classes ------------------------------------------------------

SIZEVERIFY  equ   $00000001   ; See the Programmer's Guide
NEWSIZE     equ   $00000002   ; See the Programmer's Guide
REFRESHWINDOW  equ   $00000004   ; See the Programmer's Guide
MOUSEBUTTONS   equ   $00000008   ; See the Programmer's Guide
MOUSEMOVE   equ   $00000010   ; See the Programmer's Guide
```

```
GADGETDOWN  equu   $00000020   ; See the Programmer's Guide
GADGETUP equ   $00000040   ; See the Programmer's Guide

REQSET      equ   $00000080   ; See the Programmer's Guide
MENUPICK equ   $00000100   ; See the Programmer's Guide

CLOSEWINDOW equ   $00000200   ; See the Programmer's Guide
RAWKEY      equ   $00000400   ; See the Programmer's Guide

REQVERIFY   equ   $00000800   ; See the Programmer's Guide
REQCLEAR equ   $00001000   ; See the Programmer's Guide

MENUVERIFY  equ   $00002000   ; See the Programmer's Guide
NEWPREFS equ   $00004000   ; See the Programmer's Guide

DISKINSERTED   equ   $00008000   ; See the Programmer's
  Guide
DISKREMOVED equ   $00010000   ; See the Programmer's Guide

WBENCHMESSAGE  equ   $00020000   ; See the Programmer's
  Guide
ACTIVEWINDOW   equ   $00040000   ; See the Programmer's
  Guide
INACTIVEWINDOW equ   $00080000   ; See the Programmer's
  Guide
DELTAMOVE   equ   $00100000   ; See the Programmer's Guide
VANILLAKEY  equ   $00200000   ; See the Programmer's Guide
INTUITICKS  equ   $00400000   ; See the Programmer's Guide
; NOTEZ-BIEN:     $80000000 is reserved for internal use
  by IDCMP

; the IDCMP Flags do not use this special bit, which is
  cleared when
; Intuition sends its special message to the Task, and set
  when Intuition
; gets its Message back from the Task.  Therefore, I can
  check here to
; find out fast whether or not this Message is available
  for me to send
LONELYMESSAGE  equ   $80000000



; --- IDCMP Codes ---------------------------------------------------------

; This group of codes is for the MENUVERIFY function
MENUHOT     equ   $0001 ; IntuiWants verification or MENUCANCEL

MENUCANCEL  equ   $0002 ; HOT Reply of this cancels Menu
  operation
MENUWAITING equ   $0003 ; Intuition simply wants a ReplyMsg()
  ASAP

; This group of codes is for the WBENCHMESSAGE messages
WBENCHOPEN  equ $0001
WBENCHCLOSE equ $0002




; ==========================================================================

; === Window ===============================================================

; ==========================================================================

STRUCTURE Window,0

0 APTR wd_NextWindow     ; for the linked list of a Screen

4 WORD wd_LeftEdge    ; screen dimensions
6 WORD wd_TopEdge     ; screen dimensions
8 WORD wd_Width    ; screen dimensions
10 WORD wd_Height      ; screen dimensions

12 WORD wd_MouseY      ; relative top top-left corner
14 WORD wd_MouseX      ; relative top top-left corner

16 WORD wd_MinWidth    ; minimum sizes
18 WORD wd_MinHeight      ; minimum sizes
20 WORD wd_MaxWidth    ; maximum sizes
22 WORD wd_MaxHeight      ; maximum sizes

24 LONG wd_Flags    ; see below for definitions

28 APTR wd_MenuStrip      ; first in a list of menu headers

32 APTR wd_Title    ; title text for the Window

36 APTR wd_FirstRequest   ; first in linked list of active
 Requesters
40 APTR wd_DMRequest      ; the double-menu Requester
44 WORD wd_ReqCount    ; number of Requesters blocking
 this Window
46 APTR wd_WScreen     ; this Window's Screen
50 APTR wd_RPort    ; this Window's very own RastPort

   ; the border variables describe the window border.
 If you specify
   ; GIMMEZEROZERO when you open the window, then the upper-left
 of the
   ; ClipRect for this window will be upper-left of the
 BitMap (with correct
   ; offsets when in SuperBitMap mode; you MUST select
 GIMMEZEROZERO when
   ; using SuperBitMap).  If you don't specify ZeroZero,
 then you save
   ; memory (no allocation of RastPort, Layer, ClipRect
 and associated
   ; Bitmaps), but you also must offset all your writes
 by BorderTop,
   ; BorderLeft and do your own mini-clipping to prevent
 writing over the
   ; system gadgets
54 BYTE wd_BorderLeft
55 BYTE wd_BorderTop
56 BYTE wd_BorderRight
57 BYTE wd_BorderBottom
58 APTR wd_BorderRPort
```

```
     ; You supply a linked-list of gadget that you want for
   your Window.
     ; This list DOES NOT include system Gadgets.  You get
   the standard
     ; window system Gadgets by setting flag-bits in the
   variable Flags (see
     ; the bit definitions below)
62   APTR wd_FirstGadget

     ; these are for opening/closing the windows
66   APTR wd_Parent
70   APTR wd_Descendant

     ; sprite data information for your own Pointer
     ; set these AFTER you Open the Window by calling SetPointer()
74   APTR wd_Pointer
78   BYTE wd_PtrHeight
79   BYTE wd_PtrWidth
80   BYTE wd_XOffset
81   BYTE wd_YOffset

     ; the IDCMP Flags and User's and Intuition's Message
   Ports
82   ULONG wd_IDCMPFlags
86   APTR wd_UserPort
90   APTR wd_WindowPort
94   APTR wd_MessageKey

98   BYTE wd_DetailPen
99   BYTE wd_BlockPen

     ; the CheckMark is a pointer to the imagery that will
   be used when
     ; rendering MenuItems of this Window that want to be
   checkmarked
     ; if this is equal to NULL, you'll get the default imagery
100  APTR wd_CheckMark

     ; if non-null, Screen title when Window is active
104  APTR wd_ScreenTitle

     ; These variables have the mouse coordinates relative
   to the
     ; inner-Window of GIMMEZEROZERO Windows.  This is compared
   with the
     ; MouseX and MouseY variables, which contain the mouse
   coordinates
     ; relative to the upper-left corner of the Window, GIMMEZEROZERO
     ; notwithstanding
108  SHORT wd_GZZMouseX
110  SHORT wd_GZZMouseY
     ; these variables contain the width and height of the
   inner-Window of
     ; GIMMEZEROZERO Windows
112  SHORT wd_GZZWidth
114  SHORT wd_GZZHeight

116  APTR wd_ExtData

     ; general-purpose pointer to User data extension
120  APTR wd_UserData
124  APTR wd_WLayer    ; stash of Window.RPort->Layer

     LABEL wd_Size

 ; --- FLAGS REQUESTED (NOT DIRECTLY SET THOUGH) BY THE APPLIPROG
   -------------
 WINDOWSIZING   equ $0001   ; include sizing system-gadget?

 WINDOWDRAG     equ $0002   ; include dragging system-gadget?

 WINDOWDEPTH    equ $0004   ; include depth arrangement gadget?

 WINDOWCLOSE    equ $0008   ; include close-box system-gadget?


 SIZEBRIGHT  equ $0010   ; size gadget uses right border

 SIZEBBOTTOM equ $0020   ; size gadget uses bottom border


 ; --- refresh modes -------------------------------------------
 ; combinations of the REFRESHBITS select the refresh type

 REFRESHBITS equ $00C0
 SMART_REFRESH  equ $0000
 SIMPLE_REFRESH equ $0040
 SUPER_BITMAP   equ $0080
 OTHER_REFRESH  equ $00C0

 BACKDROP equ $0100   ; this is an ever-popular BACKDROP
   window

 REPORTMOUSE equ $0200   ; set this to hear about every mouse
   move

 GIMMEZEROZERO  equ $0400   ; make extra border stuff

 BORDERLESS  equ $0800   ; set this to get a Window sans
   border

 ACTIVATE equ $1000   ; when Window opens, it's the Active
   one

 ; FLAGS SET BY INTUITION
 WINDOWACTIVE   equ $2000   ; this window is the active one

 INREQUEST      equ $4000   ; this window is in request mode

 MENUSTATE      equ $8000   ; this Window is active with
   its Menus on

 ; --- Other User Flags ----------------------------------------
 RMBTRAP     equ $00010000  ; Catch RMB events for your own

 NOCAREREFRESH  equ $00020000  ; not to be bothered with
   REFRESH


 WINDOWREFRESH  equ $01000000  ; Window is currently refreshing
```

```
WBENCHWINDOW   equ $02000000  ; WorkBench Window
WINDOWTICKED   equ $04000000  ; only one timer tick at a
  time

SUPER_UNUSED   equ $FCFC0000  ;bits of Flag unused yet


; --- see struct IntuiMessage for the IDCMP Flag definitions
  -----------------


; ==========================================================================
; === NewWindow ============================================================
; ==========================================================================
 STRUCTURE NewWindow,0

    WORD nw_LeftEdge    ; initial Window dimensions
    WORD nw_TopEdge     ; initial Window dimensions
    WORD nw_Width     ; initial Window dimensions
    WORD nw_Height      ; initial Window dimensions

    BYTE nw_DetailPen      ; for rendering the detail bits
  of the Window
    BYTE nw_BlockPen    ; for rendering the block-fill bits


    ULONG nw_IDCMPFlags    ; initial IDCMP state

    LONG nw_Flags    ; see the Flag definition under Window

    ; You supply a linked-list of Gadgets for your Window.
    ; This list DOES NOT include system Gadgets.  You get
  the standard
    ; system Window Gadgets by setting flag-bits in the
  variable Flags (see
    ; the bit definitions under the Window structure definition)
    APTR nw_FirstGadget

    ; the CheckMark is a pointer to the imagery that will
  be used when
    ; rendering MenuItems of this Window that want to be
  checkmarked
    ; if this is equal to NULL, you'll get the default imagery
    APTR nw_CheckMark

    APTR nw_Title    ; title text for the Window

    ; the Screen pointer is used only if you've defined
  a CUSTOMSCREEN and
    ; want this Window to open in it.  If so, you pass the
  address of the
    ; Custom Screen structure in this variable.  Otherwise,
  this variable
    ; is ignored and doesn't have to be initialized.
    APTR nw_Screen

    ; SUPER_BITMAP Window?  If so, put the address of your
  BitMap structure
    ; in this variable.  If not, this variable is ignored
  and doesn't have
    ; to be initialized
    APTR nw_BitMap

    ; the values describe the minimum and maximum sizes
  of your Windows.
    ; these matter only if you've chosen the WINDOWSIZING
  Gadget option,
    ; which means that you want to let the User to change
  the size of
    ; this Window.  You describe the minimum and maximum
  sizes that the
    ; Window can grow by setting these variables.  You can
  initialize
    ; any one these to zero, which will mean that you want
  to duplicate
    ; the setting for that dimension (if MinWidth == 0,
  MinWidth will be
    ; set to the opening Width of the Window).
    ; You can change these settings later using SetWindowLimits().
    ; If you haven't asked for a SIZING Gadget, you don't
  have to
    ; initialize any of these variables.
    WORD nw_MinWidth
    WORD nw_MinHeight
    WORD nw_MaxWidth
    WORD nw_MaxHeight

    ; the type variable describes the Screen in which you
  want this Window to
    ; open.  The type value can either be CUSTOMSCREEN or
  one of the
    ; system standard Screen Types such as WBENCHSCREEN.
   See the
    ; type definitions under the Screen structure
    WORD nw_Type

    LABEL nw_SIZE



; ==========================================================================
; === Screen ===============================================================
; ==========================================================================
 STRUCTURE Screen,0
```

```
0  APTR sc_NextScreen      ; linked list of screens
4  APTR sc_FirstWindow     ; linked list Screen's Windows

8  WORD sc_LeftEdge     ; parameters of the screen
10 WORD sc_TopEdge      ; parameters of the screen

12 WORD sc_Width     ; null-terminated Title text
14 WORD sc_Height       ; for Windows without ScreenTitle

16 WORD sc_MouseY       ; position relative to upper-left
18 WORD sc_MouseX       ; position relative to upper-left

20 WORD sc_Flags     ; see definitions below

22 APTR sc_Title
26 APTR sc_DefaultTitle

     ; Bar sizes for this Screen and all Window's in this Screen
30 BYTE sc_BarHeight
31 BYTE sc_BarVBorder
32 BYTE sc_BarHBorder
33 BYTE sc_MenuVBorder
34 BYTE sc_MenuHBorder
35 BYTE sc_WBorTop
36 BYTE sc_WBorLeft
37 BYTE sc_WBorRight
38 BYTE sc_WBorBottom

     ; The following variable is strictly from Kludge-City, where some people
     ; still live.  It is included solely because our types.i macros aren't
     ; smart enough to do the right thing, which would be the automatic
     ; word-alignment to these references as it SHOULD be in order to duplicate
     ; the way alignments are adjusted in the c-language.  And instead of
     ; correcting the problem, I am obliged to kludge up my include.i files.
     ; So here it is!
39   BYTE sc_KludgeFill00    ; defined as a BYTE because this does

     ; the display data structures for this Screen
40   APTR sc_Font         ; this screen's default font
44   STRUCT sc_ViewPort,vp_SIZEOF ; describing the Screen's display
     STRUCT sc_RastPort,rp_SIZEOF ; describing Screen rendering
     STRUCT sc_BitMap,bm_SIZEOF      ; auxiliary graphexcess baggage
     STRUCT sc_LayerInfo,li_SIZEOF   ; each screen gets a LayerInfo

     ; You supply a linked-list of Gadgets for your Screen.
     ; This list DOES NOT include system Gadgets.  You get the standard
     ; system Screen Gadgets by default
     APTR sc_FirstGadget

     BYTE sc_DetailPen      ; for bar/border/gadget rendering
     BYTE sc_BlockPen    ; for bar/border/gadget rendering

     ; the following variable(s) are maintained by Intuition to support the
     ; DisplayBeep() color flashing technique
     WORD sc_SaveColor0

     ; This layer is for the Screen and Menu bars
     APTR sc_BarLayer

     APTR sc_ExtData

     APTR sc_UserData    ; general-purpose pointer to User data

     LABEL sc_SIZEOF


; --- FLAGS SET BY INTUITION ---------------------------------------------
; The SCREENTYPE bits are reserved for describing various Screen types
; available under Intuition.
SCREENTYPE  equ   $000F ; all the screens types available

; --- the definitions for the Screen Type --------------------------------
WBENCHSCREEN   equ   $0001 ; Ta Da!  The Workbench
CUSTOMSCREEN   equ   $000F ; for that special look

SHOWTITLE   equ   $0010 ; this gets set by a call to ShowTitle()

BEEPING     equ   $0020 ; set when Screen is beeping

CUSTOMBITMAP   equ   $0040 ; if you are supplying your own BitMap




; ========================================================================

; === NewScreen ==========================================================

; ========================================================================

 STRUCTURE NewScreen,0

     WORD ns_LeftEdge    ; initial Screen dimensions
     WORD ns_TopEdge     ; initial Screen dimensions
     WORD ns_Width    ; initial Screen dimensions
     WORD ns_Height      ; initial Screen dimensions
     WORD ns_Depth    ; initial Screen dimensions

     BYTE ns_DetailPen      ; default rendering pens (for Windows too)
     BYTE ns_BlockPen    ; default rendering pens (for Windows too)
```

```
    WORD ns_ViewModes       ; display "modes" for this Screen

    WORD ns_Type     ; Intuition Screen Type specifier

    APTR ns_Font     ; default font for Screen and Windows

    APTR ns_DefaultTitle   ; Title when Window doesn't care

    APTR ns_Gadgets     ; Your own initial Screen Gadgets

    ; if you are opening a CUSTOMSCREEN and already have a BitMap
    ; that you want used for your Screen, you set the flags CUSTOMBITMAP in
    ; the Types variable and you set this variable to point to your BitMap
    ; structure.  The structure will be copied into your Screen structure,
    ; after which you may discard your own BitMap if you want
    APTR ns_CustomBitMap;

 LABEL    ns_SIZEOF









; ===================================================================

; === Preferences ===================================================

; ===================================================================


; these are the definitions for the printer configurations

FILENAME_SIZE equ 30       ; Filename size

POINTERSIZE    equ   (1+16+1)*2  ; Size of Pointer data buffer

; These defines are for the default font size.  These actually describe the
; height of the defaults fonts.  The default font type is the topaz
; font, which is a fixed width font that can be used in either
; eighty-column or sixty-column mode.  The Preferences structure reflects
; which is currently selected by the value found in the variable FontSize,
; which may have either of the values defined below.  These values actually
; are used to select the height of the default font.  By changing the
; height, the resolution of the font changes as well.
TOPAZ_EIGHTY    equ   8
TOPAZ_SIXTY     equ   9

; ----------------------------------------------------------------------
 STRUCTURE Preferences,0

    ; the default font height
    BYTE pf_FontHeight     ; height for system default font

    ; constant describing what's hooked up to the port
    UBYTE pf_PrinterPort   ; printer port connection

    ; the baud rate of the port
    USHORT pf_BaudRate     ; baud rate for the serial port

    ; various timing rates
    STRUCT pf_KeyRptSpeed,TV_SIZE ; repeat speed for keyboard
    STRUCT pf_KeyRptDelay,TV_SIZE ; Delay before keys repeat
    STRUCT pf_DoubleClick,TV_SIZE ; Interval allowed between clicks

    ; Intuition Pointer data
    STRUCT pf_PointerMatrix,POINTERSIZE*2 ; Definition of pointer sprite
    BYTE pf_XOffset     ; X-Offset for active 'bit'
    BYTE pf_YOffset     ; Y-Offset for active 'bit'
    WORD pf_color17     ;********************************
    WORD pf_color18     ; Colours for sprite pointer
    WORD pf_color19     ;********************************
    WORD pf_PointerTicks   ; Sensitivity of the pointer

    ; Workbench Screen colors
    WORD pf_color0      ;********************************
    WORD pf_color1      ;  Standard default colours
    WORD pf_color2      ;   Used in the Workbench
    WORD pf_color3      ;********************************

    ; positioning data for the Intuition View
    BYTE pf_ViewXOffset    ; Offset for top lefthand corner
    BYTE pf_ViewYOffset    ; X and Y dimensions
    WORD pf_ViewInitX      ; View initial offsets at startup
    WORD pf_ViewInitY      ; View initial offsets at startup

    BOOL EnableCLI      ; CLI availability switch

    ; printer configurations
    WORD pf_PrinterType    ; printer type
    STRUCT pf_PrinterFilename,FILENAME_SIZE ; file for printer

    ; print format and quality configurations
    SHORT pf_PrintPitch       ; print pitch
    WORD pf_PrintQuality   ; print quality
    WORD pf_PrintSpacing   ; number of lines per inch
    UWORD pf_PrintLeftMargin  ; left margin in characters
    UWORD pf_PrintRightMargin ; right margin in characters
    WORD  pf_PrintImage    ; positive or negative
    WORD pf_PrintAspect    ; horizontal or vertical
    WORD pf_PrintShade     ; b&w, half-tone, or color
    WORD pf_PrintThreshold ; darkness ctrl for b/w dumps
```

```
    ; print paper description
    WORD pf_PaperSize      ; paper size
    UWORD pf_PaperLength   ; paper length in lines
    WORD pf_PaperType      ; continuous or single sheet

    STRUCT pf_padding,50   ; For further system expansion

    LABEL pf_SIZEOF

; === Preferences definitions ==========================================

; PrinterPort
PARALLEL_PRINTER equ $00
SERIAL_PRINTER equ   $01

; BaudRate
BAUD_110 equ   $00
BAUD_300 equ   $01
BAUD_1200   equ   $02
BAUD_2400   equ   $03
BAUD_4800   equ   $04
BAUD_9600   equ   $05
BAUD_19200  equ   $06
BAUD_MIDI   equ   $07

; PaperType
FANFOLD  equ   $00
SINGLE      equ   $80

; PrintPitch
PICA     equ   $000
ELITE       equ   $400
FINE     equ   $800

; PrintQuality
DRAFT       equ   $000
LETTER      equ   $100

; PrintSpacing
SIX_LPI     equ   $000
EIGHT_LPI   equ   $200

; Print Image
IMAGE_POSITIVE equ   0
IMAGE_NEGATIVE equ   1

; PrintAspect
ASPECT_HORIZ   equ   0
ASPECT_VERT equ   1

; PrintShade
SHADE_BW equ   $00
SHADE_GREYSCALE   equ   $01
SHADE_COLOR equ   $02

; PaperSize
US_LETTER   equ   $00
US_LEGAL equ   $10
N_TRACTOR   equ   $20
W_TRACTOR   equ   $30
CUSTOM      equ   $40

; PrinterType
CUSTOM_NAME equ   $00
ALPHA_P_101 equ   $01
BROTHER_15XL   equ   $02
CBM_MPS1000 equ   $03
DIAB_630 equ   $04
DIAB_ADV_D25   equ   $05
DIAB_C_150  equ   $06
EPSON    equ   $07
EPSON_JX_80 equ   $08
OKIMATE_20  equ   $09
QUME_LP_20  equ   $0A
; new printer entries, 3 October 1985
HP_LASERJET equ   $0B
HP_LASERJET_PLUS equ $0C




; ======================================================================
; === Remember =========================================================
; ======================================================================
; this structure is used for remembering what memory has
  been allocated to
; date by a given routine, so that a premature abort or
  systematic exit
; can deallocate memory cleanly, easily, and completely
 STRUCTURE Remember,0

    APTR rm_NextRemember
    ULONG rm_RememberSize
    APTR rm_Memory

 LABEL    rm_SIZEOF



; ======================================================================

; === Miscellaneous ====================================================

; ======================================================================


; = MACROS =============================================================

;#define MENUNUM(n) (n & 0x1F)
;#define ITEMNUM(n) ((n >> 5) & 0x003F)
;#define SUBNUM(n) ((n >> 11) & 0x001F)
;
;#define SHIFTMENU(n) (n & 0x1F)
;#define SHIFTITEM(n) ((n & 0x3F) << 5)
;#define SHIFTSUB(n) ((n & 0x1F) << 11)
;
; = MENU STUFF =========================================================
```

```
NOMENU equ  $001F
NOITEM equ  $003F
NOSUB  equ  $001F
MENUNULL equ   $FFFF


; = =RJ='s peculiarities ==============================================

;#define FOREVER for(;;)
;#define SIGN(x) ( ((x) > 0) - ((x) < 0) )


; these defines are for the COMMSEQ and CHECKIT menu stuff.
   If CHECKIT,
; I'll use a generic Width (for all resolutions) for the
  CheckMark.
; If COMMSEQ, likewise I'll use this generic stuff
CHECKWIDTH  equ   19
COMMWIDTH   equ   27
LOWCHECKWIDTH  equ   13
LOWCOMMWIDTH   equ   16


; these are the AlertNumber defines.  if you are calling
  DisplayAlert()
; the AlertNumber you supply must have the ALERT_TYPE bits
  set to one
; of these patterns
ALERT_TYPE  equ   $80000000
RECOVERY_ALERT equ   $00000000   ; the system can recover
  from this
DEADEND_ALERT  equ   $80000000   ; no recovery possible,
  this is it


; When you're defining IntuiText for the Positive and Negative
  Gadgets
; created by a call to AutoRequest(), these defines will
  get you
; reasonable-looking text.  The only field without a define
  is the IText
; field; you decide what text goes with the Gadget
AUTOFRONTPEN    equ   0
AUTOBACKPEN equ   1
AUTODRAWMODE    equ   RP_JAM2
AUTOLEFTEDGE    equ   6
AUTOTOPEDGE equ   3
AUTOITEXTFONT  equ   0
AUTONEXTTEXT   equ   0



   ENDC
```

```
   IFND  INTUITION_INTUITIONBASE_I
INTUITION_INTUITIONBASE_I SET  1

*** intuitionbase.i ********************************************************
* Commodore-Amiga, Inc.
*
*  the IntuitionBase structure and supporting structures
*
*          Modification History
*     date    :   author :    Comments
*     ------      ------      -------------------------------------
*    3-1-85       -jimm
*
***************************************************************************/

   IFND EXEC_LIBRARIES_I
   INCLUDE "exec/libraries.i"
   ENDC

   IFND  GRAPHICS_VIEW_I
   INCLUDE  "graphics/view.i"
   ENDC

* Be sure to protect yourself against someone modifying
  these data as
* you look at them.  This is done by calling:
*
* lock = LockIBase(0), which returns a ULONG.  When done
  call
*  D0              D0
* UnlockIBase(lock) where lock is what LockIBase() returned.
*                  A0
* NOTE: these library functions are simply stubs now, but
  should be called
* to be compatible with future releases.

* ======================================================================
  *
* === IntuitionBase ====================================================
  *
* ======================================================================
  *
 STRUCTURE IntuitionBase,0

   STRUCT   ib_LibNode,LIB_SIZE
   STRUCT   ib_ViewLord,SIZEOF_VIEW
   APTR  ib_ActiveWindow
   APTR  ib_ActiveScreen

* the FirstScreen variable points to the frontmost Screen.
   Screens are
* then maintained in a front to back order using Screen.NextScreen

   APTR  ib_FirstScreen

* there is not size here because...
*
*
   ENDC
```

```
Contents
--------

libraries/diskfont.i
libraries/dos.i
libraries/dos_lib.i
libraries/dosextens.i
libraries/translator.i
```

```
   IFND  LIBRARIES_DISKFONT_I
LIBRARIES_DISKFONT_I SET   1
*********************************************************************
*               Commodore-Amiga, Inc.                               *
*               diskfont.i                                          *
*********************************************************************
*********************************************************************
*
*  diskfont library definitions
*
*********************************************************************

   IFND     EXEC_NODES_I
   INCLUDE     "exec/nodes.i"
   ENDC
   IFND     EXEC_LISTS_I
   INCLUDE     "exec/lists.i"
   ENDC
   IFND     GRAPHICS_TEXT_I
   INCLUDE     "graphics/text.i"
   ENDC

MAXFONTPATH EQU   256   ; including null terminator

 STRUCTURE  FC,0
   STRUCT   fc_FileName,MAXFONTPATH
   UWORD fc_YSize
   UBYTE fc_Style
   UBYTE fc_Flags
   LABEL fc_SIZEOF

FCH_ID      EQU   $0f00

 STRUCTURE  FCH,0
   UWORD fch_FileID  ; FCH_ID
   UWORD fch_NumEntries ; the number of FontContents elements
   LABEL fch_FC      ; the FontContents elements


DFH_ID      EQU   $0f80
MAXFONTNAME EQU   32 ; font name including ".font\0"

 STRUCTURE  DiskFontHeader,0
    ; the following 8 bytes are not actually considered a part of the
    ; DiskFontHeader, but immediately preceed it.  The NextSegment is supplie
    ; by the linker/loader, and the ReturnCode is the code at the beginning
    ; of the font in case someone runs it...
    ; ULONG dfh_NextSegment   ; actually a BPTR
    ; ULONG dfh_ReturnCode    ; MOVEQ #0,D0 : RTS
    ; here then is the official start of the DiskFontHeader...
   STRUCT   dfh_DF,LN_SIZE    ; node to link disk fonts
   UWORD dfh_FileID           ; DFH_ID
   UWORD dfh_Revision         ; the font revision in this version
   LONG  dfh_Segment          ; the segment address when loaded
   STRUCT   dfh_Name,MAXFONTNAME ; the font name (null terminated)
   STRUCT   dfh_TF,tf_SIZEOF  ; loaded TextFont structure
   LABEL dfh_SIZEOF
```

```
   IFND LIBRARIES_DOS_I
LIBRARIES_DOS_I            SET      1

*******************************************************************
*               Commodore-Amiga, Inc.                             *
*               dos.i                                             *
*******************************************************************
* Standard assembler header for Amiga DOS on the MC68000

*      IFND EXEC_TYPES_I
*      INCLUDE "exec/types.i"
*      ENDC


DOSNAME     MACRO
      DC.B  'dos.library',0
      ENDM

* Predefined Amiga DOS global constants

* Mode parameter to Open()
MODE_OLDFILE         EQU   1005   * Open existing file read/write
*                                 * positioned at beginning of file.
MODE_NEWFILE         EQU   1006   * Open freshly created file (delete
*                                 * old file) read/write

* Relative position to Seek()
OFFSET_BEGINNING     EQU   -1     * relative to Beginning Of File
OFFSET_CURRENT       EQU    0     * relative to Current file position
OFFSET_END           EQU    1     * relative to End Of File

OFFSET_BEGINING      EQU   OFFSET_BEGINNING     * Ancient compatibility

BITSPERBYTE          EQU   8
BYTESPERLONG         EQU   4
BITSPERLONG          EQU   32
MAXINT               EQU   $7FFFFFFF
MININT               EQU   $80000000

* Passed as type to Lock()
SHARED_LOCK          EQU   -2    ; File is readable by others
ACCESS_READ          EQU   -2    ; Synonym
EXCLUSIVE_LOCK       EQU   -1    ; No other access allowed
ACCESS_WRITE         EQU   -1    ; Synonym


 STRUCTURE DateStamp,0
   LONG  ds_Days                 ; Number of days since Jan. 1, 1978
   LONG  ds_Minute               ; Number of minutes past midnight
   LONG  ds_Tick                 ; Number of ticks past minute
   LABEL ds_SIZEOF               ; DateStamp
TICKS_PER_SECOND EQU 50          ; Number of ticks in one second

* Returned by Examine() and ExInfo()
 STRUCTURE FileInfoBlock,0
   LONG   fib_DiskKey
   LONG   fib_DirEntryType       ; Type of Directory. If <0, then a plain fil
                                 ; If > 0 then a directory
   STRUCT fib_FileName,108       ; Null terminated. Max 30 chars used for now
   BITDEF   AF,MEMORY,0
   BITDEF   AF,DISK,1

 STRUCTURE  AF,0
   UWORD af_Type         ; MEMORY or DISK
   STRUCT   af_Attr,ta_SIZEOF ; text attributes for font
   LABEL af_SIZEOF

 STRUCTURE  AFH,0
   UWORD afh_NumEntries    ; number of AvailFonts elements
   LABEL afh_AF          ; the AvailFonts elements

   ENDC
```

```
   LONG   fib_Protection        ; bit mask of protection, rwxd are 3-0.
   LONG   fib_EntryType
   LONG   fib_Size              ; Number of bytes in file
   LONG   fib_NumBlocks         ; Number of blocks in file
   STRUCT fib_DateStamp,ds_SIZEOF ; Date file last changed.
   STRUCT fib_Comment,116       ; Null terminated.
                                ; Comment associated with file
   LABEL  fib_SIZEOF            ; FileInfoBlock

* FIB stands for FileInfoBlock
* FIBB are bit definitions, FIBF are field definitions
   BITDEF   FIB,READ,3
   BITDEF   FIB,WRITE,2
   BITDEF   FIB,EXECUTE,1
   BITDEF   FIB,DELETE,0


* All BCPL data must be long word aligned.  BCPL pointers are the long word
* address (i.e byte address divided by 4 (>>2))

* Macro to indicate BCPL pointers
BPTR     MACRO                      * Long word pointer
         LONG     \1
         ENDM
BSTR     MACRO                      * Long word pointer to BCPL string.
         LONG     \1
         ENDM

* #define BADDR( bptr ) (bptr << 2) * Convert BPTR to byte addressed pointer

* BCPL strings have a length in the first byte and then the characters.
* For example:  s[0]=3 s[1]=S s[2]=Y s[3]=S

* returned by Info()
 STRUCTURE InfoData,0
   LONG id_NumSoftErrors      * number of soft errors on disk
   LONG id_UnitNumber         * Which unit disk is (was) mounted on
   LONG id_DiskState          * See defines below
   LONG id_NumBlocks          * Number of blocks on disk
   LONG id_NumBlocksUsed      * Number of block in use
   LONG id_BytesPerBlock
   LONG id_DiskType           * Disk Type code
   BPTR id_VolumeNode         * BCPL pointer to volume node
   LONG id_InUse              * Flag, zero if not in use
   LABEL id_SIZEOF            * InfoData

* ID stands for InfoData
*            Disk states
ID_WRITE_PROTECTED    EQU   80 * Disk is write protected
ID_VALIDATING         EQU   81 * Disk is currently being validated
ID_VALIDATED          EQU   82 * Disk is consistent and writeable
*          Disk types
ID_NO_DISK_PRESENT    EQU -1
ID_UNREADABLE_DISK    EQU  ('B'<<24)!('A'<<16)!('D'<<8)
ID_NOT_REALLY_DOS     EQU  ('N'<<24)!('D'<<16)!('O'<<8)!('S')
ID_DOS_DISK           EQU  ('D'<<24)!('O'<<16)!('S'<<8)
ID_KICKSTART_DISK     EQU  ('K'<<24)!('I'<<16)!('C'<<8)!('K')

* Errors from IoErr(), etc.
ERROR_NO_FREE_STORE              EQU  103
ERROR_OBJECT_IN_USE                 EQU  202
ERROR_OBJECT_EXISTS                 EQU  203
ERROR_OBJECT_NOT_FOUND              EQU  205
ERROR_ACTION_NOT_KNOWN              EQU  209
ERROR_INVALID_COMPONENT_NAME        EQU  210
ERROR_INVALID_LOCK                  EQU  211
ERROR_OBJECT_WRONG_TYPE             EQU  212
ERROR_DISK_NOT_VALIDATED            EQU  213
ERROR_DISK_WRITE_PROTECTED          EQU  214
ERROR_RENAME_ACROSS_DEVICES         EQU  215
ERROR_DIRECTORY_NOT_EMPTY           EQU  216
ERROR_DEVICE_NOT_MOUNTED            EQU  218
ERROR_SEEK_ERROR                    EQU  219
ERROR_COMMENT_TOO_BIG               EQU  220
ERROR_DISK_FULL                     EQU  221
ERROR_DELETE_PROTECTED              EQU  222
ERROR_WRITE_PROTECTED               EQU  223
ERROR_READ_PROTECTED                EQU  224
ERROR_NOT_A_DOS_DISK                EQU  225
ERROR_NO_DISK                       EQU  226
ERROR_NO_MORE_ENTRIES               EQU  232

* These are the return codes used by convention by AmigaDOS commands
* See FAILAT and IF for relvance to EXECUTE files
RETURN_OK                           EQU    0  * No problems, success
RETURN_WARN                         EQU    5  * A warning only
RETURN_ERROR                        EQU   10  * Something wrong
RETURN_FAIL                         EQU   20  * Complete or severe failure

* Bit numbers that signal you that a user has issued a break
   BITDEF   SIGBREAK,CTRL_C,12
   BITDEF   SIGBREAK,CTRL_D,13
   BITDEF   SIGBREAK,CTRL_E,14
   BITDEF   SIGBREAK,CTRL_F,15
```

```
*********************************************************************
*                Commodore-Amiga, Inc.                              *
*                dos_lib.i                                          *
*********************************************************************
*
* Library interface offsets for DOS library
*
reserve EQU     4
vsize   EQU     6
count   SET     -vsize*(reserve+1)
LIBENT  MACRO
_LVO\1  EQU     count
count   SET     count-vsize
        ENDM
*
*
*
   LIBENT   Open
   LIBENT   Close
   LIBENT   Read
   LIBENT   Write
   LIBENT   Input
   LIBENT   Output
   LIBENT   Seek
   LIBENT   DeleteFile
   LIBENT   Rename
   LIBENT   Lock
   LIBENT   UnLock
   LIBENT   DupLock
   LIBENT   Examine
   LIBENT   ExNext
   LIBENT   Info
   LIBENT   CreateDir
   LIBENT   CurrentDir
   LIBENT   IoErr
   LIBENT   CreateProc
   LIBENT   Exit
   LIBENT   LoadSeg
   LIBENT   UnLoadSeg
   LIBENT   GetPacket
   LIBENT   QueuePacket
   LIBENT   DeviceProc
   LIBENT   SetComment
   LIBENT   SetProtection
   LIBENT   DateStamp
   LIBENT   Delay
   LIBENT   WaitForChar
   LIBENT   ParentDir
   LIBENT   IsInteractive
   LIBENT   Execute
```

```
   IFND  LIBRARIES_DOSEXTENS_I

LIBRARIES_DOSEXTENS_I   SET   1
*********************************************************************
*                Commodore-Amiga, Inc.                              *
*                dosextens.i                                        *
*********************************************************************
* DOS structures not needed for the casual DOS user


     IFND  EXEC_TYPES_I
     INCLUDE "exec/types.i"
     ENDC
     IFND  EXEC_TASKS_I
     INCLUDE "exec/tasks.i"
     ENDC
     IFND  EXEC_PORTS_I
     INCLUDE "exec/ports.i"
     ENDC
     IFND  EXEC_LIBRARIES_I
     INCLUDE "exec/libraries.i"
     ENDC

     IFND  LIBRARIES_DOS_I
     INCLUDE "libraries/dos.i"
     ENDC


* All DOS processes have this STRUCTure
* Create and DeviceProc returns pointer to the MsgPort in this STRUCTure
* Process_addr = DeviceProc(..) - TC_SIZE

 STRUCTURE Process,0
    STRUCT  pr_Task,TC_SIZE
    STRUCT  pr_MsgPort,MP_SIZE  * This is BPTR address from DOS functions
    WORD    pr_Pad              * Remaining variables on 4 byte boundaries
    BPTR    pr_SegList          * Array of seg lists used by this process
    LONG    pr_StackSize        * Size of process stack in bytes
    APTR    pr_GlobVec          * Global vector for this process (BCPL)
    LONG    pr_TaskNum          * CLI task number of zero if not a CLI
    BPTR    pr_StackBase        * Ptr to high memory end of process stack
    LONG    pr_Result2          * Value of secondary result from last call
    BPTR    pr_CurrentDir       * Lock associated with current directory
    BPTR    pr_CIS              * Current CLI Input Stream
    BPTR    pr_COS              * Current CLI Output Stream
    APTR    pr_ConsoleTask      * Console handler process for current window
    APTR    pr_FileSystemTask   * File handler process for current drive
    BPTR    pr_CLI              * pointer to ConsoleLineInterpreter
    APTR    pr_ReturnAddr       * pointer to previous stack frame
    APTR    pr_PktWait          * Function to be called when awaiting msg
    APTR    pr_WindowPtr        * Window pointer for errors
    LABEL   pr_SIZEOF           * Process

* The long word address (BPTR) of this STRUCTure is returned by
* Open() and other routines that return a file.  You need only worry
* about this STRUCT to do async io's via PutMsg() instead of
* standard file system calls

 STRUCTURE FileHandle,0
```

```
   APTR   fh_Link          * pointer to EXEC message
   APTR   fh_Interactive   * Boolean; TRUE if interactive handle
   APTR   fh_Type          * Port to do PutMsg() to
   LONG   fh_Buf
   LONG   fh_Pos
   LONG   fh_End
   LONG   fh_Funcs
fh_Func1 EQU fh_Funcs
   LONG   fh_Func2
   LONG   fh_Func3
   LONG   fh_Args
fh_Arg1 EQU fh_Args
   LONG   fh_Arg2
   LABEL  fh_SIZEOF * FileHandle

* This is the extension to EXEC Messages used by DOS
 STRUCTURE DosPacket,0
   APTR   dp_Link          * pointer to EXEC message
   APTR   dp_Port          * pointer to Reply port for the packet
*                          * Must be filled in each send.
   LONG   dp_Type          * See ACTION_... below and
*                          * 'R' means Read, 'W' means Write to the file system
   LONG   dp_Res1          * For file system calls this is the result
*                          * that would have been returned by the
*                          * function, e.g. Write ('W') returns actual
*                          * length written
   LONG   dp_Res2          * For file system calls this is what would
*                          * have been returned by IoErr()
   LONG   dp_Arg1
*  Device packets common equivalents
dp_Action  EQU  dp_Type
dp_Status  EQU  dp_Res1
dp_Status2 EQU  dp_Res2
dp_BufAddr EQU  dp_Arg1
   LONG   dp_Arg2
   LONG   dp_Arg3
   LONG   dp_Arg4
   LONG   dp_Arg5
   LONG   dp_Arg6
   LONG   dp_Arg7
   LABEL  dp_SIZEOF * DosPacket

* A Packet does not require the Message to before it in memory, but
* for convenience it is useful to associate the two.
* Also see the function init_std_pkt for initializing this STRUCTure

 STRUCTURE StandardPacket,0
   STRUCT sp_Msg,MN_SIZE
   STRUCT sp_Pkt,dp_SIZEOF
   LABEL  sp_SIZEOF * StandardPacket


* Packet types
ACTION_NIL                EQU   0
ACTION_GET_BLOCK          EQU   2
ACTION_SET_MAP            EQU   4
ACTION_DIE                EQU   5
ACTION_EVENT              EQU   6
ACTION_CURRENT_VOLUME     EQU   7
ACTION_LOCATE_OBJECT      EQU   8
ACTION_RENAME_DISK        EQU   9
ACTION_WRITE              EQU   'W'
ACTION_READ               EQU   'R'
ACTION_FREE_LOCK          EQU   15
ACTION_DELETE_OBJECT      EQU   16
ACTION_RENAME_OBJECT      EQU   17

ACTION_COPY_DIR           EQU   19
ACTION_WAIT_CHAR          EQU   20
ACTION_SET_PROTECT        EQU   21
ACTION_CREATE_DIR         EQU   22
ACTION_EXAMINE_OBJECT     EQU   23
ACTION_EXAMINE_NEXT       EQU   24
ACTION_DISK_INFO          EQU   25
ACTION_INFO               EQU   26

ACTION_SET_COMMENT        EQU   28
ACTION_PARENT             EQU   29
ACTION_TIMER              EQU   30
ACTION_INHIBIT            EQU   31
ACTION_DISK_TYPE          EQU   32
ACTION_DISK_CHANGE        EQU   33


* DOS library node structure.
* This is the data at positive offsets from the library node.
* Negative offsets from the node is the jump table to DOS functions
* node = (STRUCT DosLibrary *) OpenLibrary( "dos.library" .. )

 STRUCTURE DosLibrary,0
   STRUCT  dl_lib,LIB_SIZE
   APTR    dl_Root             * Pointer to RootNode, described below
   APTR    dl_GV               * Pointer to BCPL global vector
   LONG    dl_A2               * Private register dump of DOS
   LONG    dl_A5
   LONG    dl_A6
   LABEL   dl_SIZEOF *  DosLibrary

*

 STRUCTURE RootNode,0
   BPTR    rn_TaskArray         * [0] is max number of CLI's
*                               * [1] is APTR to process id of CLI 1
*                               * [n] is APTR to process id of CLI n
   BPTR    rn_ConsoleSegment    * SegList for the CLI
   STRUCT  rn_Time,ds_SIZEOF    * Current time
   LONG    rn_RestartSeg        * SegList for the disk validator process
   BPTR    rn_Info              * Pointer ot the Info structure
   LABEL   rn_SIZEOF            * RootNode

 STRUCTURE DosInfo,0
   BPTR    di_McName            * Network name of this machine currently 0
   BPTR    di_DevInfo           * Device List
   BPTR    di_Devices           * Currently zero
   BPTR    di_Handlers          * Currently zero
   APTR    di_NetHand           * Network handler processid currently zero
   LABEL   di_SIZEOF            * DosInfo

* DOS Processes started from the CLI via RUN or NEWCLI have this additional
* set to data associated with them
```

```

 STRUCTURE CommandLineInterface,0
    LONG   cli_Result2         * Value of IoErr from last command
    BSTR   cli_SetName         * Name of current directory
    BPTR   cli_CommandDir      * Lock associated with command directory
    LONG   cli_ReturnCode      * Return code from last command
    BSTR   cli_CommandName     * Name of current command
    LONG   cli_FailLevel       * Fail level (set by FAILAT)
    BSTR   cli_Prompt          * Current prompt (set by PROMPT)
    BPTR   cli_StandardInput   * Default (terminal) CLI input
    BPTR   cli_CurrentInput    * Current CLI input
    BSTR   cli_CommandFile     * Name of EXECUTE command file
    LONG   cli_Interactive     * Boolean True if prompts required
    LONG   cli_Background      * Boolean True if CLI created by RUN
    BPTR   cli_CurrentOutput   * Current CLI output
    LONG   cli_DefaultStack    * Stack size to be obtained in long words
    BPTR   cli_StandardOutput  * Default (terminal) CLI output
    BPTR   cli_Module          * SegList of currently loaded command
    LABEL  cli_SIZEOF          * CommandLineInterface


*
* this structure needs some work.  It should really be a union, because
* it can take on different valued depending on whether it is a device,
* an assigned directory, or a volume.
* For now, it reflects a volume.
*
 STRUCTURE DevList,0
    BPTR dl_Next                    ; bptr to next device list
    LONG dl_Type                    ; see DLT below
    APTR dl_Task                    ; ptr to handler task
    BPTR dl_Lock                    ; not for volumes
    STRUCT  dl_VolumeDate,ds_SIZEOF ; creation date
    BPTR dl_LockList                ; outstanding locks
    LONG dl_DiskType                ; 'DOS', etc
    LONG dl_unused
    BSTR dl_Name                    ; bptr to bcpl name
    LABEL   DevList_SIZEOF

* definitions for dl_Type
DLT_DEVICE     EQU   0
DLT_DIRECTORY  EQU   1
DLT_VOLUME     EQU   2


* a lock structure, as returned by Lock() or DupLock()
 STRUCTURE FileLock,0
    BPTR fl_Link        ; bcpl pointer to next lock
    LONG fl_Key         ; disk block number
    LONG fl_Access      ; exclusive or shared
    APTR fl_Task        ; handler task's port
    BPTR fl_Volume      ; bptr to a DeviceList
    LABEL   fl_SIZEOF


```

```
   IFND  LIBRARIES_TRANSLATOR_I
LIBRARIES_TRANSLATOR_I  SET   1
*******************************************************************
*                Commodore-Amiga, Inc.                            *
*                translator.i                                     *
*******************************************************************


*     ;------  Translator error codes
TR_NotUsed  EQU   -1    ;This is an often used system rc
TR_NoMem    EQU   -2    ;Can't allocate memory
TR_MakeBad  EQU   -4    ;Error in MakeLibrary call


   ENDC
```

Contents

```
*********************************************************************
*               Commodore-Amiga, Inc.
                *
*               ciabase.i
                *
*********************************************************************

*------------------------------------------------------------------
*
*  CIA Resource Data Definition
*
*------------------------------------------------------------------


 STRUCTURE  CIAR,LIB_SIZE
    APTR    CR_HWADDR
    UWORD   CR_IntMask
    UBYTE   CR_IEnable
    UBYTE   CR_IActive
    STRUCT  CR_INTNODE,IS_SIZE
    STRUCT  CR_IVTA,IV_SIZE
    STRUCT  CR_IVTB,IV_SIZE
    STRUCT  CR_IVALRM,IV_SIZE
    STRUCT  CR_IVSP,IV_SIZE
    STRUCT  CR_IVFLG,IV_SIZE
    LABEL   CR_SIZE
```

```
   IFND  RESOURCES_DISK_I
RESOURCES_DISK_I  SET   1
*******************************************************************
*               Commodore-Amiga, Inc.                             *
*               disk.i                                            *
*******************************************************************
****************************************************************
* external declarations for disk resources
*
* SOURCE CONTROL
* ------ -------
* $Header: disk.i,v 27.3 85/07/12 23:17:43 neil Exp $
* $Locker:  $
****************************************************************

   IFND  EXEC_TYPES_I
   INCLUDE  "exec/types.i"

   IFND  EXEC_LISTS_I
   INCLUDE  "exec/lists.i"

   IFND  EXEC_PORTS_I
   INCLUDE  "exec/ports.i"


   IFND  EXEC_INTERRUPTS_I
   INCLUDE  "exec/interrupts.i"


   IFND  EXEC_LIBRARIES_I
   INCLUDE  "exec/libraries.i"


********************************************************************
* Resource structures
********************************************************************

   STRUCTURE DISCRESOURCEUNIT,MN_SIZE
      STRUCT   DRU_DISCBLOCK,IS_SIZE
      STRUCT   DRU_DISCSYNC,IS_SIZE
      STRUCT   DRU_INDEX,IS_SIZE
      LABEL    DRU_SIZE



    STRUCTURE DISCRESOURCE,LIB_SIZE
      APTR  DR_CURRENT  ; pointer to current unit structure
      UBYTE DR_FLAGS
      UBYTE DR_pad
      APTR  DR_SYSLIB
      APTR  DR_CIARESOURCE
      STRUCT   DR_UNITID,4*4
      STRUCT   DR_WAITING,LH_SIZE
      STRUCT   DR_DISCBLOCK,IS_SIZE
      STRUCT   DR_DISCSYNC,IS_SIZE
      STRUCT   DR_INDEX,IS_SIZE
      LABEL DR_SIZE

      BITDEF   DR,ALLOC0,0 ; unit zero is allocated
      BITDEF   DR,ALLOC1,1 ; unit one is allocated
      BITDEF   DR,ALLOC2,2 ; unit two is allocated
      BITDEF   DR,ALLOC3,3 ; unit three is allocated
      BITDEF   DR,ACTIVE,7 ; is the disk currently busy?


********************************************************************
* Hardware Magic
********************************************************************


DSKDMAOFF   EQU   $4000 ; idle command for dsklen register


********************************************************************
* Resource specific commands
********************************************************************

*-- DR_NAME is a generic macro to get the name of the resource.  This
*-- way if the name is ever changed you will pick up the change
*-- automatically.
*--
*-- Normal usage would be:
*--
*-- internalName: DISKNAME
*--

DISKNAME:   MACRO
      DC.B  'disk.resource',0
      DS.W  0
      ENDM

   LIBINIT LIB_BASE
   LIBDEF   DR_ALLOCUNIT
   LIBDEF   DR_FREEUNIT
   LIBDEF   DR_GETUNIT
   LIBDEF   DR_GIVEUNIT
   LIBDEF   DR_GETUNITID

DR_LASTCOMM EQU   DR_GIVEUNIT


********************************************************************
* drive types
********************************************************************

DRT_AMIGA      EQU   $00000000
DRT_37422D2S   EQU   $55555555
DRT_EMPTY      EQU   $FFFFFFFF
```

```
   IFND  RESOURCES_MISC_I
RESOURCES_MISC_I  SET   1


   IFND  EXEC_TYPES_I
   INCLUDE "exec/types.i"


   IFND  EXEC_LIBRARIES_I
   INCLUDE "exec/libraries.i"


*******************************************************************
*               Commodore-Amiga, Inc.                             *
*               misc.i                                            *
*******************************************************************

****************************************************************
*
* external declarations for misc system resources
*
* SOURCE CONTROL
* ------ -------
* $Header: misc.i,v 27.3 85/07/12 16:29:36 neil Exp $
*
* $Locker:  $
*
****************************************************************


********************************************************************
*
* Resource structures
*
********************************************************************

MR_SERIALPORT     EQU   0
MR_SERIALBITS     EQU   1
MR_PARALLELPORT   EQU   2
MR_PARALLELBITS   EQU   3

NUMMRTYPES  EQU   4

    STRUCTURE MiscResource,LIB_SIZE
      STRUCT  mr_AllocArray,4*NUMMRTYPES
      LABEL   mr_Sizeof

      LIBINIT LIB_BASE
      LIBDEF   MR_ALLOCMISCRESOURCE
      LIBDEF   MR_FREEMISCRESOURCE


MISCNAME MACRO
      DC.B  'misc.resource',0
      ENDM
```

```
   IFND     RESOURCES_POTGO_I
RESOURCES_POTGO_I EQU   1
********************************************************************
*               Commodore-Amiga, Inc.                              *
*               potgo.i                                            *
********************************************************************
POTGONAME   MACRO
      DC.B  'potgo.resource'
      DC.B  0
      DS.W  0
      ENDM
   ENDC
```

Contents

```
   IFND  WORKBENCH_ICON_I
WORKBENCH_ICON_I  SET   1

********************************************************************
*                Commodore-Amiga, Inc.                             *
*                icon.i                                            *
********************************************************************

*****************************************************************
*
* icon.i -- external declarations for workbench support library
*
* SOURCE CONTROL
* ------ -------
* $Header: icon.i,v 29.1 85/08/07 22:27:14 neil Exp $
*
* $Locker:  $
*
*****************************************************************


*********************************************************************
*
* Library structures
*
*********************************************************************


ICONNAME MACRO
      DC.B  'icon.library',0
      ENDM
```

```
*** startup.i *************************************************************
*
*  Workbench startup definitions
*
* Commodore-Amiga, Inc.
*
* $Header: startup.i,v 29.1 85/08/15 06:58:52 neil Exp $
*
* $Locker:  $
*
***************************************************************************

   IFND  EXEC_TYPES_I
   INCLUDE  "exec/types.i"


   IFND  EXEC_PORTS_I
   INCLUDE  "exec/ports.i"


   IFND  LIBRARIES_DOS_I
   INCLUDE  "libraries/dos.i"


 STRUCTURE WBStartup,0
    STRUCT  sm_Message,MN_SIZE      ; a standard message structure
    APTR    sm_Process              ; the process descriptor for you
    BPTR    sm_Segment              ; a descriptor for your code
    LONG    sm_NumArgs              ; the number of elements in ArgList
    APTR    sm_ToolWindow           ; description of window
    APTR    sm_ArgList              ; the arguments themselves
    LABEL   sm_SIZEOF

 STRUCTURE WBArg,0
    BPTR    wa_Lock                 ; a lock descriptor
    APTR    wa_Name                 ; a string relative to that lock
    LABEL   wa_SIZEOF

```

```

*************************************************************************
*
* workbench.h
*
* Commodore-Amiga, Inc.
*
* $Header: workbench.i,v 31.2 85/09/02 21:32:18 neil Exp $
*
* $Locker:  $
*
*************************************************************************

   IFND  EXEC_TYPES_I
   INCLUDE  "exec/types.i"


   IFND  EXEC_NODES_I
   INCLUDE  "exec/nodes.i"


   IFND  EXEC_LISTS_I
   INCLUDE  "exec/lists.i"


   IFND  EXEC_TASKS_I
   INCLUDE  "exec/tasks.i"


   IFND  INTUITION_INTUITION_I
   INCLUDE  "intuition/intuition.i"



; the Workbench object types
WBDISK       EQU   1
WBDRAWER     EQU   2
WBTOOL       EQU   3
WBPROJECT    EQU   4
WBGARBAGE    EQU   5
WBDEVICE     EQU   6
WBKICK       EQU   7


; the main workbench object structure
 STRUCTURE DrawerData,0
    STRUCT  dd_NewWindow,nw_SIZE ; args to open window
    LONG    dd_CurrentX    ; current x coordinate of origin
    LONG    dd_CurrentY    ; current y coordinate of origin
    LONG    dd_MinX        ; smallest x coordinate in window
    LONG    dd_MinY        ; smallest y coordinate in window
    LONG    dd_MaxX        ; largest x coordinate in window
    LONG    dd_MaxY        ; largest y coordinate in window
    STRUCT  dd_HorizScroll,gg_SIZEOF
    STRUCT  dd_VertScroll,gg_SIZEOF
    STRUCT  dd_UpMove,gg_SIZEOF
    STRUCT  dd_DownMove,gg_SIZEOF
    STRUCT  dd_LeftMove,gg_SIZEOF
    STRUCT  dd_RightMove,gg_SIZEOF
```

```
    STRUCT  dd_HorizImage,ig_SIZEOF
    STRUCT  dd_VertImage,ig_SIZEOF
    STRUCT  dd_HorizProp,pi_SIZEOF
    STRUCT  dd_VertProp,pi_SIZEOF
    APTR    dd_DrawerWin      ; pointer to drawers window
    APTR    dd_Object      ; back pointer to drawer object
    STRUCT  dd_Children,LN_SIZE  ; where our children hang out
    LONG    dd_Lock
    LABEL   dd_SIZEOF

; the amount of DrawerData actually written to disk
DRAWERDATAFILESIZE   EQU (nw_SIZE+2*(4))


 STRUCTURE DiskObject,0
    UWORD   do_Magic        ; a magic num at the start of the file
    UWORD   do_Version      ; a version number, so we can change it
    STRUCT  do_Gadget,gg_SIZEOF  ; a copy of in core gadget
    UWORD   do_Type
    APTR    do_DefaultTool
    APTR    do_ToolTypes
    LONG    do_CurrentX
    LONG    do_CurrentY
    APTR    do_DrawerData
    APTR    do_ToolWindow     ; only applies to tools
    LONG    do_StackSize      ; only applies to tools
    LABEL   do_SIZEOF

WB_DISKMAGIC   EQU   $e310 ; a magic number, not easily impersonated
WB_DISKVERSION EQU   1  ; our current version number

 STRUCTURE FreeList,0
    WORD    fl_NumFree
    STRUCT  fl_MemList,LH_SIZE
    ; weird name to avoid conflicts with FileLocks
    LABEL   FreeList_SIZEOF


 STRUCTURE WBObject,0
    STRUCT  wo_MasterNode,LN_SIZE   ; all objects are on this list
    STRUCT  wo_Siblings,LN_SIZE     ; list of drawer members
    STRUCT  wo_SelectNode,LN_SIZE   ; list of all selected objects
    STRUCT  wo_UtilityNode,LN_SIZE  ; function specific linkages
    APTR wo_Parent

    ; object flags -- see below for definitions
    UBYTE   wo_Flags

    UBYTE   wo_Type           ; what flavor object is this?
    USHORT  wo_UseCount       ; number of references to this obj
    APTR    wo_Name           ; this object's textual name
    SHORT   wo_NameXOffset    ; where to put the name
    SHORT   wo_NameYOffset

    APTR    wo_DefaultTool
    APTR    wo_DrawerData     ; if this is a drawer or disk
    APTR    wo_IconWin        ; each object's icon lives here
    LONG    wo_CurrentX       ; virtual X in drawer
    LONG    wo_CurrentY       ; virtual Y in drawer
    APTR    wo_ToolTypes      ; the types for this tool
    STRUCT  wo_Gadget,gg_SIZEOF  ; NOT a ptr, but an instance of it
    STRUCT  wo_FreeList,FreeList_SIZEOF   ; this objects free list
    APTR    wo_ToolWindow     ; character string for tool's window
    LONG    wo_StackSize      ; how much stack to give to this
    LONG    wo_Lock           ; if this tool is in the backdrop
    LABEL   wo_SIZEOF

    ; workbench object flags
    BITDEF  WO,IconDisp,7     ; icon is currently in a window
    BITDEF  WO,DrawerOpen,6   ; we're a drawer, and it is open
    BITDEF  WO,Selected,5     ; our icon is selected
    BITDEF  WO,Background,4   ; set if icon is in background


* each message that comes into the WorkBenchPort must have a type field
* in the preceeding short.  These are the defines for this type
*

MTYPE_PSTD        EQU   1  ; a "standard Potion" message
MTYPE_TOOLEXIT    EQU   2  ; exit message from our tools
MTYPE_DISKCHANGE  EQU   3  ; dos telling us of a disk change
MTYPE_TIMER       EQU   4  ; we got a timer tick
MTYPE_CLOSEDOWN   EQU   5  ; <unimplemented>
MTYPE_IOPROC      EQU   6  ; <unimplemented>

; we use the gadget id field to encode some special information
GID_WBOBJECT      EQU   0  ; a normal workbench object
GID_HORIZSCROLL   EQU   1  ; the horizontal scroll gadget for a drawer
GID_VERTSCROLL    EQU   2  ; the vertical scroll gadget for a drawer
GID_LEFTSCROLL    EQU   3  ; move one window left
GID_RIGHTSCROLL   EQU   4  ; move one window right
GID_UPSCROLL      EQU   5  ; move one window up
GID_DOWNSCROLL    EQU   6  ; move one window down
GID_NAME          EQU   7  ; the name field for an object


* workbench does different complement modes for its gadgets.
* It supports separate images, complement mode, and backfill mode.
* The first two are identical to intuitions GADGIMAGE and GADGHCOMP.
* backfill is similar to GADGHCOMP, but the region outside of the
* image (which normally would be color three when complemented)
* is flood-filled to color zero.
*
GADGBACKFILL      EQU   $0001

* if an icon does not really live anywhere, set its current position
* to here
*
NO_ICON_POSITION  EQU   ($80000000)
```

File numbers for cross-reference listing:

1:adkbits.h	2:audio.h	3:blit.h	4:bootblock.h
5:cia.h	6:clip.h	7:clipboard.h	8:collide.h
9:console.h	10:conunit.h	11:copper.h	12:ctype.h
13:custom.h	14:dec.h	15:disk.h	16:diskfont.h
17:display.h	18:dmabits.h	19:dos.h	20:dosextens.h
21:error.h	22:fcntl.h	23:gameport.h	24:gels.h
25:gfx.h	26:gfxbase.h	27:gfxmacros.h	28:graphint.h
29:icon.h	30:input.h	31:inputevent.h	32:intbits.h
33:intuinternal.h	34:intuition.h	35:intuitionbase.h	36:iosl.h
37:keyboard.h	38:keymap.h	39:layers.h	40:limits.h
41:macros.h	42:math.h	43:mathffp.h	44:misc.h
45:narrator.h	46:parallel.h	47:potgo.h	48:printer.h
49:prtbase.h	50:rastport.h	51:regions.h	52:serial.h
53:sprite.h	54:startup.h	55:stdio.h	56:text.h
57:timer.h	58:trackdisk.h	59:translator.h	60:view.h
61:workbench.h			

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Listing of clib/macros.h:

```
/* Commodore-Amiga, Inc.     */
/* shortcuts used by c code */

#define MAX(a,b)      ((a)>(b)?(a):(b))
#define MIN(a,b)      ((a)<(b)?(a):(b))
#define ABS(x)        ((x<0)?(-(x)):(x))
```

Contents

```c
#ifndef  DEVICES_CONSOLE_H
#define  DEVICES_CONSOLE_H
/*********************************************************************/
/*               Commodore-Amiga, Inc.                               */
/*               console.h                                           */
/*********************************************************************/
/*********************************************************************
*
*  Console device command definitions
*
*   Source Control
*   --------------
*   $Header: console.h,v 1.4 85/11/13 15:13:14 kodiak Exp $
*
*   $Locker:  $
*
*********************************************************************/

#ifndef     EXEC_IO_H
#include "exec/io.h"
#endif

/****** Console commands ******/
#define  CD_ASKKEYMAP      (CMD_NONSTD+0)
#define  CD_SETKEYMAP      (CMD_NONSTD+1)


/****** SGR parameters ******/

#define SGR_PRIMARY        0
#define SGR_BOLD           1
#define SGR_ITALIC         3
#define SGR_UNDERSCORE     4
#define SGR_NEGATIVE       7

/* these names refer to the ANSI standard, not the implementation */
#define SGR_BLACK          30
#define SGR_RED            31
#define SGR_GREEN          32
#define SGR_YELLOW         33
#define SGR_BLUE           34
#define SGR_MAGENTA        35
#define SGR_CYAN           36
#define SGR_WHITE          37
#define SGR_DEFAULT        39

#define SGR_BLACKBG        40
#define SGR_REDBG          41
#define SGR_GREENBG        42
#define SGR_YELLOWBG       43
#define SGR_BLUEBG         44
#define SGR_MAGENTABG      45
#define SGR_CYANBG         46
#define SGR_WHITEBG        47
#define SGR_DEFAULTBG      49

/* these names refer to the implementation, they are the preferred   */
/* names for use with the Amiga console device.       */
#define SGR_CLR0           30
#define SGR_CLR1           31
#define SGR_CLR2           32
#define SGR_CLR3           33
#define SGR_CLR4           34
#define SGR_CLR5           35
#define SGR_CLR6           36
#define SGR_CLR7           37

#define SGR_CLR0BG         40
#define SGR_CLR1BG         41
#define SGR_CLR2BG         42
#define SGR_CLR3BG         43
#define SGR_CLR4BG         44
#define SGR_CLR5BG         45
#define SGR_CLR6BG         46
#define SGR_CLR7BG         47


/****** DSR parameters ******/

#define DSR_CPR            6

/****** CTC parameters ******/
#define  CTC_HSETTAB       0
#define  CTC_HCLRTAB       2
#define  CTC_HCLRTABSALL   5

/******  TBC parameters ******/
#define  TBC_HCLRTAB       0
#define  TBC_HCLRTABSALL   3

/******  SM and RM parameters ******/
#define  M_LNM    20       /* linefeed newline mode */
#define  M_ASM    ">1"     /* auto scroll mode */
#define  M_AWM    "?7"     /* auto wrap mode */

#endif
```

```
/***********************************************************************/
/*              Commodore-Amiga, Inc.                                  */
/*              conunit.h                                              */
/***********************************************************************/
/***********************************************************************
*
*  Console device unit definitions
*
***********************************************************************/

#ifndef  EXEC_PORTS_H
#include "exec/ports.h"
#endif

#ifndef  DEVICES_CONSOLE_H
#include "devices/console.h"
#endif

#ifndef  DEVICES_KEYMAP_H
#include "devices/keymap.h"
#endif

#ifndef  DEVICES_INPUTEVENT_H
#include "devices/inputevent.h"
#endif

#define  PMB_ASM     (M_LNM+1)   /* internal storage bit for AS flag */
#define  PMB_AWM     (PMB_ASM+1) /* internal storage bit for AW flag */
#define  MAXTABS     80


struct   ConUnit {
   struct   MsgPort cu_MP;
    /* ---- read only variables */
   struct   Window *cu_Window; /* intuition window bound to this unit */
   WORD  cu_XCP;              /* character position */
   WORD  cu_YCP;
   WORD  cu_XMax;             /* max character position */
   WORD  cu_YMax;
   WORD  cu_XRSize;           /* character raster size */
   WORD  cu_YRSize;
   WORD  cu_XROrigin;         /* raster origin */
   WORD  cu_YROrigin;
   WORD  cu_XRExtant;         /* raster maxima */
   WORD  cu_YRExtant;
   WORD  cu_XMinShrink;       /* smallest area intact from resize process */
   WORD  cu_YMinShrink;
   WORD  cu_XCCP;             /* cursor position */
   WORD  cu_YCCP;

   /* ---- read/write variables (writes must must be protected) */
   /* ---- storage for AskKeyMap and SetKeyMap */
   struct   KeyMap cu_KeyMapStruct;
   /* ---- tab stops */
   UWORD cu_TabStops[MAXTABS];   /* 0 at start, 0xffff at end of list */

   /* ---- console rastport attributes */
   BYTE     cu_Mask;
   BYTE     cu_FgPen;
   BYTE     cu_BgPen;
   BYTE     cu_AOLPen;
   BYTE     cu_DrawMode;
   BYTE     cu_AreaPtSz;
   APTR     cu_AreaPtrn;           /* cursor area pattern */
   UBYTE    cu_Minterms[8];        /* console minterms */
   struct   TextFont *cu_Font;
   UBYTE    cu_AlgoStyle;
   UBYTE    cu_TxFlags;
   UWORD    cu_TxHeight;
   UWORD    cu_TxWidth;
   UWORD    cu_TxBaseline;
   UWORD    cu_TxSpacing;

   /* ---- console MODES and RAW EVENTS switches */
   UBYTE    cu_Modes[(PMB_AWM+7)/8];   /* one bit per mode */
   UBYTE    cu_RawEvents[(IECLASS_MAX+7)/8];
};
```

```c
#ifndef  DEVICES_GAMEPORT_H
#define  DEVICES_GAMEPORT_H
/*******************************************************************/
/*                Commodore-Amiga, Inc.                            */
/*                gameport.h                                       */
/*******************************************************************/
/*******************************************************************
*
*  GamePort public definitions
*
*******************************************************************/

/******  GamePort commands ******/
#define  GPD_READEVENT     (CMD_NONSTD+0)
#define  GPD_ASKCTYPE      (CMD_NONSTD+1)
#define  GPD_SETCTYPE      (CMD_NONSTD+2)
#define  GPD_ASKTRIGGER    (CMD_NONSTD+3)
#define  GPD_SETTRIGGER    (CMD_NONSTD+4)

/******  GamePort structures ******/

/* gpt_Keys */
#define  GPTB_DOWNKEYS     0
#define  GPTF_DOWNKEYS     (1<<0)
#define  GPTB_UPKEYS       1
#define  GPTF_UPKEYS       (1<<1)

struct GamePortTrigger {
   UWORD gpt_Keys;         /* key transition triggers */
   UWORD gpt_Timeout;      /* time trigger (vertical blank units) */
   UWORD gpt_XDelta;       /* X distance trigger */
   UWORD gpt_YDelta;       /* Y distance trigger */
};

/****** Controller Types ******/
#define  GPCT_ALLOCATED    -1    /* allocated by another user */
#define  GPCT_NOCONTROLLER 0

#define  GPCT_MOUSE        1
#define  GPCT_RELJOYSTICK  2
#define  GPCT_ABSJOYSTICK  3


/****** Errors ******/
#define  GPDERR_SETCTYPE   1     /* this controller not valid at this time */

#endif
```

```c
#ifndef  DEVICES_INPUT_H
#define  DEVICES_INPUT_H
/*******************************************************************/
/*                Commodore-Amiga, Inc.                            */
/*                input.h                                          */
/*******************************************************************/
/*******************************************************************
*
*  input device command definitions
*
*******************************************************************/
#ifndef     EXEC_IO_H
#include "exec/io.h"
#endif

#define  IND_ADDHANDLER    (CMD_NONSTD+0)
#define  IND_REMHANDLER    (CMD_NONSTD+1)
#define  IND_WRITEEVENT    (CMD_NONSTD+2)
#define  IND_SETTHRESH     (CMD_NONSTD+3)
#define  IND_SETPERIOD     (CMD_NONSTD+4)
#define  IND_SETMPORT      (CMD_NONSTD+5)
#define  IND_SETMTYPE      (CMD_NONSTD+6)
#define  IND_SETMTRIG      (CMD_NONSTD+7)

#endif
```

```
#ifndef  DEVICES_INPUTEVENT_H
#define  DEVICES_INPUTEVENT_H
/***********************************************************************/
/*               Commodore-Amiga, Inc.                                 */
/*               inputevent.h                                          */
/***********************************************************************/
/**********************************************************************
*
* input event definitions
*
**********************************************************************/

#ifndef     DEVICES_TIMER_H
#include "devices/timer.h"
#endif

/*------ constants -------------------------------------------------*/

/*   --- InputEvent.ie_Class --- */
/* a NOP input event */
#define  IECLASS_NULL               0x00
/* a raw keycode from the keyboard device */
#define  IECLASS_RAWKEY             0x01
/* the raw mouse report from the game port device */
#define  IECLASS_RAWMOUSE           0x02
/* a private console event */
#define  IECLASS_EVENT              0x03
/* a pointer position report */
#define  IECLASS_POINTERPOS         0x04
/* a timer event */
#define  IECLASS_TIMER              0x06
/* select button pressed down over a gadget (address in ie_EventAddress) */
#define  IECLASS_GADGETDOWN         0x07
/* select button released over the same gadget (address in ie_EventAddress) */
#define  IECLASS_GADGETUP           0x08
/* some requester activity has taken place.  See codes REQCLEAR and REQSET */
#define  IECLASS_REQUESTER          0x09
/* this is a menu number transmission (menu number is in ie_Code) */
#define  IECLASS_MENULIST           0x0A
/* user has selected the active window's close gadget */
#define  IECLASS_CLOSEWINDOW        0x0B
/* this window has a new size */
#define  IECLASS_SIZEWINDOW         0x0C
/* the window pointed to by ie_EventAddress needs to be refreshed */
#define  IECLASS_REFRESHWINDOW      0x0D
/* new preferences are available */
#define  IECLASS_NEWPREFS           0x0E
/* the disk has been removed */
#define  IECLASS_DISKREMOVED        0x0F
/* the disk has been inserted */
#define  IECLASS_DISKINSERTED       0x10
/* the window is about to be been made active */
#define IECLASS_ACTIVEWINDOW        0x11
/* the window is about to be made inactive */
#define IECLASS_INACTIVEWINDOW      0x12


/* the last class */
#define  IECLASS_MAX                0x12



/*   --- InputEvent.ie_Code ---   */
/* IECLASS_RAWKEY */
#define  IECODE_UP_PREFIX          0x80
#define  IECODE_KEY_CODE_FIRST     0x00
#define  IECODE_KEY_CODE_LAST      0x77
#define  IECODE_COMM_CODE_FIRST    0x78
#define  IECODE_COMM_CODE_LAST     0x7F

/* IECLASS_ANSI */
#define  IECODE_C0_FIRST           0x00
#define  IECODE_C0_LAST            0x1F
#define  IECODE_ASCII_FIRST        0x20
#define  IECODE_ASCII_LAST         0x7E
#define  IECODE_ASCII_DEL          0x7F
#define  IECODE_C1_FIRST           0x80
#define  IECODE_C1_LAST            0x9F
#define  IECODE_LATIN1_FIRST       0xA0
#define  IECODE_LATIN1_LAST        0xFF

/* IECLASS_RAWMOUSE */
#define  IECODE_LBUTTON            0x68  /* also uses IECODE_UP_PREFIX */
#define  IECODE_RBUTTON            0x69
#define  IECODE_MBUTTON            0x6A
#define  IECODE_NOBUTTON           0xFF

/* IECLASS_EVENT */
#define  IECODE_NEWACTIVE          0x01  /* active input window changed */

/* IECLASS_REQUESTER Codes */
/* REQSET is broadcast when the first Requester (not subsequent ones) opens
 * in the Window
 */
#define  IECODE_REQSET             0x01
/* REQCLEAR is broadcast when the last Requester clears out of the Window */
#define  IECODE_REQCLEAR           0x00


/*   --- InputEvent.ie_Qualifier --- */
#define  IEQUALIFIER_LSHIFT        0x0001
#define  IEQUALIFIER_RSHIFT        0x0002
#define  IEQUALIFIER_CAPSLOCK      0x0004
#define  IEQUALIFIER_CONTROL       0x0008
#define  IEQUALIFIER_LALT          0x0010
#define  IEQUALIFIER_RALT          0x0020
#define  IEQUALIFIER_LCOMMAND      0x0040
#define  IEQUALIFIER_RCOMMAND      0x0080
#define  IEQUALIFIER_NUMERICPAD    0x0100
#define  IEQUALIFIER_REPEAT        0x0200
#define  IEQUALIFIER_INTERRUPT     0x0400
#define  IEQUALIFIER_MULTIBROADCAST 0x0800
#define  IEQUALIFIER_LBUTTON       0x1000
#define  IEQUALIFIER_RBUTTON       0x2000
#define  IEQUALIFIER_MBUTTON       0x4000
#define  IEQUALIFIER_RELATIVEMOUSE  0x8000

/*------ InputEvent ----------------------------------------------*/
```

```c
struct InputEvent {
    struct  InputEvent *ie_NextEvent; /* chronologically next event */
    UBYTE   ie_Class;                 /* input event class */
    UBYTE   ie_SubClass;              /* optional subclass of the class */
    UWORD   ie_Code;                  /* input event code */
    UWORD   ie_Qualifier;             /* qualifiers in effect for event*/
    union {
   struct {
       WORD    ie_x;                  /* pointer position for event*/
       WORD    ie_y;
   } ie_xy;
   APTR    ie_addr;
    } ie_position;
    struct timeval ie_TimeStamp;      /* system tick at event */
};

#define  ie_X      ie_position.ie_xy.ie_x
#define  ie_Y      ie_position.ie_xy.ie_y
#define  ie_EventAddress   ie_position.ie_addr

#endif
```

```c
#ifndef  DEVICES_KEYBOARD_H
#define  DEVICES_KEYBOARD_H
/*********************************************************************/
/*               Commodore-Amiga, Inc.                               */
/*               keyboard.h                                          */
/*********************************************************************/
/********************************************************************
*
*  Keyboard device command definitions
*
*********************************************************************/

#ifndef  EXEC_IO_H
#include "exec/io.h"
#endif

#define  KBD_READEVENT        (CMD_NONSTD+0)
#define  KBD_READMATRIX       (CMD_NONSTD+1)
#define  KBD_ADDRESETHANDLER  (CMD_NONSTD+2)
#define  KBD_REMRESETHANDLER  (CMD_NONSTD+3)
#define  KBD_RESETHANDLERDONE (CMD_NONSTD+4)

#endif
```

```c
#ifndef  DEVICES_KEYMAP_H
#define  DEVICES_KEYMAP_H
/*****************************************************************/
/*              Commodore-Amiga, Inc.                            */
/*              keymap.h                                         */
/*****************************************************************/
/*****************************************************************
*
*  console.device key map definitions
*
*****************************************************************/

struct   KeyMap {
   APTR  km_LoKeyMapTypes;
   APTR  km_LoKeyMap;
   APTR  km_LoCapsable;
   APTR  km_LoRepeatable;
   APTR  km_HiKeyMapTypes;
   APTR  km_HiKeyMap;
   APTR  km_HiCapsable;
   APTR  km_HiRepeatable;
};

#define  KCB_NOP     7
#define  KCF_NOP     0x80

#define  KC_NOQUAL   0
#define  KC_VANILLA  7          /* note that SHIFT+ALT+CTRL is VANILLA */
#define  KCF_SHIFT   0x01
#define  KCF_ALT     0x02
#define  KCB_CONTROL 2
#define  KCF_CONTROL 0x04
#define  KCB_DOWNUP  3
#define  KCF_DOWNUP  0x08

#define  KCB_STRING  6
#define  KCF_STRING  0x40

#endif
```

```c
#ifndef  DEVICES_NARRATOR_H
#define DEVICES_NARRATOR_H
/*********************************************************************/
/*              Commodore-Amiga, Inc.                                */
/*              narrator.h                                           */
/*********************************************************************/

#ifndef EXEC_IO_H
#include "exec/io.h"
#endif

      /*         Error Codes    */

#define ND_NoMem     -2    /* Can't allocate memory               */
#define ND_NoAudLib  -3    /* Can't open audio device             */
#define ND_MakeBad   -4    /* Error in MakeLibrary call           */
#define ND_UnitErr   -5    /* Unit other than 0                   */
#define ND_CantAlloc -6    /* Can't allocate audio channel(s)     */
#define ND_Unimpl    -7    /* Unimplemented command               */
#define ND_NoWrite   -8    /* Read for mouth without write first  */
#define ND_Expunged  -9    /* Can't open, deferred expunge bit set */
#define ND_PhonErr   -20   /* Phoneme code spelling error         */
#define ND_RateErr   -21   /* Rate out of bounds                  */
#define ND_PitchErr  -22   /* Pitch out of bounds                 */
#define ND_SexErr    -23   /* Sex not valid                       */
#define ND_ModeErr   -24   /* Mode not valid                      */
#define ND_FreqErr   -25   /* Sampling frequency out of bounds    */
#define ND_VolErr    -26   /* Volume out of bounds                */



        /* Input parameters and defaults */

#define DEFPITCH    110    /* Default pitch          */
#define DEFRATE     150    /* Default speaking rate (wpm)      */
#define DEFVOL      64     /* Default volume (full)      */
#define DEFFREQ     22200  /* Default sampling frequency (Hz)  */
#define MALE        0      /* Male vocal tract        */
#define FEMALE      1      /* Female vocal tract         */
#define NATURALF0   0      /* Natural pitch contours     */
#define ROBOTICF0   1      /* Monotone               */
#define DEFSEX      MALE   /* Default sex             */
#define DEFMODE     NATURALF0    /* Default mode        */



      /*      Parameter bounds   */

#define MINRATE     40     /* Minimum speaking rate      */
#define MAXRATE     400    /* Maximum speaking rate      */
#define MINPITCH    65     /* Minimum pitch          */
#define MAXPITCH    320    /* Maximum pitch          */
#define MINFREQ     5000   /* Minimum sampling frequency       */
#define MAXFREQ     28000  /* Maximum sampling frequency       */
#define MINVOL      0      /* Minimum volume            */
#define MAXVOL      64     /* Maximum volume            */
```

```
      /*    Standard Write request  */

struct narrator_rb {
   struct IOStdReq  message;  /* Standard IORB     */
   UWORD rate;           /* Speaking rate (words/minute) */
   UWORD pitch;          /* Baseline pitch in Hertz       */
   UWORD mode;           /* Pitch mode       */
   UWORD sex;            /* Sex of voice        */
   UBYTE *ch_masks;      /* Pointer to audio alloc maps   */
   UWORD nm_masks;       /* Number of audio alloc maps    */
   UWORD volume;         /* Volume. 0 (off) thru 64    */
   UWORD sampfreq;       /* Audio sampling freq      */
   UBYTE mouths;         /* If non-zero, generate mouths */
   UBYTE chanmask;       /* Which ch mask used (internal)*/
   UBYTE numchan;        /* Num ch masks used (internal) */
   UBYTE pad;            /* For alignment     */
    };



      /*    Standard Read request   */

struct mouth_rb {
   struct   narrator_rb voice;   /* Speech IORB       */
   UBYTE width;          /* Width (returned value)  */
   UBYTE height;         /* Height (returned value) */
   UBYTE shape;          /* Internal use, do not modify  */
   UBYTE pad;            /* For alignment     */
   };



#endif DEVICES_NARRATOR_H
```

```
/*********************************************************************/
/*                Commodore-Amiga, Inc.                              */
/*                parallel.h                                         */
/*********************************************************************/

/*******************************************************************
*
* external declarations for Parallel Port Driver
*
* SOURCE CONTROL
* ------ -------
* $Header: parallel.h,v 25.0 85/03/27 19:14:15 tomp Exp $
*
* $Locker:  $
*
*******************************************************************/

#ifndef DEVICES_PARALLEL_H
#define DEVICES_PARALLEL_H

#ifndef   EXEC_IO_H
#include "exec/io.h"
#endif   !EXEC_IO_H

 struct  IOPArray {
        ULONG PTermArray0;
        ULONG PTermArray1;
};

/*******************************************************************/
/* CAUTION !!  IF YOU ACCESS the parallel.device, you MUST (!!!!) use
   an IOExtPar-sized structure or you may overlay innocent memory !! */
/*******************************************************************/

 struct   IOExtPar {
        struct   IOStdReq IOPar;

/*     STRUCT   MsgNode
*   0  APTR     Succ
*   4  APTR     Pred
*   8  UBYTE    Type
*   9  UBYTE    Pri
*   A  APTR     Name
*   E  APTR     ReplyPort
*  12  UWORD    MNLength
*     STRUCT   IOExt
*  14  APTR     io_Device
*  18  APTR     io_Unit
*  1C  UWORD    io_Command
*  1E  UBYTE    io_Flags
*  1F  UBYTE    io_Error
*     STRUCT   IOStdExt
*  20  ULONG    io_Actual
*  24  ULONG    io_Length
*  28  APTR     io_Data
*  2C  ULONG    io_Offset
*  30 */
        ULONG   io_PExtFlags;    /* (not used) flag extension area */
        UBYTE   io_Status;       /* status of parallel port and registers */
```

```
        UBYTE   io_ParFlags;     /* see PARFLAGS bit definitions below */
        struct  IOPArray io_PTermArray; /* termination character array */
};

#define  PARB_SHARED    5          /* ParFlags non-exclusive access bit */
#define  PARF_SHARED    (1<<5)     /*    "     non-exclusive access mask */
#define  PARB_RAD_BOOGIE 3         /*    "     (not yet implemented) */
#define  PARF_RAD_BOOGIE (1<<3)    /*    "     (not yet implemented) */
#define  PARB_EOFMODE   1          /*    "     EOF mode enabled bit */
#define  PARF_EOFMODE   (1<<1)     /*    "     EOF mode enabled mask */
#define  IOPARB_QUEUED  6          /* IO_FLAGS rqst-queued bit */
#define  IOPARF_QUEUED  (1<<6)     /*    "     rqst-queued mask */
#define  IOPARB_ABORT   5          /*    "     rqst-aborted bit */
#define  IOPARF_ABORT   (1<<5)     /*    "     rqst-aborted mask */
#define  IOPARB_ACTIVE  4          /*    "     rqst-qued-or-current bit */
#define  IOPARF_ACTIVE  (1<<4)     /*    "     rqst-qued-or-current mask */
#define  IOPTB_RWDIR    3          /* IO_STATUS read=0,write=1 bit */
#define  IOPTF_RWDIR    (1<<3)     /*    "     read=0,write=1 mask */
#define  IOPTB_PBUSY    2          /*    "     printer in busy toggle bit */
#define  IOPTF_PBUSY    (1<<2)     /*    "     printer in busy toggle mask */
#define  IOPTB_PAPEROUT 1          /*    "     paper out bit */
#define  IOPTF_PAPEROUT (1<<1)     /*    "     paper out mask */
#define  IOPTB_PSEL     0          /*    "     printer selected bit */
#define  IOPTF_PSEL     (1<<0)     /*    "     printer selected mask */

#define PARALLELNAME            "parallel.device"

#define PDCMD_QUERY     (CMD_NONSTD)
#define PDCMD_SETPARAMS (CMD_NONSTD+1)

#define ParErr_DevBusy      1
#define ParErr_BufTooBig    2
#define ParErr_InvParam     3
#define ParErr_LineErr      4
#define ParErr_NotOpen      5
#define ParErr_PortReset    6
#define ParErr_InitErr      7

#endif !DEVICES_PARALLEL_H
```

```
#ifndef     DEVICES_PRINTER_H
#define     DEVICES_PRINTER_H
/*******************************************************************/
/*                Commodore-Amiga, Inc.                            */
/*                printer.h                                        */
/*******************************************************************/
/*******************************************************************
 *
 * printer device command definitions
 *
 *  Source Control
 *  --------------
 *  $Header: printer.h,v 1.2 85/10/09 16:16:10 kodiak Exp $
 *
 *  $Locker:  $
 *
 *******************************************************************/

#ifndef  EXEC_NODES_H
#include "exec/nodes.h"
#endif

#ifndef  EXEC_LISTS_H
#include "exec/lists.h"
#endif

#ifndef  EXEC_PORTS_H
#include "exec/ports.h"
#endif

#define  PRD_RAWWRITE      (CMD_NONSTD+0)
#define  PRD_PRTCOMMAND    (CMD_NONSTD+1)
#define  PRD_DUMPRPORT     (CMD_NONSTD+2)

/* printer command definitions */

#define aRIS     0  /* ESCc  reset                    ISO */
#define aRIN     1  /* ESC#1 initialize               +++ */
#define aIND     2  /* ESCD  lf                       ISO */
#define aNEL     3  /* ESCE  return,lf                ISO */
#define aRI      4  /* ESCM  reverse lf               ISO */

#define aSGR0    5  /* ESC[0m normal char set         ISO */
#define aSGR3    6  /* ESC[3m italics on              ISO */
#define aSGR23   7  /* ESC[23m italics off            ISO */
#define aSGR4    8  /* ESC[4m underline on            ISO */
#define aSGR24   9  /* ESC[24m underline off          ISO */
#define aSGR1   10  /* ESC[1m boldface on             ISO */
#define aSGR22  11  /* ESC[22m boldface off           ISO */
#define aSFC    12  /* SGR30-39  set foreground color ISO */
#define aSBC    13  /* SGR40-49  set background color ISO */

#define aSHORP0 14  /* ESC[0w normal pitch            DEC */
#define aSHORP2 15  /* ESC[2w elite on                DEC */
#define aSHORP1 16  /* ESC[1w elite off               DEC */
#define aSHORP4 17  /* ESC[4w condensed fine on       DEC */
#define aSHORP3 18  /* ESC[3w condensed off           DEC */
#define aSHORP6 19  /* ESC[6w enlarged on             DEC */
#define aSHORP5 20  /* ESC[5w enlarged off            DEC */
```

```
#define aDEN6   21  /* ESC[6"z shadow print on        DEC (sort of) */
#define aDEN5   22  /* ESC[5"z shadow print off       DEC */
#define aDEN4   23  /* ESC[4"z doublestrike on        DEC */
#define aDEN3   24  /* ESC[3"z doublestrike off       DEC */
#define aDEN2   25  /* ESC[2"z  NLQ on                DEC */
#define aDEN1   26  /* ESC[1"z  NLQ off               DEC */

#define aSUS2   27  /* ESC[2v superscript on          +++ */
#define aSUS1   28  /* ESC[1v superscript off         +++ */
#define aSUS4   29  /* ESC[4v subscript on            +++ */
#define aSUS3   30  /* ESC[3v subscript off           +++ */
#define aSUS0   31  /* ESC[0v normalize the line      +++ */
#define aPLU    32  /* ESCL  partial line up          ISO */
#define aPLD    33  /* ESCK  partial line down        ISO */

#define aFNT0   34  /* ESC(B US char set              DEC */
#define aFNT1   35  /* ESC(R French char set          DEC */
#define aFNT2   36  /* ESC(K German char set          DEC */
#define aFNT3   37  /* ESC(A UK char set              DEC */
#define aFNT4   38  /* ESC(E Danish I char set        DEC */
#define aFNT5   39  /* ESC(H Sweden char set          DEC */
#define aFNT6   40  /* ESC(Y Italian char set         DEC */
#define aFNT7   41  /* ESC(Z Spanish char set         DEC */
#define aFNT8   42  /* ESC(J Japanese char set        +++ */
#define aFNT9   43  /* ESC(6 Norweign char set        DEC */
#define aFNT10  44  /* ESC(C Danish II char set       +++ */

#define aPROP2  45  /* ESC[2p  proportional on        +++ */
#define aPROP1  46  /* ESC[1p  proportional off       +++ */
#define aPROP0  47  /* ESC[0p  proportional clear     +++ */
#define aTSS    48  /* ESC[n E set proportional offset ISO */
#define aJFY5   49  /* ESC[5 F auto left justify      ISO */
#define aJFY7   50  /* ESC[7 F auto right justify     ISO */
#define aJFY6   51  /* ESC[6 F auto full justify      ISO */
#define aJFY0   52  /* ESC[0 F auto justify off       ISO */
#define aJFY3   53  /* ESC[3 F letter space (justify) ISO (special) */
#define aJFY1   54  /* ESC[1 F word fill(auto center) ISO (special) */

#define aVERP0  55  /* ESC[0z  1/8" line spacing      +++ */
#define aVERP1  56  /* ESC[1z  1/6" line spacing      +++ */
#define aSLPP   57  /* ESC[nt  set form length n      DEC */
#define aPERF   58  /* ESC[nq  perf skip n (n>0)      +++ */
#define aPERF0  59  /* ESC[0q  perf skip off          +++ */

#define aLMS    60  /* ESC#9   Left margin set        +++ */
#define aRMS    61  /* ESC#0   Right margin set       +++ */
#define aTMS    62  /* ESC#8   Top margin set         +++ */
#define aBMS    63  /* ESC#2   Bottom marg set        +++ */
#define aSTBM   64  /* ESC[Pn1;Pn2r  T&B margins      DEC */
#define aSLRM   65  /* ESC[Pn1;Pn2s  L&R margin       DEC */
#define aCAM    66  /* ESC#3   Clear margins          +++ */

#define aHTS    67  /* ESCH    Set horiz tab          ISO */
#define aVTS    68  /* ESCJ    Set vertical tabs      ISO */
#define aTBC0   69  /* ESC[0g  Clr horiz tab          ISO */
#define aTBC3   70  /* ESC[3g  Clear all h tab        ISO */
#define aTBC1   71  /* ESC[1g  Clr vertical tabs      ISO */
#define aTBC4   72  /* ESC[4g  Clr all v tabs         ISO */
#define aTBCALL 73  /* ESC#4   Clr all h & v tabs     +++ */
#define aTBSALL 74  /* ESC#5   Set default tabs       +++ */
#define aEXTEND 75  /* ESC[Pn"x extended commands     +++ */

struct IOPrtCmdReq {
    struct  Message io_Message;
    struct  Device  *io_Device;     /* device node pointer  */
    struct  Unit    *io_Unit;       /* unit (driver private)*/
    UWORD   io_Command;             /* device command */
    UBYTE   io_Flags;
    BYTE    io_Error;               /* error or warning num */
    UWORD   io_PrtCommand;          /* printer command */
    UBYTE   io_Parm0;               /* first command parameter */
    UBYTE   io_Parm1;               /* second command parameter */
    UBYTE   io_Parm2;               /* third command parameter */
    UBYTE   io_Parm3;               /* fourth command parameter */
};

struct IODRPReq {
    struct  Message io_Message;
    struct  Device  *io_Device;     /* device node pointer  */
    struct  Unit    *io_Unit;       /* unit (driver private)*/
    UWORD   io_Command;             /* device command */
    UBYTE   io_Flags;
    BYTE    io_Error;               /* error or warning num */
    struct  RastPort *io_RastPort;  /* raster port */
    struct  ColorMap *io_ColorMap;  /* color map */
    ULONG   io_Modes;               /* graphics viewport modes */
    UWORD   io_SrcX;                /* source x origin */
    UWORD   io_SrcY;                /* source y origin */
    UWORD   io_SrcWidth;            /* source x width */
    UWORD   io_SrcHeight;           /* source x height */
    LONG    io_DestCols;            /* destination x width */
    LONG    io_DestRows;            /* destination y height */
    UWORD   io_Special;             /* option flags */
};

#define  SPECIAL_MILCOLS   0x001    /* DestCols specified in 1/1000" */
#define  SPECIAL_MILROWS   0x002    /* DestRows specified in 1/1000" */
#define  SPECIAL_FULLCOLS  0x004    /* make DestCols maximum possible */
#define  SPECIAL_FULLROWS  0x008    /* make DestRows maximum possible */
#define  SPECIAL_FRACCOLS  0x010    /* DestCols is fraction of FULLCOLS */
#define  SPECIAL_FRACROWS  0x020    /* DestRows is fraction of FULLROWS */
#define  SPECIAL_ASPECT    0x080    /* ensure correct aspect ratio */
#define  SPECIAL_DENSITYMASK  0xf00 /* masks out density bits */
#define  SPECIAL_DENSITY1  0x100    /* lowest res */
#define  SPECIAL_DENSITY2  0x200    /* next res */
#define  SPECIAL_DENSITY3  0x300    /* next res */
#define  SPECIAL_DENSITY4  0x400    /* highest res */

#define  PDERR_CANCEL           1   /* user canceled a printer timeout */
#define  PDERR_NOTGRAPHICS      2   /* printer cannot output graphics */
#define  PDERR_INVERTHAM        3   /* cannot invert hold & modify print */
#define  PDERR_BADDIMENSION     4   /* print dimensions illegal */
#define  PDERR_DIMENSIONOVFLOW    5 /* print dimensions too large */
#define  PDERR_INTERNALMEMORY 6     /* no memory for internal variables */
#define  PDERR_BUFFERMEMORY   7     /* no memory for print buffer */
#endif
```

```c
/**********************************************************************/
/*              Commodore-Amiga, Inc.                                 */
/*              prtbase.h                                             */
/**********************************************************************/
/**********************************************************************
 *
 * printer device data definition
 *
 **********************************************************************/

#ifndef  DEVICES_PRTBASE_H
#define  DEVICES_PRTBASE_H


#ifndef  EXEC_NODES_H
#include "exec/nodes.h"
#endif
#ifndef  EXEC_LISTS_H
#include "exec/lists.h"
#endif
#ifndef  EXEC_PORTS_H
#include "exec/ports.h"
#endif
#ifndef  EXEC_LIBRARIES_H
#include "exec/libraries.h"
#endif
#ifndef  EXEC_TASKS_H
#include "exec/tasks.h"
#endif

#ifndef  DEVICES_PARALLEL_H
#include "devices/parallel.h"
#endif
#ifndef  DEVICES_SERIAL_H
#include "devices/serial.h"
#endif
#ifndef  DEVICES_TIMER_H
#include "devices/timer.h"
#endif
#ifndef  LIBRARIES_DOSEXTENS_I
#include "libraries/dosextens.h"
#endif
#ifndef  INTUITION_INTUITION_H
#include "intuition/intuition.h"
#endif


struct DeviceData {
    struct Library dd_Device; /* standard library node */
    APTR dd_Segment;          /* A0 when initialized */
    APTR dd_ExecBase;         /* A6 for exec */
    APTR dd_CmdVectors;       /* command table for device commands */
    APTR dd_CmdBytes;         /* bytes describing which command queue */
    UWORD   dd_NumCommands;   /* the number of commands supported */
};


#define  P_STKSIZE   0x800

struct   PrinterData {
   struct   DeviceData pd_Device;
   struct   MsgPort pd_Unit;  /* the one and only unit */
   BPTR     pd_PrinterSegment;   /* the printer specific segment */
   UWORD    pd_PrinterType;   /* the segment printer type */
   struct   PrinterSegment *pd_SegmentData; /* the segment data structure */
   UBYTE    *pd_PrintBuf;     /* the raster print buffer */
   VOID     (*pd_PWrite)();   /* the write function */
   VOID     (*pd_PBothReady)();  /* write function's done */
   union {                    /* port I/O request 0 */
   struct IOExtPar pd_p0;
   struct IOExtSer pd_s0;
    } pd_ior0;
#define  pd_PIOR0 pd_ior0.pd_p0
#define  pd_SIOR0 pd_ior0.pd_s0
    union {                   /*   and 1 for double buffering */
   struct IOExtPar pd_p1;
   struct IOExtSer pd_s1;
    } pd_ior1;
#define  pd_PIOR1 pd_ior1.pd_p1
#define  pd_SIOR1 pd_ior1.pd_s1
    struct timerequest pd_TIOR;  /* timer I/O request */
    struct MsgPort pd_IORPort;   /*   and message reply port */
    struct Task pd_TC;           /* write task */
    UBYTE pd_Stk[P_STKSIZE];     /*   and stack space */
    UBYTE pd_Flags;              /* device flags */
    UBYTE pd_pad;
    struct Preferences pd_Preferences; /* the latest preferences */
    UBYTE   pd_PWaitEnabled;     /* wait function switch */
};

#define  PPCB_GFX 0
#define  PPCF_GFX 0x01
#define  PPCB_COLOR  1
#define  PPCF_COLOR  0x02

#define  PPC_BWALPHA 0
#define  PPC_BWGFX   1
#define  PPC_COLORGFX   3

#define  PCC_BW      1
#define  PCC_YMC     2
#define  PCC_YMC_BW  3
#define  PCC_YMCB 4

struct PrinterExtendedData {
    char    *ped_PrinterName;    /* printer name, null terminated */
    VOID    (*ped_Init)();       /* called after LoadSeg */
    VOID    (*ped_Expunge)();    /* called before UnLoadSeg */
    VOID    (*ped_Open)();       /* called at OpenDevice */
    VOID    (*ped_Close)();      /* called at CloseDevice */
    UBYTE   ped_PrinterClass;    /* printer class */
    UBYTE   ped_ColorClass;      /* color class */
    UBYTE   ped_MaxColumns;      /* number of print columns available */
    UBYTE   ped_NumCharSets;     /* number of character sets */
    UWORD   ped_NumRows;         /* number of raster rows in a raster dump */
    ULONG   ped_MaxXDots;        /* number of dots maximum in a raster dump *
    ULONG   ped_MaxYDots;        /* number of dots maximum in a raster dump *
    UWORD   ped_XDotsInch;       /* horizontal dot density */
    UWORD   ped_YDotsInch;       /* vertical dot density */
```

```c
    char    ***ped_Commands;     /* printer text command table */
    VOID    (*ped_DoSpecial)();  /* special command handler */
    VOID    (*ped_Render)();     /* raster render function */
    LONG    ped_TimeoutSecs;     /* good write timeout */
};

struct PrinterSegment {
    ULONG   ps_NextSegment;      /* (actually a BPTR) */
    ULONG   ps_runAlert;         /* MOVEQ #0,D0 : RTS */
    UWORD   ps_Version;          /* segment version */
    UWORD   ps_Revision;         /* segment revision */
    struct  PrinterExtendedData ps_PED;   /* printer extended data */
};
#endif
```

```c
/*********************************************************************/
/*                Commodore-Amiga, Inc.                              */
/*                serial.h                                           */
/*********************************************************************/
/*****************************************************************
*
* external declarations for Serial Port Driver
*
* SOURCE CONTROL
* ------ -------
* $Header: serial.h,v 25.0 85/03/27 19:14:15 tomp Exp $
*
* $Locker:  $
*
*****************************************************************/
#ifndef DEVICES_SERIAL_H
#define DEVICES_SERIAL_H

#ifndef   EXEC_IO_H
#include "exec/io.h"
#endif   !EXEC_IO_H

                   /* array of termination char's */
                   /* to use,see serial.doc setparams */

 struct  IOTArray {
        ULONG TermArray0;
        ULONG TermArray1;
};

/*********************************************************************/
/* CAUTION !!  IF YOU ACCESS the serial.device, you MUST (!!!!) use */
/* an IOExtSer-sized structure or you may overlay innocent memory !!*/
/*********************************************************************/
 struct  IOExtSer {
        struct   IOStdReq IOSer;

/*      STRUCT   MsgNode
*   0   APTR     Succ
*   4   APTR     Pred
*   8   UBYTE    Type
*   9   UBYTE    Pri
*   A   APTR     Name
*   E   APTR     ReplyPort
*  12   UWORD    MNLength
*     STRUCT   IOExt
*  14   APTR     io_Device
*  18   APTR     io_Unit
*  1C   UWORD    io_Command
*  1E   UBYTE    io_Flags
*  1F   UBYTE    io_Error
*     STRUCT   IOStdExt
*  20   ULONG    io_Actual
*  24   ULONG    io_Length
*  28   APTR     io_Data
*  2C   ULONG    io_Offset
*

* IMPORTANT !! DON'T CHANGE the long-word alignment of ANY of these fields !!
```

```
*                           You can add to the end if you must do something.
*  30 */
   ULONG   io_CtlChar;    /* control char's (order = xON,xOFF,INQ,ACK) */
   ULONG   io_RBufLen;    /* length in bytes of serial port's read buffer */
   ULONG   io_ExtFlags;   /* (not used) flag extension area */
   ULONG   io_Baud;       /* baud rate requested (true baud) */
   ULONG   io_BrkTime;    /* duration of break signal in MICROseconds */
   struct  IOTArray io_TermArray; /* termination character array */
   UBYTE   io_ReadLen;    /* bits per read character (bit count) */
   UBYTE   io_WriteLen;   /* bits per write character (bit count) */
   UBYTE   io_StopBits;   /* stopbits for read (count) */
   UBYTE   io_SerFlags;   /* see SerFlags bit definitions below  */
   UWORD   io_Status;
};
   /* status of serial port, as follows:
*                 BIT  ACTIVE  FUNCTION
*                  0    low    busy
*                  1    low    paper out
*                  2    low    select
*                  3    low    Data Set Ready
*                  4    low    Clear To Send
*                  5    low    Carrier Detect
*                  6    low    Ready To Send
*                  7    low    Data Terminal Ready
*                  8    high   read overrun
*                  9    high   break sent
*                 10    high   break received
*                 11    high   transmit x-OFFed
*                 12    high   receive x-OFFed
*              13-15    (not)  reserved
*/

#define   SDCMD_QUERY          CMD_NONSTD
#define   SDCMD_BREAK         (CMD_NONSTD+1)
#define   SDCMD_SETPARAMS     (CMD_NONSTD+2)

#define SERB_XDISABLED  7       /* SerFlags xOn-xOff feature disabled bit */
#define SERF_XDISABLED  (1<<7)  /*    "     xOn-xOff feature disabled mask */
#define  SERB_EOFMODE   6       /*    "     EOF mode enabled bit */
#define  SERF_EOFMODE   (1<<6)  /*    "     EOF mode enabled mask */
#define  SERB_SHARED    5       /*    "     non-exclusive access bit */
#define  SERF_SHARED    (1<<5)  /*    "     non-exclusive access mask */
#define SERB_RAD_BOOGIE 4       /*    "     high-speed mode active bit */
#define SERF_RAD_BOOGIE (1<<4)  /*    "     high-speed mode active mask */
#define  SERB_QUEUEDBRK 3       /*    "     queue this Break ioRqst */
#define  SERF_QUEUEDBRK (1<<3)  /*    "     queue this Break ioRqst */
#define  SERB_7WIRE     2       /*    "     RS232 7-wire protocol */
#define  SERF_7WIRE     (1<<2)  /*    "     RS232 7-wire protocol */
#define  SERB_PARTY_ODD 1       /*    "     parity feature enabled bit */
#define  SERF_PARTY_ODD (1<<1)  /*    "     parity feature enabled mask */
#define  SERB_PARTY_ON  0       /*    "     parity-enabled bit */
#define  SERF_PARTY_ON  (1<<0)  /*    "     parity-enabled mask */
#define  IOSERB_BUFRREAD 7      /* io_Flags from read buffer bit */
#define  IOSERF_BUFRREAD (1<<7) /*    "     from read buffer mask */
#define  IOSERB_QUEUED  6       /*    "     rqst-queued bit */
#define  IOSERF_QUEUED  (1<<6)  /*    "     rqst-queued mask */
#define  IOSERB_ABORT   5       /*    "     rqst-aborted bit */
#define  IOSERF_ABORT   (1<<5)  /*    "     rqst-aborted mask */
#define  IOSERB_ACTIVE  4       /*    "     rqst-qued-or-current bit */
#define  IOSERF_ACTIVE  (1<<4)  /*    "     rqst-qued-or-current mask */
#define  IOSTB_XOFFREAD 4       /* iost_hob receive currently xOFF'ed bit */
#define  IOSTF_XOFFREAD (1<<4)  /*    "     receive currently xOFF'ed mask */
#define  IOSTB_XOFFWRITE 3      /*    "     transmit currently xOFF'ed bit */
#define  IOSTF_XOFFWRITE (1<<3) /*    "     transmit currently xOFF'ed mask *
#define  IOSTB_READBREAK 2      /*    "     break was latest input bit */
#define  IOSTF_READBREAK (1<<2) /*    "     break was latest input mask */
#define  IOSTB_WROTEBREAK 1     /*    "     break was latest output bit */
#define  IOSTF_WROTEBREAK (1<<1) /*   "     break was latest output mask */
#define  IOSTB_OVERRUN  0       /*    "     status word RBF overrun bit */
#define  IOSTF_OVERRUN  (1<<0)  /*    "     status word RBF overrun mask */

#define SerErr_DevBusy          1
#define SerErr_BaudMismatch     2
#define SerErr_InvBaud          3
#define SerErr_BufErr           4
#define SerErr_InvParam         5
#define SerErr_LineErr          6
#define SerErr_NotOpen          7
#define SerErr_PortReset        8
#define SerErr_ParityErr        9
#define SerErr_InitErr         10
#define SerErr_TimerErr        11
#define SerErr_BufOverflow     12
#define SerErr_NoDSR           13
#define SerErr_NoCTS           14
#define SerErr_DetectedBreak   15

#define SERIALNAME     "serial.device"

#endif !DEVICES_SERIAL_H
```

```c
/*********************************************************************/
/*                 Commodore-Amiga, Inc.                             */
/*                 timer.h                                           */
/*********************************************************************/
/********************************************************************
*
* SOURCE CONTROL
* ------ -------
* $Header: timer.h,v 27.1 85/06/24 13:32:37 neil Exp $
*
* $Locker:  $
*
*********************************************************************/

#ifndef DEVICES_TIMER_H
#define DEVICES_TIMER_H

#ifndef EXEC_IO_H
#include "exec/io.h"
#endif EXEC_IO_H

/* unit defintions */
#define UNIT_MICROHZ 0
#define UNIT_VBLANK  1

#define TIMERNAME "timer.device"

struct timeval {
    ULONG tv_secs;
    ULONG tv_micro;
};

struct timerequest {
    struct IORequest tr_node;
    struct timeval tr_time;
};

/* IO_COMMAND to use for adding a timer */
#define TR_ADDREQUEST   CMD_NONSTD
#define TR_GETSYSTIME   (CMD_NONSTD+1)
#define TR_SETSYSTIME   (CMD_NONSTD+2)

#endif DEVICES_TIMER_H
```

```c
/*********************************************************************/
/*                 Commodore-Amiga, Inc.                             */
/*                 trackdisk.h                                       */
/*********************************************************************/
/********************************************************************
*
* trackdisk.h
*
* Source Control
* ------ -------
*
* $Header: trackdisk.h,v 27.3 85/07/12 23:16:05 neil Exp $
*
* $Locker:  $
*
*********************************************************************/


#ifndef DEVICES_TRACKDISK_H
#define DEVICES_TRACKDISK_H

#ifndef EXEC_IO_H
#include "exec/io.h"
#endif !EXEC_IO_H

/*
 *--------------------------------------------------------------------
 *
 * Physical drive constants
 *
 *--------------------------------------------------------------------
 */

#define  NUMCYLS  80             /*  normal # of cylinders */
#define  MAXCYLS  (NUMCYLS+20)   /* max # cyls to look for during cal */
#define  NUMSECS  11
#define  NUMHEADS 2
#define  MAXRETRY 10
#define  NUMTRACKS (NUMCYLS*NUMHEADS)
#define NUMUNITS 4

/*
 *--------------------------------------------------------------------
 *
 * Useful constants
 *
 *--------------------------------------------------------------------
 */

/*-- sizes before mfm encoding */
#define  TD_SECTOR 512
#define  TD_SECSHIFT 9        /* log TD_SECTOR */

/*
 *--------------------------------------------------------------------
 *
 * Driver Specific Commands
 *
 *--------------------------------------------------------------------
```

```c
 */

/*
 *-- TD_NAME is a generic macro to get the name of the driver.  This
 *-- way if the name is ever changed you will pick up the change
 *-- automatically.
 *--
 *-- Normal usage would be:
 *--
 *-- char internalName[] = TD_NAME;
 *--
 */

#define  TD_NAME  "trackdisk.device"

#define  TDF_EXTCOM (1<<15)           /* for internal use only! */


#define  TD_MOTOR       (CMD_NONSTD+0) /* control the disk's motor */
#define  TD_SEEK        (CMD_NONSTD+1) /* explicit seek (for testing) */
#define  TD_FORMAT      (CMD_NONSTD+2) /* format disk */
#define  TD_REMOVE      (CMD_NONSTD+3) /* notify when disk changes */
#define  TD_CHANGENUM   (CMD_NONSTD+4) /* number of disk changes */
#define  TD_CHANGESTATE (CMD_NONSTD+5) /* is there a disk in the drive? */
#define  TD_PROTSTATUS  (CMD_NONSTD+6) /* is the disk write protected? */

#define  TD_LASTCOMM TD_PROTSTATUS

/*
 *
 * The disk driver has an "extended command" facility.  These commands
 * take a superset of the normal IO Request block.
 *
 */

#define  ETD_WRITE   (CMD_WRITE|TDF_EXTCOM)
#define  ETD_READ    (CMD_READ|TDF_EXTCOM)
#define  ETD_MOTOR   (TD_MOTOR|TDF_EXTCOM)
#define  ETD_SEEK    (TD_SEEK|TDF_EXTCOM)
#define  ETD_FORMAT  (TD_FORMAT|TDF_EXTCOM)
#define  ETD_UPDATE  (CMD_UPDATE|TDF_EXTCOM)
#define  ETD_CLEAR   (CMD_CLEAR|TDF_EXTCOM)

/*
 *
 * extended IO has a larger than normal io request block.
 *
 */

struct IOExtTD {
   struct   IOStdReq iotd_Req;
   ULONG iotd_Count;
   ULONG iotd_SecLabel;
};

/* labels are TD_LABELSIZE bytes per sector */

#define  TD_LABELSIZE 16

/*
 *----------------------------------------------------------------------
 *
 * Driver error defines
 *
 *----------------------------------------------------------------------
 */

#define  TDERR_NotSpecified   20
#define  TDERR_NoSecHdr       21
#define  TDERR_BadSecPreamble 22
#define  TDERR_BadSecID       23
#define  TDERR_BadHdrSum      24
#define  TDERR_BadSecSum      25
#define  TDERR_TooFewSecs     26
#define  TDERR_BadSecHdr      27
#define  TDERR_WriteProt      28
#define  TDERR_DiskChanged    29
#define  TDERR_SeekError      30
#define  TDERR_NoMem          31
#define  TDERR_BadUnitNum     32
#define  TDERR_BadDriveType   33
#define  TDERR_DriveInUse     34

#endif DEVICES_TRACKDISK_H
```

Contents

```
#ifndef GRAPHICS_CLIP_H
#define GRAPHICS_CLIP_H

#ifndef GRAPHICS_GFX_H
#include <graphics/gfx.h>
#endif
#ifndef EXEC_PORTS_H
#include <exec/ports.h>
#endif

/********************************************************************/
/*                Commodore-Amiga, Inc.                              */
/*                clip.h                                             */
/********************************************************************/
/*
*   Modification History
*   date    :   author :    Comments
*  -------      ------      ---------------------------------------
*   02-04-85    Dale        created file from graph.h
*******************************************************************/

/* structures used by and constructed by windowlib.a */
/* understood by rom software */

struct Layer
{
    struct  Layer *front,*back;     /* ignored by roms */
    struct  ClipRect    *ClipRect;  /* read by roms to find first cliprect */
    struct  RastPort    *rp;        /* ignored by roms, I hope */
    struct  Rectangle   bounds;     /* ignored by roms */
    UBYTE   Lock;                   /* roms, obey locking/unlocking
                                       convention */
    UBYTE   LockCount;              /* roms can nest their own locks and
                                       still work */
    UBYTE   LayerLockCount;         /* lock counter used by layer software */
    UBYTE   reserved;
    UWORD   reserved1;
    UWORD   Flags;                  /* obscured ?, Virtual BitMap? */
    struct  BitMap *SuperBitMap;
    struct  ClipRect *SuperClipRect; /* super bitmap cliprects if
                                        VBitMap != 0*/
                                  /* else damage cliprect list for refresh */
    APTR    Window;                 /* reserved for user interface use */
    SHORT   Scroll_X,Scroll_Y;
    struct  MsgPort LockPort;
    struct  Message LockMessage;
    struct  MsgPort ReplyPort;
    struct  Message l_LockMessage;
    struct  Region  *DamageList;    /* list of rectangles to refresh
                                       through */
   struct   ClipRect *_cliprects;   /* system use during refresh */
   struct   Layer_Info  *LayerInfo; /* points to head of the list */
   struct   Task  *LayerLocker;     /* points to task that has layerlock */
   struct   ClipRect *SuperSaveClipRects; /* preallocated cr's */
   struct   ClipRect *cr,*cr2,*crnew;  /* used by dedice */
   APTR  _p1;                       /* system use, reserved */
};

struct ClipRect
```

```
{
    struct  ClipRect *Next;         /* roms used to find next ClipRect */
    struct  ClipRect *prev;         /* ignored by roms, used by windowlib */
    struct  Layer   *lobs;          /* ignored by roms, used by windowlib */
    struct  BitMap  *BitMap;
    struct  Rectangle   bounds;     /* set up by windowlib, used by roms */
    struct  ClipRect *_p1,*_p2;     /* system reserved */
    LONG    reserved;               /* system use */
#ifdef NEWCLIPRECTS_1_1
    LONG    Flags;                  /* only exists in layer allocation */
#endif
};

/* internal cliprect flags */
#define CR_NEEDS_NO_CONCEALED_RASTERS  1

/* defines for code values for getcode */
#define ISLESSX 1
#define ISLESSY 2
#define ISGRTRX 4
#define ISGRTRY 8
#endif
```

```
#ifndef GRAPHICS_COLLIDE_H
#define GRAPHICS_COLLIDE_H
/********************************************************************/
/*                                                                  */
/*              Commodore-Amiga, Inc.                               */
/*                                                                  */
/*                  Modification History                            */
/*  date     :  author :   Comments                                 */
/*  -------     ------  ------------------------------------------- */
/*  8-24-84     Dale       added this header file                   */
/*                                                                  */
/********************************************************************/

/* include file for collision detection and control */

/* These bit descriptors are used by the GEL collide routines.
 *  These bits are set in the hitMask and meMask variables of
 *  a GEL to describe whether or not these types of collisions
 *  can affect the GEL.  BNDRY_HIT is described further below;
 *  this bit is permanently assigned as the boundary-hit flag.
 *  The other bit GEL_HIT is meant only as a default to cover
 *  any GEL hitting any other; the user may redefine this bit.
 */
#define BORDERHIT 0

/* These bit descriptors are used by the GEL boundry hit routines.
 *  When the user's boundry-hit routine is called (via the argument
 *  set by a call to SetCollision) the first argument passed to
 *  the user's routine is the address of the GEL involved in the
 *  boundry-hit, and the second argument has the appropriate bit(s)
 *  set to describe which boundry was surpassed
 */
#define TOPHIT    1
#define BOTTOMHIT 2
#define LEFTHIT   4
#define RIGHTHIT  8

#endif
```

```
#ifndef GRAPHICS_COPPER_H
#define GRAPHICS_COPPER_H
/****** copper.h ****************************************************/
/*                                                                  */
/*              Commodore-Amiga, Inc.                               */
/*                                                                  */
/*                  Modification History                            */
/*  date    :   author :    Comments                                */
/*  -------     ------      ------------------------------------- */
/*  8-24-84     Dale        added this header file                  */
/*  9-11-84     Dale        redefined with unions                   */
/*  2-09-85     Dale        made #defines for union ignorance       */
/********************************************************************/

#define COPPER_MOVE 0       /* pseude opcode for move #XXXX,dir */
#define COPPER_WAIT 1       /* pseudo opcode for wait y,x */
#define CPRNXTBUF   2       /* continue processing with next buffer */
#define CPR_NT_LOF  0x8000  /* copper instruction only for short frames */
#define CPR_NT_SHT  0x4000  /* copper instruction only for long frames */
struct CopIns
{
    short   OpCode; /* 0 = move, 1 = wait */
    union
    {
    struct CopList *nxtlist;
    struct
    {
   union
   {
   SHORT   VWaitPos;        /* vertical beam wait */
   SHORT   DestAddr;        /* destination address of copper move */
   } u1;
   union
   {
   SHORT   HWaitPos;        /* horizontal beam wait position */
   SHORT   DestData;        /* destination immediate data to send */
   } u2;
    } u4;
    } u3;
};
/* shorthand for above */
#define NXTLIST     u3.nxtlist
#define VWAITPOS    u3.u4.u1.VWaitPos
#define DESTADDR    u3.u4.u1.DestAddr
#define HWAITPOS    u3.u4.u2.HWaitPos
#define DESTDATA    u3.u4.u2.DestData


/* structure of cprlist that points to list that hardware actually executes */
struct cprlist
{
    struct cprlist *Next;
    UWORD   *start;         /* start of copper list */
    SHORT   max;            /* number of long instructions */
};

struct CopList
{
    struct  CopList *Next;  /* next block for this copper list */
    struct  CopList *_CopList;  /* system use */
    struct  ViewPort *_ViewPort;    /* system use */
    struct  CopIns *CopIns; /* start of this block */
    struct  CopIns *CopPtr; /* intermediate ptr */
    UWORD   *CopLStart;     /* mrgcop fills this in for Long Frame*/
    UWORD   *CopSStart;     /* mrgcop fills this in for Short Frame*/
    SHORT   Count;          /* intermediate counter */
    SHORT   MaxCount;       /* max # of copins for this block */
    SHORT   DyOffset;       /* offset this copper list vertical waits */
};

struct UCopList
{
    struct UCopList *Next;
    struct CopList  *FirstCopList; /* head node of this copper list */
    struct CopList  *CopList;      /* node in use */
};

struct copinit
{
    UWORD diagstrt[4];      /* copper list for first bitplane */
    UWORD sprstrtup[(2*8*2)+2+(2*2)+2];
    UWORD   sprstop[2];
};

#endif
```

```
/****** display.h ***********************************************/
/*                                                                */
/*              Commodore-Amiga, Inc.                             */
/*                                                                */
/*                 Modification History                           */
/*  date    :  author :    Comments                               */
/*  -------    ------      ------------------------------------- */
/*  8-24-84    Dale        added this header file                 */
/*                                                                */
/******************************************************************/

/* include define file for display control registers */
/* bplcon0 defines */
#define MODE_640      0x8000
#define PLNCNTMSK     0x7              /* how many bit planes? */
                                       /* 0 = none, 1->6 = 1->6, 7 = reserved */
#define PLNCNTSHFT  12                 /* bits to shift for bplcon0 */
#define PF2PRI        0x40             /* bplcon2 bit */
#define COLORON       0x0200           /* disable color burst */
#define DBLPF         0x400
#define HOLDNMODIFY 0x800
#define INTERLACE     4                /* interlace mode for 400 */

/* bplcon1 defines */
#define PFA_FINE_SCROLL        0xF
#define PFB_FINE_SCROLL_SHIFT 4
#define PF_FINE_SCROLL_MASK    0xF

/* display window start and stop defines */
#define DIW_HORIZ_POS    0x7F       /* horizontal start/stop */
#define DIW_VRTCL_POS    0x1FF      /* vertical start/stop */
#define DIW_VRTCL_POS_SHIFT 7

/* Data fetch start/stop horizontal position */
#define DFTCH_MASK       0xFF

/* vposr bits */
#define VPOSRLOF         0x8000
```

```
#ifndef GRAPHICS_GELS_H
#define GRAPHICS_GELS_H

/****************************************************************************
 *
 * include file for AMIGA GELS (Graphics Elements)
 *
 *              Commodore-Amiga, Inc.
 *
 *                 Modification History
 *  date    :  author :    Comments
 *  -------    ------      --------------------------------------
 *  8-24-84    Dale        added this header file
 *  9-28-84    -=RJ=-      for GELS16 added Bob.h to this file
 *                         made name and declaration changes
 *
 ****************************************************************************/


/* VSprite flags */
/* user-set VSprite flags: */
#define SUSERFLAGS  0x00FF    /* mask of all user-settable VSprite-flags */
#define VSPRITE     0x0001    /* set if VSprite, clear if Bob */
#define SAVEBACK    0x0002    /* set if background is to be saved/restored */
#define OVERLAY     0x0004    /* set to mask image of Bob onto background */
#define MUSTDRAW    0x0008    /* set if VSprite absolutely must be drawn */
/* system-set VSprite flags: */
#define BACKSAVED   0x0100    /* this Bob's background has been saved */
#define BOBUPDATE   0x0200    /* temporary flag, useless to outside world */
#define GELGONE     0x0400    /* set if gel is completely clipped (offscreen)
#define VSOVERFLOW  0x0800    /* VSprite overflow (if MUSTDRAW set we draw!)

/* Bob flags */
/* these are the user flag bits */
#define BUSERFLAGS  0x00FF    /* mask of all user-settable Bob-flags */
#define SAVEBOB     0x0001    /* set to not erase Bob */
#define BOBISCOMP   0x0002    /* set to identify Bob as AnimComp */
/* these are the system flag bits */
#define BWAITING    0x0100    /* set while Bob is waiting on 'after' */
#define BDRAWN      0x0200    /* set when Bob is drawn this DrawG pass*/
#define BOBSAWAY    0x0400    /* set to initiate removal of Bob */
#define BOBNIX      0x0800    /* set when Bob is completely removed */
#define SAVEPRESERVE 0x1000   /* for back-restore during double-buffer*/
#define OUTSTEP     0x2000    /* for double-clearing if double-buffer */

/* defines for the animation procedures */
#define ANFRACSIZE  6
#define ANIMHALF    0x0020
#define RINGTRIGGER 0x0001


/* UserStuff definitions
 *  the user can define these to be a single variable or a sub-structure
 *  if undefined by the user, the system turns these into innocuous variables
 *  see the manual for a thorough definition of the UserStuff definitions
 *
 */
#ifndef VUserStuff           /* VSprite user stuff */
#define VUserStuff SHORT
```

```
#endif

#ifndef BUserStuff            /* Bob user stuff */
#define BUserStuff SHORT
#endif

#ifndef AUserStuff            /* AnimOb user stuff */
#define AUserStuff SHORT
#endif




/********************** GEL STRUCTURES ***********************************/

struct VSprite
{
/* --------------------- SYSTEM VARIABLES -------------------------------- */
/* GEL linked list forward/backward pointers sorted by y,x value */
    struct VSprite   *NextVSprite;
    struct VSprite   *PrevVSprite;

/* GEL draw list constructed in the order the Bobs are actually drawn, then
 *  list is copied to clear list
 *  must be here in VSprite for system boundary detection
 */
    struct VSprite   *DrawPath;     /* pointer of overlay drawing */
    struct VSprite   *ClearPath;    /* pointer for overlay clearing */

/* the VSprite positions are defined in (y,x) order to make sorting
 *  sorting easier, since (y,x) as a long integer
 */
    WORD OldY, OldX;          /* previous position */

/* --------------------- COMMON VARIABLES --------------------------------- */
    WORD Flags;               /* VSprite flags */


/* --------------------- USER VARIABLES ----------------------------------- */
/* the VSprite positions are defined in (y,x) order to make sorting
 *  sorting easier, since (y,x) as a long integer
 */
    WORD Y, X;                /* screen position */

    WORD Height;
    WORD Width;               /* number of words per row of image data */
    WORD Depth;               /* number of planes of data */

    WORD MeMask;              /* which types can collide with this VSprite*/
    WORD HitMask;             /* which types this VSprite can collide with*/

    WORD *ImageData;          /* pointer to VSprite image */

/* borderLine is the one-dimensional logical OR of all
 *  the VSprite bits, used for fast collision detection of edge
 */
    WORD *BorderLine;         /* logical OR of all VSprite bits */
    WORD *CollMask;           /* similar to above except this is a matrix */

/* pointer to this VSprite's color definitions (not used by Bobs) */
    WORD *SprColors;

    struct Bob *VSBob;        /* points home if this VSprite is part of
                                   a Bob */

/* planePick flag:  set bit selects a plane from image, clear bit selects
 *  use of shadow mask for that plane
 * OnOff flag: if using shadow mask to fill plane, this bit (corresponding
 *  to bit in planePick) describes whether to fill with 0's or 1's
 * There are two uses for these flags:
 *      - if this is the VSprite of a Bob, these flags describe how the Bob
 *        is to be drawn into memory
 *      - if this is a simple VSprite and the user intends on setting the
 *        MUSTDRAW flag of the VSprite, these flags must be set too to descri
 *        which color registers the user wants for the image
 */
    BYTE PlanePick;
    BYTE PlaneOnOff;

    VUserStuff VUserExt;      /* user definable:  see note above */
};

struct Bob
/* blitter-objects */
{
/* --------------------- SYSTEM VARIABLES --------------------------------- *

/* --------------------- COMMON VARIABLES --------------------------------- *
    WORD Flags;          /* general purpose flags (see definitions below) */

/* --------------------- USER VARIABLES ----------------------------------- *
    WORD *SaveBuffer;    /* pointer to the buffer for background save */

/* used by Bobs for "cookie-cutting" and multi-plane masking */
    WORD *ImageShadow;

/* pointer to BOBs for sequenced drawing of Bobs
 *  for correct overlaying of multiple component animations
 */
    struct Bob *Before; /* draw this Bob before Bob pointed to by before */
    struct Bob *After;  /* draw this Bob after Bob pointed to by after */

    struct VSprite   *BobVSprite;   /* this Bob's VSprite definition */

    struct AnimComp  *BobComp;      /* pointer to this Bob's AnimComp def */

    struct DBufPacket *DBuffer;     /* pointer to this Bob's dBuf packet */

    BUserStuff BUserExt;            /* Bob user extension */
};

struct AnimComp
{
/* --------------------- SYSTEM VARIABLES --------------------------------- *

/* --------------------- COMMON VARIABLES --------------------------------- *
    WORD Flags;                     /* AnimComp flags for system & user */

/* timer defines how long to keep this component active:
 *  if set non-zero, timer decrements to zero then switches to nextSeq
```

```
 *  if set to zero, AnimComp never switches
 */
    WORD Timer;

/* --------------------- USER VARIABLES ----------------------------------- */
/* initial value for timer when the AnimComp is activated by the system */
    WORD TimeSet;

/* pointer to next and previous components of animation object */
    struct AnimComp  *NextComp;
    struct AnimComp  *PrevComp;

/* pointer to component component definition of next image in sequence */
    struct AnimComp  *NextSeq;
    struct AnimComp  *PrevSeq;

    WORD (*AnimCRoutine)(); /* address of special animation procedure */

    WORD YTrans;      /* initial y translation (if this is a component) */
    WORD XTrans;      /* initial x translation (if this is a component) */

    struct AnimOb     *HeadOb;

    struct Bob        *AnimBob;
};

struct AnimOb
{
/* --------------------- SYSTEM VARIABLES --------------------------------- */
    struct AnimOb     *NextOb, *PrevOb;

/* number of calls to Animate this AnimOb has endured */
    LONG Clock;

    WORD AnOldY, AnOldX;            /* old y,x coordinates */

/* --------------------- COMMON VARIABLES --------------------------------- */
    WORD AnY, AnX;                  /* y,x coordinates of the AnimOb */

/* --------------------- USER VARIABLES ----------------------------------- */
    WORD YVel, XVel;                /* velocities of this object */
    WORD YAccel, XAccel;            /* accelerations of this object */

    WORD RingYTrans, RingXTrans;    /* ring translation values */

    WORD (*AnimORoutine)();         /* address of special animation
                                       procedure */

    struct AnimComp  *HeadComp;     /* pointer to first component */

    AUserStuff AUserExt;            /* AnimOb user extension */
};

/* dBufPacket defines the values needed to be saved across buffer to buffer
 *  when in double-buffer mode
 */
struct DBufPacket
{
    WORD BufY, BufX;                /* save the other buffers screen coordinates */
    struct VSprite   *BufPath;      /* carry the draw path over the gap */

/* these pointers must be filled in by the user */
/* pointer to other buffer's background save buffer */
    WORD *BufBuffer;
};



/* ********************************************************************** */

/* these are GEL functions that are currently simple enough to exist as a
 *  definition.  It should not be assumed that this will always be the case
 */
#define InitAnimate(animKey) {*(animKey) = NULL;}
#define RemBob(b) {(b)->Flags |= BOBSAWAY;}


/* ********************************************************************** */

#define B2NORM      0
#define B2SWAP      1
#define B2BOBBER    2

/* ********************************************************************** */

/* a structure to contain the 16 collision procedure addresses */
struct collTable
{
    int (*collPtrs[16])();
};


#endif
```

```c
#ifndef GRAPHICS_GFX_H
#define GRAPHICS_GFX_H
/****** gfx.h ****************************************************/
/*                                                               */
/*              Commodore-Amiga, Inc.                            */
/*                                                               */
/*      Modification History                                     */
/*  date    :author  :Comments                                   */
/*--------------------------------------------------------------*/
/*  8-24-84 Dale     added this header file                      */
/*  Feb 85  Dale     added Rectangle,BitMap structures           */
/*****************************************************************/

/* general include file for application programs */
#define BITSET  0x8000
#define BITCLR  0

#define AGNUS
#ifdef AGNUS
#define TOBB(a)      ((long)(a))
#else
#define TOBB(a)      ((long)(a)>>1)  /* convert Chip adr to Bread Board Adr */
#endif

struct Rectangle
{
    SHORT   MinX,MinY;
    SHORT   MaxX,MaxY;
};

typedef UBYTE *PLANEPTR;

struct BitMap
{
    UWORD   BytesPerRow;
    UWORD   Rows;
    UBYTE   Flags;
    UBYTE   Depth;
    UWORD   pad;
    PLANEPTR Planes[8];
};

#define RASSIZE(w,h)    ((h)*( (w+15)>>3&0xFFFE))

#endif
```

```c
#ifndef GRAPHICS_GFXBASE_H
#define GRAPHICS_GFXBASE_H

#ifndef EXEC_LISTS_H
#include <exec/lists.h>
#endif
#ifndef EXEC_LIBRARIES_H
#include <exec/libraries.h>
#endif
#ifndef EXEC_INTERRUPTS_H
#include <exec/interrupts.h>
#endif

/****** gfxbase.h ***********************************************************/
/*                                                                          */
/*              Commodore-Amiga, Inc.                                       */
/*                                                                          */
/*                 Modification History                                     */
/*  date    :  author :    Comments                                         */
/*  -------    ------      -------------------------------------            */
/*  10-20-84   Kodiak      added this header file & TextFonts               */
/*                                                                          */
/****************************************************************************/
struct GfxBase
{
    struct  Library  LibNode;
    struct  View     *ActiView;
    struct  copinit  *copinit; /* ptr to copper start up list */
    long    *cia;              /* for 8520 resource use */
    long    *blitter;          /* for future blitter resource use */
    UWORD   *LOFlist;
    UWORD   *SHFlist;
    struct  bltnode  *blthd,*bltt1;
    struct  bltnode  *bsblthd,*bsbltt1;
    struct  Interrupt vbsrv,timsrv,bltsrv;
    struct  List     TextFonts;
    struct  TextFont *DefaultFont;
    UWORD   Modes;             /* copy of current first bplcon0 */
    BYTE    VBlank;
    BYTE    Debug;
    SHORT   BeamSync;
    SHORT   system_bplcon0;   /* this is initialized to 0 */
        /* it is ored into each bplcon0 for display */
    UBYTE   SpriteReserved;
    UBYTE   bytereserved;
    /* candidates for removal */
    USHORT  Flags;
    SHORT   BlitLock;
    short   BlitNest;

    struct  List  BlitWaitQ;
    struct  Task  *BlitOwner;
    struct  List    TOF_WaitQ;
    UWORD   DisplayFlags;     /* NTSC PAL GENLOC etc*/
                              /* Display flags are determined at power on */
    ULONG   reserved[2];      /* for future use */
};

#define NTSC            1
```

```
#define GENLOC          2
#define PAL             4

#define BLITMSG_FAULT   4
#endif
```

```
#ifndef GRAPHICS_GFXMACROS_H
#define GRAPHICS_GFXMACROS_H
/****** gfxmacros.h ************************************************/
/*                                                                 */
/*              Commodore-Amiga, Inc.                              */
/*                                                                 */
/*                 Modification History                            */
/*  date    :  author :   Comments                                 */
/*  -------    ------     ------------------------------------- */
/*  8-24-84    Dale       added this header file                  */
/*  9-06-84    Dale       fixed macros using w-> to use (w)->     */
/*  9-07-84    Dale       fixed macros to use new RastPort        */
/*                                                                 */
/*******************************************************************/

#ifndef  GRAPHICS_RASTPORT_H
#include <graphics/rastport.h>
#endif

#define ON_DISPLAY      custom.dmacon = BITSET|DMAF_RASTER;
#define OFF_DISPLAY     custom.dmacon = BITCLR|DMAF_RASTER;
#define ON_SPRITE       custom.dmacon = BITSET|DMAF_SPRITE;
#define OFF_SPRITE      custom.dmacon = BITCLR|DMAF_SPRITE;

#define ON_VBLANK       custom.intena = BITSET|INTF_VERTB
#define OFF_VBLANK      custom.intena = BITCLR|INTF_VERTB

#define SetOPen(w,c)    {(w)->AOlPen = c;(w)->Flags |= AREAOUTLINE;}
#define SetDrPt(w,p)    {(w)->LinePtrn = p;(w)->Flags |= FRST_DOT;}
#define SetWrMsk(w,m)   {(w)->Mask = m;}
#define SetAfPt(w,p,n)  {(w)->AreaPtrn = p;(w)->AreaPtSz = n;}

#define BNDRYOFF        (w) { ->Flags &= ~AREAOUTLINE}

#define CINIT(c,n)      { UCopperListInit(c,n); }
#define CMOVE(c,a,b)    { CMove(c,&a,b);CBump(c); }
#define CWAIT(c,a,b)    { CWait(c,a,b);CBump(c); }
#define CEND(c)         { CWAIT(c,10000,255); }

#endif
```

```c
#ifndef GRAPHICS_GRAPHINT_H
#define GRAPHICS_GRAPHINT_H
/*******************************************************************/
/*              Commodore-Amiga, Inc.                              */
/*              graphint.h                                         */
/*******************************************************************/

#ifndef EXEC_NODES_H
#include <exec/nodes.h>
#endif

/* structure used by AddTOFTask */
struct Isrvstr
{
    struct Node is_Node;
    struct Isrvstr *Iptr;   /* passed to srvr by os */
    int (*code)();
    int (*ccode)();
    int Carg;
};

#endif
```

```c
/*******************************************************************/
/*               Commodore-Amiga, Inc.                             */
/*******************************************************************/

#ifndef GRAPHICS_LAYERS_H
#define GRAPHICS_LAYERS_H

#ifndef EXEC_PORTS_H
#include <exec/ports.h>
#endif

#ifndef EXEC_LISTS_H
#include <exec/lists.h>
#endif

#define LAYERSIMPLE     1
#define LAYERSMART      2
#define LAYERSUPER      4
#define LAYERBACKDROP   0x40
#define LAYERREFRESH    0x80

struct Layer_Info
{
    struct Layer *top_layer;
    struct Layer *check_lp;         /* system use */
    struct Layer *obs;              /* system use */
    struct MsgPort  RP_ReplyPort;   /* for rastport locking */
    struct MsgPort  LockPort;       /* for screen locking */
    UBYTE  Lock;
    UBYTE  broadcast;               /* bunch of messages sent */
    UBYTE  LockNest;
    UBYTE  Flags;
    struct Task *Locker;
    BYTE   fatten_count;
    UBYTE  bytereserved;
    UWORD  wordreserved;  /* used to be a node in here someplace */
    UWORD  LayerInfo_extra_size;
    ULONG  longreserved;
    struct LayerInfo_extra *LayerInfo_extra;
};

#define NEWLAYERINFO_CALLED 1
#define ALERTLAYERSNOMEM 0x83010000

#endif
```

```c
#ifndef GRAPHICS_RASTPORT_H
#define GRAPHICS_RASTPORT_H

#ifndef GRAPHICS_GFX_H
#include <graphics/gfx.h>
#endif

/****** rastport.h ************************************************
*
*               Commodore-Amiga, Inc.
*
*   Modification History
*   date    :   author :    Comments
*  -------     ------      ----------------------------------------
*   02-04-85    Dale        created from graph.h
*******************************************************************/

struct AreaInfo
{
    SHORT   *VctrTbl;          /* ptr to start of vector table */
    SHORT   *VctrPtr;          /* ptr to current vertex */
    BYTE    *FlagTbl;          /* ptr to start of vector flag table */
    BYTE    *FlagPtr;          /* ptrs to areafill flags */
    SHORT   Count;             /* number of vertices in list */
    SHORT   MaxCount;          /* AreaMove/Draw will not allow Count>MaxCount*/
    SHORT   FirstX,FirstY;     /* first point for this polygon */
};

struct TmpRas
{
    BYTE *RasPtr;
    LONG Size;
    /* other misc junk for freelist etc. */
};

/* unoptimized for 32bit alignment of pointers */
struct GelsInfo
{
    BYTE sprRsrvd;             /* flag of which sprites to reserve from
                                  vsprite system */
    UBYTE Flags;               /* system use */
    struct VSprite *gelHead, *gelTail; /* dummy vSprites for list management*/
    /* pointer to array of 8 WORDS for sprite available lines */
    WORD *nextLine;
    /* pointer to array of 8 pointers for color-last-assigned to vSprites */
    WORD **lastColor;
    struct collTable *collHandler;    /* addresses of collision routines */
    short leftmost, rightmost, topmost, bottommost;
   APTR firstBlissObj,lastBlissObj;    /* system use only */
};

struct RastPort
{
    struct  Layer *Layer;
    struct  BitMap   *BitMap;
    USHORT  *AreaPtrn;         /* ptr to areafill pattern */
    struct  TmpRas *TmpRas;
    struct  AreaInfo *AreaInfo;
    struct  GelsInfo *GelsInfo;
    UBYTE   Mask;              /* write mask for this raster */
    BYTE    FgPen;             /* foreground pen for this raster */
    BYTE    BgPen;             /* background pen  */
    BYTE    AOlPen;            /* areafill outline pen */
    BYTE    DrawMode;          /* drawing mode for fill, lines, and text */
    BYTE    AreaPtSz;          /* 2^n words for areafill pattern */
    BYTE    linpatcnt;         /* current line drawing pattern preshift */
    BYTE    dummy;
    USHORT  Flags;             /* miscellaneous control bits */
    USHORT  LinePtrn;          /* 16 bits for textured lines */
    SHORT   cp_x, cp_y;        /* current pen position */
    UBYTE   minterms[8];
    SHORT   PenWidth;
    SHORT   PenHeight;
    struct  TextFont *Font;    /* current font address */
    UBYTE   AlgoStyle;         /* the algorithmically generated style */
    UBYTE   TxFlags;           /* text specific flags */
    UWORD   TxHeight;          /* text height */
    UWORD   TxWidth;           /* text nominal width */
    UWORD   TxBaseline;        /* text baseline */
    WORD    TxSpacing;         /* text spacing (per character) */
    APTR    *RP_User;
    UWORD   wordreserved[7];   /* used to be a node */
    ULONG   longreserved[2];
    UBYTE   reserved[8];       /* for future use */
};

/* drawing modes */
#define JAM1        0          /* jam 1 color into raster */
#define JAM2        1          /* jam 2 colors into raster */
#define COMPLEMENT  2          /* XOR bits into raster */
#define INVERSVID   4          /* inverse video for drawing modes */

/* these are the flag bits for RastPort flags */
#define FRST_DOT    0x01       /* draw the first dot of this line ? */
#define ONE_DOT     0x02       /* use one dot mode for drawing lines */
#define DBUFFER     0x04       /* flag set when RastPorts
                                  are double-buffered */

            /* only used for bobs */

#define AREAOUTLINE 0x08       /* used by areafiller */
#define NOCROSSFILL 0x20       /* areafills have no crossovers */

/* there is only one style of clipping: raster clipping */
/* this preserves the continuity of jaggies regardless of clip window */
/* When drawing into a RastPort, if the ptr to ClipRect is nil then there */
/* is no clipping done, this is dangerous but useful for speed */

#endif
```

```c
#ifndef  GRAPHICS_REGIONS_H
#define GRAPHICS_REGIONS_H

#ifndef GRAPHICS_GFX_H
#include <graphics/gfx.h>
#endif
/********************************************************************/
/*              Commodore-Amiga, Inc.                               */
/*              regions.h                                           */
/********************************************************************/

struct RegionRectangle
{
    struct RegionRectangle *Next,*Prev;
    struct Rectangle bounds;
};

struct Region
{
    struct Rectangle bounds;
    struct RegionRectangle *RegionRectangle;
};

#endif
```

```c
#ifndef GRAPHICS_SPRITE_H
#define GRAPHICS_SPRITE_H
/********************************************************************/
/*              Commodore-Amiga, Inc.                               */
/*              sprite.h                                            */
/********************************************************************/

#define SPRITE_ATTACHED 0x80

struct SimpleSprite
{
    UWORD *posctldata;
    UWORD height;
    UWORD   x,y;    /* current position */
    UWORD   num;
};
#endif
```

```
#ifndef  GRAPHICS_TEXT_H
#define  GRAPHICS_TEXT_H
/********************************************************************/
/*              Commodore-Amiga, Inc.                               */
/*              file.h                                              */
/********************************************************************/
/*******************************************************************
*  graphics library text structures
*
********************************************************************/

#ifndef     EXEC_PORTS_H
#include "exec/ports.h"
#endif

/*------ Font Styles ------------------------------------------------*/
#define FS_NORMAL    0        /* normal text (no style bits set) */
#define FSB_EXTENDED 3        /* extended face (wider than normal) */
#define FSF_EXTENDED (1<<3)
#define FSB_ITALIC   2        /* italic (slanted 1:2 right) */
#define FSF_ITALIC   (1<<2)
#define FSB_BOLD     1        /* bold face text (ORed w/ shifted) */
#define FSF_BOLD     (1<<1)
#define FSB_UNDERLINED  0     /* underlined (under baseline) */
#define FSF_UNDERLINED  (1<<0)

/*------ Font Flags -------------------------------------------------*/
#define FPB_ROMFONT  0        /* font is in rom */
#define FPF_ROMFONT  (1<<0)
#define FPB_DISKFONT 1        /* font is from diskfont.library */
#define FPF_DISKFONT (1<<1)
#define FPB_REVPATH  2        /* designed path is reversed (e.g. left) */
#define FPF_REVPATH  (1<<2)
#define  FPB_TALLDOT 3        /* designed for hires non-interlaced */
#define  FPF_TALLDOT (1<<3)
#define  FPB_WIDEDOT 4        /* designed for lores interlaced */
#define  FPF_WIDEDOT (1<<4)
#define FPB_PROPORTIONAL   5  /* character sizes can vary from nominal */
#define FPF_PROPORTIONAL   (1<<5)
#define FPB_DESIGNED 6        /* size is "designed", not constructed */
#define FPF_DESIGNED (1<<6)
#define FPB_REMOVED  7        /* the font has been removed */
#define FPF_REMOVED  (1<<7)

/****** TextAttr node, matches text attributes in RastPort **********/
struct TextAttr {
   STRPTR   ta_Name;          /* name of the font */
   UWORD    ta_YSize;         /* height of the font */
   UBYTE    ta_Style;         /* intrinsic font style */
   UBYTE    ta_Flags;         /* font preferences and flags */
};


/****** TextFonts node **********************************************/
struct TextFont {
   struct Message tf_Message;       /* reply message for font removal */
                              /* font name in LN       \   used in this */
   UWORD    tf_YSize;         /* font height            |   order to best */
   UBYTE    tf_Style;         /* font style             |   match a font */
   UBYTE    tf_Flags;         /* preferences and flags  /    request. */
   UWORD    tf_XSize;         /* nominal font width */
   UWORD    tf_Baseline;      /* distance from the top of char to baseline */
   UWORD    tf_BoldSmear;     /* smear to affect a bold enhancement */

   UWORD    tf_Accessors;     /* access count */

   UBYTE    tf_LoChar;        /* the first character described here */
   UBYTE    tf_HiChar;        /* the last character described here */
   APTR     tf_CharData;      /* the bit character data */

   UWORD    tf_Modulo;        /* the row modulo for the strike font data */
   APTR     tf_CharLoc;       /* ptr to location data for the strike font */
                 /*    2 words: bit offset then size */
   APTR     tf_CharSpace;     /* ptr to words of proportional spacing data */
   APTR     tf_CharKern;      /* ptr to words of kerning data */
};

#endif
```

```c
#ifndef GRAPHICS_VIEW_H
#define GRAPHICS_VIEW_H

#ifndef GRAPHICS_GFX_H
#include <graphics/gfx.h>
#endif

/********************************************************************/
/*              Commodore-Amiga, Inc.                               */
/*              view.h                                              */
/********************************************************************/
/*******************************************************************
*   Modification History
*   date    :   author :    Comments
*  -------      ------      -------------------------------------
*   2-4-85      Dale        created from graph.h
*   2-8-85      Dale        conversion to 24 View->ViewPort
*******************************************************************/

struct ColorMap
{
   UBYTE Flags;
   UBYTE Type;
   UWORD Count;
   APTR  ColorTable;
};
/* if Type == 0 then ColorTable is a table of UWORDS xRGB */

struct ViewPort
{
   struct   ViewPort *Next;
   struct   ColorMap  *ColorMap;    /* table of colors for this viewport */
                /* if this is nil, MakeVPort assumes default values */
   struct   CopList  *DspIns;       /* user by MakeView() */
   struct   CopList  *SprIns;       /* used by sprite stuff */
   struct   CopList  *ClrIns;       /* used by sprite stuff */
   struct   UCopList *UCopIns;      /* User copper list */
   SHORT    DWidth,DHeight;
   SHORT    DxOffset,DyOffset;
   UWORD    Modes;
   UWORD    reserved;
   struct   RasInfo *RasInfo;
};

struct View
{
   struct ViewPort *ViewPort;
   struct cprlist *LOFCprList;   /* used for interlaced and noninterlaced */
   struct cprlist *SHFCprList;   /* only used during interlace */
   short DyOffset,DxOffset;   /* for complete View positioning */
                              /* offsets are +- adjustments to standard #s */
   UWORD   Modes;             /* such as INTERLACE, GENLOC */
};

/* defines used for Modes in IVPargs */
#define PFBA            0x40
#define DUALPF          0x400
#define HIRES           0x8000
#define LACE            4
#define HAM             0x800
#define SPRITES         0x4000      /* reuse one of plane ctr bits */
#define VP_HIDE         0x2000      /* reuse another plane crt bit */
#define GENLOCK_AUDIO   0x100
#define GENLOCK_VIDEO   2
#define EXTRA_HALFBRITE 0x80

struct RasInfo  /* used by callers to and InitDspC() */
{
   struct   RasInfo *Next;          /* used for dualpf */
   struct   BitMap *BitMap;
   SHORT    RxOffset,RyOffset;      /* scroll offsets in this BitMap */
};

#endif
```

Contents

```
/******************************************************************
* Commodore-Amiga, Inc.
* adkbits.h -- bit definitions for adkcon register
*
* $Header: adkbits.h,v 27.1 85/06/24 14:42:34 neil Exp $
*
* $Locker:  $
*
******************************************************************/

#ifndef HARDWARE_ADKBITS_H
#define HARDWARE_ADKBITS_H

#define  ADKB_SETCLR    15 /* standard set/clear bit */
#define  ADKB_PRECOMP1  14 /* two bits of precompensation */
#define  ADKB_PRECOMP0  13
#define  ADKB_MFMPREC   12 /* use mfm style precompensation */
#define  ADKB_UARTBRK   11 /* force uart output to zero */
#define  ADKB_WORDSYNC  10 /* enable DSKSYNC register matching */
#define  ADKB_MSBSYNC   9  /* (Apple GCR Only) sync on MSB for reading */
#define  ADKB_FAST      8  /* 1 -> 2 us/bit (mfm), 2 -> 4 us/bit (gcr) */
#define  ADKB_USE3PN    7  /* use aud chan 3 to modulate period of ?? */
#define  ADKB_USE2P3    6  /* use aud chan 2 to modulate period of 3 */
#define  ADKB_USE1P2    5  /* use aud chan 1 to modulate period of 2 */
#define  ADKB_USE0P1    4  /* use aud chan 0 to modulate period of 1 */
#define  ADKB_USE3VN    3  /* use aud chan 3 to modulate volume of ?? */
#define  ADKB_USE2V3    2  /* use aud chan 2 to modulate volume of 3 */
#define  ADKB_USE1V2    1  /* use aud chan 1 to modulate volume of 2 */
#define  ADKB_USE0V1    0  /* use aud chan 0 to modulate volume of 1 */

#define  ADKF_SETCLR    (1<<15)
#define  ADKF_PRECOMP1  (1<<14)
#define  ADKF_PRECOMP0  (1<<13)
#define  ADKF_MFMPREC   (1<<12)
#define  ADKF_UARTBRK   (1<<11)
#define  ADKF_WORDSYNC  (1<<10)
#define  ADKF_MSBSYNC   (1<<9)
#define  ADKF_FAST      (1<<8)
#define  ADKF_USE3PN    (1<<7)
#define  ADKF_USE2P3    (1<<6)
#define  ADKF_USE1P2    (1<<5)
#define  ADKF_USE0P1    (1<<4)
#define  ADKF_USE3VN    (1<<3)
#define  ADKF_USE2V3    (1<<2)
#define  ADKF_USE1V2    (1<<1)
#define  ADKF_USE0V1    (1<<0)

#define ADKF_PRE000NS   0                              /* 000 ns of precomp */
#define ADKF_PRE140NS   (ADKF_PRECOMP0)                /* 140 ns of precomp */
#define ADKF_PRE280NS   (ADKF_PRECOMP1)                /* 280 ns of precomp */
#define ADKF_PRE560NS   (ADKF_PRECOMP0|ADKF_PRECOMP1) /* 560 ns of precomp

#endif !HARDWARE_ADKBITS_H
```

```
/***********************************************************************
* blit.h
* Commodore-Amiga, Inc.
*
* $Header: blit.h,v 27.1 85/06/24 14:42:40 neil Exp $
*
* $Locker:  $
*
***********************************************************************/

#ifndef HARDWARE_BLIT_H
#define HARDWARE_BLIT_H

/* include file for blitter */
#define  HSIZEBITS   6
#define VSIZEBITS 16-HSIZEBITS
#define HSIZEMASK 0x3f        /* 2^6 -- 1 */
#define VSIZEMASK 0x3FF       /* 2^10 - 1 */

#define  MAXBYTESPERROW 128

/* definitions for blitter control register 0 */

#define ABC    0x80
#define ABNC   0x40
#define ANBC   0x20
#define ANBNC  0x10
#define NABC   0x8
#define NABNC  0x4
#define NANBC  0x2
#define NANBNC 0x1

/* some commonly used operations */
#define A_OR_B    ABC|ANBC|NABC | ABNC|ANBNC|NABNC
#define A_OR_C    ABC|NABC|ABNC | ANBC|NANBC|ANBNC
#define A_XOR_C   NABC|ABNC   | NANBC|ANBNC
#define A_TO_D    ABC|ANBC|ABNC|ANBNC

#define BC0B_DEST 8
#define BC0B_SRCC 9
#define BC0B_SRCB   10
#define BC0B_SRCA 11
#define BC0F_DEST 0x100
#define BC0F_SRCC 0x200
#define BC0F_SRCB 0x400
#define BC0F_SRCA 0x800

#define BC1F_DESC   2         /* blitter descend direction */

#define DEST 0x100
#define SRCC 0x200
#define SRCB 0x400
#define SRCA 0x800

#define ASHIFTSHIFT  12       /* bits to right align ashift value */
#define BSHIFTSHIFT  12       /* bits to right align bshift value */

/* definations for blitter control register 1 */
#define LINEMODE     0x1
#define FILL_OR      0x8
#define FILL_XOR     0x10
#define FILL_CARRYIN 0x4
#define ONEDOT       0x2      /* one dot per horizontal line */
#define OVFLAG       0x20
#define SIGNFLAG     0x40
#define BLITREVERSE  0x2

#define SUD          0x10
#define SUL          0x8
#define AUL          0x4

#define OCTANT8   24
#define OCTANT7   4
#define OCTANT6   12
#define OCTANT5   28
#define OCTANT4   20
#define OCTANT3   8
#define OCTANT2   0
#define OCTANT1   16

/* stuff for blit qeuer */
struct bltnode
{
    struct  bltnode *n;
    int     (*function)();
    char    stat;
    short   blitsize;
    short   beamsync;
    int     (*cleanup)();
};

/* defined bits for bltstat */
#define CLEANUP 0x40
#define CLEANME CLEANUP

#endif !HARDWARE_BLIT_H
```

```
/***********************************************************************/
/*              Commodore-Amiga, Inc.                                  */
/*              cia.h                                                  */
/***********************************************************************/

#define  CIAANAME "ciaa.resource"
#define  CIABNAME "ciab.resource"

```

```
/*********************************************************************
* Commodore-Amiga, Inc.
* custom.h
*
* $Header: custom.h,v 27.1 85/06/24 14:42:53 neil Exp $
*
* $Locker:  $
*
*********************************************************************/

#ifndef  HARDWARE_CUSTOM_H
#define  HARDWARE_CUSTOM_H

/*
 * do this to get base of custom registers:
 * extern struct Custom custom;
 */


struct Custom {
    UWORD   bltddat;
    UWORD   dmaconr;
    UWORD   vposr;
    UWORD   vhposr;
    UWORD   dskdatr;
    UWORD   joy0dat;
    UWORD   joy1dat;
    UWORD   clxdat;
    UWORD   adkconr;
    UWORD   pot0dat;
    UWORD   pot1dat;
    UWORD   potinp;
    UWORD   serdatr;
    UWORD   dskbytr;
    UWORD   intenar;
    UWORD   intreqr;
    APTR    dskpt;
    UWORD   dsklen;
    UWORD   dskdat;
    UWORD   refptr;
    UWORD   vposw;
    UWORD   vhposw;
    UWORD   copcon;
    UWORD   serdat;
    UWORD   serper;
    UWORD   potgo;
    UWORD   joytest;
    UWORD   strequ;
    UWORD   strvbl;
    UWORD   strhor;
    UWORD   strlong;
    UWORD   bltcon0;
    UWORD   bltcon1;
    UWORD   bltafwm;
    UWORD   bltalwm;
    APTR    bltcpt;
    APTR    bltbpt;
    APTR    bltapt;
    APTR    bltdpt;
```

```
    UWORD   bltsize;
    UWORD   pad2d[3];
    UWORD   bltcmod;
    UWORD   bltbmod;
    UWORD   bltamod;
    UWORD   bltdmod;
    UWORD   pad34[4];
    UWORD   bltcdat;
    UWORD   bltbdat;
    UWORD   bltadat;
    UWORD   pad3b[4];
    UWORD   dsksync;
    ULONG   cop1lc;
    ULONG   cop2lc;
    UWORD   copjmp1;
    UWORD   copjmp2;
    UWORD   copins;
    UWORD   diwstrt;
    UWORD   diwstop;
    UWORD   ddfstrt;
    UWORD   ddfstop;
    UWORD   dmacon;
    UWORD   clxcon;
    UWORD   intena;
    UWORD   intreq;
    UWORD   adkcon;
    struct  AudChannel {
      UWORD *ac_ptr; /* ptr to start of waveform data */
      UWORD ac_len;     /* length of waveform in words */
      UWORD ac_per;     /* sample period */
      UWORD ac_vol;     /* volume */
      UWORD ac_dat;     /* sample pair */
      UWORD ac_pad[2];  /* unused */
    } aud[4];
    APTR    bplpt[6];
    UWORD   pad7c[4];
    UWORD   bplcon0;
    UWORD   bplcon1;
    UWORD   bplcon2;
    UWORD   pad83;
    UWORD   bpl1mod;
    UWORD   bpl2mod;
    UWORD   pad86[2];
    UWORD   bpldat[6];
    UWORD   pad8e[2];
    APTR    sprpt[8];
    struct  SpriteDef {
      UWORD pos;
      UWORD ctl;
      UWORD dataa;
      UWORD datab;
    } spr[8];
    UWORD   color[32];
};
#endif !HARDWARE_CUSTOM_H
```

```
/*****************************************************************
* Commodore-Amiga, Inc.
* dmabits.h
*
* $Header: dmabits.h,v 27.1 85/06/24 14:42:59 neil Exp $
*
* $Locker:  $
*
*****************************************************************/

#ifndef  HARDWARE_DMABITS_H
#define  HARDWARE_DMABITS_H

/* include file for defining dma control stuff */

/* write definitions for dmaconw */
#define DMAF_SETCLR  0x8000
#define DMAF_AUDIO   0x000F   /* 4 bit mask */
#define DMAF_AUD0    0x0001
#define DMAF_AUD1    0x0002
#define DMAF_AUD2    0x0004
#define DMAF_AUD3    0x0008
#define DMAF_DISK    0x0010
#define DMAF_SPRITE  0x0020
#define DMAF_BLITTER 0x0040
#define DMAF_COPPER  0x0080
#define DMAF_RASTER  0x0100
#define DMAF_MASTER  0x0200
#define DMAF_BLITHOG 0x0400
#define DMAF_ALL     0x01FF   /* all dma channels */

/* read definitions for dmaconr */
/* bits 0-8 correspnd to dmaconw definitions */
#define DMAF_BLTDONE 0x4000
#define DMAF_BLTNZERO   0x2000

#define DMAB_SETCLR  15
#define DMAB_AUD0    0
#define DMAB_AUD1    1
#define DMAB_AUD2    2
#define DMAB_AUD3    3
#define DMAB_DISK    4
#define DMAB_SPRITE  5
#define DMAB_BLITTER 6
#define DMAB_COPPER  7
#define DMAB_RASTER  8
#define DMAB_MASTER  9
#define DMAB_BLITHOG 10
#define DMAB_BLTDONE 14
#define DMAB_BLTNZERO   13


#endif   !HARDWARE_DMABITS_H
```

```
/*********************************************************************
* Commodore-Amiga, Inc.
* intenabits.h -- definitions for the bits in the interrupt enable
* (and interrupt request) register
*
* $Header: intbits.h,v 27.1 85/06/24 14:43:04 neil Exp $
*
* $Locker:  $
*
*********************************************************************/

#ifndef HARDWARE_INTBITS_H
#define HARDWARE_INTBITS_H

#define  INTB_SETCLR    (15)  /* Set/Clear control bit. Determines if bits */
            /* written with a 1 get set or cleared. Bits */
            /* written with a zero are allways unchanged */
#define  INTB_INTEN     (14)  /* Master interrupt (enable only ) */
#define  INTB_EXTER     (13)  /* External interrupt */
#define  INTB_DSKSYNC   (12)  /* Disk re-SYNChronized */
#define  INTB_RBF       (11)  /* serial port Receive Buffer Full */
#define  INTB_AUD3      (10)  /* Audio channel 3 block finished */
#define  INTB_AUD2      (9)   /* Audio channel 2 block finished */
#define  INTB_AUD1      (8)   /* Audio channel 1 block finished */
#define  INTB_AUD0      (7)   /* Audio channel 0 block finished */
#define  INTB_BLIT      (6)   /* Blitter finished */
#define  INTB_VERTB     (5)   /* start of Vertical Blank */
#define  INTB_COPER     (4)   /* Coprocessor */
#define  INTB_PORTS     (3)   /* I/O Ports and timers */
#define  INTB_SOFTINT   (2)   /* software interrupt request */
#define  INTB_DSKBLK    (1)   /* Disk Block done */
#define  INTB_TBE       (0)   /* serial port Transmit Buffer Empty */



#define  INTF_SETCLR    (1<<15)
#define  INTF_INTEN     (1<<14)
#define  INTF_EXTER     (1<<13)
#define  INTF_DSKSYNC   (1<<12)
#define  INTF_RBF       (1<<11)
#define  INTF_AUD3      (1<<10)
#define  INTF_AUD2      (1<<9)
#define  INTF_AUD1      (1<<8)
#define  INTF_AUD0      (1<<7)
#define  INTF_BLIT      (1<<6)
#define  INTF_VERTB     (1<<5)
#define  INTF_COPER     (1<<4)
#define  INTF_PORTS     (1<<3)
#define  INTF_SOFTINT   (1<<2)
#define  INTF_DSKBLK    (1<<1)
#define  INTF_TBE       (1<<0)

#endif !HARDWARE_INTBITS_H
```

Contents

```c
#ifndef INTUITION_INTUITION_H
#define INTUITION_INTUITION_H TRUE

/*** intuition.h ******************************************************************
 * Commodore-Amiga, Inc.
 *
 *  intuition.h main include for c programmers
 *
 *         Modification History
 *     date    :   author :    Comments
 *    ------      ------      -------------------------------------
 *    1-30-85     -=RJ=-      created this file!
 *   10-03-85                 Support for HP printers
 *
 *******************************************************************************/

#ifndef INTUITION_INTUITIONBASE_H
#include "intuition/intuitionbase.h"
#endif

#ifndef GRAPHICS_GFX_H
#include "graphics/gfx.h"
#endif

#ifndef GRAPHICS_CLIP_H
#include "graphics/clip.h"
#endif

#ifndef GRAPHICS_VIEW_H
#include "graphics/view.h"
#endif

#ifndef GRAPHICS_RASTPORT_H
#include "graphics/rastport.h"
#endif

#ifndef GRAPHICS_LAYERS_H
#include "graphics/layers.h"
#endif

#ifndef GRAPHICS_TEXT_H
#include "graphics/text.h"
#endif

#ifndef EXEC_PORTS_H
#include "exec/ports.h"
#endif

#ifndef DEVICES_TIMER_H
#include "devices/timer.h"
#endif

#ifndef DEVICES_INPUTEVENT_H
#include "devices/inputevent.h"
#endif


/* ==========================================================================
  */
/* === Menu ================================================================
  */
/* ==========================================================================
  */
struct   Menu
{
   struct   Menu *NextMenu;          /* same level */
   SHORT    LeftEdge, TopEdge;       /* position of the select
  box */
   SHORT    Width, Height;           /* dimensions of the
  select box */
   USHORT   Flags;                   /* see flag definitions
  below */
   BYTE    *MenuName;                /* text for this Menu
  Header */
   struct   MenuItem *FirstItem;     /* pointer to first
  in chain */

     /* these mysteriously-named variables are for internal
  use only */
   SHORT    JazzX, JazzY, BeatX, BeatY;
};


/* FLAGS SET BY BOTH THE APPLIPROG AND INTUITION */
#define MENUENABLED  0x0001       /* whether or not this
  menu is enabled */

/* FLAGS SET BY INTUITION */
#define MIDRAWN      0x0100       /* this menu's items are
  currently drawn */






/* ==========================================================================
  */
/* === MenuItem ============================================================
  */
/* ==========================================================================
  */
struct   MenuItem
{
   struct   MenuItem *NextItem;      /* pointer to next in
  chained list */
   SHORT    LeftEdge, TopEdge;       /* position of the select
  box */
   SHORT    Width, Height;           /* dimensions of the
  select box */
   USHORT   Flags;                   /* see the defines below
  */

   LONG     MutualExclude;           /* set bits mean this
  item
                                        excludes that */
```

```
    APTR     ItemFill;              /* points to Image,
   IntuiText, or NULL */

      /* when this item is pointed to by the cursor and the
   items highlight
      *   mode HIGHIMAGE is selected, this alternate image
   will be displayed
      */
    APTR     SelectFill;         /* points to Image, IntuiText,
   or NULL */

    BYTE     Command;            /* only if appliprog sets
   the COMMSEQ flag */

    struct   MenuItem *SubItem;   /* if non-zero, DrawMenu
   shows "->" */

      /* The NextSelect field represents the menu number of
   next selected
      *  item (when user has drag-selected several items)
      */
    USHORT   NextSelect;
};


/* FLAGS SET BY THE APPLIPROG */
#define CHECKIT       0x0001  /* whether to check this item
   if selected */
#define ITEMTEXT      0x0002  /* set if textual, clear if
   graphical item */
#define COMMSEQ       0x0004  /* set if there's an command
   sequence */
#define MENUTOGGLE    0x0008  /* set to toggle the check
   of a menu item */
#define ITEMENABLED   0x0010  /* set if this item is enabled
   */

/* these are the SPECIAL HIGHLIGHT FLAG state meanings */

#define HIGHFLAGS     0x00C0   /* see definitions below for
   these bits */
#define HIGHIMAGE     0x0000   /* use the user's "select
   image" */
#define HIGHCOMP      0x0040   /* highlight by complementing
   the selectbox */
#define HIGHBOX       0x0080   /* highlight by "boxing" the
   selectbox */
#define HIGHNONE      0x00C0   /* don't highlight */

/* FLAGS SET BY BOTH APPLIPROG AND INTUITION */
#define CHECKED       0x0100   /* if CHECKIT, then set this
   when selected */

/* FLAGS SET BY INTUITION */
#define ISDRAWN       0x1000   /* this item's subs are currently
   drawn */
#define HIGHITEM      0x2000   /* this item is currently
   highlighted */
#define MENUTOGGLED   0x4000   /* this item was already toggled
   */





/* ========================================================================
   */
/* === Requester ==========================================================
   */
/* ========================================================================
   */
struct   Requester
{
      /* the ClipRect and BitMap and used for rendering the
   requester */
    struct   Requester *OlderRequest;
    SHORT    LeftEdge, TopEdge;      /* dimensions of the
   entire box */
    SHORT    Width, Height;          /* dimensions of the
   entire box */
    SHORT    RelLeft, RelTop;        /* for Pointer relativity
   offsets */

    struct   Gadget *ReqGadget;      /* pointer to a list
   of Gadgets */
    struct   Border *ReqBorder;      /* the box's border
   */
    struct   IntuiText *ReqText;     /* the box's text */
    USHORT   Flags;                  /* see definitions below
   */

     /* pen number for back-plane fill before draws */
     UBYTE   BackFill;
     /* Layer in place of clip rect  */
    struct   Layer *ReqLayer;

     UBYTE   ReqPad1[32];

     /* If the BitMap plane pointers are non-zero, this tells
   the system
      * that the image comes pre-drawn (if the appliprog
   wants to define
      * it's own box, in any shape or size it wants!);  this
   is OK by
      * Intuition as long as there's a good correspondence
   between
      * the image and the specified Gadgets
      */
    struct   BitMap *ImageBMap; /* points to the BitMap of
   PREDRAWN imagery */
    struct   Window *RWindow;   /* added.  points back to
   Window */
     UBYTE ReqPad2[36]
};


/* FLAGS SET BY THE APPLIPROG */
#define POINTREL    0x0001 /* if POINTREL set,TopLeft is
   relative to pointer*/
```

```
#define PREDRAWN    0x0002 /* if ReqBMap points to predrawn
  Requester
                              imagery */
/* FLAGS SET BY BOTH THE APPLIPROG AND INTUITION */

/* FLAGS SET BY INTUITION */
#define REQOFFWINDOW 0x1000   /* part of one of the Gadgets
  was offwindow */
#define REQACTIVE    0x2000   /* this requester is active
  */
#define SYSREQUEST   0x4000   /* this requester caused by
  system */
#define DEFERREFRESH 0x8000   /* this Requester stops a
  Refresh broadcast */






/* =====================================================================
  */
/* === Gadget =========================================================
  */
/* =====================================================================
  */
struct   Gadget
{
   struct   Gadget *NextGadget;  /* next gadget in the list
  */

   SHORT    LeftEdge, TopEdge;   /* "hit box" of gadget
  */
   SHORT    Width, Height;       /* "hit box" of gadget
  */

   USHORT   Flags;               /* see below for list of
  defines */

   USHORT   Activation;          /* see below for list of
  defines */

   USHORT   GadgetType;          /* see below for defines
  */

     /* appliprog can specify that the Gadget be rendered
  as either as Border
     * or an Image.  This variable points to which (or equals
  NULL if there's
     * nothing to be rendered about this Gadget)
     */
   APTR     GadgetRender;

     /* appliprog can specify "highlighted" imagery rather
  than algorithmic
     * this can point to either Border or Image data
     */
   APTR     SelectRender;

   struct   IntuiText *GadgetText;   /* text for this gadget
  */

     /* by using the MutualExclude word, the appliprog can
  describe
     * which gadgets mutually-exclude which other ones.
   The bits
     * in MutualExclude correspond to the gadgets in object
  containing
     * the gadget list.  If this gadget is selected and
  a bit is set
     * in this gadget's MutualExclude and the gadget corresponding
  to
     * that bit is currently selected (e.g. bit 2 set and
  gadget 2
     * is currently selected) that gadget must be unselected.

     * Intuition does the visual unselecting (with checkmarks)
  and
     * leaves it up to the program to unselect internally
     */
   LONG     MutualExclude;       /* set bits mean this gadget
  excludes
                                    that gadget */

     /* pointer to a structure of special data required by
  Proportional,
     * String and Integer Gadgets
     */
   APTR     SpecialInfo;

   USHORT   GadgetID;            /* user-definable ID field
  */
   APTR     UserData;            /* ptr to general purpose
  User data
                                    (ignored by In) */
};


/* --- FLAGS SET BY THE APPLIPROG -----------------------------------------
  */
/* combinations in these bits describe the highlight technique
  to be used */
#define GADGHIGHBITS    0x0003
#define GADGHCOMP       0x0000   /* Complement the select
  box */
#define GADGHBOX        0x0001   /* Draw a box around the
  image */
#define GADGHIMAGE      0x0002   /* Blast in this alternate
  image */
#define GADGHNONE       0x0003   /* don't highlight */

/* set this flag if the GadgetRender and SelectRender point
  to Image imagery,
 * clear if it's a Border
 */
#define GADGIMAGE       0x0004

/* combinations in these next two bits specify to which
  corner the gadget's
 *  Left & Top coordinates are relative.  If relative to
```

```
   Top/Left,
 *  these are "normal" coordinates (everything is relative
   to something in
 *  this universe)
 */
#define GRELBOTTOM      0x0008   /* set if rel to bottom,
   clear if rel top */
#define GRELRIGHT       0x0010   /* set if rel to right,
   clear if to left */
/* set the RELWIDTH bit to spec that Width is relative to
   width of screen */
#define GRELWIDTH       0x0020
/* set the RELHEIGHT bit to spec that Height is rel to height
   of screen */
#define GRELHEIGHT      0x0040

/* the SELECTED flag is initialized by you and set by Intuition.
    It
 * specifies whether or not this Gadget is currently selected/highlighted
 */
#define SELECTED        0x0080


/* the GADGDISABLED flag is initialized by you and later
   set by Intuition
 * according to your calls to On/OffGadget().  It specifies
   whether or not
 * this Gadget is currently disabled from being selected
 */
#define GADGDISABLED    0x0100


/* --- These are the Activation flag bits ---------------------------------
   */
/* RELVERIFY is set if you want to verify that the pointer
   was still over
 *  the gadget when the select button was released
 */
#define RELVERIFY       0x0001

/* the flag GADGIMMEDIATE, when set, informs the caller
   that the gadget
 *  was activated when it was activated.  this flag works
   in conjunction with
 *  the RELVERIFY flag
 */
#define GADGIMMEDIATE   0x0002

/* the flag ENDGADGET, when set, tells the system that this
   gadget, when
 * selected, causes the Requester or AbsMessage to be ended.
    Requesters or
 *  AbsMessages that are ended are erased and unlinked from
   the system */
#define ENDGADGET       0x0004

/* the FOLLOWMOUSE flag, when set, specifies that you want
   to receive
 * reports on mouse movements (ie, you want the REPORTMOUSE
   function for
 * your Window).  When the Gadget is deselected (immediately
   if you have
 * no RELVERIFY) the previous state of the REPORTMOUSE flag
   is restored
 * You probably want to set the GADGIMMEDIATE flag when
   using FOLLOWMOUSE,
 * since that's the only reasonable way you have of learning
   why Intuition
 * is suddenly sending you a stream of mouse movement events.
    If you don't
 * set RELVERIFY, you'll get at least one Mouse Position
   event.
 */
#define FOLLOWMOUSE     0x0008

/* if any of the BORDER flags are set in a Gadget that's
   included in the
 * Gadget list when a Window is opened, the corresponding
   Border will
 * be adjusted to make room for the Gadget
 */
#define RIGHTBORDER     0x0010
#define LEFTBORDER      0x0020
#define TOPBORDER       0x0040
#define BOTTOMBORDER    0x0080

#define TOGGLESELECT    0x0100   /* this bit for toggle-select
   mode */

#define STRINGCENTER    0x0200   /* should be a StringInfo
   flag, but it's OK*/
#define STRINGRIGHT     0x0400   /* should be a StringInfo
   flag, but it's OK*/

#define LONGINT         0x0800   /* this String Gadget is
   actually LONG Int */

#define ALTKEYMAP       0x1000   /* this String has an alternate
   keymap */


/* --- GADGET TYPES -------------------------------------------------------
   */
/* These are the Gadget Type definitions for the variable
   GadgetType
 * gadget number type MUST start from one.  NO TYPES OF
   ZERO ALLOWED.
 * first comes the mask for Gadget flags reserved for Gadget
   typing
 */
#define GADGETTYPE      0xFC00   /* all Gadget Global Type
   flags (padded) */
#define SYSGADGET       0x8000   /* 1 = SysGadget, 0 = AppliGadget
   */
#define SCRGADGET       0x4000   /* 1 = ScreenGadget, 0
   = WindowGadget */
#define GZZGADGET       0x2000   /* 1 = Gadget for GIMMEZEROZERO
   borders */
#define REQGADGET       0x1000   /* 1 = this is a Requester
   Gadget */
```

```
/* system gadgets */
#define SIZING          0x0010
#define WDRAGGING       0x0020
#define SDRAGGING       0x0030
#define WUPFRONT        0x0040
#define SUPFRONT        0x0050
#define WDOWNBACK       0x0060
#define SDOWNBACK       0x0070
#define CLOSE           0x0080
/* application gadgets */
#define BOOLGADGET      0x0001
#define GADGET0002      0x0002
#define PROPGADGET      0x0003
#define STRGADGET       0x0004






/* ==========================================================================
  */
/* === PropInfo ============================================================
  */
/* ==========================================================================
  */
/* this is the special data required by the proportional
  Gadget
 * typically, this data will be pointed to by the Gadget
  variable SpecialInfo
 */
struct   PropInfo
{
   USHORT   Flags;      /* general purpose flag bits (see
  defines below) */

     /* You initialize the Pot variables before the Gadget
  is added to
     * the system.  Then you can look here for the current
  settings
     * any time, even while User is playing with this Gadget.
   To
     * adjust these after the Gadget is added to the System,
  use
     * ModifyProp();  The Pots are the actual proportional
  settings,
     * where a value of zero means zero and a value of MAXPOT
  means
     * that the Gadget is set to its maximum setting.
     */
   USHORT   HorizPot;   /* 16-bit FixedPoint horizontal
  quantity percentage */
   USHORT   VertPot;    /* 16-bit FixedPoint vertical quantity
  percentage */

     /* the 16-bit FixedPoint Body variables describe what
  percentage of
     * the entire body of stuff referred to by this Gadget
  is actually
     * shown at one time.  This is used with the AUTOKNOB
  routines,
     * to adjust the size of the AUTOKNOB according to how
  much of
     * the data can be seen.  This is also used to decide
  how far
     * to advance the Pots when User hits the Container
  of the Gadget.
     * For instance, if you were controlling the display
  of a 5-line
     * Window of text with this Gadget, and there was a
  total of 15
     * lines that could be displayed, you would set the
  VertBody value to
     *     (MAXBODY / (TotalLines / DisplayLines)) = MAXBODY
  / 3.
     * Therefore, the AUTOKNOB would fill 1/3 of the container,
  and
     * if User hits the Cotainer outside of the knob, the
  pot would
     * advance 1/3 (plus or minus) If there's no body to
  show, or
     * the total amount of displayable info is less than
  the display area,
     * set the Body variables to the MAX.  To adjust these
  after the
     * Gadget is added to the System, use ModifyProp();

     */
   USHORT   HorizBody;  /* horizontal Body */
   USHORT   VertBody;   /* vertical Body */

    /* these are the variables that Intuition sets and maintains
  */
   USHORT   CWidth;     /* Container width (with any relativity
  absoluted) */
   USHORT   CHeight;    /* Container height (with any relativity
  absoluted) */
   USHORT   HPotRes, VPotRes; /* pot increments */
   USHORT   LeftBorder; /* Container borders */
   USHORT   TopBorder;  /* Container borders */
};


/* --- FLAG BITS ----------------------------------------------------------
  */
#define AUTOKNOB        0x0001   /* this flag sez:  gimme
  that old auto-knob*/
#define FREEHORIZ       0x0002   /* if set, the knob can
  move horizontally */
#define FREEVERT        0x0004   /* if set, the knob can
  move vertically */
#define PROPBORDERLESS  0x0008   /* if set, no border will
  be rendered */
#define KNOBHIT         0x0100   /* set when this Knob is
  hit */

#define KNOBHMIN  6              /* minimum horizontal size
  of the Knob */
#define KNOBVMIN  4              /* minimum vertical size
  of the Knob */
```

```
#define MAXBODY         0xFFFF   /* maximum body value */
#define MAXPOT          0xFFFF   /* maximum pot value */






/* ======================================================================
 */
/* === StringInfo =======================================================
 */
/* ======================================================================
 */
/* this is the special data required by the string Gadget
 * typically, this data will be pointed to by the Gadget
 variable SpecialInfo
 */
struct   StringInfo
{
    /* you initialize these variables, and then Intuition
  maintains them */
   UBYTE    *Buffer;    /* the buffer containing the start
  and final string */
   UBYTE    *UndoBuffer;  /* optional buffer for undoing
  current entry */
   SHORT    BufferPos;  /* character position in Buffer
  */
   SHORT    MaxChars;   /* max number of chars in Buffer
  (including NULL) */
   SHORT    DispPos;    /* Buffer position of first displayed
  character */

    /* Intuition initializes and maintains these variables
  for you */
   SHORT    UndoPos;    /* character position in the undo
  buffer */
   SHORT    NumChars;   /* number of characters currently
  in Buffer */
   SHORT    DispCount;  /* number of whole characters visible
  in Container */
   SHORT    CLeft, CTop;  /* topleft offset of the container
  */
   struct   Layer *LayerPtr;   /* the RastPort containing
  this Gadget */

    /* you can initialize this variable before the gadget
  is submitted to
     * Intuition, and then examine it later to discover
  what integer
     * the user has entered (if the user never plays with
  the gadget,
     * the value will be unchanged from your initial setting)
     */
   LONG     LongInt;

    /* If you want this Gadget to use your own Console keymapping,
  you
     * set the ALTKEYMAP bit in the Activation flags of
  the Gadget, and then
     * set this variable to point to your keymap.  If you
  don't set the
     * ALTKEYMAP, you'll get the standard ASCII keymapping.
     */
   struct   KeyMap *AltKeyMap;
};






/* ======================================================================
 */
/* === IntuiText ========================================================
 */
/* ======================================================================
 */
/* IntuiText is a series of strings that start with a screen
 location
 *  (always relative to the upper-left corner of something)
 and then the
 *  text of the string.  The text is null-terminated.
 */
struct   IntuiText
{
   UBYTE    FrontPen, BackPen;      /* the pen numbers for
 the rendering */
   UBYTE    DrawMode;               /* the mode for rendering
 the text */
   SHORT    LeftEdge;               /* relative start location
 for the text */
   SHORT    TopEdge;                /* relative start location
 for the text */
   struct   TextAttr *ITextFont;    /* if NULL, you accept
 the default */
   UBYTE    *IText;                 /* pointer to null-terminated
 text */
   struct   IntuiText *NextText;    /* continuation to TxWrite
 another text */
};






/* ======================================================================
 */
/* === Border ===========================================================
 */
/* ======================================================================
 */
/* Data type Border, used for drawing a series of lines
 which is intended for
 *  use as a border drawing, but which may, in fact, be
 used to render any
 *  arbitrary vector shape.
 *  The routine DrawBorder sets up the RastPort with the
 appropriate
```

```
 *  variables, then does a Move to the first coordinate,
  then does Draws
 *  to the subsequent coordinates.
 *  After all the Draws are done, if NextBorder is non-zero
  we call DrawBorder
 *  recursively
 */
struct   Border
{
   SHORT    LeftEdge, TopEdge;      /* initial offsets from
  the origin */
   UBYTE    FrontPen, BackPen;      /* pens numbers for
  rendering */
   UBYTE    DrawMode;               /* mode for rendering
  */
   BYTE    Count;                   /* number of XY pairs
  */
   SHORT    *XY;                    /* vector coordinate
  pairs relitive
                                       to LeftTop */
   struct   Border *NextBorder;     /* pointer to any other
  Border too */
};






/* =====================================================================
  */
/* === Image ===========================================================
  */
/* =====================================================================
  */
/* This is a brief image structure for very simple transfers
   of
 * image data to a RastPort
 */
struct   Image
{
   SHORT    LeftEdge;            /* starting offset relative
  to some origin */
   SHORT    TopEdge;             /* starting offsets relative
  to some origin*/
   SHORT    Width;               /* pixel size (though data
  is word-aligned)*/
   SHORT    Height, Depth;       /* pixel sizes */
   USHORT   *ImageData;          /* pointer to the actual
  word-aligned bits */

     /* the PlanePick and PlaneOnOff variables work much
  the same way as the
      * equivalent GELS Bob variables.  It's a space-saving

      * mechanism for image data.  Rather than defining the
  image data
      * for every plane of the RastPort, you need define
  data only
      * for the planes that are not entirely zero or one.
```

MUST BE CHIP MEM.

```
   As you
     * define your Imagery, you will often find that most
  of the planes
     * ARE just as color selectors.  For instance, if you're
  designing
     * a two-color Gadget to use colors two and three, and
  the Gadget
     * will reside in a five-plane display, bit plane zero
  of your
     * imagery would be all ones, bit plane one would have
  data that
     * describes the imagery, and bit planes two through
  four would be
     * all zeroes.  Using these flags allows you to avoid
  wasting all
     * that memory in this way:  first, you specify which
  planes you
     * want your data to appear in using the PlanePick variable.
   For
     * each bit set in the variable, the next "plane" of
  your image
     * data is blitted to the display.  For each bit clear
  in this
     * variable, the corresponding bit in PlaneOnOff is
  examined.
     * If that bit is clear, a "plane" of zeroes will be
  used.
     * If the bit is set, ones will go out instead.  So,
  for our example:
     *   Gadget.PlanePick = 0x02;
     *   Gadget.PlaneOnOff = 0x01;
     * Note that this also allows for generic Gadgets, like
   the
     * System Gadgets, which will work in any number of
  bit planes.
     * Note also that if you want an Image that is only
  a filled
     * rectangle, you can get this by setting PlanePick
  to zero
     * (pick no planes of data) and set PlaneOnOff to describe
  the pen
     * color of the rectangle.
     */
   UBYTE    PlanePick, PlaneOnOff;

    /* if the NextImage variable is not NULL, Intuition
  presumes that
     * it points to another Image structure with another
  Image to be
     * rendered
     */
   struct   Image *NextImage;
};






/* =====================================================================
```

```
  */
/* === IntuiMessage =========================================================
  */
/* ==========================================================================
  */
struct   IntuiMessage
{
   struct   Message ExecMessage;

    /* the Class bits correspond directly with the IDCMP
  Flags, except for the
     * special bit LONELYMESSAGE (defined below)
     */
   ULONG    Class;

    /* the Code field is for special values like MENU number
  */
   USHORT   Code;

    /* the Qualifier field is a copy of the current InputEvent's
  Qualifier */
   USHORT   Qualifier;

    /* IAddress contains particular addresses for Intuition
  functions, like
     * the pointer to the Gadget or the Screen
     */
   APTR     IAddress;

    /* when getting mouse movement reports, any event you
  get will have the
     * the mouse coordinates in these variables.  the coordinates
  are relative
     * to the upper-left corner of your Window (GIMMEZEROZERO
  notwithstanding)
     */
   SHORT    MouseX, MouseY;

    /* the time values are copies of the current system
  clock time.  Micros
     * are in units of microseconds, Seconds in seconds.
     */
   ULONG    Seconds, Micros;

    /* the IDCMPWindow variable will always have the address
  of the Window of
     * this IDCMP
     */
   struct   Window *IDCMPWindow;

    /* system-use variable */
   struct   IntuiMessage *SpecialLink;
};


/* --- IDCMP Classes ---------------------------------------------------------
  */
#define SIZEVERIFY          0x00000001  /*  See the Programmer's
  Guide  */
#define NEWSIZE             0x00000002  /*  See the Programmer's
  Guide  */
#define REFRESHWINDOW       0x00000004  /*  See the Programmer's
  Guide  */
#define MOUSEBUTTONS        0x00000008  /*  See the Programmer's
  Guide  */
#define MOUSEMOVE           0x00000010  /*  See the Programmer's
  Guide  */
#define GADGETDOWN          0x00000020  /*  See the Programmer's
  Guide  */
#define GADGETUP            0x00000040  /*  See the Programmer's
  Guide  */
#define REQSET              0x00000080  /*  See the Programmer's
  Guide  */
#define MENUPICK            0x00000100  /*  See the Programmer's
  Guide  */
#define CLOSEWINDOW         0x00000200  /*  See the Programmer's
  Guide  */
#define RAWKEY              0x00000400  /*  See the Programmer's
  Guide  */
#define REQVERIFY           0x00000800  /*  See the Programmer's
  Guide  */
#define REQCLEAR            0x00001000  /*  See the Programmer's
  Guide  */
#define MENUVERIFY          0x00002000  /*  See the Programmer's
  Guide  */
#define NEWPREFS            0x00004000  /*  See the Programmer's
  Guide  */
#define DISKINSERTED        0x00008000  /*  See the Programmer's
  Guide  */
#define DISKREMOVED         0x00010000  /*  See the Programmer's
  Guide  */
#define WBENCHMESSAGE       0x00020000  /*  See the Programmer's
  Guide  */
#define ACTIVEWINDOW        0x00040000  /*  See the Programmer's
  Guide  */
#define INACTIVEWINDOW      0x00080000  /*  See the Programmer's
  Guide  */
#define DELTAMOVE           0x00100000  /*  See the Programmer's
  Guide  */
#define VANILLAKEY          0x00200000  /*  See below  */
#define INTUITICKS          0x00400000  /*  See below  */
/* NOTEZ-BIEN:              0x80000000 is reserved for internal
  use   */

/*
VANILLAKEY
This is the raw keycode RAWKEY event translated into the
  current
default character keymap of the Console Device.  In the
  USA, the
default keymap is ASCII character.  When you set this flag,
  you
will get IntuiMessages where the Code field has a character
representing the key struck on the keyboard.  This character
  is
from the default character KeyMap of the Console Device.
*/

/*
```

```
INTUITICKS
You can get simple timer events from Intuition when your window is
the active one, which may help you avoid opening and managing the
timer device.  Intuition receives timer events 10 times a
second (approximately).  You can receive these events too, by setting
the INTUITICKS flag.  You will only get one queued-up INTUITICKS
message at a time; if Intuition notices that you've been sent an
INTUITICKS message but you haven't replied to it yet, another message
will NOT be sent.
*/

/* the IDCMP Flags do not use this special bit, which is cleared when
 * Intuition sends its special message to the Task, and set when Intuition
 * gets its Message back from the Task.  Therefore, I can check here to
 * find out fast whether or not this Message is available for me to send.
 */
#define LONELYMESSAGE      0x80000000


/* --- IDCMP Codes ---------------------------------------------------- */
/* This group of codes is for the MENUVERIFY function */
#define MENUHOT       0x0001   /* IntuiWants verification or MENUCANCEL    */
#define MENUCANCEL    0x0002   /* HOT Reply of this cancels Menu operation */
#define MENUWAITING   0x0003   /* Intuition simply wants a ReplyMsg() ASAP */

/* This group of codes is for the WBENCHMESSAGE messages */
#define WBENCHOPEN    0x0001
#define WBENCHCLOSE   0x0002



/* ================================================================== */
/* === Window ======================================================= */
/* ================================================================== */
struct   Window
{
0  struct   Window *NextWindow;     /* for the linked list in a screen */

4  SHORT    LeftEdge, TopEdge;      /* screen dimensions of window */
8  SHORT    Width, Height;          /* screen dimensions of window */

12 SHORT    MouseY, MouseX;         /* relative to upper-left of window */

16 SHORT    MinWidth, MinHeight;    /* minimum sizes */
20 SHORT    MaxWidth, MaxHeight;    /* maximum sizes */

24 ULONG    Flags;                  /* see below for defines */

28 struct   Menu *MenuStrip;        /* the strip of Menu headers */

32 UBYTE    *Title;                 /* the title text for this window */

36 struct   Requester *FirstRequest; /* all active Requesters */

40 struct   Requester *DMRequest;   /* double-click Requester */

44 SHORT    ReqCount;               /* count of reqs blocking Window */

46 struct   Screen *WScreen;        /* this Window's Screen */
50 struct   RastPort *RPort;        /* this Window's very own RastPort */

   /* the border variables describe the window border. If you specify
    * GIMMEZEROZERO when you open the window, then the upper-left of the
    * ClipRect for this window will be upper-left of the BitMap (with correct
    * offsets when in SuperBitMap mode; you MUST select GIMMEZEROZERO when
    * using SuperBitMap).  If you don't specify ZeroZero, then you save
    * memory (no allocation of RastPort, Layer, ClipRect and associated
    * Bitmaps), but you also must offset all your writes by BorderTop,
    * BorderLeft and do your own mini-clipping to prevent writing over the
    * system gadgets
    */
54 BYTE   BorderLeft, BorderTop, BorderRight, BorderBottom;
58 struct   RastPort *BorderRPort;


   /* You supply a linked-list of Gadgets for your Window.
    * This list DOES NOT include system gadgets.  You get the standard
    * window system gadgets by setting flag-bits in the variable Flags (see
    * the bit definitions below)
```

```
        */
64   struct   Gadget *FirstGadget;

      /* these are for opening/closing the windows */
66   struct   Window *Parent, *Descendant;

      /* sprite data information for your own Pointer
       * set these AFTER you Open the Window by calling SetPointer()
       */
74   USHORT  *Pointer;                /* sprite data */
78   BYTE    PtrHeight;               /* sprite height (not
   including
                                         sprite padding) */
79   BYTE    PtrWidth;                /* sprite width (must
   be less than or
                                         equal to 16) */
80   BYTE    XOffset, YOffset;        /* sprite offsets */

      /* the IDCMP Flags and User's and Intuition's Message
   Ports */
82   ULONG    IDCMPFlags;             /* User-selected flags
   */
86   struct   MsgPort *UserPort, *WindowPort;
     struct   IntuiMessage *MessageKey;

     UBYTE    DetailPen, BlockPen;    /* for bar/border/gadget
   rendering */

      /* the CheckMark is a pointer to the imagery that will
   be used when
       * rendering MenuItems of this Window that want to be
   checkmarked
       * if this is equal to NULL, you'll get the default
   imagery
       */
     struct   Image *CheckMark;

     UBYTE    *ScreenTitle; /* if non-null, Screen title when
   Window is active*/

      /* These variables have the mouse coordinates relative
   to the
       * inner-Window of GIMMEZEROZERO Windows.  This is compared
   with the
       * MouseX and MouseY variables, which contain the mouse
   coordinates
       * relative to the upper-left corner of the Window,
   GIMMEZEROZERO
       * notwithstanding
       */
     SHORT    GZZMouseX;
     SHORT    GZZMouseY;
      /* these variables contain the width and height of the
   inner-Window of
       * GIMMEZEROZERO Windows
       */
     SHORT    GZZWidth;
     SHORT    GZZHeight;

     UBYTE    *ExtData;

     BYTE     *UserData;  /* general-purpose pointer to User
   data extension */

      /** jimm: NEW: 11/18/85: this pointer keeps a duplicate
   of what
       * Window.RPort->Layer is _supposed_ to be pointing
   at
       */
     struct   Layer *WLayer;
};


/* --- FLAGS REQUESTED (NOT DIRECTLY SET THOUGH) BY THE
   APPLIPROG --------- */
#define WINDOWSIZING     0x0001      /* include sizing system-gadget?
   */
#define WINDOWDRAG       0x0002      /* include dragging
   system-gadget? */
#define WINDOWDEPTH      0x0004      /* include depth arrangement
   gadget? */
#define WINDOWCLOSE      0x0008      /* include close-box
   system-gadget? */

#define SIZEBRIGHT       0x0010      /* size gadget uses
   right border */
#define SIZEBBOTTOM      0x0020      /* size gadget uses
   bottom border */

/* --- refresh modes ------------------------------------------------
   */
/* combinations of the REFRESHBITS select the refresh type
   */
#define REFRESHBITS      0x00C0
#define SMART_REFRESH    0x0000
#define SIMPLE_REFRESH   0x0040
#define SUPER_BITMAP     0x0080
#define OTHER_REFRESH    0x00C0

#define BACKDROP         0x0100   /* this is an ever-popular
   BACKDROP window */

#define REPORTMOUSE      0x0200   /* set this to hear about
   every mouse move */

#define GIMMEZEROZERO    0x0400   /* make extra border stuff
   */

#define BORDERLESS       0x0800   /* set this to get a Window
   sans border */

#define ACTIVATE         0x1000   /* when Window opens, it's
   the Active one */

/* FLAGS SET BY INTUITION */
#define WINDOWACTIVE      0x2000  /* this window is the active
   one */
#define INREQUEST         0x4000  /* this window is in request
   mode */
#define MENUSTATE         0x8000  /* this Window is active
```

```
                                                              with its Menus on */

/* --- Other User Flags --------------------------------------------------- */
#define RMBTRAP          0x00010000  /* Catch RMB events for your own */
#define NOCAREREFRESH    0x00020000  /* not to be bothered with REFRESH */


/* --- Other Intuition Flags ---------------------------------------------- */
#define WINDOWREFRESH    0x01000000  /* Window is currently refreshing */
#define WBENCHWINDOW     0x02000000  /* WorkBench tool ONLY Window */
#define WINDOWTICKED     0x04000000  /* only one timer tick at a time */

#define SUPER_UNUSED     0xFCFC0000  /* bits of Flag unused yet */


/* --- see struct  IntuiMessage for the IDCMP Flag definitions ------------ */




/* ====================================================================== */
/* === NewWindow ======================================================== */
/* ====================================================================== */
struct  NewWindow
{
0   SHORT    LeftEdge, TopEdge;       /* screen dimensions of window */
4   SHORT    Width, Height;           /* screen dimensions of window */

8   UBYTE    DetailPen, BlockPen;     /* for bar/border/gadget rendering */

10  ULONG    IDCMPFlags;              /* User-selected IDCMP flags */

14  ULONG    Flags;                   /* see Window struct for defines */

    /* You supply a linked-list of Gadgets for your Window.
     *  This list DOES NOT include system Gadgets.  You get the standard
     *  system Window Gadgets by setting flag-bits in the variable Flags (see
     *  the bit definitions under the Window structure definition)
     */
18  struct   Gadget *FirstGadget;

    /* the CheckMark is a pointer to the imagery that will be used when
     * rendering MenuItems of this Window that want to be checkmarked
     * if this is equal to NULL, you'll get the default imagery
     */
22  struct   Image *CheckMark;

26  UBYTE    *Title;                  /* the title text for this window */

    /* the Screen pointer is used only if you've defined a CUSTOMSCREEN and
     * want this Window to open in it.  If so, you pass the address of the
     * Custom Screen structure in this variable.  Otherwise, this variable
     * is ignored and doesn't have to be initialized.
     */
30  struct   Screen *Screen;

    /* SUPER_BITMAP Window?  If so, put the address of your BitMap structure
     * in this variable.  If not, this variable is ignored and doesn't have
     * to be initialized
     */
34  struct   BitMap *BitMap;

    /* the values describe the minimum and maximum sizes of your Windows.
     * these matter only if you've chosen the WINDOWSIZING Gadget option,
     * which means that you want to let the User to change the size of
     * this Window.  You describe the minimum and maximum sizes that the
     * Window can grow by setting these variables.  You can initialize
     * any one these to zero, which will mean that you want to duplicate
     * the setting for that dimension (if MinWidth == 0, MinWidth will be
     * set to the opening Width of the Window).
     * You can change these settings later using SetWindowLimits().
     * If you haven't asked for a SIZING Gadget, you don't have to
     * initialize any of these variables.
     */
38  SHORT    MinWidth, MinHeight;     /* minimums */
42  SHORT    MaxWidth, MaxHeight;     /* maximums */

    /* the type variable describes the Screen in which you want this Window to
     * open.  The type value can either be CUSTOMSCREEN or one of the
     * system standard Screen Types such as WBENCHSCREEN.  See the
     * type definitions under the Screen structure
```

```
      */
    USHORT   Type;
};





/* ==========================================================================
  */
/* === Screen ===============================================================
  */
/* ==========================================================================
  */
struct   Screen
{
    struct   Screen *NextScreen;     /* linked list of screens
  */
    struct   Window *FirstWindow;    /* linked list Screen's
  Windows */

    SHORT    LeftEdge, TopEdge;      /* parameters of the
  screen */
    SHORT    Width, Height;          /* parameters of the
  screen */

    SHORT    MouseY, MouseX;         /* position relative
  to upper-left */

    USHORT   Flags;                  /* see definitions below
  */

    UBYTE    *Title;                 /* null-terminated Title
  text */
    UBYTE    *DefaultTitle;          /* for Windows without
  ScreenTitle */

      /* Bar sizes for this Screen and all Window's in this
  Screen */
    BYTE    BarHeight, BarVBorder, BarHBorder, MenuVBorder,
  MenuHBorder;
    BYTE    WBorTop, WBorLeft, WBorRight, WBorBottom;

    struct   TextAttr *Font;         /* this screen's default
  font */

      /* the display data structures for this Screen */
    struct   ViewPort ViewPort;      /* describing the Screen's
  display */
    struct   RastPort RastPort;      /* describing Screen
  rendering */
    struct   BitMap BitMap;          /* auxiliary graphexcess
  baggage */
    struct   Layer_Info LayerInfo;   /* each screen gets
  a LayerInfo */

      /* You supply a linked-list of Gadgets for your Screen.
       *  This list DOES NOT include system Gadgets.  You
  get the standard
       *  system Screen Gadgets by default
       */
    struct   Gadget *FirstGadget;

    UBYTE    DetailPen, BlockPen;      /* for bar/border/gadget
  rendering */

      /* the following variable(s) are maintained by Intuition
  to support the
       * DisplayBeep() color flashing technique
       */
    USHORT   SaveColor0;

      /* This layer is for the Screen and Menu bars */
    struct   Layer *BarLayer;

    UBYTE    *ExtData;

    UBYTE    *UserData; /* general-purpose pointer to User
  data extension */
};


/* --- FLAGS SET BY INTUITION -------------------------------------------
  */
/* The SCREENTYPE bits are reserved for describing various
  Screen types
 * available under Intuition.
 */
#define SCREENTYPE   0x000F          /* all the screens types
  available */
/* --- the definitions for the Screen Type ------------------------------
  */
#define WBENCHSCREEN 0x0001          /* Ta Da!  The Workbench
  */
#define CUSTOMSCREEN 0x000F          /* for that special
  look */

#define SHOWTITLE    0x0010          /* this gets set by
  a call to
                                        ShowTitle()*/

#define BEEPING      0x0020          /* set when Screen is
  beeping */

#define CUSTOMBITMAP 0x0040          /* if you are supplying
  your own BitMap */




/* ==========================================================================
  */
/* === NewScreen ============================================================
  */
/* ==========================================================================
  */
struct   NewScreen
{
    SHORT    LeftEdge, TopEdge, Width, Height, Depth;  /*
```

```
    screen dimensions */

     UBYTE    DetailPen, BlockPen;    /* for bar/border/gadget
    rendering */

     USHORT   ViewModes;              /* the Modes for the
    ViewPort (and View)*/

     USHORT   Type;                   /* the Screen type (see
    defines above) */

     struct   TextAttr *Font;         /* this Screen's default
    text attributes*/

     UBYTE    *DefaultTitle;          /* the default title
    for this Screen */

     struct   Gadget *Gadgets;        /* your own Gadgets
    for this Screen */

      /* if you are opening a CUSTOMSCREEN and already have
    a BitMap
       * that you want used for your Screen, you set the flags
    CUSTOMBITMAP in
       * the Types variable and you set this variable to point
    to your BitMap
       * structure.  The structure will be copied into your
    Screen structure,
       * after which you may discard your own BitMap if you
    want
       */
     struct   BitMap *CustomBitMap;
  };




  /* ====================================================================
    */
  /* === Preferences ====================================================
    */
  /* ====================================================================
    */

  /* these are the definitions for the printer configurations
    */
  #define  FILENAME_SIZE  30         /* Filename size */

  #define  POINTERSIZE (1 + 16 + 1) * 2  /* Size of Pointer
    data buffer */

  /* These defines are for the default font size.  These actually
    describe the
   * height of the defaults fonts.  The default font type
    is the topaz
   * font, which is a fixed width font that can be used in
    either
   * eighty-column or sixty-column mode.  The Preferences
    structure reflects
   * which is currently selected by the value found in the
    variable FontSize,
   * which may have either of the values defined below.  These
    values actually
   * are used to select the height of the default font.  By
    changing the
   * height, the resolution of the font changes as well.
   */
  #define TOPAZ_EIGHTY 8
  #define TOPAZ_SIXTY 9


  struct   Preferences
  {
      /* the default font height */
     BYTE    FontHeight;              /* height for system
    default font  */

      /* constant describing what's hooked up to the port
    */
     UBYTE    PrinterPort;            /* printer port connection
      */

      /* the baud rate of the port */
     USHORT   BaudRate;       /* baud rate for the serial
    port   */

      /* various timing rates */
     struct   timeval KeyRptSpeed;    /* repeat speed for
    keyboard     */
     struct   timeval KeyRptDelay;    /* Delay before keys
    repeat         */
     struct   timeval DoubleClick;    /* Interval allowed
    between clicks */

      /* Intuition Pointer data */
     USHORT   PointerMatrix[POINTERSIZE]; /* Definition of
    pointer sprite    */
     BYTE    XOffset;                 /* X-Offset for active
    'bit'       */
     BYTE    YOffset;                 /* Y-Offset for active
    'bit'       */
     USHORT   color17;                /***********************************/
     USHORT   color18;                /* Colours for sprite
    pointer      */
     USHORT   color19;                /***********************************/
     USHORT   PointerTicks;           /* Sensitivity of the
    pointer    */

      /* Workbench Screen colors */
     USHORT   color0;                 /***********************************/
     USHORT   color1;                 /*  Standard default
    colours         */
     USHORT   color2;                 /*   Used in the Workbench
          */
     USHORT   color3;                 /***********************************/

      /* positioning data for the Intuition View */
     BYTE    ViewXOffset;             /* Offset for top lefthand
    corner  */
     BYTE    ViewYOffset;             /* X and Y dimensions
```

```
            */
    WORD ViewInitX, ViewInitY;      /* View initial offset
  values      */

    BOOL EnableCLI;                 /* CLI availability
  switch */

    /* printer configurations */
   USHORT   PrinterType;            /* printer type
              */
   UBYTE    PrinterFilename[FILENAME_SIZE];  /* file for
  printer       */

    /* print format and quality configurations */
   USHORT   PrintPitch;             /* print pitch
     */
   USHORT   PrintQuality;           /* print quality
     */
   USHORT   PrintSpacing;           /* number of lines per
  inch      */
    UWORD PrintLeftMargin;          /* left margin in characters
     */
    UWORD PrintRightMargin;         /* right margin in characters
     */
   USHORT   PrintImage;             /* positive or negative
       */
   USHORT   PrintAspect;            /* horizontal or vertical
     */
   USHORT   PrintShade;             /* b&w, half-tone, or
  color      */
    WORD PrintThreshold;            /* darkness ctrl for
  b/w dumps      */

    /* print paper descriptors */
   USHORT   PaperSize;              /* paper size
     */
    UWORD PaperLength;              /* paper length in number
  of lines */
   USHORT   PaperType;              /* continuous or single
  sheet      */

   BYTE    padding[50];             /* For further system
  expansion     */
};


/* PrinterPort */
#define PARALLEL_PRINTER 0x00
#define SERIAL_PRINTER  0x01

/* BaudRate */
#define BAUD_110     0x00
#define BAUD_300     0x01
#define BAUD_1200    0x02
#define BAUD_2400    0x03
#define BAUD_4800    0x04
#define BAUD_9600    0x05
#define BAUD_19200   0x06
#define BAUD_MIDI    0x07

/* PaperType */
#define FANFOLD      0x00
#define SINGLE       0x80

/* PrintPitch */
#define PICA         0x000
#define ELITE        0x400
#define FINE         0x800

/* PrintQuality */
#define DRAFT        0x000
#define LETTER       0x100

/* PrintSpacing */
#define SIX_LPI      0x000
#define EIGHT_LPI    0x200

/* Print Image */
#define IMAGE_POSITIVE  0x00
#define IMAGE_NEGATIVE  0x01

/* PrintAspect */
#define ASPECT_HORIZ 0x00
#define ASPECT_VERT  0x01

/* PrintShade */
#define SHADE_BW        0x00
#define SHADE_GREYSCALE 0x01
#define SHADE_COLOR     0x02

/* PaperSize */
#define US_LETTER    0x00
#define US_LEGAL     0x10
#define N_TRACTOR    0x20
#define W_TRACTOR    0x30
#define CUSTOM       0x40

/* PrinterType */
#define CUSTOM_NAME     0x00
#define  ALPHA_P_101    0x01
#define BROTHER_15XL    0x02
#define CBM_MPS1000     0x03
#define DIAB_630        0x04
#define DIAB_ADV_D25    0x05
#define DIAB_C_150      0x06
#define EPSON           0x07
#define EPSON_JX_80     0x08
#define OKIMATE_20      0x09
#define QUME_LP_20      0x0A
/* new printer entries, 3 October 1985 */
#define HP_LASERJET     0x0B
#define HP_LASERJET_PLUS   0x0C





/* ===========================================================================
  */
/* === Remember ==============================================================
```

```
   */
/* ======================================================================
   */
/* this structure is used for remembering what memory has
   been allocated to
 * date by a given routine, so that a premature abort or
   systematic exit
 * can deallocate memory cleanly, easily, and completely
 */
struct   Remember
{
   struct   Remember *NextRemember;
   ULONG    RememberSize;
   UBYTE    *Memory;
};




/* ======================================================================
   */
/* === Miscellaneous ====================================================
   */
/* ======================================================================
   */

/* = MACROS ============================================================
   */
#define MENUNUM(n)   (n & 0x1F)
#define ITEMNUM(n)   ((n >> 5) & 0x003F)
#define SUBNUM(n)    ((n >> 11) & 0x001F)

#define SHIFTMENU(n) (n & 0x1F)
#define SHIFTITEM(n) ((n & 0x3F) << 5)
#define SHIFTSUB(n)  ((n & 0x1F) << 11)

/* = MENU STUFF =========================================================
   */
#define NOMENU       0x001F
#define NOITEM       0x003F
#define NOSUB        0x001F
#define MENUNULL     0xFFFF


/* = =RJ='s peculiarities ===============================================
   */
#define FOREVER for(;;)
#define SIGN(x) ( ((x) > 0) - ((x) < 0) )
#define NOT !

/* these defines are for the COMMSEQ and CHECKIT menu stuff.
    If CHECKIT,
 * I'll use a generic Width (for all resolutions) for the
   CheckMark.
 * If COMMSEQ, likewise I'll use this generic stuff
 */
#define CHECKWIDTH      19
#define COMMWIDTH       27
#define LOWCHECKWIDTH   13
#define LOWCOMMWIDTH    16


/* these are the AlertNumber defines.  if you are calling
   DisplayAlert()
 * the AlertNumber you supply must have the ALERT_TYPE bits
   set to one
 * of these patterns
 */
#define ALERT_TYPE      0x80000000
#define RECOVERY_ALERT  0x00000000  /* the system can recover
   from this */
#define DEADEND_ALERT   0x80000000  /* no recovery possible,
   this is it */


/* When you're defining IntuiText for the Positive and Negative
   Gadgets
 * created by a call to AutoRequest(), these defines will
   get you
 * reasonable-looking text.  The only field without a define
   is the IText
 * field; you decide what text goes with the Gadget
 */
#define AUTOFRONTPEN    0
#define AUTOBACKPEN     1
#define AUTODRAWMODE    JAM2
#define AUTOLEFTEDGE    6
#define AUTOTOPEDGE     3
#define AUTOITEXTFONT   NULL
#define AUTONEXTTEXT    NULL


/* --- RAWMOUSE Codes and Qualifiers (Console OR IDCMP)
   ------------------- */
#define SELECTUP        (IECODE_LBUTTON | IECODE_UP_PREFIX)
#define SELECTDOWN      (IECODE_LBUTTON)
#define MENUUP          (IECODE_RBUTTON | IECODE_UP_PREFIX)
#define MENUDOWN        (IECODE_RBUTTON)
#define ALTLEFT         (IEQUALIFIER_LALT)
#define ALTRIGHT        (IEQUALIFIER_RALT)
#define AMIGALEFT       (IEQUALIFIER_LCOMMAND)
#define AMIGARIGHT      (IEQUALIFIER_RCOMMAND)
#define AMIGAKEYS       (AMIGALEFT | AMIGARIGHT)

#define CURSORUP        0x4C
#define CURSORLEFT      0x4F
#define CURSORRIGHT     0x4E
#define CURSORDOWN      0x4D
#define KEYCODE_Q       0x10
#define KEYCODE_X       0x32
#define KEYCODE_N       0x36
#define KEYCODE_M       0x37



#endif

```

```
#ifndef INTUITION_INTUITIONBASE_H
#define INTUITION_INTUITIONBASE_H 1

/*** intuitionbase.h ************************************************************
 * Commodore-Amiga, Inc.
 *
 *  the IntuitionBase structure and supporting structures
 *
 *          Modification History
 *      date    :   author :    Comments
 *     ------       ------      -------------------------------------
 *     3-1-85      -=RJ=-  created this file!
 *
 ****************************************************************************/

#ifndef EXEC_LIBRARIES_H
#include "exec/libraries.h"
#endif

#ifndef  GRAPHICS_VIEW_H
#include "graphics/view.h"
#endif

/*
 * Be sure to protect yourself against someone modifying these data as
 * you look at them.  This is done by calling:
 *
 * lock = LockIBase(0), which returns a ULONG.  When done call
 * UnlockIBase(lock) where lock is what LockIBase() returned.
 *
 * NOTE: these library functions are simply stubs now, but should be called
 * to be compatible with future releases.
 */

/* ======================================================================== */
/* === IntuitionBase ====================================================== */
/* ======================================================================== */
struct IntuitionBase
{
    struct Library LibNode;

    struct View ViewLord;

    struct Window *ActiveWindow;
    struct Screen *ActiveScreen;

/* the FirstScreen variable points to the frontmost Screen.  Screens are
 * then maintained in a front to back order using Screen.NextScreen
 */
    struct Screen *FirstScreen; /* for linked list of all screens */
};

#endif
```

```
Contents
--------

lattice/ctype.h
lattice/dec.h
lattice/dos.h
lattice/error.h
lattice/fcntl.h
lattice/iosl.h
lattice/limits.h
lattice/math.h
lattice/stdio.h
```

Listing of ctype.h

```c
/**
* This header file defines various ASCII character manipulation macros,
* as follows:
*
*       isalpha(c)    non-zero if c is alpha
*       isupper(c)    non-zero if c is upper case
*       islower(c)    non-zero if c is lower case
*       isdigit(c)    non-zero if c is a digit (0 to 9)
*       isxdigit(c)   non-zero if c is a hexadecimal digit (0 to 9, A to F,
*                   a to f)
*       isspace(c)    non-zero if c is white space
*       ispunct(c)    non-zero if c is punctuation
*       isalnum(c)    non-zero if c is alpha or digit
*       isprint(c)    non-zero if c is printable (including blank)
*       isgraph(c)    non-zero if c is graphic (excluding blank)
*       iscntrl(c)    non-zero if c is control character
*       isascii(c)    non-zero if c is ASCII
*       iscsym(c)     non-zero if valid character for C symbols
*       iscsymf(c)    non-zero if valid first character for C symbols
*
**/

#define _U 1          /* upper case flag */
#define _L 2          /* lower case flag */
#define _N 4          /* number flag */
#define _S 8          /* space flag */
#define _P 16         /* punctuation flag */
#define _C 32         /* control character flag */
#define _B 64         /* blank flag */
#define _X 128        /* hexadecimal flag */

extern char _ctype[];   /* character type table */

#define isalpha(c)      (_ctype[(c)+1]&(_U|_L))
#define isupper(c)      (_ctype[(c)+1]&_U)
#define islower(c)      (_ctype[(c)+1]&_L)
#define isdigit(c)      (_ctype[(c)+1]&_N)
#define isxdigit(c)     (_ctype[(c)+1]&_X)
#define isspace(c)      (_ctype[(c)+1]&_S)
#define ispunct(c)      (_ctype[(c)+1]&_P)
#define isalnum(c)      (_ctype[(c)+1]&(_U|_L|_N))
#define isprint(c)      (_ctype[(c)+1]&(_P|_U|_L|_N|_B))
#define isgraph(c)      (_ctype[(c)+1]&(_P|_U|_L|_N))
#define iscntrl(c)      (_ctype[(c)+1]&_C)
#define isascii(c)      ((unsigned)(c)<=127)
#define iscsym(c)       (isalnum(c)||(((c)&127)==0x5f))
#define iscsymf(c)      (isalpha(c)||(((c)&127)==0x5f))

#define toupper(c)     (islower(c)?((c)-('a'-'A')):(c))
#define tolower(c)     (isupper(c)?((c)+('a'-'A')):(c))
#define toascii(c)      ((c)&127)
```

Listing of dec.h

```c
/**
* This file contains information used by the decimal arithmetic package.
*
* A floating decimal number is a byte array consisting of a two-byte
* header followed by a byte for each two digits.  The header has the
* following format:
*
*       Byte 0, bit 7:         Set if negative number
*       Byte 0, bits 0 to 6:   Number of digit bytes (array length - 2)
*       Byte 1                 Decimal exponent (-128 to +127)
*
**/


#define D_DIG 8                    /* Maximum number of digit bytes */
#define D_MAX (D_DIG+2)            /* Maximum number of bytes */

extern char I0[],I1[],I2[];        /* Integer constants 0, 1, 2 */
extern char D5[],D05[],D005[];     /* Decimal constants 0.5, 0.05, 0.005 */
extern char PI[],PID2[],PIM2[];    /* Constants PI, PI/2, PI*2 */
extern char E[];                   /* Constant E (base of natural logs) */
extern char M[];                   /* Constant log10(E) */
extern char DPR[],RPD[];           /* Degrees per radian, radians per degree */
extern char SR10[];                /* Square root of 10 */
extern char X[],Y[],Z[];           /* Work areas */
extern char X1[],Y1[],Z1[];        /* Work areas */

extern char FDEDIT;                /* Set to include leading dollar sign */
extern char FDTYPE;                /* Set if last cvfd input was exponential */
extern char FDDECP;                /* decimal point character */
extern char FDMONY;                /* money symbol */

extern char *cvfd(),*cvfdx(),*vcfd(),*vcfdi(),*vcfde(),*vcfddc();
```

Listing of "lattice/dos.h"

```
/**
* This header file supplies information needed to interface with the
* particular operating system and C compiler being used.
**/

/**
* The following definitions specify the particular C compiler being used.
*
*       LATTICE         Lattice C compiler
*       BDS             BDS C compiler
*       BTL             Bell Labs C compiler or equivalent
*       MANX            MANX Aztec C compiler
*
*/
#define LATTICE 1


/**
* The following type definitions take care of the particularly nasty
* machine dependency caused by the unspecified handling of sign extension
* in the C language.  When converting "char" to "int" some compilers
* will extend the sign, while others will not.  Both are correct, and
* the unsuspecting programmer is the loser.  For situations where it
* matters, the new type "byte" is equivalent to "unsigned char".
*
*/
#if LATTICE
typedef char byte;
#endif

#if BDS
#define byte char
#endif

#if BTL
typedef unsigned char byte;
#endif

#if MANX
#define byte char
#endif

/**
*
* Miscellaneous definitions
*
*/
#define SECSIZ 128              /* disk sector size */

/**
*
* The following structure is a File Control Block.  Operating systems
* with CPM-like characteristics use the FCB to store information about
* a file while it is open.
*
*/
struct FCB
        {
        char fcbdrv;            /* drive code */
        char fcbnam[8];         /* file name */
        char fcbext[3];         /* file name extension */
        char fcbexn;            /* extent number */
        char fcbs1;             /* reserved */
        char fcbs2;             /* reserved */
        char fcbrc;             /* record count */
        char fcbsys[16];        /* reserved */
        char fcbcr;             /* current record number */
        short fcbrec;           /* random record number */
        char fcbovf;            /* random record overflow */
        };

#define FCBSIZ sizeof(struct FCB)

/**
*
* The following symbols define the sizes of file names and node names.
*
*/
#define FNSIZE 30       /* maximum file node name size */
#define FMSIZE 30       /* maximum file name size */


/**
*
* The following codes are used to open files in various modes.
*
*/
#if LATTICE
#define OPENR 0x8000            /* open for reading */
#define OPENW 0x8001            /* open for writing */
#define OPENU 0x8002            /* open for read/write */
#define OPENC 0x8001            /* create and open for writing */
#else
#define OPENR 0
#define OPENW 1
#define OPENU 2
#endif

/**
*
* The following structure appears at the beginning (low address) of
* each free memory block.
*
*/
struct MELT
        {
        struct MELT *fwd;       /* points to next free block */
#if SPTR
        unsigned size;          /* number of MELTs in this block */
#else
        long size;              /* number of MELTs in this block */
#endif
        };
#define MELTSIZE sizeof(struct MELT)
```

Listing of error.h

```
/**
* The file "/include/libraries/dos.h" contains all the error messages.
* Do not use this file.
*
*/

#include "include/libraries/dos.h"
```

Listing of fcntl.h

```
/**
*
* The following symbols are used for the "open" and "creat" functions.
*
**/
#define O_RDONLY 0      /* Read-only value (right byte of mode word) */
#define O_WRONLY 1      /* Write-only value */
#define O_RDWR 2        /* Read-write value */

#define O_NDELAY 4      /* Non-blocking I/O flag */
#define O_APPEND 8      /* Append mode flag */
#define O_CREAT 0x0100  /* File creation flag */
#define O_TRUNC 0x200   /* File truncation flag */
#define O_EXCL 0x400    /* Exclusive access flag */

#define O_RAW 0x8000    /* Raw I/O flag (Lattice feature) */

/**
*
* The following symbols are used for the "fcntl" function.
*
*/
#define F_DUPFD 0       /* Duplicate file descriptor */
#define F_GETFD 1       /* Get file descriptor flags */
#define F_SETFD 2       /* Set file descriptor flags */
#define F_GETFL 3       /* Get file flags */
#define F_SETFL 4       /* Set file flags */
```

Listing of ios1.h

```
/**
*
* The following structure is a UNIX file block that retains information about
* a file being accessed via the level 1 I/O functions.
*/
struct UFB
{
char ufbflg;             /* flags */
char ufbtyp;
int ufbfh;               /* file handle */
};
#define NUFBS 20         /* number of UFBs defined */

/*
*
* UFB.ufbflg definitions
*
*/
#define UFB_OP 0x80      /* file is open */
#define UFB_RA 0x40      /* reading is allowed */
#define UFB_WA 0x20      /* writing is allowed */
#define UFB_NT 0x10      /* access file with no translation */
#define UFB_AP 8         /* append mode flag */
#define UFB_NC 4         /* no-close flag */

/*
*
* UFB.ufbtyp definitions
*
*/
#if MSDOS1
#define D_DISK 0
#define D_CON 1
#define D_PRN 2
#define D_AUX 3
#define D_NULL 4
#endif
```

Listing of limits.h

```
#define HUGE_VAL 1.797693E+308
```

Listing of math.h

```c
/**
*
* Redefine secondary simulation function names to become primary names
* for systems without a Numeric Data Processor.
*
*/
#ifdef NONDP
#define _acos acos
#define _asin asin
#define _atan atan
#define _cos cos
#define _cosh cosh
#define _cot cot
#define _exp exp
#define _fabs fabs
#define _ldexp ldexp
#define _log log
#define _log10 log10
#define _modf modf
#define _pow pow
#define _pow2 pow2
#define _sin sin
#define _sinh sinh
#define _sqrt sqrt
#define _tan tan
#define _tanh tanh
#endif

/**
*
* Structure to hold information about math exceptions
*
*/
struct exception
        {
        int type;               /* error type */
        char *name;             /* math function name */
        double arg1, arg2;      /* function arguments */
        double retval;          /* proposed return value */
        };

/*
*
* Exception type codes, found in exception.type
*
*/
#define DOMAIN    1     /* domain error */
#define SING      2     /* singularity */
#define OVERFLOW  3     /* overflow */
#define UNDERFLOW 4     /* underflow */
#define TLOSS     5     /* total loss of significance */
#define PLOSS     6     /* partial loss of significance */

/**
*
* Error codes generated by basic arithmetic operations (+ - * /)
*
*/
#define FPEUND 1        /* underflow */
#define FPEOVF 2        /* overflow */
#define FPEZDV 3        /* zero divisor */
#define FPENAN 4        /* not a number (invalid operation) */

/**
*
* Constants
*
*/
#define PI   3.14159265358979323846
#define PID2 1.57079632679489661923     /* PI divided by 2 */
#define PID4 0.78539816339744830962     /* PI divided by 4 */
#define I_PI 0.31830988618379067154     /* Inverse of PI */
#define I_PID2 0.63661977236758134308   /* Inverse of PID2 */

#define HUGE 1.797693e308               /* huge value */
#define TINY 2.2e-308                   /* tiny value */
#define LOGHUGE 709.778                 /* natural log of huge value */
#define LOGTINY -708.396                /* natural log of tiny value */

/**
*
* External declarations
*
*/
extern int _fperr;      /* floating point arithmetic error */
extern int errno;       /* UNIX error code */

extern char *ecvt();
extern short *seed48();
extern int atoi(),matherr();
extern long atol(),strtol(),lrand48(),nrand48(),mrand48(),jrand48();
extern double atof(),exp(),log(),log10(),pow(),sqrt();
extern double floor(),ceil(),fmod(),fabs(),frexp(),ldexp(),modf();
extern double sinh(),cosh(),tanh(),sin(),cos(),tan(),cot(),asin(),acos();
extern double atan(),atan2(),except();
extern double drand48(),erand48();
```

Listing of stdio.h

```c
/**
*
* This header file defines the information used by the standard I/O
* package.
*
**/
#define _BUFSIZ 512              /* standard buffer size */
#define BUFSIZ 512               /* standard buffer size */
#define _NFILE 20                /* maximum number of files */

struct _iobuf
{
unsigned char *_ptr;                     /* current buffer pointer */
int _rcnt;                       /* current byte count for reading */
int _wcnt;                       /* current byte count for writing */
unsigned char *_base;                    /* base address of I/O buffer */
char _flag;                      /* control flags */
char _file;                      /* file number */
int _size;                       /* size of buffer */
unsigned char _cbuff;                    /* single char buffer */
char _pad;                       /* (pad to even number of bytes) */
};

extern struct _iobuf _iob[_NFILE];

#define _IOREAD 1                /* read flag */
#define _IOWRT 2                 /* write flag */
#define _IONBF 4                 /* non-buffered flag */
#define _IOMYBUF 8               /* private buffer flag */
#define _IOEOF 16                /* end-of-file flag */
#define _IOERR 32                /* error flag */
#define _IOSTRG 64
#define _IORW 128                /* read-write (update) flag */

#ifndef NULL
#if SPTR
#define NULL 0                   /* null pointer value */
#else
#define NULL 0L
#endif
#endif
#define FILE struct _iobuf       /* shorthand */
#define EOF (-1)                 /* end-of-file code */

#define stdin (&_iob[0])         /* standard input file pointer */
#define stdout (&_iob[1])        /* standard output file pointer */
#define stderr (&_iob[2])        /* standard error file pointer */

#define getc(p)  (--(p)->_rcnt>=0? *(p)->_ptr++:_filbf(p))
#define getchar()  getc(stdin)
#define putc(c,p)  (--(p)->_wcnt>=0? ((int)(*(p)->_ptr++=(c))):_flsbf((c),p))
#define putchar(c)  putc(c,stdout)
#define feof(p)  (((p)->_flag&_IOEOF)!=0)
#define ferror(p)  (((p)->_flag&_IOERR)!=0)
#define fileno(p)  (p)->_file
#define rewind(fp)  fseek(fp,0L,0)
#define fflush(fp)  _flsbf(-1,fp)
#define clearerr(fp)  clrerr(fp)

FILE *fopen();
FILE *freopen();
long ftell();
char *fgets();

#define abs(x)  ((x)<0?-(x):(x))
#define max(a,b)  ((a)>(b)?(a):(b))
#define min(a,b)  ((a)<=(b)?(a):(b))
```

Contents

```
#ifndef     LIBRARIES_DISKFONT_H
#define     LIBRARIES_DISKFONT_H
/*********************************************************************/
/*                Commodore-Amiga, Inc.                              */
/*                diskfont.h                                         */
/*********************************************************************/
/*********************************************************************
 *
 * diskfont library definitions
 *
 *********************************************************************/

#ifndef     EXEC_NODES_H
#include "exec/nodes.h"
#endif
#ifndef     EXEC_LISTS_H
#include "exec/lists.h"
#endif
#ifndef     GRAPHICS_TEXT_H
#include "graphics/text.h"
#endif

#define     MAXFONTPATH 256   /* including null terminator */

struct FontContents {
   char  fc_FileName[MAXFONTPATH];
   UWORD fc_YSize;
   UBYTE fc_Style;
   UBYTE fc_Flags;
};

#define     FCH_ID      0x0f00

struct FontContentsHeader {
   UWORD fch_FileID; /* FCH_ID */
   UWORD fch_NumEntries;   /* the number of FontContents elements */
    /*   struct FontContents fch_FC[]; */
};

#define     DFH_ID      0x0f80
#define     MAXFONTNAME 32 /* font name including ".font\0" */

struct DiskFontHeader {
    /* the following 8 bytes are not actually considered a part of the */
    /* DiskFontHeader, but immediately preceed it. The NextSegment is  */
    /* supplied by the linker/loader, and the ReturnCode is the code   */
    /* at the beginning of the font in case someone runs it...         */
    /*   ULONG dfh_NextSegment;/* actually a BPTR */
    /*   ULONG dfh_ReturnCode;   /* MOVEQ #0,D0 : RTS */
    /* here then is the official start of the DiskFontHeader...      */
   struct   Node dfh_DF;   /* node to link disk fonts */
   UWORD dfh_FileID; /* DFH_ID */
   UWORD dfh_Revision;  /* the font revision */
   LONG  dfh_Segment;   /* the segment address when loaded */
   char  dfh_Name[MAXFONTNAME];  /* the font name (null terminated) */
   struct   TextFont dfh_TF;/* loaded TextFont structure */
};
```

```
#define     AFB_MEMORY  0
#define     AFF_MEMORY  1
#define     AFB_DISK 1
#define     AFF_DISK 2

struct AvailFonts {
   UWORD af_Type;    /* MEMORY or DISK */
   struct   TextAttr af_Attr; /* text attributes for font */
};

struct AvailFontsHeader {
   UWORD afh_NumEntries;      /* number of AvailFonts elements */
    /*   struct   AvailFonts afh_AF[]; */
};

#endif
```

```
#ifndef LIBRARIES_DOS_H
#define LIBRARIES_DOS_H
/**********************************************************************/
/*              Commodore-Amiga, Inc.
              */
/*              dos.h
              */
/*         Standard C header for AmigaDOS on the MC68000
             */
/**********************************************************************/

#ifndef EXEC_TYPES_H
#include "exec/types.h"
#endif

#define  DOSNAME  "dos.library"

/* Predefined Amiga DOS global constants */

/* Mode parameter to Open() */
#define MODE_OLDFILE         1005   /* Open existing file
  read/write
                                     * positioned at beginning
  of file. */
#define MODE_NEWFILE         1006   /* Open freshly created
  file (delete
                                     * old file) read/write
             */

/* Relative position to Seek() */
#define OFFSET_BEGINNING    -1      /* relative to Begining
  Of File */
#define OFFSET_CURRENT       0      /* relative to Current
  file position */
#define OFFSET_END           1      /* relative to End Of
  File    */

#define OFFSET_BEGINING     OFFSET_BEGINNING  /* ancient
  compatibility */

#define BITSPERBYTE          8
#define BYTESPERLONG         4
#define BITSPERLONG          32
#define MAXINT               0x7FFFFFFF
#define MININT               0x80000000

/* Passed as type to Lock() */
#define SHARED_LOCK          -2     /* File is readable
  by others */
#define ACCESS_READ          -2     /* Synonym */
#define EXCLUSIVE_LOCK       -1     /* No other access allowed
     */
#define ACCESS_WRITE         -1     /* Synonym */

struct DateStamp {
   LONG  ds_Days;              /* Number of days since Jan.
  1, 1978 */
   LONG  ds_Minute;            /* Number of minutes past
  midnight */
```

```
   LONG  ds_Tick;              /* Number of ticks past minute
  */
}; /* DateStamp */
#define TICKS_PER_SECOND      50   /* Number of ticks in
  one second */

/* Returned by Examine() and ExInfo(), must be on a 4 byte
  boundary */
struct FileInfoBlock {
   LONG   fib_DiskKey;
   LONG   fib_DirEntryType;  /* Type of Directory. If <
  0, then a plain file.
                              * If > 0 a directory */
   char   fib_FileName[108]; /* Null terminated. Max 30
  chars used for now */
   LONG   fib_Protection;    /* bit mask of protection,
  rwxd are 3-0.      */
   LONG   fib_EntryType;
   LONG   fib_Size;          /* Number of bytes in file
  */
   LONG   fib_NumBlocks;     /* Number of blocks in file
  */
   struct DateStamp fib_Date;/* Date file last changed */
   char   fib_Comment[116];  /* Null terminated.
                              * Comment associated with
  file */
}; /* FileInfoBlock */

/* FIB stands for FileInfoBlock */
/* FIBB are bit definitions, FIBF are field definitions
  */
#define FIBB_READ      3
#define FIBB_WRITE     2
#define FIBB_EXECUTE   1
#define FIBB_DELETE    0
#define FIBF_READ      (1<<FIBB_READ)
#define FIBF_WRITE     (1<<FIBB_WRITE)
#define FIBF_EXECUTE   (1<<FIBB_EXECUTE)
#define FIBF_DELETE    (1<<FIBB_DELETE)


/* All BCPL data must be long word aligned.  BCPL pointers
  are the long word
 *  address (i.e byte address divided by 4 (>>2)) */
typedef long  BPTR;                /* Long word pointer
  */
typedef long  BSTR;                /* Long word pointer
  to BCPL string  */
#define BADDR( bptr ) (bptr << 2)  /* Convert BPTR to typical
  C pointer */
/* BCPL strings have a length in the first byte and then
  the characters.
 * For example:  s[0]=3 s[1]=S s[2]=Y s[3]=S
                   */

/* returned by Info(), must be on a 4 byte boundary */
struct InfoData {
   LONG   id_NumSoftErrors;   /* number of soft errors on
  disk */
   LONG   id_UnitNumber;      /* Which unit disk is (was)
  mounted on */
   LONG   id_DiskState;       /* See defines below */
   LONG   id_NumBlocks;       /* Number of blocks on disk
  */
   LONG   id_NumBlocksUsed;   /* Number of block in use
  */
   LONG   id_BytesPerBlock;
   LONG   id_DiskType;        /* Disk Type code */
   BPTR   id_VolumeNode;      /* BCPL pointer to volume
  node */
   LONG   id_InUse;           /* Flag, zero if not in use
  */
}; /* InfoData */

/* ID stands for InfoData */
        /* Disk states */
#define ID_WRITE_PROTECTED 80    /* Disk is write protected
  */
#define ID_VALIDATING      81    /* Disk is currently being
  validated */
#define ID_VALIDATED       82    /* Disk is consistent and
  writeable */

        /* Disk types */
#define ID_NO_DISK_PRESENT (-1)
#define ID_UNREADABLE_DISK (('B'<<24) | ('A'<<16) | ('D'<<8))
#define ID_DOS_DISK        (('D'<<24) | ('O'<<16) | ('S'<<8))
#define ID_NOT_REALLY_DOS  (('N'<<24) | ('D'<<16) | ('O'<<8)
  | ('S'))
#define ID_KICKSTART_DISK  (('K'<<24) | ('I'<<16) | ('C'<<8)
  | ('K'))

/* Errors from IoErr(), etc. */
#define ERROR_NO_FREE_STORE              103
#define ERROR_NO_DEFAULT_DIR             201
#define ERROR_OBJECT_IN_USE              202
#define ERROR_OBJECT_EXISTS              203
#define ERROR_DIR_NOT_FOUND              204
#define ERROR_OBJECT_NOT_FOUND           205
#define ERROR_BAD_STREAM_NAME            206
#define ERROR_OBJECT_TOO_LARGE           207
#define ERROR_ACTION_NOT_KNOWN           209
#define ERROR_INVALID_COMPONENT_NAME     210
#define ERROR_INVALID_LOCK               211
#define ERROR_OBJECT_WRONG_TYPE          212
#define ERROR_DISK_NOT_VALIDATED         213
#define ERROR_DISK_WRITE_PROTECTED       214
#define ERROR_RENAME_ACROSS_DEVICES      215
#define ERROR_DIRECTORY_NOT_EMPTY        216
#define ERROR_TOO_MANY_LEVELS            217
#define ERROR_DEVICE_NOT_MOUNTED         218
#define ERROR_SEEK_ERROR                 219
#define ERROR_COMMENT_TOO_BIG            220
#define ERROR_DISK_FULL                  221
#define ERROR_DELETE_PROTECTED           222
#define ERROR_WRITE_PROTECTED            223
#define ERROR_READ_PROTECTED             224
#define ERROR_NOT_A_DOS_DISK             225
#define ERROR_NO_DISK                    226
#define ERROR_NO_MORE_ENTRIES            232
```

```c

/* These are the return codes used by convention by AmigaDOS
  commands */
/* See FAILAT and IF for relvance to EXECUTE files
              */
#define RETURN_OK                          0  /* No problems,
  success */
#define RETURN_WARN                        5  /* A warning
  only */
#define RETURN_ERROR                      10  /* Something
  wrong */
#define RETURN_FAIL                       20  /* Complete
  or severe failure*/

/* Bit numbers that signal you that a user has issued a
  break */
#define SIGBREAKB_CTRL_C   12
#define SIGBREAKB_CTRL_D   13
#define SIGBREAKB_CTRL_E   14
#define SIGBREAKB_CTRL_F   15

/* Bit fields that signal you that a user has issued a break
  */
/* for example:  if (SetSignal(0,0) & BREAK_CTRL_CF) cleanup_and_exit();
  */
#define SIGBREAKF_CTRL_C   (1<<SIGBREAKB_CTRL_C)
#define SIGBREAKF_CTRL_D   (1<<SIGBREAKB_CTRL_D)
#define SIGBREAKF_CTRL_E   (1<<SIGBREAKB_CTRL_E)
#define SIGBREAKF_CTRL_F   (1<<SIGBREAKB_CTRL_F)

#endif LIBRARIES_DOS_H

```



```c

#ifndef LIBRARIES_DOSEXTENS_H
#define LIBRARIES_DOSEXTENS_H 1
/*********************************************************************/
/*                Commodore-Amiga, Inc.                              */
/*                dosextens.h                                        */
/*********************************************************************/
/* DOS structures not needed for the casual DOS user */

#ifndef EXEC_TYPES_H
#include "exec/types.h"
#endif
#ifndef EXEC_TASKS_H
#include "exec/tasks.h"
#endif
#ifndef EXEC_PORTS_H
#include "exec/ports.h"
#endif
#ifndef EXEC_LIBRARIES_H
#include "exec/libraries.h"
#endif

#ifndef LIBRARIES_DOS_H
#include "libraries/dos.h"
#endif

/* All DOS processes have this structure */
/* Create and Device Proc returns pointer to the MsgPort in this structure */
/* dev_proc = (struct Process *) (DeviceProc(..) - sizeof(struct Task)); */

struct Process {
    struct  Task    pr_Task;
    struct  MsgPort pr_MsgPort; /* This is BPTR address from DOS functions  *
    WORD    pr_Pad;             /* Remaining variables on 4 byte boundaries *
    BPTR    pr_SegList;         /* Array of seg lists used by this process  *
    LONG    pr_StackSize;       /* Size of process stack in bytes           *
    APTR    pr_GlobVec;         /* Global vector for this process (BCPL)    *
    LONG    pr_TaskNum;         /* CLI task number of zero if not a CLI     *
    BPTR    pr_StackBase;       /* Ptr to high memory end of process stack  *
    LONG    pr_Result2;         /* Value of secondary result from last call *
    BPTR    pr_CurrentDir;      /* Lock associated with current directory   *
    BPTR    pr_CIS;             /* Current CLI Input Stream                 *
    BPTR    pr_COS;             /* Current CLI Output Stream                *
    APTR    pr_ConsoleTask;     /* Console handler process for the
                                 * current window*/
    APTR    pr_FileSystemTask;  /* File handler process for current drive   *
    BPTR    pr_CLI;             /* pointer to ConsoleLineInterpreter        *
    APTR    pr_ReturnAddr;      /* pointer to previous stack frame          *
    APTR    pr_PktWait;         /* Function to be called when awaiting msg  *
    APTR    pr_WindowPtr;       /* Window for error printing */
};  /* Process */

/* The long word address (BPTR) of this structure is returned by
 * Open() and other routines that return a file.  You need only worry
 * about this struct to do async io's via PutMsg() instead of
 * standard file system calls */

struct FileHandle {
   struct Message *fh_Link;      /* EXEC message              */
```

```
   struct MsgPort *fh_Port;      /* Reply port for the packet */
   struct MsgPort *fh_Type;      /* Port to do PutMsg() to
                                  * Address is negative if a plain file */
   LONG fh_Buf;
   LONG fh_Pos;
   LONG fh_End;
   LONG fh_Funcs;
#define fh_Func1 fh_Funcs
   LONG fh_Func2;
   LONG fh_Func3;
   LONG fh_Args;
#define fh_Arg1 fh_Args
   LONG fh_Arg2;
}; /* FileHandle */

/* This is the extension to EXEC Messages used by DOS */

struct DosPacket {
   struct Message *dp_Link;      /* EXEC message              */
   struct MsgPort *dp_Port;      /* Reply port for the packet */
                                 /* Must be filled in each send. */
   LONG dp_Type;                 /* See ACTION_... below and
                                  * 'R' means Read, 'W' means Write to the
                                  * file system */
   LONG dp_Res1;                 /* For file system calls this is the result
                                  * that would have been returned by the
                                  * function, e.g. Write ('W') returns actual
                                  * length written */
   LONG dp_Res2;                 /* For file system calls this is what would
                                  * have been returned by IoErr() */
/*  Device packets common equivalents */
#define dp_Action  dp_Type
#define dp_Status  dp_Res1
#define dp_Status2 dp_Res2
#define dp_BufAddr dp_Arg1
   LONG dp_Arg1;
   LONG dp_Arg2;
   LONG dp_Arg3;
   LONG dp_Arg4;
   LONG dp_Arg5;
   LONG dp_Arg6;
   LONG dp_Arg7;
}; /* DosPacket */

/* A Packet does not require the Message to be before it in memory, but
 * for convenience it is useful to associate the two.
 * Also see the function init_std_pkt for initializing this structure */

struct StandardPacket {
   struct Message   sp_Msg;
   struct DosPacket sp_Pkt;
}; /* StandardPacket */

/* Packet types */
#define ACTION_NIL              0
#define ACTION_GET_BLOCK        2
#define ACTION_SET_MAP          4
#define ACTION_DIE              5
#define ACTION_EVENT            6
#define ACTION_CURRENT_VOLUME   7
#define ACTION_LOCATE_OBJECT    8
#define ACTION_RENAME_DISK      9
#define ACTION_WRITE            'W'
#define ACTION_READ             'R'
#define ACTION_FREE_LOCK        15
#define ACTION_DELETE_OBJECT    16
#define ACTION_RENAME_OBJECT    17

#define ACTION_COPY_DIR         19
#define ACTION_WAIT_CHAR        20
#define ACTION_SET_PROTECT      21
#define ACTION_CREATE_DIR       22
#define ACTION_EXAMINE_OBJECT   23
#define ACTION_EXAMINE_NEXT     24
#define ACTION_DISK_INFO        25
#define ACTION_INFO             26

#define ACTION_SET_COMMENT      28
#define ACTION_PARENT           29
#define ACTION_TIMER            30
#define ACTION_INHIBIT          31
#define ACTION_DISK_TYPE        32
#define ACTION_DISK_CHANGE      33

/* DOS library node structure.
 * This is the data at positive offsets from the library node.
 * Negative offsets from the node is the jump table to DOS functions
 * node = (struct DosLibrary *) OpenLibrary( "dos.library" .. )      */

struct DosLibrary {
    struct  Library dl_lib;
    APTR    dl_Root;          /* Pointer to RootNode, described below */
    APTR    dl_GV;            /* Pointer to BCPL global vector        */
    LONG    dl_A2;            /* Private register dump of DOS         */
    LONG    dl_A5;
    LONG    dl_A6;
};  /*  DosLibrary */

/*                            */

struct RootNode {
    BPTR    rn_TaskArray;            /* [0] is max number of CLI's
                                      * [1] is APTR to process id of CLI 1
                                      * [n] is APTR to process id of CLI n */
    BPTR    rn_ConsoleSegment; /* SegList for the CLI                       */
    struct  DateStamp rn_Time; /* Current time                              */
    LONG    rn_RestartSeg;     /* SegList for the disk validator process    */
    BPTR    rn_Info;           /* Pointer ot the Info structure             */
};  /* RootNode */

struct DosInfo {
    BPTR    di_McName;         /* Network name of this machine; currently 0 *
    BPTR    di_DevInfo;        /* Device List                               *
    BPTR    di_Devices;        /* Currently zero                            *
    BPTR    di_Handlers;       /* Currently zero                            *
    APTR    di_NetHand;        /* Network handler processid; currently zero *
};  /* DosInfo */

/* DOS Processes started from the CLI via RUN or NEWCLI have this additional
 * set to data associated with them */
```

```
struct CommandLineInterface {
    LONG   cli_Result2;        /* Value of IoErr from last command        */
    BSTR   cli_SetName;        /* Name of current directory               */
    BPTR   cli_CommandDir;     /* Lock associated with command directory  */
    LONG   cli_ReturnCode;     /* Return code from last command           */
    BSTR   cli_CommandName;    /* Name of current command                 */
    LONG   cli_FailLevel;      /* Fail level (set by FAILAT)              */
    BSTR   cli_Prompt;         /* Current prompt (set by PROMPT)          */
    BPTR   cli_StandardInput;  /* Default (terminal) CLI input            */
    BPTR   cli_CurrentInput;   /* Current CLI input                       */
    BSTR   cli_CommandFile;    /* Name of EXECUTE command file            */
    LONG   cli_Interactive;    /* Boolean; True if prompts required       */
    LONG   cli_Background;     /* Boolean; True if CLI created by RUN     */
    BPTR   cli_CurrentOutput;  /* Current CLI output                      */
    LONG   cli_DefaultStack;   /* Stack size to be obtained in long words */
    BPTR   cli_StandardOutput; /* Default (terminal) CLI output           */
    BPTR   cli_Module;         /* SegList of currently loaded command     */
}; /* CommandLineInterface */

/*
 * this structure needs some work.  It should really be a union, because
 * it can take on different valued depending on whether it is a device,
 * an assigned directory, or a volume.
 * For now, it reflects a volume.
 */
struct DeviceList {
    BPTR    dl_Next;                /* bptr to next device list */
    LONG    dl_Type;                /* see DLT below */
    struct MsgPort * dl_Task;       /* ptr to handler task */
    BPTR    dl_Lock;                /* not for volumes */
    struct DateStamp dl_VolumeDate; /* creation date */
    BPTR    dl_LockList;            /* outstanding locks */
    LONG    dl_DiskType;            /* 'DOS', etc */
    LONG    dl_unused;
    BSTR *  dl_Name;                /* bptr to bcpl name */
};

/* definitions for dl_Type */
#define DLT_DEVICE    0
#define DLT_DIRECTORY   1
#define DLT_VOLUME    2


/* a lock structure, as returned by Lock() or DupLock() */
struct FileLock {
    BPTR    fl_Link;                 /* bcpl pointer to next lock */
    LONG    fl_Key;                  /* disk block number */
    LONG    fl_Access;               /* exclusive or shared */
    struct MsgPort * fl_Task;        /* handler task's port */
    BPTR    fl_Volume;               /* bptr to a DeviceList */
};

#endif LIBRARIES_DOSEXTENS_H
```

```
#ifndef  LIBRARIES_MATHFFP_H
#define  LIBRARIES_MATHFFP_H
/*******************************************************************/
/*               Commodore-Amiga, Inc.                             */
/*               mathffp.h                                         */
/*******************************************************************/

/*
 * general floating point declarations
 */
#define PI        ((FLOAT) 3.1415192653857)
#define TWO_PI    (((FLOAT) 2) * PI)
#define PI2       (PI / ((FLOAT) 2))
#define PI4       (PI / ((FLOAT) 4))
#define E         ((FLOAT) 2.7182818284590453)
#define LOG10     ((FLOAT) 2.3025850929940456)

#define FPTEN     ((FLOAT) 10.0)
#define FPONE     ((FLOAT) 1.0)
#define FPHALF    ((FLOAT) 0.5)
#define FPZERO    ((FLOAT) 0.0)

#define trunc(x)  ((int) (x))
#define round(x)  ((int) ((x) + 0.5))
#define itof(i)   ((FLOAT) (i))

int      SPFix();                              /* Basic math functions */
FLOAT    SPFlt();
int      SPCmp();
int      SPTst();
FLOAT    SPAbs(),   abs();
FLOAT    SPNeg();
FLOAT    SPAdd();
FLOAT    SPSub();
FLOAT    SPMul();
FLOAT    SPDiv();

FLOAT    SPAsin(),  SPAcos(),  SPAtan();  /* Transcendental math functions */
FLOAT    SPSin(),   SPCos(),   SPTan(),   SPSincos();
FLOAT    SPSinh(),  SPCosh(),  SPTanh();
FLOAT    SPExp(),   SPLog(),   SPLog10(), SPPow();
FLOAT    SPSqrt(),  SPFieee();

FLOAT    afp(),    dbf();                     /* Math conversion functions */

#endif   !LIBRARIES_MATHFFP_H
```

```c
#ifndef  LIBRARIES_TRANSLATOR_H
#define LIBRARIES_TRANSLATOR_H
/************************************************************************/
/*              Commodore-Amiga, Inc.                                   */
/*              translator.h                                            */
/************************************************************************/


/* Translator error return codes */

#define  TR_NotUsed  -1       /* This is an oft used system rc */
#define  TR_NoMem    -2       /* Can't allocate memory      */
#define  TR_MakeBad  -4       /* Error in MakeLibrary call     */

#endif LIBRARIES_TRANSLATOR_H
```

Contents

```c
/***********************************************************************/
/*              Commodore-Amiga, Inc.
                */
/*              cia.h
                */
/***********************************************************************/

#define  CIAANAME "ciaa.resource"
#define  CIABNAME "ciab.resource"


```

```c

#ifndef  RESOURCES_DISK_H
#define RESOURCES_DISK_H
/***********************************************************************/
/*              Commodore-Amiga, Inc.                                  */
/*              disk.h                                                 */
/***********************************************************************/

/*******************************************************************
*
* external declarations for disk resources
*
* SOURCE CONTROL
* ------ -------
* $Header: disk.h,v 27.2 85/07/12 23:12:44 neil Exp $
*
* $Locker:  $
*
*******************************************************************/

#ifndef  EXEC_TYPES_H
#include "exec/types.h"
#endif !EXEC_TYPES_H

#ifndef  EXEC_LISTS_H
#include "exec/lists.h"
#endif !EXEC_LISTS_H

#ifndef  EXEC_PORTS_H
#include "exec/ports.h"
#endif !EXEC_PORTS_H

#ifndef  EXEC_INTERRUPTS_H
#include "exec/interrupts.h"
#endif !EXEC_INTERRUPTS_H

#ifndef  EXEC_LIBRARIES_H
#include "exec/libraries.h"
#endif !EXEC_LIBRARIES_H


/**********************************************************************
*
* Resource structures
*
**********************************************************************/


struct DiscResourceUnit {
    struct Message dru_Message;
    struct Interrupt dru_DiscBlock;
    struct Interrupt dru_DiscSync;
    struct Interrupt dru_Index;
};

struct DiscResource {
    struct Library      dr_Library;
    struct DiscResourceUnit   *dr_Current;
    UBYTE               dr_Flags;
```

```
    UBYTE               dr_pad;
    struct Library      *dr_SysLib;
    struct Library      *dr_CiaResource;
    ULONG               dr_UnitID[4];
    struct List         dr_Waiting;
    struct Interrupt    dr_DiscBlock;
    struct Interrupt    dr_DiscSync;
    struct Interrupt    dr_Index;
};

/* dr_Flags entries */
#define DRB_ALLOC0   0       /* unit zero is allocated */
#define DRB_ALLOC1   1       /* unit one is allocated */
#define DRB_ALLOC2   2       /* unit two is allocated */
#define DRB_ALLOC3   3       /* unit three is allocated */
#define DRB_ACTIVE   7       /* is the disk currently busy? */

#define DRF_ALLOC0   (1<<0)  /* unit zero is allocated */
#define DRF_ALLOC1   (1<<1)  /* unit one is allocated */
#define DRF_ALLOC2   (1<<2)  /* unit two is allocated */
#define DRF_ALLOC3   (1<<3)  /* unit three is allocated */
#define DRF_ACTIVE   (1<<7)  /* is the disk currently busy? */



/*********************************************************************
*
* Hardware Magic
*
*********************************************************************/


#define  DSKDMAOFF   0x4000  /* idle command for dsklen register */


/*********************************************************************
*
* Resource specific commands
*
*********************************************************************/

/*
 * DISKNAME is a generic macro to get the name of the resource.
 * This way if the name is ever changed you will pick up the
 *  change automatically.
 */

#define DISKNAME  "disk.resource"


#define  DR_ALLOCUNIT   (LIB_BASE - 0*LIB_VECTSIZE)
#define  DR_FREEUNIT    (LIB_BASE - 1*LIB_VECTSIZE)
#define  DR_GETUNIT     (LIB_BASE - 2*LIB_VECTSIZE)
#define  DR_GIVEUNIT    (LIB_BASE - 3*LIB_VECTSIZE)
#define  DR_GETUNITID   (LIB_BASE - 4*LIB_VECTSIZE)


#define  DR_LASTCOMM    (DR_GIVEUNIT)

/*********************************************************************
*
* drive types
*
*********************************************************************/

#define  DRT_AMIGA      (0x00000000)
#define  DRT_37422D2S   (0x55555555)
#define DRT_EMPTY       (0xFFFFFFFF)

#endif RESOURCES_DISK_H
```

```c
#ifndef RESOURCES_MISC_I
#define RESOURCES_MISC_I
/*********************************************************************/
/*              Commodore-Amiga, Inc.                                */
/*              misc.h                                               */
/*********************************************************************/

/*****************************************************************
*
* external declarations for misc system resources
*
* SOURCE CONTROL
* ------ -------
* $Header: misc.h,v 27.3 85/07/12 16:28:29 neil Exp $
*
* $Locker:  $
*
*****************************************************************/

#ifndef EXEC_TYPES_H
#include "exec/types.h"
#endif   !EXEC_TYPES_H

#ifndef EXEC_LIBRARIES_H
#include "exec/libraries.h"
#endif   !EXEC_LIBRARIES_H


/********************************************************************
*
* Resource structures
*
********************************************************************/

#define  MR_SERIALPORT     0
#define  MR_SERIALBITS     1
#define  MR_PARALLELPORT   2
#define  MR_PARALLELBITS   3

#define NUMMRTYPES         4

struct MiscResource {
    struct Library mr_Library;
    ULONG mr_AllocArray[NUMMRTYPES];
};

#define MR_ALLOCMISCRESOURCE  (LIB_BASE)
#define MR_FREEMISCRESOURCE   (LIB_BASE + LIB_VECSIZE)


#define MISCNAME "misc.resource"

#endif   !RESOURCES_MISC_H
```

```c
#ifndef     RESOURCES_POTGO_H
#define     RESOURCES_POTGO_H
/*********************************************************************/
/*              Commodore-Amiga, Inc.                                */
/*              potgo.h                                              */
/*********************************************************************/
#define  POTGONAME   "potgo.resource"
#endif
```

Contents

```

#ifndef LIBRARIES_ICON_H
#define LIBRARIES_ICON_H

/********************************************************************/
/*                Commodore-Amiga, Inc.                             */
/*                icon.h                                            */
/********************************************************************/

/*****************************************************************
 *
 * icon.h -- external declarations for workbench support library
 *
 * SOURCE CONTROL
 * ------ -------
 * $Header: icon.h,v 31.1 85/08/31 09:10:56 neil Exp $
 *
 * $Locker:  $
 *
 *****************************************************************/


/*******************************************************************
 *
 * library structures
 *
 *******************************************************************/


#define  ICONNAME "icon.library"

/*******************************************************************
 *
 * function types
 *
 *******************************************************************/

struct WBObject *GetWBObject(), *AllocWBObject();
LONG   PutWBObject(), PutIcon(), GetIcon(), MatchToolValue();
VOID   FreeFreeList(), FreeWBObject(), AddFreeList();
char   *ToolTypeArray();


#endif !LIBRARIES_ICON_H
```

```c
/********************************************************************/
/*              Commodore-Amiga, Inc.                               */
/*              startup.h                                           */
/********************************************************************/

/* NOTE: This file is NOT used to generate lib/Astartup.obj or */
/* lib/Lstartup.obj. */

#ifndef EXEC_TYPES_H
#include "exec/types.h"
#endif !EXEC_TYPES_H

#ifndef EXEC_PORTS_H
#include "exec/ports.h"
#endif !EXEC_PORTS_H

#ifndef LIBRARIES_DOS_H
#include "libraries/dos.h"
#endif !LIBRARIES_DOS_H

struct WBStartup {
    struct Message    sm_Message;    /* a standard message structure */
    struct MsgPort *  sm_Process;    /* the process descriptor for you */
    BPTR              sm_Segment;    /* a descriptor for your code */
    LONG              sm_NumArgs;    /* the number of elements in ArgList */
    char *            sm_ToolWindow; /* description of window */
    struct WBArg *    sm_ArgList;    /* the arguments themselves */
};

struct WBArg {
    BPTR              wa_Lock;       /* a lock descriptor */
    BYTE *            wa_Name;       /* a string relative to that lock */
};

```

```c

/**********************************************************************
 *
 * workbench.h
 *
 * Commodore-Amiga, Inc.
 *
 * $Header: workbench.h,v 31.4 85/10/27 13:50:28 neil Exp $
 *
 * $Locker:  $
 *
 **********************************************************************/

#ifndef EXEC_TYPES_H
#include "exec/types.h"
#endif !EXEC_TYPES_H

#ifndef  EXEC_NODES_H
#include "exec/nodes.h"
#endif !EXEC_NODES_H

#ifndef  EXEC_LISTS_H
#include "exec/lists.h"
#endif !EXEC_LISTS_H

#ifndef EXEC_TASKS_H
#include "exec/tasks.h"
#endif !EXEC_TASKS_H

#ifndef INTUITION_INTUITION_H
#include "intuition/intuition.h"
#endif !INTUITION_INTUITION_H

#define  WBDISK      1
#define  WBDRAWER    2
#define  WBTOOL      3
#define  WBPROJECT   4
#define  WBGARBAGE   5
#define  WBDEVICE    6
#define  WBKICK      7

struct DrawerData {
    struct NewWindow dd_NewWindow;     /* args to open window */
    LONG                dd_CurrentX;   /* current x coordinate of origin */
    LONG                dd_CurrentY;   /* current y coordinate of origin */
    LONG                dd_MinX;       /* smallest x coordinate in window */
    LONG                dd_MinY;       /* smallest y coordinate in window */
    LONG                dd_MaxX;       /* largest x coordinate in window */
    LONG                dd_MaxY;       /* largest y coordinate in window */
    struct Gadget       dd_HorizScroll;
    struct Gadget       dd_VertScroll;
    struct Gadget       dd_UpMove;
    struct Gadget       dd_DownMove;
    struct Gadget       dd_LeftMove;
    struct Gadget       dd_RightMove;
    struct Image        dd_HorizImage;
    struct Image        dd_VertImage;
    struct PropInfo     dd_HorizProp;
    struct PropInfo     dd_VertProp;
```

```
    struct Window *     dd_DrawerWin;  /* pointer to drawers window */
    struct WBObject *   dd_Object;     /* back pointer to drawer object */
    struct List         dd_Children;   /* where our children hang out */
    LONG                dd_Lock;
};

/* the amount of DrawerData actually written to disk */
#define DRAWERDATAFILESIZE (sizeof( struct NewWindow ) + 2*sizeof(LONG))


struct DiskObject {
    UWORD               do_Magic; /* a magic number at the start of the file*/
    UWORD               do_Version; /* a version number, so we can change it*/
    struct Gadget       do_Gadget;  /* a copy of in core gadget */
    UBYTE               do_Type;
    char *              do_DefaultTool;
    char **             do_ToolTypes;
    LONG                do_CurrentX;
    LONG                do_CurrentY;
    struct DrawerData * do_DrawerData;
    char *              do_ToolWindow;     /* only applies to tools */
    LONG                do_StackSize;      /* only applies to tools */

};

#define WB_DISKMAGIC 0xe310       /* a magic number, not easily impersonated */
#define WB_DISKVERSION  1         /* our current version number */

struct FreeList {
    WORD                fl_NumFree;
    struct List         fl_MemList;
};

struct WBObject {
    struct Node         wo_MasterNode; /* all objects are on this list */
    struct Node         wo_Siblings;   /* list of drawer members */
    struct Node         wo_SelectNode; /* list of all selected objects */
    struct Node         wo_UtilityNode;   /* function specific linkages */
    struct WBObject *   wo_Parent;

    /* object flags */
#ifdef SMARTCOMPILER
    UBYTE               wo_IconDisp:1;    /* icon is currently in a window */
    UBYTE               wo_DrawerOpen:1;  /* we're a drawer, and it is open */
    UBYTE               wo_Selected:1;    /* our icon is selected */
    UBYTE               wo_Background:1;  /* set if icon is in background */
#else
    /* lattice is not full system V compatible (yet)... */
    UBYTE               wo_Flags;
#endif

    UBYTE               wo_Type;          /* what flavor object is this? */
    USHORT              wo_UseCount;      /* number of references to this
                                             object */
    char *              wo_Name;          /* this object's textual name */
    SHORT               wo_NameXOffset;   /* where to put the name */
    SHORT               wo_NameYOffset;

    char *              wo_DefaultTool;
    struct DrawerData * wo_DrawerData;    /* if this is a drawer or disk */
    struct Window *     wo_IconWin;       /* each object's icon lives here */
    LONG                wo_CurrentX;      /* virtual X in drawer */
    LONG                wo_CurrentY;      /* virtual Y in drawer */
    char **             wo_ToolTypes;     /* the types for this tool */
    struct Gadget       wo_Gadget;        /* NOT a pointer, but an instance
                                             of a gadget structure */
    struct FreeList     wo_FreeList;      /* this objects free list */
    char *              wo_ToolWindow;    /* character string for tool's
                                             window */
    LONG                wo_StackSize;     /* how much stack to give to this *
    LONG                wo_Lock;          /* if this tool is in the backdrop*

};

#define TMAlloc( size, type ) ((type)MAlloc( size ))
#define ObjAlloc( obj, size, type )   ((type)OAlloc( obj, size ))
#define STREQ( a, b )      (!strcmp( a, b ))

/* each message that comes into the WorkBenchPort must have a type field
 * in the preceeding short.  These are the defines for this type
 */

#define MTYPE_PSTD          1  /* a "standard Potion" message */
#define MTYPE_TOOLEXIT      2  /* exit message from our tools */
#define MTYPE_DISKCHANGE    3  /* dos telling us of a disk change */
#define MTYPE_TIMER         4  /* we got a timer tick */
#define MTYPE_CLOSEDOWN     5  /* <unimplemented> */
#define MTYPE_IOPROC        6  /* <unimplemented> */

/* we use the gadget id field to encode some special information */
#define GID_WBOBJECT        0  /* a normal workbench object */
#define GID_HORIZSCROLL     1  /* the horizontal scroll gadget for a drawer */
#define GID_VERTSCROLL      2  /* the vertical scroll gadget for a drawer */
#define GID_LEFTSCROLL      3  /* move one window left */
#define GID_RIGHTSCROLL     4  /* move one window right */
#define GID_UPSCROLL        5  /* move one window up */
#define GID_DOWNSCROLL      6  /* move one window down */
#define GID_NAME            7  /* the name field for an object */


/* workbench does different complement modes for its gadgets.
 * It supports separate images, complement mode, and backfill mode.
 * The first two are identical to intuitions GADGIMAGE and GADGHCOMP.
 * backfill is similar to GADGHCOMP, but the region outside of the
 * image (which normally would be color three when complemented)
 * is flood-filled to color zero.
 */
#define GADGBACKFILL        0x0001

/* if an icon does not really live anywhere, set its current position
 * to here
 */
#define NO_ICON_POSITION   (0x80000000)
```

Appendix E

Printer Device Source Code

This appendix contains the printer-dependent source code for the following printers:

hpplus - Hewlett Packard LaserJet Plus

okimate20 - Okidata

epson - Epson X-80 series

diablo_c - Diablo C-150

In addition, this appendix includes the following:

- *macros.i*, which is required in order to assemble any of the ".asm" files
- *prtbase.h*, which contains printer data structure definitions
- a document called *Amiga Printer Support Information*, which contains additional information about supported printers and supported features, standard cables for printers, and standard switch settings for printers.

The files in this appendix are intended to aid developers in creating their own custom printer drivers that can be added to the DEVS: directory on an AmigaDOS disk. The documentation that explains the contents of these files is in the "Printer Device" chapter of this manual.

The sequence of linking the various files together is critical. Here is a sample command to ALINK that specifies the files in the correct sequence. Note that the drive specifiers given in this sample link command simply reflect the disks on which the various files were placed and do not necessarily reflect your development environment.

```
ALINK   DF1:lib/Astartup.obj+DF0:printertag.obj+DF0:init.obj+
        DF0:data.o+DF0:dospecial.o+DF0:render.o+DF0:wait.obj
        library DF1:lib/amiga.lib+DF1:lib/lc.lib TO
        DF0:printer.ld
```

```
        SECTION         printer

*------ Included Files -----------------------------------------------

        INCLUDE         "exec/types.i"
        INCLUDE         "exec/ports.i"
        INCLUDE         "exec/devices.i"
        INCLUDE         "exec/io.i"

        INCLUDE         "devices/timer.i"

*(INCLUDE   "macros.i")

**********************************************************************
*       printer device macro definitions
**********************************************************************

*------ external definition macros -----------------------------------

XREF_EXE        MACRO
        XREF            _LVO\1
                ENDM

XREF_DOS        MACRO
        XREF            _LVO\1
                ENDM

XREF_GFX        MACRO
        XREF            _LVO\1
                ENDM

XREF_ITU        MACRO
        XREF            _LVO\1
                ENDM

*------ library dispatch macros --------------------------------------

CALLEXE         MACRO
                CALLLIB _LVO\1
                ENDM

LINKEXE         MACRO
                LINKLIB _LVO\1,_SysBase
                ENDM

LINKDOS         MACRO
                LINKLIB _LVO\1,_DOSBase
                ENDM

LINKGFX         MACRO
                LINKLIB _LVO\1,_GfxBase
                ENDM

LINKITU         MACRO
                LINKLIB _LVO\1,_IntuitionBase
                ENDM


        INCLUDE         "devices/prtbase.i"
```

```
*------ Imported Functions -------------------------------------------

        XREF_EXE        Forbid
        XREF_EXE        Permit
        XREF_EXE        WaitIO
        XREF            _SysBase

        XREF            _PD

*------ Exported Functions -------------------------------------------

        XDEF            _PWait

*------ printer.device/PWait -----------------------------------------
*
*   NAME
*       PWait - wait for a time
*
*   SYNOPSIS
*       PWait(seconds, microseconds);
*
*   FUNCTION
*       PWait uses the timer device to wait after writes are complete
*
*---------------------------------------------------------------------
_PWait:
                MOVEM.L A4/A6,-(A7)
                MOVE.L  _PD,A4
                MOVE.L  pd_PBothReady(A4),A0
                JSR     (A0)
                TST.L   D0
                BNE.S   error

                LEA     pd_TIOR(A4),A1
                MOVE.W  #TR_ADDREQUEST,IO_COMMAND(A1)
                MOVE.L  12(A7),IOTV_TIME+TV_SECS(A1)
                MOVE.L  16(A7),IOTV_TIME+TV_MICRO(A1)
                CLR.B   IO_FLAGS(A1)
                MOVE.L  IO_DEVICE(A1),A6
                JSR     DEV_BEGINIO(A6)
                LINKEXE Forbid
                LEA     pd_TIOR(A4),A1
                LINKEXE WaitIO
                LINKEXE Permit
                MOVEQ   #0,D0
                TST.L   D0
error:
                MOVEM.L (A7)+,A4/A6
                RTS
                END
```

```c
/*********************************************************************/
/*              Commodore-Amiga, Inc.                                */
/*              prtbase.h                                            */
/*********************************************************************/
/*********************************************************************
 *
 * printer device data definition
 *
 *********************************************************************/

#ifndef  DEVICES_PRTBASE_H
#define  DEVICES_PRTBASE_H


#ifndef  EXEC_NODES_H
#include "exec/nodes.h"
#endif
#ifndef  EXEC_LISTS_H
#include "exec/lists.h"
#endif
#ifndef  EXEC_PORTS_H
#include "exec/ports.h"
#endif
#ifndef  EXEC_LIBRARIES_H
#include "exec/libraries.h"
#endif
#ifndef  EXEC_TASKS_H
#include "exec/tasks.h"
#endif

#ifndef  DEVICES_PARALLEL_H
#include "devices/parallel.h"
#endif
#ifndef  DEVICES_SERIAL_H
#include "devices/serial.h"
#endif
#ifndef  DEVICES_TIMER_H
#include "devices/timer.h"
#endif
#ifndef  LIBRARIES_DOSEXTENS_I
#include "libraries/dosextens.h"
#endif
#ifndef  INTUITION_INTUITION_H
#include "intuition/intuition.h"
#endif


struct DeviceData {
    struct Library dd_Device; /* standard library node */
    APTR dd_Segment;          /* A0 when initialized */
    APTR dd_ExecBase;         /* A6 for exec */
    APTR dd_CmdVectors;       /* command table for device commands */
    APTR dd_CmdBytes;         /* bytes describing which command queue */
    UWORD   dd_NumCommands;   /* the number of commands supported */
};


#define  P_STKSIZE   0x800

struct   PrinterData {
   struct   DeviceData pd_Device;
   struct   MsgPort pd_Unit;  /* the one and only unit */
   BPTR     pd_PrinterSegment;   /* the printer specific segment */
   UWORD    pd_PrinterType;   /* the segment printer type */
   struct   PrinterSegment *pd_SegmentData; /* the segment data structure */
   UBYTE    *pd_PrintBuf;     /* the raster print buffer */
   int      (*pd_PWrite)();   /* the write function */
   int      (*pd_PBothReady)();  /* write function's done */
   union {                    /* port I/O request 0 */
   struct IOExtPar pd_p0;
   struct IOExtSer pd_s0;
    } pd_ior0;
#define  pd_PIOR0 pd_ior0.pd_p0
#define  pd_SIOR0 pd_ior0.pd_s0
    union {                   /*   and 1 for double buffering */
   struct IOExtPar pd_p1;
   struct IOExtSer pd_s1;
    } pd_ior1;
#define  pd_PIOR1 pd_ior1.pd_p1
#define  pd_SIOR1 pd_ior1.pd_s1
    struct timerequest pd_TIOR;  /* timer I/O request */
    struct MsgPort pd_IORPort;   /*   and message reply port */
    struct Task pd_TC;           /* write task */
    UBYTE pd_Stk[P_STKSIZE];     /*   and stack space */
    UBYTE pd_Flags;              /* device flags */
    UBYTE pd_pad;
    struct Preferences pd_Preferences; /* the latest preferences */
    UBYTE   pd_PWaitEnabled;     /* wait function switch */
};

#define  PPCB_GFX 0
#define  PPCF_GFX 0x01
#define  PPCB_COLOR  1
#define  PPCF_COLOR  0x02

#define  PPC_BWALPHA 0 /* black&white alphanumerics */
#define  PPC_BWGFX   1 /* black&white graphics */
#define  PPC_COLORGFX   3 /* color graphics */

#define PCC_BW          1       /* only black&white */
#define PCC_YMC         2       /* only yellow/magenta/cyan */
#define PCC_YMC_BW      3       /* yellow/magenta/cyan or black&white */
#define PCC_YMCB        4       /* yellow/magenta/cyan/black */

#define PCC_4COLOR      0x4     /* a flag for YMCB and BGRW */
#define PCC_ADDITIVE    0x8     /* not yellow/magenta/cyan/black, */
                                /*   but blue/green/red/white */
#define PCC_WB          0x9     /* only black&white, 0 == BLACK */
#define PCC_BGR         0xa     /* blue/green/red */
#define PCC_BGR_WB      0xb     /* blue/green/red or black&white */
#define PCC_BGRW        0xc     /* blue/green/red/white */

struct PrinterExtendedData {
    char    *ped_PrinterName;    /* printer name, null terminated */
    VOID    (*ped_Init)();       /* called after LoadSeg */
    VOID    (*ped_Expunge)();    /* called before UnLoadSeg */
    VOID    (*ped_Open)();       /* called at OpenDevice */
    VOID    (*ped_Close)();      /* called at CloseDevice */
    UBYTE   ped_PrinterClass;    /* printer class */
```

```
    UBYTE   ped_ColorClass;       /* color class */
    UBYTE   ped_MaxColumns;       /* number of print columns available */
    UBYTE   ped_NumCharSets;      /* number of character sets */
    UWORD   ped_NumRows;          /* number of raster rows in a raster dump */
    ULONG   ped_MaxXDots;         /* number of dots maximum in a raster dump */
    ULONG   ped_MaxYDots;         /* number of dots maximum in a raster dump */
    UWORD   ped_XDotsInch;        /* horizontal dot density */
    UWORD   ped_YDotsInch;        /* vertical dot density */
    char    ***ped_Commands;      /* printer text command table */
    VOID    (*ped_DoSpecial)();   /* special command handler */
    VOID    (*ped_Render)();      /* raster render function */
    LONG    ped_TimeoutSecs;      /* good write timeout */
    /* the following only exists if the segment version is 33 or greater */
    char    **ped_8BitChars;      /* conversion strings for the extended font */
};

struct PrinterSegment {
    ULONG   ps_NextSegment;       /* (actually a BPTR) */
    ULONG   ps_runAlert;          /* MOVEQ #0,D0 : RTS */
    UWORD   ps_Version;           /* segment version */
    UWORD   ps_Revision;          /* segment revision */
    struct  PrinterExtendedData ps_PED;   /* printer extended data */
};
#endif
```

Listing of diablo_c/data.c

```
/* diablo C-150 command table */

/****** printer.device/printers/Diablo_C-150_functions ****************
 *
 *   NAME
 *   Diablo C-150 functions implemented:
 *
 *      aRIS, aIND, aNEL,
 *      aSLPP, aLMS, aRMS,
 *      aHTS, aTBC0, aTBC3, aTBCALL, aTBSALL
 *
 *      special functions implemented:
 *      aRIN, aSLRM, aSFC, aSBC
 *
 **********************************************************************/

char *CommandTable[]={
        "\375\033\015P\375",   /*reset                RIS      ESCc */
        "\377",         /*initialize*/
        "\012",         /* lf                IND      ESCD */
        "\015\012",     /* return,lf         NEL      ESCE */
        "\377",         /* reverse lf        RI       ESCM */

        "\377",         /*normal char set    SGR 0    ESC[0m */
        "\377",         /*italics on         SGR 3    ESC[3m */
        "\377",         /*italics off        SGR 23   ESC[23m */
        "\377",         /*underline on       SGR 4    ESC[4m */
        "\377",         /*underline off      SGR 24   ESC[24m */
        "\377",         /*boldface on        SGR 1    ESC[1m */
        "\377",         /*boldface off       SGR 22   ESC[22m */
        "\377",         /* set foreground color */
        "\377",         /* set background color */

        "\377",         /*normal space       DECSHORP ESC[0w */
        "\377",         /*elite on           DECSHORP ESC[2w */
        "\377",         /*elite off          DECSHORP ESC[1w */
        "\377",         /* fine on */
        "\377",         /* fine off */
        "\377",         /*enlarged on        GSM (special) */
        "\377",         /*enlarged off       GSM (special) */

        "\377",         /*shadow print on*/
        "\377",         /*shadow print off*/
        "\377",         /*doublestrike on*/
        "\377",         /*doublestrike off*/
        "\377",         /* NLQ on*/
        "\377",         /* NLQ off*/

        "\377",         /*superscript on     PLU      ESCL */
        "\377",         /*superscript off    PLD (special) */
        "\377",         /*subscript on       PLD      ESCK */
        "\377",         /*subscript off      PLU (special) */
        "\377",         /* normalize */
        "\377",         /* partial line up   PLU      ESCL */
        "\377",         /* partial line down PLD      ESCK */
```

```
"\377",        /*US char set                 ESC(B */
"\377",        /*French char set             ESC(R */
"\377",        /*German char set             ESC(K */
"\377",        /*UK char set                 ESC(A */
"\377",        /*Danish I char set           ESC E */
"\377",        /*Sweden char set             ESC(H */
"\377",        /*Italian char set   FNT 6 */
"\377",        /*Spanish char set   FNT 7 */
"\377",        /*Japanese char set  FNT 8 */
"\377",        /*Norweigen char set     FNT 9 */
"\377",        /*Danish II char set*/

"\377",        /*proportional on */
"\377",        /*proportional off*/
"\377",        /*proportional clear*/
"\377",        /*set prop offset    TSS */
"\377",        /*auto left justify  JFY 5 */
"\377",        /*auto right justify JFY 7 */
"\377",        /*auto full justify  JFY 3,6 */
"\377",        /*auto justify off   JFY 0 */
"\377",        /*place holder */
"\377",        /*auto center on     JFY 2,6 */

"\377",        /* 1/8" line space   DECVERP  ESC[0z */
"\377",        /* 1/6" line spacing DECVERP  ESC[1z */
"\033\014",    /* set form length   DECSLPP  ESC[Pnt */
"\377",        /* perf skip n */
"\377",        /* perf skip off */

"\0339",       /* Left margin set   DECSLRM  ESC[Pn1;Pn2s */
" \0330",       /* Right margin set */
"\377",        /* Top margin set    DECSTBM  ESC[Pn1;Pn2r */
"\377",        /* Bottom marg set */
"\377",        /* T&B margin set   STBM      ESC[Pn1;Pn2r */
"\377",        /* L&R margin set   SLRM      ESC[Pn1;Pn2s */
               /* Clear margins */
"\03315\015\033r90\015",

"\0331",       /* Set horiz tab     HTS      ESCH */
"\377",        /* Set vertical tab  VTS      ESCJ */
"\0338",       /* Clr horiz tab     TBC 0    ESC0g */
"\0332",       /* Clear all h tabs  TBC 3    ESC3g */
"\377",        /* Clr vertical tab  TBC 1    ESC1g */
"\377",        /* Clr all v tabs    TBC 4    ESC4g */
"\0332",       /* Clr all h & v tabs */
               /* set default tabs */
"\033i9,17,25,33,41,49,57,65,73,81,89,97,105,113,121,129",
"\377"         /* extended commands */

};
```

Listing of diablo_c/dospecial.c

```
/* diablo C-150 special printer functions */

/****** printer.device/printers/Diablo_C-150_special_functions **********
 *
 *   NAME
 *   Diablo C-150 special functions implemented:
 *
 ************************************************************************/

#include       "exec/types.h"
#include "devices/printer.h"
#include "devices/prtbase.h"

extern struct PrinterData *PD;

DoSpecial(command,outputBuffer,vline,currentVMI,crlfFlag,Parms)
   char outputBuffer[];
   UWORD *command;

   BYTE *vline;
   UBYTE *currentVMI; /* used for color on this printer */
   BYTE *crlfFlag;
   UBYTE Parms[];
{
    int x=0;
    int y=0;
    static BYTE ISOcolorTable[10]= {49,51,53,52,55,50,54,48,49,49};
    static unsigned char initMarg[]="\033l00\015\033r00\015";

if(*command==aRIN) {
   *currentVMI=0x70; /* white background, black text */
    outputBuffer[x++]='\015';
    outputBuffer[x++]='\012';

    Parms[0]=(PD->pd_Preferences.PrintLeftMargin);
    Parms[1]=(PD->pd_Preferences.PrintRightMargin);
    *command=aSLRM;
}
if(*command==aSLRM) {
    Parms[0]=Parms[0]+4;
    if(Parms[0]<5)Parms[0]=5;

    Parms[1]=Parms[1]+5;
    if(Parms[1]>90)Parms[1]=90;

    initMarg[2]=(char)((Parms[0]/10)+'0');
    initMarg[3]=(char)((Parms[0]-(UBYTE)(Parms[0]/10)*10)+'0');
    initMarg[7]=(char)((Parms[1]/10)+'0');
    initMarg[8]=(char)((Parms[1]-(UBYTE)(Parms[1]/10)*10)+'0');
    while(y<10)outputBuffer[x++]=initMarg[y++];
    return(x);
}
if(*command==aSFC)
        {
if(Parms[0]==39)Parms[0]=30; /* set defaults */
if(Parms[0]==49)Parms[0]=47;
```

```
if(Parms[0]<40) *currentVMI=((*currentVMI)&240)+(Parms[0]-30);
else *currentVMI=((*currentVMI)&15)+((Parms[0]-40)*16);

        outputBuffer[x++]='\033';
        outputBuffer[x++]='@';
        outputBuffer[x++]=ISOcolorTable[(*currentVMI)&15];
        outputBuffer[x++]=ISOcolorTable[(((*currentVMI)&240)/16)];
        return(x);
        }

if(*command==aRIS) PD->pd_PWaitEnabled=253;

return(0);
}
```

Listing of diablo_c/init.asm

```
        TTL     '$Header: init.asm,v 1.1 85/10/09 19:27:06 kodiak Exp $'
**********************************************************************
*                                                                    *
*   Copyright 1985, Commodore-Amiga Inc.   All rights reserved.      *
*   No part of this program may be reproduced, transmitted,          *
*   transcribed, stored in retrieval system, or translated into      *
*   any language or computer language, in any form or by any         *
*   means, electronic, mechanical, magnetic, optical, chemical,      *
*   manual or otherwise, without the prior written permission of     *
*   Commodore-Amiga Incorporated, 983 University Ave. Building #D,   *
*   Los Gatos, California, 95030                                     *
*                                                                    *
**********************************************************************
*
*       printer device functions
*
*   Source Control
*   --------------
*   $Header: init.asm,v 1.1 85/10/09 19:27:06 kodiak Exp $
*   $Locker:  $
*   $Log:       init.asm,v $
*   Revision 1.1  85/10/09  19:27:06  kodiak
*   remove _stdout variable
*   Revision 1.0  85/10/09  19:23:00  kodiak
*   added to rcs for updating in version 1
*   Revision 1.0  85/09/25  18:31:27  kodiak
*   added to rcs for updating in version 1
*   Revision 25.0  85/06/16  01:01:22  kodiak
*   added to rcs
*
**********************************************************************

        SECTION         printer

*------ Included Files -----------------------------------------------

        INCLUDE         "exec/types.i"
        INCLUDE         "exec/nodes.i"
        INCLUDE         "exec/lists.i"
        INCLUDE         "exec/memory.i"
        INCLUDE         "exec/ports.i"
        INCLUDE         "exec/libraries.i"

        INCLUDE         "macros.i"

*------ Imported Functions -------------------------------------------

        XREF_EXE        CloseLibrary
        XREF_EXE        OpenLibrary
        XREF            _AbsExecBase

        XREF            _PEDData


*------ Exported Globals ---------------------------------------------
```

```
        XDEF            _Init
        XDEF            _Expunge
        XDEF            _Open
        XDEF            _Close
        XDEF            _PD
        XDEF            _PED
        XDEF            _SysBase
        XDEF            _DOSBase
        XDEF            _GfxBase
        XDEF            _IntuitionBase

**********************************************************************
        SECTION         printer,DATA
_PD             DC.L    0
_PED            DC.L    0
_SysBase        DC.L    0
_DOSBase        DC.L    0
_GfxBase        DC.L    0
_IntuitionBase  DC.L    0

**********************************************************************
        SECTION         printer,CODE
_Init:
                MOVE.L  4(A7),_PD
                LEA     _PEDData(PC),A0
                MOVE.L  A0,_PED
                MOVE.L  A6,-(A7)
                MOVE.L  _AbsExecBase,A6
                MOVE.L  A6,_SysBase

*           ;------ open the dos library
                LEA     DLName(PC),Al
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_DOSBase
                BEQ     initDLErr


*           ;------ open the graphics library
                LEA     GLName(PC),Al
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_GfxBase
                BEQ     initGLErr

*           ;------ open the intuition library
                LEA     ILName(PC),Al
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_IntuitionBase
                BEQ     initILErr

                MOVEQ   #0,D0
pdiRts:
                MOVE.L  (A7)+,A6
                RTS

initPAErr:
                MOVE.L  _IntuitionBase,Al
                LINKEXE CloseLibrary

initILErr:
                MOVE.L  _GfxBase,Al
                LINKEXE CloseLibrary

initGLErr:
                MOVE.L  _DOSBase,Al
                LINKEXE CloseLibrary

initDLErr:
                MOVEQ   #-1,D0
                BRA.S   pdiRts

ILName:
                DC.B    'intuition.library'
                DC.B    0
DLName:
                DC.B    'dos.library'
                DC.B    0
GLName:
                DC.B    'graphics.library'
                DC.B    0
                DS.W    0

*----------------------------------------------------------------------
_Expunge:
                MOVE.L  _IntuitionBase,Al
                LINKEXE CloseLibrary

                MOVE.L  _GfxBase,Al
                LINKEXE CloseLibrary

                MOVE.L  _DOSBase,Al
                LINKEXE CloseLibrary


*----------------------------------------------------------------------
_Open:
                MOVEQ   #0,D0
                RTS

*----------------------------------------------------------------------
_Close:
                MOVEQ   #0,D0
                RTS

                END
```

Listing of diablo_c/printertag.asm

```
        TTL    '$Header: printertag.asm,v 32.1 86/02/10 14:32:33 kodiak Exp $'
**********************************************************************
*                                                                    *
*   Copyright 1985, Commodore-Amiga Inc.   All rights reserved.      *
*   No part of this program may be reproduced, transmitted,          *
*   transcribed, stored in retrieval system, or translated into      *
*   any language or computer language, in any form or by any         *
*   means, electronic, mechanical, magnetic, optical, chemical,      *
*   manual or otherwise, without the prior written permission of     *
*   Commodore-Amiga Incorporated, 983 University Ave. Building #D,   *
*   Los Gatos, California, 95030                                     *
*                                                                    *
**********************************************************************
*
*       printer device dependent code tag
*
*   Source Control
*   --------------
*   $Header: printertag.asm,v 32.1 86/02/10 14:32:33 kodiak Exp $
*
*   $Locker:  $
*
*   $Log:       printertag.asm,v $
*   Revision 32.1  86/02/10  14:32:33  kodiak
*   add null 8BitChars field
*
*   Revision 32.0  86/02/10  14:22:17  kodiak
*   added to rcs for updating
*
*   Revision 1.2  85/10/09  23:57:10  kodiak
*   replace reference to pdata w/ prtbase
*
*   Revision 1.1  85/09/25  18:45:12  kodiak
*   double timeout: alpha is too slow to print 400 chars in 30 sec.
*
*   Revision 1.0  85/09/25  18:32:57  kodiak
*   added to rcs for updating in version 1
*
*   Revision 25.1  85/06/16  01:02:15  kodiak
*   *** empty log message ***
*
*   Revision 25.0  85/06/15  06:40:00  kodiak
*   added to rcs
*
*   Revision 25.0  85/06/13  18:53:36  kodiak
*   added to rcs
*
*
**********************************************************************

        SECTION         printer

*------ Included Files -----------------------------------------------

        INCLUDE         "exec/types.i"
        INCLUDE         "exec/nodes.i"
        INCLUDE         "exec/strings.i"

        INCLUDE         "devices/prtbase.i"

*------ Imported Names -----------------------------------------------

        XREF            _Init
        XREF            _Expunge
        XREF            _Open
        XREF            _Close
        XREF            _CommandTable
        XREF            _PrinterSegmentData
        XREF            _DoSpecial
        XREF            _Render

*------ Exported Names -----------------------------------------------

        XDEF            _PEDData

**********************************************************************

                MOVEQ   #0,D0           ; show error for OpenLibrary()
                RTS
                DC.W    VERSION
                DC.W    REVISION
_PEDData:
                DC.L    printerName
                DC.L    _Init
                DC.L    _Expunge
                DC.L    _Open
                DC.L    _Close
                DC.B    PPC_COLORGFX    ; PrinterClass
                DC.B    PCC_YMCB        ; ColorClass
                DC.B    80              ; MaxColumns
                DC.B    1               ; NumCharSets
                DC.W    4               ; NumRows
                DC.L    1024            ; MaxXDots
                DC.L    0               ; MaxYDots
                DC.W    120             ; XDotsInch
                DC.W    120             ; YDotsInch
                DC.L    _CommandTable   ; Commands
                DC.L    _DoSpecial
                DC.L    _Render
                DC.L    60              ; twice normal: slow alpha
                DC.L    0               ; 8BitChars

printerName:
                STRING  <'Diablo C-150'>

                END
```

Listing of diablo_c/render.c

```
/*********************************************************************/
#include <exec/types.h>
#include <exec/nodes.h>
#include <exec/lists.h>
#include <exec/memory.h>
#include "devices/printer.h"
#include "devices/prtbase.h"

extern struct PrinterData *PD;
extern struct PrinterExtendedData *PED;

/* for the DIABLO C-150 */
int Render(ct, x, y, status)    /* passed a color type */
        UBYTE ct;               /* the color type to use (0, 1, 2 or 3) */
        UWORD x, y;     /* the x & y co-ordinates */
                        /* or the pc & pr print values, or special */
        UBYTE status;   /* print status (0-init, 1-enter pixel, 2-dump) */
{
        static UWORD ROWSIZE, ROWSIZES[4];
        static UWORD COLORSIZE;
        static UWORD BUFSIZE;
        static UWORD colors[4]; /* color ptrs */
        static BYTE huns,tens,ones, center; /* used to program buffer size */
        static UWORD bufptr;    /* for double buffering; points to buffer 1 or 2 */
        static UBYTE *ptr, bit_table[] = {128, 64, 32, 16, 8, 4, 2, 1};
        UWORD i;                                /* mics. var */
        BYTE err;                               /* the error # */

        switch(status)
        {
        case 0 :   /* alloc memory for printer buffer (uses double buffering) */
                i = (center) ? ((PED->ped_MaxXDots - x) / 2) : 0;
                        /* get # of centering pixels */
                ROWSIZE=(x+i+7)/8; /* pc/8 pixels per row on the DIABLO C-150 */
                huns=ROWSIZE/100;
                tens=(ROWSIZE-huns*100)/10;
                ones=(ROWSIZE-huns*100-tens*10);
                ROWSIZE += 7; /* plus 7 cmd bytes */
                COLORSIZE=(ROWSIZE*4); /*the size of each color buffer */
                BUFSIZE=(COLORSIZE*4+3);
                        /* buffer size required for DIABLO C-150 */
                i = (i+7) / 8; /* convert to byte offset */
                colors[0] = 7 + i; /* black */
                colors[1] = COLORSIZE*2+7 + i; /* yellow */
                colors[2] = COLORSIZE+7 + i; /* magenta */
                colors[3] = COLORSIZE*3+7 + i; /* cyan */
                for (i=0; i<4; i++) ROWSIZES[i] = i * ROWSIZE;
                                /* compute ROWSIZES */
                PD->pd_PrintBuf = (UBYTE *)
                        AllocMem(BUFSIZE*2,MEMF_PUBLIC); /* alloc public mem */
                if (err=(PD->pd_PrintBuf==0)) return(err);
                if (err=(*(PD->pd_PWrite))("\033\rP",3)) return(err);
                                /* reset printer to power-up */
                if (err=PWait(1,0)) return(err);
                if (err=(*(PD->pd_PWrite))("\03315\r",4)) return(err);
                                /* set l margin to .5 inch. */
                if (err=(*(PD->pd_PWrite))("\033r90\r",5)) return(err);
                                /* set r margin to 9 inch. */
                bufptr=0; /* init to first buffer */
                return(0); /* flag all ok */
                break;

        case 1 :   /* put pixel in buffer (called a max of 16384
                    * times/print cycle) */
                i = bufptr+x/8+(y&3)*ROWSIZE+colors[ct];
                        /* calc which byte to use */
                PD->pd_PrintBuf[i] = PD->pd_PrintBuf[i] | (1 << (7-(x&7)));
                        /* fill print buffer */
                PD->pd_PrintBuf[bufptr+(x>>3)+ROWSIZES[y&3]+colors[ct]]
                        |= bit_table[x&7];      /* fill print buffer */
                return(0);      /* flag all ok */
                break;

        case 2 :        /* dump buffer to printer */
                if (err=(*(PD->pd_PWrite))(&(PD->pd_PrintBuf[bufptr]),
                        BUFSIZE)) return(err);
                bufptr=BUFSIZE-bufptr;  /* switch to other buffer */
                return(0);      /* flag all ok */
                break;

        case 3 :        /* clear and init buffer */
/*              for (i=bufptr; i<BUFSIZE+bufptr; i++)
                        PD->pd_PrintBuf[i] = 0;         /* clear buffer */
                ptr = &PD->pd_PrintBuf[bufptr];
                i = BUFSIZE;
                while(i--) *ptr++ = 0;          /* clear buffer */
                for (i=0; i<16; i++) {
                        PD->pd_PrintBuf[bufptr+i*ROWSIZE] = 27;
                        PD->pd_PrintBuf[bufptr+i*ROWSIZE+1] = 'g';
                        PD->pd_PrintBuf[bufptr+i*ROWSIZE+2] = i+'0';
                        PD->pd_PrintBuf[bufptr+i*ROWSIZE+3] = huns + '0';
                        PD->pd_PrintBuf[bufptr+i*ROWSIZE+4] = tens + '0';
                        PD->pd_PrintBuf[bufptr+i*ROWSIZE+5] = ones + '0';
                        PD->pd_PrintBuf[bufptr+i*ROWSIZE+6] = ',';
                                /* select # of bytes for each line */
                }
                PD->pd_PrintBuf[bufptr+BUFSIZE-3] = 27;
                PD->pd_PrintBuf[bufptr+BUFSIZE-2] = 'k';
                PD->pd_PrintBuf[bufptr+BUFSIZE-1] = '1';
                return(0);      /* flag all ok */
                break;

        case 4 :        /* free the print buffer memory */
                err=(*(PD->pd_PBothReady))();
                        /* wait for both buffers to be clear */
                FreeMem(PD->pd_PrintBuf,BUFSIZE*2);
                        /* free the print buffers memory */
                return(err);    /* return status */
                break;

        case 5 :        /* io_special flags call */
                center = x & SPECIAL_CENTER;    /* set center flag */
                return(0);      /* flag all ok */
                break;

        default : return(0);    /* flag all ok */
        }
```

```
}
```

Listing of epson/data.c

```
/* epson X80 series */

/****** printer.device/printers/Epson_functions *************************
 *
 *   Epson X-80 functions implemented:
 *      aRIS, aIND, aNEL, aSGR0, aSGR3, aSGR23, aSGR4, aSGR24, aSGR1, aSGR22,
 *      aSHORP0, aSHORP1, aSHORP2, aSHORP3, aSHORP4, aSHORP5, aSHORP6,
 *      aDEN1, aDEN2, aDEN3, aDEN4,
 *      aSUS0, aSUS1, aSUS2, aSUS3, aSUS4,
 *      aFNT0, aFNT1, aFNT2, aFNT3, aFNT4, aFNT5, aFNT6, aFNT7, aFNT8
 *      aFNT9, aFNT10,
 *      aPROP1, aPROP2, aJFY5, aJFY7, aJFY6, aJFY0, aJFY3, aJFY2,
 *      aVERP0, aVERP1, aSLPP, aPERF, aPERF0,
 *      aTBC3, aTBC4, aTBCALL, aTBSALL
 *   special functions implemented:
 *      aRIN, aSUS0, aSUS1, aSUS2, aSUS3, aSUS4,
 *      aPLU, aPLD, aVERP0, aVERP1, aSLRM, aIND, aCAM
 *
 ************************************************************************/

char *CommandTable[] ={
         "\375\033@\375",       /*reset      RIS      ESCc */
         "\377",        /*initialize*/
         "\012",        /* lf                IND      ESCD */
         "\015\012",    /* return,lf         NEL      ESCE */
         "\377",        /* reverse lf        RI       ESCM */

                        /*normal char set    SGR 0    ESC[0m */
         "\0335\033-\376\033F",
         "\0334",       /*italics on         SGR 3    ESC[3m */
         "\0335",       /*italics off        SGR 23   ESC[23m */
         "\033-\001",   /*underline on       SGR 4    ESC[4m */
         "\033-\376",   /*underline off      SGR 24   ESC[24m */
         "\033E",       /*boldface on        SGR 1    ESC[1m */
         "\033F",       /*boldface off       SGR 22   ESC[22m */
         "\377",        /* set foreground color */
         "\377",        /* set background color */

                        /* normal char set   SHORP    ESC[0w */
         "\033P\022\033W\376",
         "\033M",       /*elite on           SHORP    ESC[2w */
         "\033P",       /*elite off          SHORP    ESC[1w */
         "\017",        /*condensed(fine) on SHORP    ESC[4w */
         "\022",        /*condensed off      SHORP    ESC[3w */
         "\033W\001",   /*enlarged on        SHORP    ESC[6w */
         "\033W\376",   /*enlarged off       SHORP    ESC[5w */

         "\377",        /*shadow print on    DEN6     ESC[6"z */
         "\377",        /*shadow print off   DEN5     ESC[5"z */
         "\033G",       /*doublestrike on    DEN4     ESC[4"z */
         "\033H",       /*doublestrike off   DEN3     ESC[3"z */
         "\033x\001",   /* NLQ on            DEN2     ESC[2"z */
         "\033x\376",   /* NLQ off           DEN1     ESC[1"z */

         "\033S\376",   /*superscript on              ESC[2u */
         "\033T",       /*superscript off             ESC[1u */
```

```
    "\033S\001",    /*subscript on              ESC[4u */
    "\033T",        /*subscript off             ESC[3u */
    "\033T",        /*normalize                 ESC[0u */
    "\377",         /* partial line up   PLU    ESCL */
    "\377",         /* partial line down PLD    ESCK */

    "\033R\376",    /*US char set        FNT0   ESC(B */
    "\033R\001",    /*French char set    FNT1   ESC(R */
    "\033R\002",    /*German char set    FNT2   ESC(K */
    "\033R\003",    /*UK char set        FNT3   ESC(A */
    "\033R\004",    /*Danish I char set  FNT4   ESC E */
    "\033R\005",    /*Sweden char set    FNT5   ESC(H */
    "\033R\006",    /*Italian char set   FNT6   ESC(Y */
    "\033R\007",    /*Spanish char set   FNT7   ESC(Z */
    "\033R\010",    /*Japanese char set  FNT8   ESC(J */
    "\033R\011",    /*Norweign char set  FNT9   ESC(6 */
    "\033R\012",    /*Danish II char set FNT10  ESC(C */

    "\033p1",    /*proportional on    PROP     ESC[2p */
    "\033p0",    /*proportional off   PROP     ESC[1p */
    "\377",         /*proportional clear PROP   ESC[0p */
    "\377",         /*set prop offset    TSS */
    "\033x\001\033a\376",   /*auto left justify  JFY5     ESC[5 F */
    "\033x\001\033a\002",   /*auto right justify JFY7     ESC[7 F */
    "\033x\001\033a\003",   /*auto full justify  JFY6     ESC[6 F */
    "\033a\376",    /*auto justify/center off   ESC[0 F */
    "\377",         /*place holder       JFY3   ESC[3 F */
    "\033x\001\033a\001",   /*auto center on    JFY2 ESC[2 F */

    "\0330",        /* 1/8" line space   VERP   ESC[0z */
    "\0332",        /* 1/6" line spacing VERP   ESC[1z */
    "\033C",        /* set form length   SLPP   ESC[Pnt */
    "\033N",        /* perf skip n              ESC[nq */
    "\033O",        /* perf skip off            ESC[0q */

    "\377",         /* Left margin set          ESC[2x */
    "\377",         /* Right margin set         ESC[3x */
    "\377",         /* top margin set           ESC[4x */
    "\377",         /* Bottom marg set          ESC[5x */
    "\377",         /* T&B margin set   STBM    ESC[Pn1;Pn2r */
    "\377",         /* L&R margin set   SLRM    ESC[Pn1;Pn2s */
    "\377",         /* Clear margins            ESC[0x */

    "\377",         /* Set horiz tab     HTS    ESCH */
    "\377",         /* Set vertical tab  VTS    ESCJ */
    "\377",         /* Clr horiz tab     TBC 0  ESC[0g */
    "\033D\376",    /* Clear all h tabs  TBC 3  ESC[3g */
    "\377",         /* Clr vertical tab  TBC 1  ESC[1g */
    "\377",         /* Clr all v tabs    TBC 4  ESC[4g */
    "\033D\376",    /* Clr all h & v tabs       ESC#4 */
    "\33D\010\020\030\040\050\060\070\100\110\120\130\376",
                    1/*set default tabs */
    "\377"          /* extended command */
};
```

```
Listing of epson/dospecial.c


/* epson X80 special commands */

/****** printer.device/printers/Epson_special_functions ******************
 *
 *   NAME
 *   Epson X80 special functions
 *
 ************************************************************************/

#include        "exec/types.h"
#include "devices/printer.h"
#include "devices/prtbase.h"

extern struct PrinterData *PD;

DoSpecial(command,outputBuffer,vline,currentVMI,crlfFlag,Parms)
   char outputBuffer[];
   UWORD *command;
   BYTE *vline;
   BYTE *currentVMI;
   BYTE *crlfFlag;
   UBYTE Parms[];

{
   int x=0;
   int y=0;
   static char initMarg[]="\375\0331L\033Qq\375";
static char
    initThisPrinter[]="\033x\001\0332\022\0335\033P\033-\376\033F\n\033W";


if(*command==aRIN) {
    while(x<18){outputBuffer[x]=initThisPrinter[x];x++;}
    outputBuffer[x++]='\000';
    outputBuffer[12]='\000';

    if((PD->pd_Preferences.PrintQuality)==DRAFT)outputBuffer[2]='\000';

    *currentVMI=36; /* assume 1/6 line spacing */
    if((PD->pd_Preferences.PrintSpacing)==EIGHT_LPI) { /* wrong again */
        outputBuffer[4]='0';
        *currentVMI=27;
    }
    if ((PD->pd_Preferences.PrintPitch) != PICA)outputBuffer[x++]='\033';
    if((PD->pd_Preferences.PrintPitch)==ELITE)outputBuffer[x++]='M';
        else if((PD->pd_Preferences.PrintPitch)==FINE)
        outputBuffer[x++]='\017';

    Parms[0]=(PD->pd_Preferences.PrintLeftMargin);
    Parms[1]=(PD->pd_Preferences.PrintRightMargin);
    *command=aSLRM;
}

if(*command==aSLRM) {
        PD->pd_PWaitEnabled=253; /* wait after this character */
```

```
        if(Parms[0]==0)initMarg[3]=0;
        else initMarg[3]=Parms[0]-1;
        initMarg[6]=Parms[1];
        while(y<8)outputBuffer[x++]=initMarg[y++];
        return(x);
}

if(*command==aCAM) {
        PD->pd_PWaitEnabled=253;
        initMarg[3]=0;
if(PD->pd_Preferences.PrintPitch == FINE)initMarg[6]=96;
else if(PD->pd_Preferences.PrintPitch == ELITE)initMarg[6]=137;
else initMarg[6]=80;
        while(y<8)outputBuffer[x++]=initMarg[y++];
        return(x);
}

if(*command==aPLU) {
        if((*vline)==0){(*vline)=1; *command=aSUS2; return(0);}
        if((*vline)<0){(*vline)=0; *command=aSUS3; return(0);}
        return(-1);
}

if(*command==aPLD) {
        if((*vline)==0){(*vline)=(-1); *command=aSUS4; return(0);}
        if((*vline)>0){(*vline)=0; *command=aSUS1; return(0);}
        return(-1);
}

if(*command==aSUS0) *vline=0;
if(*command==aSUS1) *vline=0;
if(*command==aSUS2) *vline=1;
if(*command==aSUS3) *vline=0;
if(*command==aSUS4) *vline=(-1);

if(*command==aVERP0) *currentVMI=27;

if(*command==aVERP1) *currentVMI=36;

if(*command==aIND) {
        outputBuffer[x++]='\033';
        outputBuffer[x++]='J';
        outputBuffer[x++]= *currentVMI;
        return(x);
}

if(*command==aRIS) PD->pd_PWaitEnabled=253;

return(0);
```


Listing of epson/init.asm

```
        TTL    '$Header: init.asm,v 1.1 85/10/09 19:27:14 kodiak Exp $'
**********************************************************************
*                                                                    *
*   Copyright 1985, Commodore-Amiga Inc.   All rights reserved.      *
*   No part of this program may be reproduced, transmitted,          *
*   transcribed, stored in retrieval system, or translated into      *
*   any language or computer language, in any form or by any         *
*   means, electronic, mechanical, magnetic, optical, chemical,      *
*   manual or otherwise, without the prior written permission of     *
*   Commodore-Amiga Incorporated, 983 University Ave. Building #D,   *
*   Los Gatos, California, 95030                                     *
*                                                                    *
**********************************************************************
*       printer device functions
*
*   Source Control
*   --------------
*   $Header: init.asm,v 1.1 85/10/09 19:27:14 kodiak Exp $
*   $Locker:  $
*   $Log:       init.asm,v $
*   Revision 1.1  85/10/09  19:27:14  kodiak
*   remove _stdout variable
*   Revision 1.0  85/10/09  19:23:12  kodiak
*   added to rcs for updating in version 1
*   Revision 25.0  85/06/16  01:01:22  kodiak
*   added to rcs
*
**********************************************************************

        SECTION         printer

*------ Included Files -----------------------------------------------

        INCLUDE         "exec/types.i"
        INCLUDE         "exec/nodes.i"
        INCLUDE         "exec/lists.i"
        INCLUDE         "exec/memory.i"
        INCLUDE         "exec/ports.i"
        INCLUDE         "exec/libraries.i"

        INCLUDE         "macros.i"

*------ Imported Functions -------------------------------------------

        XREF_EXE        CloseLibrary
        XREF_EXE        OpenLibrary
        XREF            _AbsExecBase


        XREF            _PEDData


*------ Exported Globals ---------------------------------------------

        XDEF            _Init
        XDEF            _Expunge
```

```
        XDEF            _Open
        XDEF            _Close
        XDEF            _PD
        XDEF            _PED
        XDEF            _SysBase
        XDEF            _DOSBase
        XDEF            _GfxBase
        XDEF            _IntuitionBase

**********************************************************************
        SECTION         printer,DATA
_PD             DC.L    0
_PED            DC.L    0
_SysBase        DC.L    0
_DOSBase        DC.L    0
_GfxBase        DC.L    0
_IntuitionBase  DC.L    0

**********************************************************************
        SECTION         printer,CODE
_Init:
                MOVE.L  4(A7),_PD
                LEA     _PEDData(PC),A0
                MOVE.L  A0,_PED
                MOVE.L  A6,-(A7)
                MOVE.L  _AbsExecBase,A6
                MOVE.L  A6,_SysBase

*           ;------ open the dos library
                LEA     DLName(PC),A1
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_DOSBase
                BEQ     initDLErr


*           ;------ open the graphics library
                LEA     GLName(PC),A1
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_GfxBase
                BEQ     initGLErr

*           ;------ open the intuition library
                LEA     ILName(PC),A1
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_IntuitionBase
                BEQ     initILErr

                MOVEQ   #0,D0
pdiRts:
                MOVE.L  (A7)+,A6
                RTS

initPAErr:
                MOVE.L  _IntuitionBase,A1
                LINKEXE CloseLibrary

initILErr:
                MOVE.L  _GfxBase,A1
                LINKEXE CloseLibrary

initGLErr:
                MOVE.L  _DOSBase,A1
                LINKEXE CloseLibrary

initDLErr:
                MOVEQ   #-1,D0
                BRA.S   pdiRts

ILName:
                DC.B    'intuition.library'
                DC.B    0
DLName:
                DC.B    'dos.library'
                DC.B    0
GLName:
                DC.B    'graphics.library'
                DC.B    0
                DS.W    0

*---------------------------------------------------------------------
_Expunge:
                MOVE.L  _IntuitionBase,A1
                LINKEXE CloseLibrary

                MOVE.L  _GfxBase,A1
                LINKEXE CloseLibrary

                MOVE.L  _DOSBase,A1
                LINKEXE CloseLibrary


*---------------------------------------------------------------------
_Open:
                MOVEQ   #0,D0
                RTS

*---------------------------------------------------------------------
_Close:
                MOVEQ   #0,D0
                RTS

                END
```

Listing of epson/printertag.asm

```
        TTL    '$Header: printertag.asm,v 32.2 86/02/12 18:15:55 kodiak Exp $'
**********************************************************************
*                                                                    *
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*   No part of this program may be reproduced, transmitted,          *
*   transcribed, stored in retrieval system, or translated into      *
*   any language or computer language, in any form or by any         *
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*   manual or otherwise, without the prior written permission of     *
*   Commodore-Amiga Incorporated, 983 University Ave. Building #D,   *
*   Los Gatos, California, 95030                                     *
*                                                                    *
**********************************************************************
*
*       printer device dependent code tag
*
*   Source Control
*   --------------
*   $Header: printertag.asm,v 32.2 86/02/12 18:15:55 kodiak Exp $
*
*   $Locker:  $
*   $Log:       printertag.asm,v $
*   Revision 32.2  86/02/12  18:15:55  kodiak
*   YDotsInch -> 72
*   Revision 32.1  86/02/10  14:32:42  kodiak
*   add null 8BitChars field
*   Revision 32.0  86/02/10  14:22:38  kodiak
*   added to rcs for updating
*   Revision 1.1  85/10/09  23:57:27  kodiak
*   replace reference to pdata w/ prtbase
*   Revision 1.0  85/10/09  23:57:21  kodiak
*   added to rcs for updating in version 1
*   Revision 29.1  85/08/19  08:32:10  kodiak
*   flag a graphics printer, not BWALPHA
*   Revision 29.0  85/08/19  08:31:06  kodiak
*   added to rcs for updating in version 29
*   Revision 25.1  85/06/16  01:02:15  kodiak
*   *** empty log message ***
*
*   Revision 25.0  85/06/15  06:40:00  kodiak
*   added to rcs
*
*   Revision 25.0  85/06/13  18:53:36  kodiak
*   added to rcs
*
*
**********************************************************************

        SECTION         printer

*------ Included Files -----------------------------------------------

        INCLUDE         "exec/types.i"
        INCLUDE         "exec/nodes.i"
        INCLUDE         "exec/strings.i"
        INCLUDE         "devices/prtbase.i"

*------ Imported Names -----------------------------------------------

        XREF            _Init
        XREF            _Expunge
        XREF            _Open
        XREF            _Close
        XREF            _CommandTable
        XREF            _PrinterSegmentData
        XREF            _DoSpecial
        XREF            _Render

*------ Exported Names -----------------------------------------------

        XDEF            _PEDData

**********************************************************************

                MOVEQ   #0,D0                   ; show error for OpenLibrary()
                RTS
                DC.W    VERSION
                DC.W    REVISION
_PEDData:
                DC.L    printerName
                DC.L    _Init
                DC.L    _Expunge
                DC.L    _Open
                DC.L    _Close
                DC.B    PPC_BWGFX               ; PrinterClass
                DC.B    PCC_BW                  ; ColorClass
                DC.B    80                      ; MaxColumns
                DC.B    10                      ; NumCharSets
                DC.W    8                       ; NumRows
                DC.L    960                     ; MaxXDots
                DC.L    0                       ; MaxYDots
                DC.W    120                     ; XDotsInch
                DC.W    72                      ; YDotsInch
                DC.L    _CommandTable           ; Commands
                DC.L    _DoSpecial
                DC.L    _Render
                DC.L    30
                DC.L    0                       ; 8BitChars

printerName:
                STRING  <'Epson'>

                END
```

epson/render.c

```c
/*********************************************************************/
#include <exec/types.h>
#include <exec/nodes.h>
#include <exec/lists.h>
#include <exec/memory.h>
#include "devices/printer.h"
#include "devices/prtbase.h"

extern struct PrinterData *PD;
extern struct PrinterExtendedData *PED;

/* for the EPSON    */
int Render(ct, x, y, status)
UBYTE ct;   /* null for b/w printers */
UWORD x, y;     /* the x & y co-ordinates */
                /* or the pc & pr print values, or special */
UBYTE status;   /* print status (0-init, 1-enter pixel, 2-dump) */
{
    static UWORD ROWSIZE;
    static UWORD BUFSIZE;
    static UWORD bufptr, offset;
        static BYTE center, spacing;
        static UBYTE *ptr, bit_table[] = {128, 64, 32, 16, 8, 4, 2, 1};
    UWORD i;                    /* mics. var */
    BYTE err;               /* the error # */

    switch(status)
    {
    case 0 :    /* alloc memory for printer buffer */
        i = (center) ? ((PED->ped_MaxXDots - x) / 2) : 0;
        offset = i + 4;
        ROWSIZE=x+i; /* row size required for EPSON */
        BUFSIZE=(6+ROWSIZE); /* buffer size required for EPSON */
        PD->pd_PrintBuf = (UBYTE *)
            AllocMem(BUFSIZE*2,MEMF_PUBLIC); /* alloc public mem */
        if (err=(PD->pd_PrintBuf == 0)) return(err);
        /* reset printer to power-up state */
        if (err=(*(PD->pd_PWrite))("\033@",2)) return(err);
        if (err=PWait(1,0)) return(err);
/* special epson spacing code */
        if (spacing==7) {
                if (err=(*(PD->pd_PWrite))("\0331",2)) return(err);
                        /* select 7/72 inch spacing */
        }
        else {
                if (err=(*(PD->pd_PWrite))("\0333\030",3)) return(err);
                        /* select 24/216 (8/72) inch spacing */
        }
/* end of special epson spacing code */
        if (err=(*(PD->pd_PWrite))("\033U1",3)) return(err);
                        /* set unidirec mode */
        bufptr=0;
        return(0);       /* flag all ok */
        break;

    case 1 :            /* put pixel in buffer */
        i = bufptr+x+4; /* calc which byte to use */
        PD->pd_PrintBuf[i] = PD->pd_PrintBuf[i] | (1 << (7-(y&7)));
                        /* fill print buffer */
        PD->pd_PrintBuf[bufptr+x+offset] |= bit_table[y&7];
        return(0); /* flag all ok */
        break;

    case 2 :            /* dump buffer to printer */
        if (err=(*(PD->pd_PWrite))(&(PD->pd_PrintBuf[bufptr]),
                BUFSIZE)) return(err);
        bufptr=BUFSIZE-bufptr;
        return(0);      /* flag all ok */
        break;

    case 3 :            /* clear and init buffer */
        for (i=bufptr; i<bufptr+BUFSIZE; i++)
            PD->pd_PrintBuf[i] = 0;      /* clear buffer */
        ptr = &PD->pd_PrintBuf[bufptr];
        i = BUFSIZE;
        while (i--) *ptr++ = 0;
        PD->pd_PrintBuf[bufptr] = 27;
        PD->pd_PrintBuf[bufptr+1] = 'L';
        PD->pd_PrintBuf[bufptr+2] = ROWSIZE & 0xff;
        PD->pd_PrintBuf[bufptr+3] = ROWSIZE >> 8;
        PD->pd_PrintBuf[bufptr+BUFSIZE-2] = 10;
        PD->pd_PrintBuf[bufptr+BUFSIZE-1] = 13;
        return(0); /* flag all ok */
        break;

    case 4 :    /* free the print buffer memory */
        err=(*(PD->pd_PWrite))("\033@",2);
                /* reset printer to power-up state */
        if (!err) err=(*(PD->pd_PBothReady))();
                /* wait for both buffers to empty */
        FreeMem(PD->pd_PrintBuf,BUFSIZE*2); /* free print buffer's memory */
        return(err); /* return status */
        break;

    case 5 :    /* io_special flag call */
                center = x & SPECIAL_CENTER; /* set center flag */
                        /* special code for epson spacing */
                if (PD->pd_Preferences.PaperSize==CUSTOM) {
                        PED->ped_YDotsInch = (UWORD)82;
                        /* for 7/72 spacing */
                        /* (72/7*8 gives 82.3)/ there are 82 dpi in y */
                        spacing = 7;     /* 7/72 inch spacing */
                }
                else { /* else use default of 8/72 spacing */
                        PED->ped_YDotsInch = (UWORD)72;
                        /* (72/8*8 gives 72); there are 72 dpi in y */
                        spacing = 8;    /* 8/72 inch spacing */
                }
                return(0);      /* flag all ok */
                break;

    default: return(0);
    }
}
```

Listing for hpplus/data.c

```
/* HP command table */

/****** printer.device/HP_LaserJet_Plus_functions ************************
 *
 *   NAME
 *   HP LaserJet 2686A functions implemented:
 *
 *      aRIS, aIND, aNEL,
 *      aSGR0, aSGR3, aSGR23, aSGR4, aSGR24, aSGR1, aSGR22,
 *      aSHORP0, aSHORP1, aSHORP2, aSHORP3, aSHORP4
 *      aDEN3, aDEN4, aPLU, aPLD,
 *      aFNT0, aFNT3, aFNT8,
 *      aPROP0, aPROP1, aPROP2,
 *      aVERP0, aVERP1, aPERF, aPERF0, aCAM
 *
 *************************************************************************/

char *CommandTable[]={
        "\375\033E\375",      /*reset*/
        "\377",        /*initialize*/
        "\012",        /* lf               IND      ESCD */
        "\015\012",    /* return,lf        NEL      ESCE */
        "\033&a-1R",
                       /* reverse lf       RI       ESCM */

       "\033&d@\033(sbS",     /*normal char set    SGR 0 */
        "\033(s1S",        /*italics on*/
        "\033(sS",        /*italics off*/
        "\033&dD",       /*underline on*/
        "\033&d@",       /*underline off */
        "\033(s5B",       /*boldface on*/
        "\033(sB",       /*boldface off*/
        "\377",        /* set foreground color */
        "\377",        /* set background color */

        "\033(s10h1T",        /* normal pitch */
        "\033(s12h2T",        /* elite on*/
        "\033(s10h1T",        /* elite off*/
        "\033(s15H",/* condensed on*/
        "\033(s10H",/* condensed off*/
        "\377",        /* enlarged on*/
        "\377",        /* enlarged off*/

        "\033(s7B",    /*shadow print on*/
        "\033(sB",     /*shadow print off*/
        "\033(s3B",    /*doublestrike on*/
        "\033(sB",     /*doublestrike off*/
        "\377",        /* NLQ on*/
        "\377",        /* NLQ off*/

        "\377",        /*superscript on*/
        "\377",        /*superscript off*/
        "\377",        /*subscript on*/
        "\377",        /*subscript off*/
        "\377",        /* normalize */

        "\033&a-.5R",  /* partial line up   PLU      ESCL */
        "\033=",       /* partial line down PLD      ESCK */

        "\033(U",      /*US char set */
        "\033(F",      /*French char set*/
        "\033(G",      /*German char set*/
        "\033(1E",     /*UK char set*/
        "\033(D",      /*Danish I char set*/
        "\033(S",      /*Sweden char set*/
        "\033(I",      /*Italian char set*/
        "\033(1S",     /*Spanish char set*/
        "\033(8K",     /*Japanese char set*/
        "\033(D",      /*Norweigen char set*/
        "\033(D",      /*Danish II char set*/

        "\033(s1P",    /*proportional on*/
        "\033(sP",     /*proportional off*/
        "\033(sP",     /*proportional clear*/
        "\377",        /*set prop offset*/
        "\377",        /*auto left justify on*/
        "\377",        /*auto right justify on*/
        "\377",        /*auto full justify on*/
        "\377",        /*auto justify/center off*/
        "\377",        /*place holder */
        "\377",        /*auto center on*/

        "\033&l8D",    /* 1/8" line space*/
        "\033&l6D",    /* 1/6" line spacing*/
        "\377",        /* set form length n */
        "\033&l1L",    /* perf skip n */
        "\033&lL",    /* Perf skip off */

        "\377",        /* Left margin set */
        "\377",        /* Right margin set */
        "\377",        /* Top margin set */
        "\377",        /* Bottom marg set */
        "\377",        /* T&B margin set   STBM      ESC[Pn1;Pn2r */
        "\377",        /* L&R margin set   SLRM      ESC[Pn1;Pn2s */
        "\0339",       /* Clear margins */

        "\377",        /* Set horiz tab */
        "\377",        /* Set vertical tab */
        "\377",        /* Clr horiz tab */
        "\377",        /* Clear all h tabs */
        "\377",        /* Clear vertical tab */
        "\377",        /* Clr all v tabs    TBC 4 */
        "\377",        /* Clr all h & v tabs */
        "\377",        /* set default tabs */
        "\377"         /* extended commands */
};
```

Listing for hpplus/density.c

```
/* ***** density.c ***** */
#include <exec/types.h>
#include "devices/prtbase.h"
#include "devices/printer.h"

extern struct PrinterExtendedData *PED;
extern char density[];

SetDensity(level)
UWORD level;
{
        switch (level) {
        case SPECIAL_DENSITY1:
                PED->ped_MaxXDots = 600;
                PED->ped_MaxYDots = 795;
                PED->ped_XDotsInch = PED->ped_YDotsInch = 75;
                density[3] = '0';
                density[4] = '7';
                density[5] = '5';
                break;

        case SPECIAL_DENSITY2:
                PED->ped_MaxXDots = 800;
                PED->ped_MaxYDots = 1060;
                PED->ped_XDotsInch = PED->ped_YDotsInch = 100;
                density[3] = '1';
                density[4] = '0';
                density[5] = '0';
                break;

        case SPECIAL_DENSITY3:
                PED->ped_MaxXDots = 1200;
                PED->ped_MaxYDots = 1590;
                PED->ped_XDotsInch = PED->ped_YDotsInch = 150;
                density[3] = '1';
                density[4] = '5';
                density[5] = '0';
                break;

        case SPECIAL_DENSITY4:
                PED->ped_MaxXDots = 2400;
                PED->ped_MaxYDots = 3180;
                PED->ped_XDotsInch = PED->ped_YDotsInch = 300;
                density[3] = '3';
                density[4] = '0';
                density[5] = '0';
                break;

        default: break;
        }
}
```

Listing for hpplus/dospecial.c

```
/* hp special printer functions */

/****** printer.device/printers/HP_LaserJet_Plus_special_functions *******
 *
 *   NAME
 *   HP LaserJet 2686A special functions implemented:
 *
 *      aRIN,
 *      aSUS0, aSUS1, aSUS2, aSUS3, aSUS4
 *      aPLU, aPLD, aVERP0, aVERP1,
 *      aSLPP, aSLRM, aSTBM
 *
 ************************************************************************/

#include "exec/types.h"
#include "devices/printer.h"
#include "devices/prtbase.h"

extern struct PrinterData *PD;
UWORD textlength,topmargin;


DoSpecial(command,outputBuffer,vline,currentVMI,crlfFlag,Parms)
   char outputBuffer[];
   UWORD *command;
   BYTE *vline;
   BYTE *currentVMI;
   BYTE *crlfFlag;
   UBYTE Parms[];
{
    int x=0;
    int y=0;
    int j=0;
    static char initThisPrinter[]="\033&d@\033&l6D\033(sb10hpsltul2V";
    static char initMarg[]="\033&a0001000M";
    static char initTMarg[]="\033&l000e000F";
    static char initForm[]="\033&l002e000F";

if(*command==aRIN) {
    while(x<24){outputBuffer[x]=initThisPrinter[x];x++;}
    if((PD->pd_Preferences.PrintSpacing)==EIGHT_LPI) { /* wrong again */
        outputBuffer[7]='8';
    }

    if((PD->pd_Preferences.PrintPitch)==ELITE) {
        outputBuffer[14]='2';
        outputBuffer[18]='2';
    }
    if((PD->pd_Preferences.PrintPitch)==FINE) {
        outputBuffer[14]='5';
    }
    j=x; /* set the formlength=textlength, top margin of 2 */
    textlength=PD->pd_Preferences.PaperLength;
    topmargin=2;

    while(y<11)outputBuffer[x++]=initForm[y++];
```

```
        numberString(textlength,j+7,outputBuffer);
        y=0;

        Parms[0]=(PD->pd_Preferences.PrintLeftMargin);
        Parms[1]=(PD->pd_Preferences.PrintRightMargin);
        *command=aSLRM;
    }

    if(*command==aSLRM) {
            j=x;
            while(y<11)outputBuffer[x++]=initMarg[y++];
            numberString(Parms[0]-1,j+3,outputBuffer);
            numberString(Parms[1]-1,j+7,outputBuffer);
            return(x);
    }

    if((*command==aSUS2)&&(*vline==0)) {*command=aPLU; *vline=1; return(0);}
    if((*command==aSUS2)&&(*vline<0)) {*command=aRI; *vline=1; return(0);}
    if((*command==aSUS1)&&(*vline>0)) {*command=aPLD; *vline=0; return(0);}

    if((*command==aSUS4)&&(*vline==0)) {*command=aPLD; *vline=(-1); return(0);}
    if((*command==aSUS4)&&(*vline>0)) {*command=aIND; *vline=(-1); return(0);}
    if((*command==aSUS3)&&(*vline<0)) {*command=aPLU; *vline=0; return(0);}

    if(*command==aSUS0)
            {
            if(*vline>0) *command=aPLD;
            if(*vline<0) *command=aPLU;
            *vline=0;
            return(0);
            }

    if(*command==aPLU){(*vline)++; return(0);}

    if(*command==aPLD){(*vline)--; return(0);}

    if(*command==aSTBM) {

    if(Parms[0]== 0)Parms[0]=topmargin;
    else topmargin = --Parms[0];

    if(Parms[1]== 0)Parms[1]=textlength;
    else textlength=Parms[1];

            while(x<11){outputBuffer[x]=initTMarg[x]; x++;}
            numberString(Parms[0],3,outputBuffer);
            numberString(Parms[1]-Parms[0],7,outputBuffer);
            return(x);
            }

    if(*command==aSLPP) {
            while(x<11){outputBuffer[x]=initForm[x]; x++;}
            numberString(topmargin,3,outputBuffer); /*restore textlength,margin*/
            numberString(textlength,7,outputBuffer);
            return(x);
            }

    if(*command==aRIS) PD->pd_PWaitEnabled=253;

    return(0);
}

VOID
numberString(Param,x,outputBuffer)
   BYTE Param;
   int x;
   char outputBuffer[];
{

if(Param>199){outputBuffer[x++]='2'; Param-=200;}
   else if(Param>99){outputBuffer[x++]='1'; Param-=100;}
   else outputBuffer[x++]='0'; /* always return 3 digits */

if(Param>9)outputBuffer[x++]=(BYTE)(Param/10)+'0';
   else outputBuffer[x++]='0';

outputBuffer[x++]=Param%10+'0';
}

Close()
{
/*(*(PD->pd_PWrite))("\033E",2);*/
(*(PD->pd_PWrite))("\014",1);
(*(PD->pd_PBothReady))();
return(0);
}
```

Listing for hpplus/init.asm

```
        TTL    '$Header: init.asm,v 1.1 85/10/09 19:27:38 kodiak Exp $'
**********************************************************************
*                                                                    *
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*   means, electronic, mechanical, magnetic, optical, chemical,      *
*   manual or otherwise, without the prior written permission of     *
*   Commodore-Amiga Incorporated, 983 University Ave. Building #D,   *
*   Los Gatos, California, 95030                                     *
*                                                                    *
**********************************************************************
*
*       printer device functions
*
*   Source Control
*   --------------
*   $Header: init.asm,v 1.1 85/10/09 19:27:38 kodiak Exp $
*   $Locker:  $
*   $Log:       init.asm,v $
*   Revision 1.1  85/10/09  19:27:38  kodiak
*   remove _stdout variable
*   Revision 1.0  85/10/09  19:23:53  kodiak
*   added to rcs for updating in version 1
*   Revision 29.1  85/08/02  16:58:43  kodiak
*   remove dummy _Close routine -- it's used to finish print of last page.
*   Revision 29.0  85/08/02  16:58:17  kodiak
*   added to rcs for updating in version 29
*   Revision 25.0  85/06/16  01:01:22  kodiak
*   added to rcs
*
*
**********************************************************************

        SECTION         printer

*------ Included Files -----------------------------------------------

        INCLUDE         "exec/types.i"
        INCLUDE         "exec/nodes.i"
        INCLUDE         "exec/lists.i"
        INCLUDE         "exec/memory.i"
        INCLUDE         "exec/ports.i"
        INCLUDE         "exec/libraries.i"

        INCLUDE         "macros.i"

*------ Imported Functions -------------------------------------------

        XREF_EXE        CloseLibrary
        XREF_EXE        OpenLibrary
        XREF            _AbsExecBase


        XREF            _PEDData

*------ Exported Globals ---------------------------------------------

        XDEF            _Init
        XDEF            _Expunge
        XDEF            _Open
        XDEF            _PD
        XDEF            _PED
        XDEF            _SysBase
        XDEF            _DOSBase
        XDEF            _GfxBase
        XDEF            _IntuitionBase


**********************************************************************
        SECTION         printer,DATA
_PD             DC.L    0
_PED            DC.L    0
_SysBase        DC.L    0
_DOSBase        DC.L    0
_GfxBase        DC.L    0
_IntuitionBase  DC.L    0


**********************************************************************
        SECTION         printer,CODE
_Init:
                MOVE.L  4(A7),_PD
                LEA     _PEDData(PC),A0
                MOVE.L  A0,_PED
                MOVE.L  A6,-(A7)
                MOVE.L  _AbsExecBase,A6
                MOVE.L  A6,_SysBase

*           ;------ open the dos library
                LEA     DLName(PC),A1
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_DOSBase
                BEQ     initDLErr


*           ;------ open the graphics library
                LEA     GLName(PC),A1
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_GfxBase
                BEQ     initGLErr

*           ;------ open the intuition library
                LEA     ILName(PC),A1
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_IntuitionBase
                BEQ     initILErr

                MOVEQ   #0,D0
pdiRts:
                MOVE.L  (A7)+,A6
```

```
                RTS

initPAErr:
                MOVE.L  _IntuitionBase,A1
                LINKEXE CloseLibrary

initILErr:
                MOVE.L  _GfxBase,A1
                LINKEXE CloseLibrary

initGLErr:
                MOVE.L  _DOSBase,A1
                LINKEXE CloseLibrary

initDLErr:
                MOVEQ   #-1,D0
                BRA.S   pdiRts

ILName:
                DC.B    'intuition.library'
                DC.B    0
DLName:
                DC.B    'dos.library'
                DC.B    0
GLName:
                DC.B    'graphics.library'
                DC.B    0
                DS.W    0

*----------------------------------------------------------------------
_Expunge:
                MOVE.L  _IntuitionBase,A1
                LINKEXE CloseLibrary

                MOVE.L  _GfxBase,A1
                LINKEXE CloseLibrary

                MOVE.L  _DOSBase,A1
                LINKEXE CloseLibrary


*----------------------------------------------------------------------
_Open:
                MOVEQ   #0,D0
                RTS

                END
```


Listing for hpplus/printertag.asm

```
        TTL     '$Header: printertag.asm,v 32.1 86/02/10 14:33:17 kodiak Exp $'
**********************************************************************
*                                                                    *
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*   Los Gatos, California, 95030                                     *
*                                                                    *
**********************************************************************
*
*       printer device dependent code tag
*
*   Source Control
*   --------------
*   $Header: printertag.asm,v 32.1 86/02/10 14:33:17 kodiak Exp $
*
*   $Locker:  $
*
*   $Log:       printertag.asm,v $
*   Revision 32.1  86/02/10  14:33:17  kodiak
*   add null 8BitChars field
*
*   Revision 32.0  86/02/10  14:23:56  kodiak
*   added to rcs for updating
*
*   Revision 1.2  85/10/09  23:58:23  kodiak
*   replace reference to pdata w/ prtbase
*
*   Revision 1.1  85/10/09  16:11:31  kodiak
*   daveb density changes
*
*   Revision 25.1  85/06/16  01:02:15  kodiak
*   *** empty log message ***
*
*   Revision 25.0  85/06/15  06:40:00  kodiak
*   added to rcs
*
*   Revision 25.0  85/06/13  18:53:36  kodiak
*   added to rcs
*
*
**********************************************************************

        SECTION         printer

*------ Included Files -----------------------------------------------

        INCLUDE         "exec/types.i"
        INCLUDE         "exec/nodes.i"
        INCLUDE         "exec/strings.i"
```

```
        INCLUDE         "devices/prtbase.i"

*------ Imported Names -----------------------------------------------

        XREF            _Init
        XREF            _Expunge
        XREF            _Open
        XREF            _Close
        XREF            _CommandTable
        XREF            _PrinterSegmentData
        XREF            _DoSpecial
        XREF            _Render

*------ Exported Names -----------------------------------------------

        XDEF            _PEDData

**********************************************************************

                MOVEQ   #0,D0           ; show error for OpenLibrary()
                RTS
                DC.W    VERSION
                DC.W    REVISION
_PEDData:
                DC.L    printerName
                DC.L    _Init
                DC.L    _Expunge
                DC.L    _Open
                DC.L    _Close
                DC.B    PPC_BWGFX       ; PrinterClass
                DC.B    PCC_BW          ; ColorClass
                DC.B    0               ; MaxColumns
                DC.B    0               ; NumCharSets
                DC.W    1               ; NumRows
                DC.L    800     ; MaxXDots
                DC.L    1020    ; MaxYDots
                DC.W    100     ; XDotsInch
                DC.W    100     ; YDotsInch
                DC.L    _CommandTable   ; Commands
                DC.L    _DoSpecial
                DC.L    _Render
                DC.L    30
                DC.L    0               ; 8BitChars

printerName:
                STRING  <'HP LaserJet Plus'>

                END
```

Listing for hpplus/render.c

```
/**********************************************************************/
#include <exec/types.h>
#include <exec/nodes.h>
#include <exec/lists.h>
#include <exec/memory.h>
#include "devices/prtbase.h"
#include "devices/printer.h"

extern struct PrinterData *PD;
extern struct PrinterExtendedData *PED;
extern SetDensity();
char density[8] = "\033*t100R";

/* for the HP+ 2686A */
int Render(ct, x, y, status)
        UBYTE ct;       /* null for b/w printers */
        UWORD x, y;     /* the x & y co-ordinates */
                        /* or the pc & pr print values, or special */
        UBYTE status;   /* print status (0-init, 1-enter pixel,
                         * 2-dump, 3-close, 4-end) */
{
        static UWORD ROWSIZE;
        static UWORD BUFSIZE, offset;
        static BYTE center,huns,tens,ones; /* used to program buffer size */
        static UWORD bufptr;            /* used for double buffering;
                                         * points to buffer 1 or 2 */
        static UBYTE *ptr, bit_table[] = {128, 64, 32, 16, 8, 4, 2, 1};
        UWORD i;                        /* mics. var */
        BYTE err;                       /* the error # */

#ifdef  DEBUG
kprintf("hp render(%ld, %ld, %ld, %ld, %ld);\n", ct, x, y, status);
#endif
        switch(status)
        {
        case 0 :   /* alloc memory for printer buffer (uses double buffering) */
      i = (center) ? ((PED->ped_MaxXDots - x) / 2) : 0;
      offset = (i+7)/8 + 7; /* calc centering offset */
                ROWSIZE=(x+7+i)/8; /* row size required for HP */
                huns=ROWSIZE/100;
                tens=(ROWSIZE-huns*100)/10;
                ones=(ROWSIZE-huns*100-tens*10);
                BUFSIZE=(ROWSIZE+7); /* buffer size required for HP */
                PD->pd_PrintBuf = (UBYTE *)
                        AllocMem(BUFSIZE*2,MEMF_PUBLIC); /* alloc public mem */
                if (err=(PD->pd_PrintBuf == 0)) return(err);
                if (err=(*(PD->pd_PWrite))("\033E",2)) return(err);
                                        /* reset printer */
                if (err=PWait(1,0)) return(err);
                if (err=(*(PD->pd_PWrite))(density,7)) return(err);
                                        /* set resolution */
                if (err=(*(PD->pd_PWrite))("\033*r0A",5)) return(err);
                                        /* start raster gfx */
                bufptr=0;       /* init to first buffer */
                return(0);      /* flag all ok */
                break;
```

```
        case 1 :        /* put pixel in buffer */
/*              i = bufptr+x/8+7;         /* calc which byte to use */
/*              PD->pd_PrintBuf[i] = PD->pd_PrintBuf[i] | (1 << (7-(x&7)));
                                /* fill print buffer */
                PD->pd_PrintBuf[bufptr+(x>>3)+offset] |= bit_table[x&7];
                return(0); /* flag all ok */
                break;

        case 2 :         /* dump buffer to printer */
                if (err=(*(PD->pd_PWrite))(&(PD->pd_PrintBuf[bufptr]),
                        BUFSIZE)) return(err);
                bufptr=BUFSIZE-bufptr;          /* switch to other buffer */
                return(0);                       /* flag all ok */
                break;

        case 3 :         /* clear and init buffer */
                for (i=bufptr; i<BUFSIZE+bufptr; i++)
                        PD->pd_PrintBuf[i] = 0; /* clear buffer */
        ptr = &PD->pd_PrintBuf[bufptr];
        i = BUFSIZE;
        while (i--) *ptr++ = 0;
                PD->pd_PrintBuf[bufptr] = 27;
                PD->pd_PrintBuf[bufptr+1] = '*';
                PD->pd_PrintBuf[bufptr+2] = 'b';
                PD->pd_PrintBuf[bufptr+3] = huns + '0';
                PD->pd_PrintBuf[bufptr+4] = tens + '0';
                PD->pd_PrintBuf[bufptr+5] = ones + '0';
                PD->pd_PrintBuf[bufptr+6] = 'W';
                return(0); /* flag all ok */
                break;

        case 4 : /* free the print buffer memory */
                /* end raster graphics, unload paper, and reset printer */
                err=(*(PD->pd_PWrite))("\033*rB\014\033E",7);
                if (!err) err=(*(PD->pd_PBothReady))();
                        /* wait for both buffers to be clear */
                FreeMem(PD->pd_PrintBuf,BUFSIZE*2);
                        /* free the print buffers memory */
                return(err);     /* return status */
                break;

        case 5:
                center = x & SPECIAL_CENTER; /* set center flag */
                if ((x & SPECIAL_DENSITYMASK) == 0) { /* if use prefs */
                        if (PD->pd_Preferences.PrintQuality == DRAFT)
                                SetDensity(SPECIAL_DENSITY2); /* 100 dpi */
                        else SetDensity(SPECIAL_DENSITY3); /* 150 dpi */
                }
                else SetDensity(x & SPECIAL_DENSITYMASK);
                                /* else use SPECIAL */
                return(0);
                break;

        default :
                return(0);
                break;
        }
}
```

Listing for okimate20/data.c

```
/* okimate 20 commands */

/****** printer.device/printers/Okimate_20_functions ********************
 *
 *   Okimate 20 functions implemented:
 *
 *      aRIS, aIND, aNEL, aSGR0, aSGR3, aSGR23, aSGR4, aSGR24
 *      aSHORP0, aSHORP1, aSHORP2, aSHORP3, aSHORP4, aSHORP5, aSHORP6
 *      aDEN1, aDEN2, aSUS0, aSUS1, aSUS2, aSUS3, aSUS4,
 *      aVERP0, aVERP1, aSLPP, aPERF, aPERF0
 *   special functions implemented:
 *      aRIN, ,aRI, aSUS0, aSUS1, aSUS2, aSUS3, aSUS4, aPLU, aPLD
 *
 ************************************************************************/

char *CommandTable[]= {
        "\033W\376\022\033A\014\0332\033I\001\033%H\033-\376\033T\033C\376\011",
                        /*reset              aRIS      ESCc */
        "\377",         /*initialize         aRIN           */
        "\012",         /* lf                IND       ESCD */
        "\015\012",     /* return,lf         NEL       ESCE */
        "\377",         /* reverse lf        RI        ESCM */

        "\033%H\033-\376",
                        /*normal char set    SGR 0     ESC[0m */
        "\033%G",       /*italics on         SGR 3     ESC[3m */
        "\033%H",       /*italics off        SGR 23    ESC[23m */
        "\033-\001",    /*underline on       SGR 4     ESC[4m */
        "\033-\376",    /*underline off      SGR 24    ESC[24m */
        "\377",         /*boldface on        SGR 1     ESC[1m */
        "\377",         /*boldface off       SGR 22    ESC[22m */
        "\377",         /* set foreground color */
        "\377",         /* set background color */

                        /*normal spacing     DECSHORP ESC[0w */
        "\022\033W\376",
        "\033:",        /*elite on          DECSHORP ESC[2w */
        "\022",         /*elite off         DECSHORP ESC[1w */
        "\017",         /* fine on          GSM (special) */
        "\022",         /* fine off         GSM (special) */
        "\033W\001",    /*enlarged on       GSM (special) */
        "\033W\376",    /*enlarged off      GSM (special) */

        "\377",         /*shadow print on*/
        "\377",         /*shadow print off*/
        "\377",         /*doublestrike on*/
        "\377",         /*doublestrike off*/
        "\033I\002",    /* NLQ on*/
        "\033I\001",    /* NLQ off*/

        "\033S\376",    /*superscript on     PLU       ESCL */
        "\033T",        /*superscript off    PLD (special) */
        "\033S\001",    /*subscript on       PLD       ESCK */
        "\033T",        /*subscript off      PLU (special) */
        "\033T",        /* normalize */
```

```
"\377",         /* partial line up   PLU      ESCL */
"\377",         /* partial line down PLD      ESCK */

"\377",  /*US char set                 ESC(B */
"\377",  /*French char set             ESC(R */
"\377",  /*German char set             ESC(K */
"\377",  /*UK char set                 ESC(A */
"\377",  /*Danish I char set           ESC E */
"\377",  /*Sweden char set             ESC(H */
"\377",  /*Italian char set   FNT 6 */
"\377",  /*Spanish char set   FNT 7 */
"\377",  /*Japanese char set  FNT 8 */
"\377",  /*Norweigen char set     FNT 9 */
"\377",  /*Danish II char set*/

"\377",  /*proportional on */
"\377",  /*proportional off*/
"\377",  /*proportional clear*/
"\377",  /*set prop offset    TSS */
"\377",  /*auto left justify  JFY 5 */
"\377",  /*auto right justify JFY 7 */
"\377",  /*auto full justify  JFY 3,6 */
"\377",  /*auto justify off   JFY 0 */
"\377",  /*place holder */
"\377",  /*auto center on     JFY 2,6 */

"\0330",        /* 1/8" line space   DECVERP  ESC[0z */
"\033A\014\0332",
               /* 1/6" line spacing DECVERP  ESC[1z */
"\033C",        /* set form length   DECSLPP  ESC[Pnt */
"\033N\001",    /* perf skip n */
"\033O",        /* perf skip off */

"\377",         /* Left margin set   DECSLRM  ESC[Pn1;Pn2s */
"\377",         /* Right margin set */
"\377",         /* Top margin set    DECSTBM  ESC[Pn1;Pn2r */
"\377",         /* Bottom marg set */
"\377",         /* T&B margin set   STBM      ESC[Pn1;Pn2r */
"\377",         /* L&R margin set   SLRM      ESC[Pn1;Pn2s */
"\377",         /* Clear margins */

"\377",         /* Set horiz tab     HTS      ESCH */
"\377",         /* Set vertical tab  VTS      ESCJ */
"\377",         /* Clr horiz tab     TBC 0    ESC0g */
"\033D\376",    /* Clear all h tabs  TBC 3    ESC3g */
"\377",         /* Clr vertical tab  TBC 1    ESC1g */
"\033D\376",         /* Clr all v tabs    TBC 4    ESC4g */
"\377",         /* Clr all h & v tabs */
"\033D\010\020\030\040\050\060\070\100\110\120\376",
                /* set default tabs */
"\377"          /* extended command */
};
```

Listing for okimate20/dospecial.c

```
/* okimate 20 special commands */

/****** printer.device/printers/Okimate_20_special_functions ***********
 *
 *   NAME
 *   Okimate 20 special functions
 *
 ***********************************************************************/
#include "exec/types.h"
#include "devices/printer.h"
#include "devices/prtbase.h"

extern struct PrinterData *PD;
extern struct PrinterExtendedData *PED;

DoSpecial(command,outputBuffer,vline,currentVMI,crlfFlag,Parms)
   char outputBuffer[];
   UWORD *command;
   BYTE *vline;
   BYTE *currentVMI;
   BYTE *crlfFlag;
   UBYTE Parms[];

{
   int x=0;
   static char initThisPrinter[]="\033I\001\022\0330\033%H\033-\376\r\033W";

if(*command==aRIN)
   {
   while(x<15){outputBuffer[x]=initThisPrinter[x];x++;}
    outputBuffer[11]='\000';
   outputBuffer[x++]='\000';

   if((PD->pd_Preferences.PrintQuality)==LETTER)outputBuffer[2]='\002';

   if((PD->pd_Preferences.PrintPitch)==ELITE) {
        outputBuffer[x++]='\033';
        outputBuffer[x++]=':';
   }
   else if((PD->pd_Preferences.PrintPitch)==FINE)outputBuffer[x++]='\017';

   *currentVMI=27; /* assume 1/8 line spacing */
   if((PD->pd_Preferences.PrintSpacing)==SIX_LPI) { /* wrong again */
        outputBuffer[x++]='\033';
        outputBuffer[x++]='A';
        outputBuffer[x++]='\014';
        outputBuffer[x++]='\033';
        outputBuffer[x++]='2';
        *currentVMI=36;
   }
   return(x);
   }

if(*command==aPLU) {
        if((*vline)==0){(*vline)=1; *command=aSUS2; return(0);}
```

```
		if((*vline)<0){(*vline)=0; *command=aSUS3; return(0);}
		return(-1);
	}

	if(*command==aPLD) {
		if((*vline)==0){(*vline)=(-1); *command=aSUS4; return(0);}
		if((*vline)>0){(*vline)=0; *command=aSUS1; return(0);}
		return(-1);
	}

	if(*command==aSUS0) *vline=0;
	if(*command==aSUS1) *vline=0;
	if(*command==aSUS2) *vline=1;
	if(*command==aSUS3) *vline=0;
	if(*command==aSUS4) *vline=(-1);

	if(*command==aVERP0) *currentVMI=27;

	if(*command==aVERP1) *currentVMI=36;

	return(0);
	}
```

Listing for okimate20/init.asm

```
        TTL    '$Header: init.asm,v 1.2 85/10/09 23:58:49 kodiak Exp $'
**********************************************************************
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*   Commodore-Amiga Incorporated, 983 University Ave. Building #D,   *
*   Los Gatos, California, 95030                                     *
*                                                                    *
**********************************************************************
*
*       printer device functions
*
*   Source Control
*   --------------
*   $Header: init.asm,v 1.2 85/10/09 23:58:49 kodiak Exp $
*
*   $Locker:  $
*
*   $Log:       init.asm,v $
*   Revision 1.2  85/10/09  23:58:49  kodiak
*   replace reference to pdata w/ prtbase
*
*   Revision 1.1  85/10/09  19:27:50  kodiak
*   remove _stdout variable
*
*   Revision 1.0  85/10/09  19:24:13  kodiak
*   added to rcs for updating in version 1
*
*   Revision 29.0  85/08/07  22:25:32  kodiak
*   added to rcs for updating in version 29
*
*   Revision 25.0  85/06/16  01:01:22  kodiak
*   added to rcs
*
*
**********************************************************************

        SECTION         printer

*------ Included Files -----------------------------------------------

        INCLUDE         "exec/types.i"
        INCLUDE         "exec/nodes.i"
        INCLUDE         "exec/lists.i"
        INCLUDE         "exec/memory.i"
        INCLUDE         "exec/ports.i"
        INCLUDE         "exec/libraries.i"

        INCLUDE         "macros.i"
        INCLUDE         "devices/prtbase.i"
```

```
*------ Imported Functions ------------------------------------------

        XREF_EXE        CloseLibrary
        XREF_EXE        OpenLibrary
        XREF            _AbsExecBase


        XREF            _PEDData
        XREF            _RenderBW
        XREF            _RenderColor

*------ Exported Globals --------------------------------------------

        XDEF            _Init
        XDEF            _Expunge
        XDEF            _Open
        XDEF            _Close
        XDEF            _PD
        XDEF            _PED
        XDEF            _SysBase
        XDEF            _DOSBase
        XDEF            _GfxBase
        XDEF            _IntuitionBase


**********************************************************************
        SECTION         printer,DATA
_PD             DC.L    0
_PED            DC.L    0
_SysBase        DC.L    0
_DOSBase        DC.L    0
_GfxBase        DC.L    0
_IntuitionBase  DC.L    0


**********************************************************************
        SECTION         printer,CODE
_Init:
                MOVE.L  4(A7),_PD
                LEA     _PEDData(PC),A0
                MOVE.L  A0,_PED
                MOVE.L  A6,-(A7)
                MOVE.L  _AbsExecBase,A6
                MOVE.L  A6,_SysBase

*           ;------ open the dos library
                LEA     DLName(PC),A1
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_DOSBase
                BEQ     initDLErr


*           ;------ open the graphics library
                LEA     GLName(PC),A1
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_GfxBase
                BEQ     initGLErr

*           ;------ open the intuition library
                LEA     ILName(PC),A1
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_IntuitionBase
                BEQ     initILErr

                MOVEQ   #0,D0
pdiRts:
                MOVE.L  (A7)+,A6
                RTS

initPAErr:
                MOVE.L  _IntuitionBase,A1
                LINKEXE CloseLibrary

initILErr:
                MOVE.L  _GfxBase,A1
                LINKEXE CloseLibrary

initGLErr:
                MOVE.L  _DOSBase,A1
                LINKEXE CloseLibrary

initDLErr:
                MOVEQ   #-1,D0
                BRA.S   pdiRts

ILName:
                DC.B    'intuition.library'
                DC.B    0
DLName:
                DC.B    'dos.library'
                DC.B    0
GLName:
                DC.B    'graphics.library'
                DC.B    0
                DS.W    0


*---------------------------------------------------------------------
_Expunge:
                MOVE.L  _IntuitionBase,A1
                LINKEXE CloseLibrary

                MOVE.L  _GfxBase,A1
                LINKEXE CloseLibrary

                MOVE.L  _DOSBase,A1
                LINKEXE CloseLibrary


*---------------------------------------------------------------------
_Open:
                MOVE.L  _PD,A0
                CMPI.W  #SHADE_COLOR,pd_Preferences+pf_PrintShade(A0)
                BEQ.S   colorRender
                LEA     _RenderBW,A0
                MOVE.L  A0,_PEDData+ped_Render
```

```
                BRA.S   openEnd
colorRender:
                LEA     _RenderColor,A0
                MOVE.L  A0,_PEDData+ped_Render
openEnd:
                MOVEQ   #0,D0
                RTS


*----------------------------------------------------------------------
_Close:
                MOVEQ   #0,D0
                RTS

                END
```

okimate20/init.asm

```
        TTL    '$Header: init.asm,v 1.2 85/10/09 23:58:49 kodiak Exp $'
**********************************************************************
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*   means, electronic, mechanical, magnetic, optical, chemical,      *
*   manual or otherwise, without the prior written permission of     *
*   Commodore-Amiga Incorporated, 983 University Ave. Building #D,   *
*   Los Gatos, California, 95030                                     *
*                                                                    *
**********************************************************************
*
*       printer device functions
*
*   Source Control
*   --------------
*   $Header: init.asm,v 1.2 85/10/09 23:58:49 kodiak Exp $
*
*   $Locker:  $
*
*   $Log:       init.asm,v $
*   Revision 1.2  85/10/09  23:58:49  kodiak
*   replace reference to pdata w/ prtbase
*
*   Revision 1.1  85/10/09  19:27:50  kodiak
*   remove _stdout variable
*
*   Revision 1.0  85/10/09  19:24:13  kodiak
*   added to rcs for updating in version 1
*
*   Revision 29.0  85/08/07  22:25:32  kodiak
*   added to rcs for updating in version 29
*
*   Revision 25.0  85/06/16  01:01:22  kodiak
*   added to rcs
*
*
**********************************************************************

        SECTION         printer

*------ Included Files -----------------------------------------------

        INCLUDE         "exec/types.i"
        INCLUDE         "exec/nodes.i"
        INCLUDE         "exec/lists.i"
        INCLUDE         "exec/memory.i"
        INCLUDE         "exec/ports.i"
        INCLUDE         "exec/libraries.i"

        INCLUDE         "macros.i"
        INCLUDE         "devices/prtbase.i"
```

```
*------ Imported Functions ---------------------------------------------

        XREF_EXE        CloseLibrary
        XREF_EXE        OpenLibrary
        XREF            _AbsExecBase


        XREF            _PEDData
        XREF            _RenderBW
        XREF            _RenderColor


*------ Exported Globals -----------------------------------------------

        XDEF            _Init
        XDEF            _Expunge
        XDEF            _Open
        XDEF            _Close
        XDEF            _PD
        XDEF            _PED
        XDEF            _SysBase
        XDEF            _DOSBase
        XDEF            _GfxBase
        XDEF            _IntuitionBase


**********************************************************************
        SECTION         printer,DATA
_PD             DC.L    0
_PED            DC.L    0
_SysBase        DC.L    0
_DOSBase        DC.L    0
_GfxBase        DC.L    0
_IntuitionBase  DC.L    0


**********************************************************************
        SECTION         printer,CODE
_Init:
                MOVE.L  4(A7),_PD
                LEA     _PEDData(PC),A0
                MOVE.L  A0,_PED
                MOVE.L  A6,-(A7)
                MOVE.L  _AbsExecBase,A6
                MOVE.L  A6,_SysBase

*           ;------ open the dos library
                LEA     DLName(PC),A1
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_DOSBase
                BEQ     initDLErr


*           ;------ open the graphics library
                LEA     GLName(PC),A1
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_GfxBase
                BEQ     initGLErr

*           ;------ open the intuition library
                LEA     ILName(PC),A1
                MOVEQ   #0,D0
                CALLEXE OpenLibrary
                MOVE.L  D0,_IntuitionBase
                BEQ     initILErr

                MOVEQ   #0,D0
pdiRts:
                MOVE.L  (A7)+,A6
                RTS

initPAErr:
                MOVE.L  _IntuitionBase,A1
                LINKEXE CloseLibrary

initILErr:
                MOVE.L  _GfxBase,A1
                LINKEXE CloseLibrary

initGLErr:
                MOVE.L  _DOSBase,A1
                LINKEXE CloseLibrary

initDLErr:
                MOVEQ   #-1,D0
                BRA.S   pdiRts

ILName:
                DC.B    'intuition.library'
                DC.B    0
DLName:
                DC.B    'dos.library'
                DC.B    0
GLName:
                DC.B    'graphics.library'
                DC.B    0
                DS.W    0


*---------------------------------------------------------------------
_Expunge:
                MOVE.L  _IntuitionBase,A1
                LINKEXE CloseLibrary

                MOVE.L  _GfxBase,A1
                LINKEXE CloseLibrary

                MOVE.L  _DOSBase,A1
                LINKEXE CloseLibrary


*---------------------------------------------------------------------
_Open:
                MOVE.L  _PD,A0
                CMPI.W  #SHADE_COLOR,pd_Preferences+pf_PrintShade(A0)
                BEQ.S   colorRender
                LEA     _RenderBW,A0
                MOVE.L  A0,_PEDData+ped_Render
```

```
                BRA.S   openEnd
colorRender:
                LEA     _RenderColor,A0
                MOVE.L  A0,_PEDData+ped_Render
openEnd:
                MOVEQ   #0,D0
                RTS


*------------------------------------------------------------------------
_Close:
                MOVEQ   #0,D0
                RTS

                END
```

Listing for okimate20/printertag.asm

```
        TTL    '$Header: printertag.asm,v 32.1 86/02/10 14:33:25 kodiak Exp $'
**********************************************************************
*                                                                    *
*   Copyright 1985, Commodore-Amiga Inc.   All rights reserved.      *
*   No part of this program may be reproduced, transmitted,          *
*   transcribed, stored in retrieval system, or translated into      *
*   any language or computer language, in any form or by any         *
*   means, electronic, mechanical, magnetic, optical, chemical,      *
*   manual or otherwise, without the prior written permission of     *
*   Commodore-Amiga Incorporated, 983 University Ave. Building #D,   *
*   Los Gatos, California, 95030                                     *
*                                                                    *
**********************************************************************
*
*       printer device dependent code tag
*
*   Source Control
*   --------------
*   $Header: printertag.asm,v 32.1 86/02/10 14:33:25 kodiak Exp $
*   $Locker:  $
*   $Log:       printertag.asm,v $
*   Revision 32.1  86/02/10  14:33:25  kodiak
*   add null 8BitChars field
*
*   Revision 32.0  86/02/10  14:24:28  kodiak
*   added to rcs for updating
*
*   Revision 1.1  85/10/09  23:59:05  kodiak
*   replace reference to pdata w/ prtbase
*
*   Revision 1.0  85/10/09  23:58:58  kodiak
*   added to rcs for updating in version 1
*
*   Revision 29.1  85/07/31  18:27:25  kodiak
*   change XDotsInch from 144 to 120
*
*   Revision 29.0  85/07/31  18:26:50  kodiak
*   added to rcs for updating in version 29
*
*   Revision 25.1  85/06/16  01:02:15  kodiak
*   *** empty log message ***
*
*   Revision 25.0  85/06/15  06:40:00  kodiak
*   added to rcs
*
*   Revision 25.0  85/06/13  18:53:36  kodiak
*   added to rcs
**********************************************************************

        SECTION         printer

*------ Included Files -----------------------------------------------

        INCLUDE         "exec/types.i"
        INCLUDE         "exec/nodes.i"
```

```
        INCLUDE         "exec/strings.i"


        INCLUDE         "devices/prtbase.i"


*------ Imported Names -----------------------------------------------

        XREF            _Init
        XREF            _Expunge
        XREF            _Open
        XREF            _Close
        XREF            _CommandTable
        XREF            _PrinterSegmentData
        XREF            _DoSpecial

*------ Exported Names -----------------------------------------------

        XDEF            _PEDData

**********************************************************************

                MOVEQ   #0,D0           ; show error for OpenLibrary()
                RTS
                DC.W    VERSION
                DC.W    REVISION
_PEDData:
                DC.L    printerName
                DC.L    _Init
                DC.L    _Expunge
                DC.L    _Open
                DC.L    _Close
                DC.B    PPC_COLORGFX    ; PrinterClass
                DC.B    PCC_YMC_BW      ; ColorClass
                DC.B    80              ; MaxColumns
                DC.B    1               ; NumCharSets
                DC.W    24              ; NumRows
                DC.L    960             ; MaxXDots
                DC.L    0               ; MaxYDots
                DC.W    120             ; XDotsInch
                DC.W    144             ; YDotsInch
                DC.L    _CommandTable   ; Commands
                DC.L    _DoSpecial
                DC.L    0               ; Render
                DC.L    30
                DC.L    0               ; 8BitChars

printerName:
                STRING  <'OKIMATE 20'>

                END
```

Listing for okimate20/render.c

```
/*********************************************************************/
#include <exec/types.h>
#include <exec/nodes.h>
#include <exec/lists.h>
#include <exec/memory.h>
#include "devices/printer.h"
#include "devices/prtbase.h"

extern struct PrinterData *PD;
extern struct PrinterExtendedData *PED;

static UWORD rowsize;
static UWORD bufsize;
static UWORD bufptr;
static UWORD colors[4]; /* color ptrs */
static BYTE center; /* center picture flag */
static UBYTE bit_table[8] = {128, 64, 32, 16, 8, 4, 2, 1};
UBYTE *ptr;

/* for the OKIMATE 20 (Color) */
int RenderColor(ct, x, y, status)       /* passed a color type */
UBYTE ct;       /* the color type to use (0, 1, or 2) */
UWORD x, y;     /* the x & y co-ordinates */
                /* or the pc & pr print values, or special */
UBYTE status;   /* print status (0-init, 1-enter pixel, 2-dump, 3-end) */
{
    UWORD i;                    /* mics. var */
    BYTE err;                   /* the error # */
    switch(status)
    {
    case 0 :    /*alloc memory for printer buffer */
        i = (center) ? ((PED->ped_MaxXDots - x) / 2 * 3) : 0;
                        /* need this many more pixels */
        rowsize=(x*3+i); /* pc pixels per row x 3 colors on the OKIMATE 20 */
        bufsize=(rowsize*3+31); /* buffer size required for OKIMATE 20 */
        colors[0] = 0 + i;
        colors[1] = 7 + i;
        colors[2] = 9+rowsize+7 + i;
        colors[3] = (9+rowsize)*2+7 + i;
        PD->pd_PrintBuf = (UBYTE *)
            AllocMem(bufsize*2,MEMF_PUBLIC); /* alloc public mem */
        if (err=(PD->pd_PrintBuf == 0)) return(err);
        bufptr=0;
        /* set line spacing to 24 printer lines (24/144 -> 36/216 inch) */
        return((*(PD->pd_PWrite))("\0333\044", 3));     /* thats Esc3<36> */
        break;

    case 1 :    /* put pixel in buffer (called 69,120 times/print cycle) */
        i = bufptr+(y % 24)/8 + x*3 + colors[ct];
                /* calc which byte to use */
        PD->pd_PrintBuf[i] = PD->pd_PrintBuf[i] | (1 << (7-(y&7)));
                /* set pixel */
        PD->pd_PrintBuf[bufptr + ((y%24)>>3) + (x<<1) + x + colors[ct]]
                |= bit_table[y & 7]; /* calc byte posn and set pixel */
        return(0);      /* flag all ok */
        break;
```

```
    case 2 : /* dump buffer to printer */
        if (err=(*(PD->pd_PWrite))(&(PD->pd_PrintBuf[bufptr]),
                bufsize)) return(err);
        bufptr = bufsize - bufptr;
        return(0);       /* flag all ok */
        break;

    case 3 : /* clear and init buffer (called once/print cycle) */
        ptr = &PD->pd_PrintBuf[bufptr];
        *ptr++ = 27; /* (bufptr) */
        *ptr++ = 25; /* align ribbon (bufptr+1)*/
        i = bufsize - 2; /* less the previous cmds */
        while (i--) *ptr++ = 0; /* clear buffer (executed 8,571 - 2 times) */
        for (ct=0; ct<3; ct++) { /* for all color types */
            PD->pd_PrintBuf[2+bufptr+ct*(rowsize+9)] = 27;
            PD->pd_PrintBuf[3+bufptr+ct*(rowsize+9)] = '%';
            PD->pd_PrintBuf[4+bufptr+ct*(rowsize+9)] = 'O';
                        /* enter 24-dot mode */
            PD->pd_PrintBuf[5+bufptr+ct*(rowsize+9)] = (rowsize/3) & 0xff;
            PD->pd_PrintBuf[6+bufptr+ct*(rowsize+9)] = (rowsize/3) >> 8;
                        /* set # of dots */
            PD->pd_PrintBuf[1+bufptr+(ct+1)*(rowsize+9)] = 13;
                        /* advance color */
        }
        PD->pd_PrintBuf[bufptr+bufsize-2] = 10;     /* lf */
        PD->pd_PrintBuf[bufptr+bufsize-1] = 13;     /* cr */
        return(0); /* flag all ok */
        break;

    case 4 : /* free the print buffer memory */
        err=(*(PD->pd_PBothReady))(); /* wait for both buffers to empty */
        FreeMem(PD->pd_PrintBuf,bufsize*2); /* free printers memory */
        return(err); /* return status */
        break;

        case 5 : /* io_special flag call */
                center = x & SPECIAL_CENTER; /* set center flag */
                return(0); /* flag all ok */
                break;

    default: return(0); /* flag all ok */
    }
}
/**********************************************************************/

/* for the OKIMATE 20 (b/w) */
int RenderBW(ct, x, y, status)  /* passed a color type */
    UBYTE ct;                    /* not used with b/w printers */
    UWORD x, y;          /* the x & y co-ordinates */
                         /* or the pc & pr print values, or special */
    UBYTE status         /* print status (0-init, 1-enter pixel,
                          * 2-dump, 3-end) */
{
    UWORD i;             /* mics. var */
    BYTE err;            /* the error # */
        static UWORD offset;

    switch(status)
    {
    case 0 :    /*alloc memory for printer buffer */
        i = (center) ? ((PED->ped_MaxXDots - x) / 2 * 3) : 0;
                        /* need this many more pixels */
        offset = 5 + i;
        rowsize=(x*3+i); /* pc pixels per row x 3 blocks on the OKIMATE 20 bw */
        bufsize=(rowsize+7); /* buffer size required for OKIMATE 20 bw */
        PD->pd_PrintBuf = (UBYTE *)
            AllocMem(bufsize*2,MEMF_PUBLIC); /* alloc public mem */
        if (err=(PD->pd_PrintBuf == 0)) return(err);
        bufptr = 0;      /* init to first buffer */
        /* set line spacing to 24 printer lines (24/144 -> 36/216 inch) */
        return((*(PD->pd_PWrite))("\0333\044", 3));     /* thats Esc3<36> */
        break;

    case 1 :    /* put pixel in buffer */
        i = bufptr + (y % 24)/8 + x*3 + 5; /* calc which byte to use */
        PD->pd_PrintBuf[i] = PD->pd_PrintBuf[i] | (1 << (7-(y&7)));
                        /* fill print buffer */
        PD->pd_PrintBuf[bufptr + ((y % 24)>>3) + (x<<1) + x + offset]
                |= bit_table[y&7];
        return(0); /* flag all ok */
        break;

    case 2 :    /* dump buffer to printer */
        if (err=(*(PD->pd_PWrite))(&(PD->pd_PrintBuf[bufptr]),
                bufsize)) return(err);
        bufptr = bufsize - bufptr; /* switch to other buffer */
        return(0); /* flag all ok */
        break;

    case 3 : /* clear and init buffer */
        for (i=bufptr; i<bufptr+bufsize; i++)
            PD->pd_PrintBuf[i] = 0; /* clear buffer */
        ptr = &PD->pd_PrintBuf[bufptr];
        i = bufsize;
        while (i--) *ptr++ = 0; /* clear buffer */
        PD->pd_PrintBuf[bufptr] = 27;
        PD->pd_PrintBuf[bufptr+1] = '%';
        PD->pd_PrintBuf[bufptr+2] = 'O';    /* enter 24-dot mode */
        PD->pd_PrintBuf[bufptr+3] = (rowsize/3) & 0xff;
        PD->pd_PrintBuf[bufptr+4] = (rowsize/3) >> 8;
                        /* there is rowsize dots */
        PD->pd_PrintBuf[bufptr+bufsize-2] = 13;     /* cr */
        PD->pd_PrintBuf[bufptr+bufsize-1] = 10;     /* lf */
        return(0); /* flag all ok */
        break;

    case 4 : /* free the print buffer memory */
        err=(*(PD->pd_PBothReady))(); /* wait for both buffers to empty */
        FreeMem(PD->pd_PrintBuf,bufsize*2); /* free the print buffer mem */
        return(err);
        break;

        case 5 : /* io_special flag call */
                center = x & SPECIAL_CENTER; /* set center flag */
                return(0); /* flag all ok */
                break;

        default: return(0);
         }
}
```

Amiga
Printer Support
Information

General Information

The Amiga printer drivers are among the most complete in the industry. We have made every effort to provide support for a wide variety of printers and an extensive list of features. The Preferences tool on your Workbench disk lists the available printers that are supported. (The default printer settings in Preferences are for the Epson printers.) See *Introduction to Amiga* for instructions on changing the Preferences settings.

This document provides the following information:

How to use the Preferences printer settings with the printer device

How to use the parallel and serial devices

How to use the printer.library routines for direct printer I/O

How to set the standard cables and switch settings for printers

For an unsupported printer, use the "Custom/Generic" Preferences setting. See the *Amiga ROM Kernal Manual* for instructions on constructing a custom printer driver for an unsupported printer.

AmigaDos provides three "handlers," or interface routines, for printer I/O:

PAR:	parallel device
SER:	serial device
PRT:	printer device

Each of these handlers translates the device-independent file system calls, such as Write() and Open(), into the appropriate message traffic to the printer devices that are implemented in Exec. Exec is the multi-tasking kernel of the Amiga.

The "PAR:" handler uses the "parallel.device", which is the Exec code that manages the parallel port connector on the back of your Amiga. Similarly, the "SER:" handler uses the device "serial.device" to manage the serial port connector. Note that, aside from the baud rate setting for the serial port, the Preferences printer settings have no effect on the function of the PAR: and SER: handlers. The characters sent to the printer using these devices are not examined or converted.

In other words, when you send output to PAR: or SER:, your application is talking straight through to the hardware with no intervening levels of interpretation. If you have a printer connected to your parallel port, escape sequences sent to PAR: will reach it directly and will have whatever effect they are defined to have by the printer manufacturer.

On the other hand, the PRT: handler uses the Exec device, "printer.device." The printer device uses the information it finds in the current Preferences settings to understand which kind of printer you have connected and how you want it to be used. The printer device can talk to either the parallel or the serial device, depending on the current Preferences setting.

The following figures illustrate the difference between sending a particular escape sequence to a printer using the PRT: handler instead of the PAR: or SER: handlers.

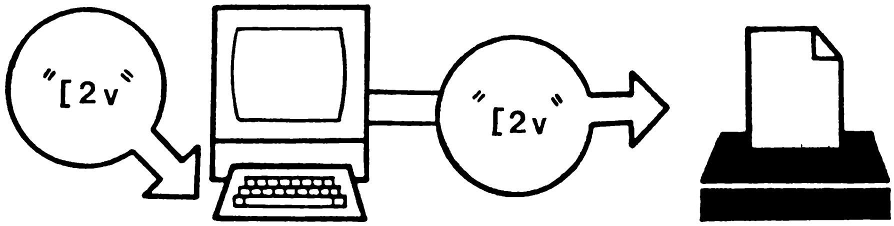


Figure 1: Printer I/O Through SER: or PAR: Handlers

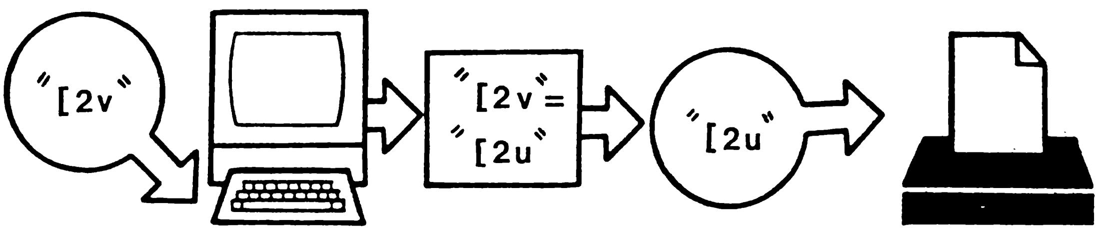


Figure 2: Printer I/O Through PRT: Handler Via Preferences Tool

The escape sequence for turning on superscripts is defined for the Epson JX-80 to be the escape character (ASCII code 27) plus the string, "[2u". However, the Amiga printer-independent escape sequence for a superscript is "[2v". Therefore, the printer driver for this particular printer must convert the latter string into the former in order for the printer to effect superscript mode. The PAR: and SER: handlers perform no such conversion.

Deciding which printer handler to use depends on the nature of your application. If you use the printer device (PRT:), you can write code that is largely independent of the type of printer your customers have attached to their Amigas. This is the recommended method.

Printing to PAR: or SER: is fairly straightforward. Keep in mind that a standard AmigaDOS text file uses LF (line feed) as a line separator--not CR or CR-LF) and that a file may or may not have an LF at the end. You may wish to add a carriage return character to the ends of your lines of text. Or, if your printer offers the option, you can flip the switch that automatically gives a CR when the printer receives an LF.

The CLI commands expect you to use the handler names as file parameters. For example, you can send a file to the printer with the command,

copy *myfile* to prt:

If you want to send output to the printer using the AmigaDOS file system routines directly, you must Open() one of the handlers and do Write() calls to it.

Similarly, you should use the handler names with I/O to the printer from languages such as ABasiC. Note that--for compatability--Microsoft's Amiga Basic defines LPT1: to be the same as PRT:.

You can circumvent the handlers entirely and perform a direct OpenDevice() on the Exec device of interest to you. You then pass I/O request blocks to the device using the I/O calls provided by Exec (such as DoIO()). Doing so provides greater flexibility, such as allowing asynchronous I/O and setting device parameters (serial baud rate, for example). By using the printer.library, you have full control over the printer.

Note that you must open the printer.library directly in order to use the command names instead of the defined escape sequences. See Table 3 for a list of the printer features and their command names. See the *Amiga ROM Kernal Manual* for more information on calling system library and device routines.

Note the following information regarding sending I/O between the Amiga and various printers:

Printer Device (PRT:)

The printer device understands only its own, *printer-independent,* escape sequences. It converts these escape sequences into the printer-specific escape sequences appropriate for the printer currently selected in Preferences. In addition, the Initialize function (which is invoked when you open the printer device or when you send it the Initialize escape sequence) causes the appropriate escapes to be sent to your printer to configure it according to the options you have selected in Preferences. This, for example, is how your margin settings are sent to the printer.

Note that, when you use the printer device, you should *turn off* any option on your printer that provides an autiomatic CR, LF, or CR-LF whenever the printer receives an LF. The printer device provides end of line CR-LFs as needed.

Also keep in mind that--in addition to the alphanumeric printing described here--the printer device provides for black and white, grey-scale, and full color raster-graphics printing. This function is only available when your application talks *directly* to the printer device and *not* through the AmigaDOS PRT: handler. See the *Amiga ROM Kernal Manual* for an example.

Serial and Parallel Handlers (SER:, PAR:)

The Preferences tool printer settings have no effect on the function of the PAR: and SER: handlers (other than setting the baud rate used by SER:, as noted above). Any special function you want your printer to perform is up to you. You must choose the correct escape sequences to send, including even initialization functions such as the setting of margins. Clearly, you must know which printer is connected to your Amiga and whether it is connected to the serial or the parallel port. This is not the recommended method of controlling printers.

Specific serial device features (for SER:) that you *cannot* set in Preferences include:

Hardware (7-wire) or software (3-wire) handshaking	(XON XOFF always used)
Number of bits	(8 bits always used)
Parity	(none)

See the *ROM Kernel Manual* for details on setting these features.

PRINTER.LIBRARY

With the printer.library, you not only can send escape sequences to the printer, you can also call the printer-unique entry point, "PRT". This entry point allows you to control the printer directly--the necessary escape sequences will be generated for you.

In addition, there is a printer-unique function, "RAW_WRITE" that sends characters without converting them. This functions the same as SER: and PAR:, except that you don't need to know which port is connected to the printer.

Types of Supported Printers

The available printers that are supported for the Amiga include both whole character (daisy wheel) and dot matrix (wire, ink jet, and laser) types. As with printer capabilities, printer prices range widely, from just over $200 to over $3500. In general, the dot matrix printers are capable of graphics output, while "whole character" printers are not.

Every attempt has been made to support a given feature on each printer that, itself, supports that feature. For example, the daisy wheel printers lack the capability to produce characters such as enlarged or italic print. Similarly, the dot matrix printers often lack such features as proportional spacing.

None of the supported printers currently supports all of the available features. (The Epson JX-80 and the HP LaserJet come closest.) Whenever the system requests an unsupported feature, the PRT: handler simply ignores that request. (The "generic" printer driver currently ignores all feature requests.)

If two or more features are each available for a particular printer, they should be usable in combination. For example, Bold-Italic-Underscore is a possible style for many printers.

If your printer is not among those supported for the Amiga, you have two options. If your printer shares a number of common features with one of the supported printers, you can select that printer in Preferences.

Keep in mind, however, that one or more of the chosen printer's features might not produce a similar effect on your printer.

Your second option is to select "Custom" from the list of supported printers in Preferences and "Generic" as the custom printer name. You can then construct a custom printer driver following the directions in the *Amiga ROM Kernel Manual.*

The following table lists the printers that are currently supported for the Amiga, grouped according to print technology.

Table 1: Printers Supported on the Amiga

Dot Matrix (Wire), Parallel

Manufacturer	Model
Commodore	CBM MPS 1000
Epson	Epson JX-80
Epson	Epson MX-80, FX-80, ...
Okimate	Okimate 20

Daisy Wheel, Parallel

Manufacturer	Model
Alphacom	Alphapro 101
Brother	HR-15XL
Diablo	630 (Some models are serial)
Diablo	Advantage D25
Qume	LetterPro 20

Ink Jet, Parallel

Manufacturer	Model
Diablo	C-150

Laser, Serial

Manufacturer	Model
Hewlett Packard	Laser Jet
Hewlett Packard	Laser Jet Plus

Other (Custom)

Limited support is offered for a "generic" printer.

Table 2: Printer Features Supported on the Amiga

Legend:

ISO indicates that the sequence has been defined by the International Standards Organization. This is also very similar to ANSII x3.64.

DEC indicates a control sequence defined by Digital Equipment Corperation.

*	Entire escape sequence consists of ESC (ASCII 27) plus indicated code.
**	Near Letter Quality
***	Sequence unique to Amiga
†	Paper perforation skip, *n* lines

Code*	Description	Defined	Alphacom AlphaPro101	Brother HR-15XL	Diablo630	CBM MPS-1000	Epson JX-80	Epson X-80	Diablo AdvantageD25	Diablo C-150	Okimate 20	HP LaserJet	HP LaserJet Plus	Qume LetterPro 20
c	Reset	ISO	x	x	x	x	x	x	x	x	x	x	x	x
#1	Initialize	***	x	x	x	x	x	x	x	x	x	x	x	x
D	Line feed	ISO	x	x	x	x	x	x	x	x		x	x	x
E	Line feed, CR	ISO	x	x	x	x	x	x	x	x	x	x	x	x
M	Reverse line feed	ISO	x	x	x		x		x			x	x	x
[0m	Normal char. set	ISO	x	x	x	x	x	x	x		x	x	x	x
[3m	Italics on	ISO					x	x			x	x	x	
[23m	Italics off	ISO					x	x			x	x	x	
[4m	Underline on	ISO	x	x	x	x	x	x	x		x	x	x	x
[24m	Underline off	ISO	x	x	x	x	x	x	x		x	x	x	x
[1m	Boldface on	ISO	x	x	x	x	x	x	x			x	x	x
[22m	Boldface off	ISO	x	x	x	x	x	x	x			x	x	x
[*n*m	Set foreground color (*n* = {30-39})	ISO	x	x	x		x		x	x				
[*n*m	Set background color (*n* = {40-49})	ISO								x				
[0w	Normal pitch	DEC	x	x	x	x	x	x	x		x	x	x	x
[2w	Elite on	DEC	x	x	x	x	x	x	x		x	x	x	x
[1w	Elite off	DEC	x	x	x	x	x	x	x		x	x	x	x
[4w	Condensed fine on	DEC	x	x	x	x	x	x	x		x	x	x	x
[3w	Condensed off	DEC	x	x	x	x	x	x	x		x	x	x	x
[6w	Enlarged on	DEC				x	x	x			x			
[5w	Enlarged off	DEC				x	x	x			x			
[6"z	Shadow print on	DEC	x	x	x				x			x	x	x
[5"z	Shadow print off	DEC	x	x	x				x			x	x	x
[4"z	Doublestrike on	DEC	x	x	x	x	x	x	x			x	x	x
[3"z	Doublestrike off	DEC	x	x	x	x	x	x	x			x	x	x
[2"z	NLQ on **	DEC				x	x	x			x			
[1"z	NLQ off **	DEC				x	x	x			x			

Code	Description	Defined	Alphacom AlphaPro101	Brother HR-15XL	Diablo630	CBM MPS-1000	Epson JX-80	Epson X-80	Diablo AdvantageD25	Diablo C-150	Okimate 20	HP LaserJet	HP LaserJet Plus	Qume LetterPro 20
[2v	Superscript on	***	x	x	x	x	x	x	x		x	x	x	x
[1v	Superscript off	***	x	x	x	x	x	x	x		x	x	x	x
[4v	Subscript on	***	x	x	x	x	x	x	x		x	x	x	x
[3v	Subscript off	***	x	x	x	x	x	x	x		x	x	x	x
[0v	Normalize the line	***	x	x	x	x	x	x	x		x	x	x	x
L	Partial line up	ISO	x	x	x	x	x	x	x		x	x	x	x
K	Partial line down	ISO	x	x	x	x	x	x	x		x	x	x	x
(B	U.S. char. set	DEC					x	x				x	x	
(R	French “ ”	DEC					x	x				x	x	
(K	German “ ”	DEC					x	x				x	x	
(A	UK “ ”	DEC					x	x				x	x	
(E	Danish I “ ”	DEC					x	x				x	x	
(H	Swedish “ ”	DEC					x	x				x	x	
(Y	Italian “ ”	DEC					x	x				x	x	
(Z	Spanish “ ”	DEC					x	x				x	x	
(J	Japanese “ ”	***					x	x				x	x	
(6	Norwegian “ ”	DEC					x	x				x	x	
(C	Danish II “ ”	***					x	x				x	x	
[2p	Proportional on	***		x	x	x	x	x	x			x	x	x
[1p	Proportional off	***		x	x	x	x	x	x			x	x	x
[0p	Proportional clear	***		x	x				x			x	x	x
[*n* E	Set prop. offset (*n*)	ISO												
[5 F	Auto left justify	ISO			x			x						
[7 F	Auto right justify	ISO						x						
[6 F	Auto full justify	ISO						x						
[0 F	Justify off	ISO			x			x	x					
[3 F	Letter space (justify)	ISO						x						
[1 F	Word fill (auto center)	ISO			x			x						
[0z	1/8" line spacing	***	x	x	x	x	x	x	x		x	x	x	x
[1z	1/6" line spacing	***	x	x	x	x	x	x	x		x	x	x	x
[*n*t	Set form length (*n*)	DEC	x	x	x	x	x	x	x	x	x	x	x	x
[*n*q	Perf skip (*n*>0)†	***				x	x	x			x	x	x	
[0q	Perf skip off	***				x	x	x			x	x	x	

Code	Description	Defined	Alphacom AlphaPro101	Brother HR-15XL	Diablo630	CBM MPS-1000	Epson JX-80	Epson X-80	Diablo AdvantageD25	Diablo C-150	Okimate 20	HP LaserJet	HP LaserJet Plus	Qume LetterPro 20
#9	Left margin set	***	x	x	x				x	x				x
#0	Right margin set	***	x	x	x				x	x				x
#8	Top margin set	***	x	x	x				x					
#2	Bottom margin set	***	x	x	x				x					
[*n1*;*n2*r	Top;Bottom margins	DEC										x	x	
[*n1*;*n2*s	Left;Right margins	DEC	x	x	x	x	x	x	x	x		x	x	x
#3	Clear margins	***	x	x	x	x	x	x	x	x		x	x	x
H	Set horiz. tab	ISO		x	x				x	x				
J	Set vert. tab	ISO		x	x				x					
[0g	Clear horiz. tab	ISO		x	x				x	x				
[3g	Clear all hor. tabs	ISO		x	x	x	x	x	x	x	x			
[1g	Clear vert. tab	ISO									x			
[4g	Clear all vert. tabs	ISO		x		x	x	x						
#4	Clear all h & v tabs	***		x	x	x	x	x	x	x				
#5	Set default tabs	***		x	x	x	x	x	x	x	x			
[*n*"x	(Extended commands)	***												

Table 3: Printer Command Definitions

The following table describes the supported printer functions. You can use the escape sequences with PRT: and the printer.library. To use the command names, open the printer.library directly.

Again, recall that SER: and PAR: will ignore all of these and pass them directly on to the attached device.

Cmd Name	Escape Sequence	Function	Defined by:*
aRIS	ESCc	reset	ISO
aRIN	ESC#1	initialize	***
aIND	ESCD	lf	ISO
aNEL	ESCE	return,lf	ISO
aRI	ESCM	reverse lf	ISO
aSGR0	ESC[0m	normal char set	ISO
aSGR3	ESC[3m	italics on	ISO
aSGR23	ESC[23m	italics off	ISO
aSGR4	ESC[4m	underline on	ISO
aSGR24	ESC[24m	underline off	ISO
aSGR1	ESC[1m	boldface on	ISO
aSGR22	ESC[22m	boldface off	ISO
aSFC	ESC[*n*m (*n*= {30–39})	set foreground color	ISO
aSBC	ESC[*n*m (*n*= {40–49})	set background color	ISO
aSHORP0	ESC[0w	normal pitch	DEC
aSHORP2	ESC[2w	elite on	DEC
aSHORP1	ESC[1w	elite off	DEC
aSHORP4	ESC[4w	condensed fine on	DEC
aSHORP3	ESC[3w	condensed off	DEC
aSHORP6	ESC[6w	enlarged on	DEC
aSHORP5	ESC[5w	enlarged off	DEC
aDEN6	ESC[6"z	shadow print on	DEC (sort of)
aDEN5	ESC[5"z	shadow print off	DEC
aDEN4	ESC[4"z	doublestrike on	DEC
aDEN3	ESC[3"z	doublestrike off	DEC
aDEN2	ESC[2"z	NLQ on	DEC
aDEN1	ESC[1"z	NLQ off	DEC
aSUS2	ESC[2v	superscript on	***
aSUS1	ESC[1v	superscript off	***
aSUS4	ESC[4v	subscript on	***
aSUS3	ESC[3v	subscript off	***
aSUS0	ESC[0v	normalize the line	***
aPLU	ESCL	partial line up	ISO
aPLD	ESCK	partial line down	ISO
aFNT0	ESC(B	US char set	DEC
aFNT1	ESC(R	French char set	DEC
aFNT2	ESC(K	German char set	DEC

aFNT3	ESC(A	UK char set	DEC
aFNT4	ESC(E	Danish I char set	DEC
aFNT5	ESC(H	Swedish char set	DEC
aFNT6	ESC(Y	Italian char set	DEC
aFNT7	ESC(Z	Spanish char set	DEC
aFNT8	ESC(J	Japanese char set	***
aFNT9	ESC(6	Norweign char set	DEC
aFNT10	ESC(C	Danish II char set	***
aPROP2	ESC[2p	proportional on	***
aPROP1	ESC[1p	proportional off	***
aPROP0	ESC[0p	proportional clear	***
aTSS	ESC[n E	set proportional offset	ISO
aJFY5	ESC[5 F	auto left justify	ISO
aJFY7	ESC[7 F	auto right justify	ISO
aJFY6	ESC[6 F	auto full justify	ISO
aJFY0	ESC[0 F	auto justify off	ISO
aJFY3	ESC[3 F	letter space (justify)	ISO (special)
aJFY1	ESC[1 F	word fill(auto center)	ISO (special)
aVERP0	ESC[0z	1/8" line spacing	***
aVERP1	ESC[1z	1/6" line spacing	***
aSLPP	ESC[nt	set form length n	DEC
aPERF	ESC[nq	perf skip n (n>0)	***
aPERF0	ESC[0q	perf skip off	***
aLMS	ESC#9	Left margin set	***
aRMS	ESC#0	Right margin set	***
aTMS	ESC#8	Top margin set	***
aBMS	ESC#2	Bottom marg set	***
aSTBM	ESC[*n1*;*n2*r	T&B margins	DEC
aSLRM	ESC[*n1*;*n2*s	L&R margin	DEC
aCAM	ESC#3	Clear margins	***
aHTS	ESCH	Set horiz tab	ISO
aVTS	ESCJ	Set vertical tabs	ISO
aTBC0	ESC[0g	Clr horiz tab	ISO
aTBC3	ESC[3g	Clear all h tab	ISO
aTBC1	ESC[1g	Clr vertical tabs	ISO
aTBC4	ESC[4g	Clr all v tabs	ISO
aTBCALL	ESC#4	Clr all h & v tabs	***
aTBSALL	ESC#5	Set default tabs	***
aEXTEND	ESC[*n*"x	extended commands	***

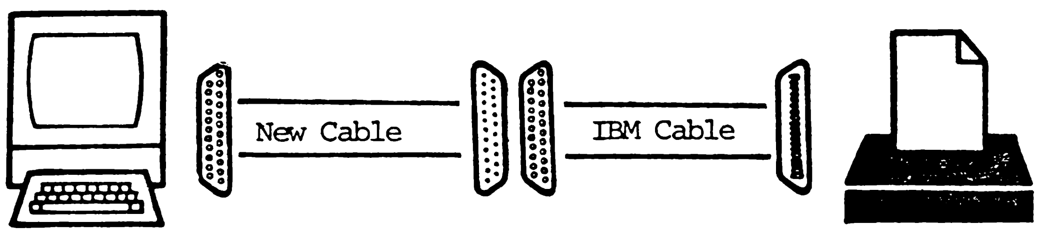
* See legend for Table 2.

Standard Cable Connections for Printers

If you want to connect a printer to the Amiga parallel port (25 pin female) and you have an IBM PC parallel to Centronics (36 pin) cable, make the following 25 pin female to female cable:

Amiga Side	IBM Cable Side
1-13	1-13
14-16 (cut)	
17-22	17-22
23 (cut)	
24	24
26 connect over to	16

Now arrange as follows:



Note: Don't connect pin 14 (parallel); it causes extra line feeds on Epson printers.

Amiga to Centronics Adapter

Amiga Side	Centronics Side
1-13 (straight)	1-13
14-16 (cut)	
17-22 (straight)	17-22
23 (cut)	
24	24
25 connect over to	16
	25 (cut)

Table 4: Standard Switch Settings for Printers

The standard switch settings for the Amiga supported printers are as follows:

Alphacom AlphaPro 101

	Off	On
Mode A	x	
Mode B	x	

	10	12	15
Pitch	x		

Brother HR-15XL

SW1	1	2	3	4	5	6	7	8
ON								
OFF	x	x	x	x	x	x	x	x

SW2	1	2	3	4	5	6	7	8
ON								
OFF	x	x	x	x	x	x	x	x

CBM MPS-1000

SW1	1	2	3	4	5	6	7	8
ON	x							x
OFF		x	x	x	x	x	x	

SW2: unused

Diablo Advantage D25

SW1

	1	2	3	4	5	6	7	8
ON								
OFF	x	x	x	x	x	x	x	x

SW2

	1	2	3	4	5	6	7	8
ON								
OFF	x	x	x	x	x	x	x	x

Diablo 630

SW1

	1	2	3	4	5	6	7	8
ON								
OFF	x	x	x	x	x	x	x	x

SW2

	1	2	3	4	5	6	7	8
ON								
OFF	x	x	x	x	x	x	x	x

Diablo C-150

SW1

	1	2	3	4	5	6	7	8
ON			x	x	x			
OFF	x	x				x	x	x

Epson LX-80

SW1

	1	2	3	4	5	6	7	8
						x	x	x
	x	x	x	x	x			

SW2

	1	2	3	4
		x		
	x		x	x

Epson JX-80

SW1

	1	2	3	4	5	6	7	8
ON				x		x	x	x
OFF	x	x	x		x			

SW2

	1	2	3	4
ON	x	x		
OFF			x	x

Okimate 20

(No switches available)

Qume Letterpro 20P

	1	2	3	4	5	6	7	8
ON							x	
OFF	x	x	x	x	x	x		x

SW1

	1	2	3	4	5
ON		x	x		
OFF	x			x	x

SW2

HP LaserJet and LaserJet Plus

(Switches should be set to default settings: See the Owner's Manual.)

Appendix F

Skeleton Device/Library Code

This appendix contains source code for a skeleton device and a skeleton library. You can use this code to create your own custom devices and libraries to add to the Amiga.

```
***********************************************************************
*                                                                     *
*       Copyright (C) 1985, Commodore Amiga Inc.  All rights reserved. *
*                                                                     *
***********************************************************************


***********************************************************************
*
* asmsupp.i -- random low level assembly support routines
*
* Source Control
* ------ -------
*
* $Header: asmsupp.i,v 31.1 85/10/13 23:12:33 neil Exp $
*
* $Locker:  $
*
***********************************************************************

CLEAR   MACRO           ; quick way to clear a D register on 68000
        MOVEQ   #0,\1
        ENDM

BHS     MACRO
        BCC.\0  \1
        ENDM

BLO     MACRO
        BCS.\0  \1
        ENDM

EVEN    MACRO           ; word align code stream
        DS.W    0
        ENDM

LINKSYS MACRO           ; link to a library without having to see a _LVO
        LINKLIB _LVO\1,\2
        ENDM

CALLSYS MACRO           ; call a library without having to see _LVO
        CALLLIB _LVO\1
        ENDM

XLIB    MACRO           ; define a library reference without the _LVO
        XREF    _LVO\1
        ENDM
```



```
*******************************************************************
*                                                                 *
* Copyright (C) 1985, Commodore Amiga Inc.  All rights reserved. *
*                                                                 *
*******************************************************************


*******************************************************************
*
* mydev.i -- external declarations for skeleton device
*
* SOURCE CONTROL
* ------ -------
* $Header: ramlib.i,v 31.1 85/10/13 23:12:51 neil Exp $
*
* $Locker: neil $
*
*******************************************************************

;-----------------------------------------------------------------------
;
; device command definitions
;
;-----------------------------------------------------------------------

        DEVINIT
        DEVCMD  MYDEV_FOO
        DEVCMD  MYDEV_BAR
        DEVCMD  MYDEV_END       ; place marker -- first illegal command #

;-----------------------------------------------------------------------
;
; device data structures
;
;-----------------------------------------------------------------------

; maximum number of units in this device
MD_NUMUNITS     EQU     4

    STRUCTURE MyDev,LIB_SIZE
        ULONG   md_SysLib
        ULONG   md_DosLib
        ULONG   md_SegList
        UBYTE   md_Flags
        UBYTE   md_pad
        STRUCT  md_Units,MD_NUMUNITS*4
        LABEL   MyDev_Sizeof

    STRUCTURE MyDevMsg,MN_SIZE
        APTR    mdm_Device
        APTR    mdm_Unit
        LABEL   MyDevMsg_Sizeof

    STRUCTURE MyDevUnit,UNIT_SIZE
        UBYTE   mdu_UnitNum
        UBYTE   mdu_pad
        STRUCT  mdu_Msg,MyDevMsg_Sizeof
        APTR    mdu_Process
```

```
        LABEL   MyDevUnit_Sizeof

        ;------ state bit for unit stopped
        BITDEF  MDU,STOPPED,2

; stack size and priority for the process we will create
MYPROCSTACKSIZE EQU     $200
MYPROCPRI       EQU     0

MYDEVNAME       MACRO
                DC.B    'mydev.device',0
                ENDM
```



```
************************************************************************
*                                                                      *
*       Copyright (C) 1985, Commodore Amiga Inc.  All rights reserved. *
*                                                                      *
***********************************************************************/


************************************************************************
*
* mydev.asm -- skeleton device code
*
* Source Control
* ------ -------
*
* $Header: amain.asm,v 31.3 85/10/18 19:04:04 neil Exp $
*
* $Locker: neil $
*
* $Log: amain.asm,v $
*
***********************************************************************/
        SECTION section

        NOLIST
        include "exec/types.i"
        include "exec/nodes.i"
        include "exec/lists.i"
        include "exec/libraries.i"
        include "exec/devices.i"
        include "exec/io.i"
        include "exec/alerts.i"
        include "exec/initializers.i"
        include "exec/memory.i"
        include "exec/resident.i"
        include "exec/ables.i"
        include "exec/errors.i"
        include "libraries/dos.i"
        include "libraries/dosextens.i"

        include "asmsupp.i"

        include "mydev.i"

        LIST

        ;------ These don't have to be external, but it helps some
        ;------ debuggers to have them globally visible
        XDEF    Init
        XDEF    Open
        XDEF    Close
        XDEF    Expunge
        XDEF    Null
        XDEF    myName
        XDEF    BeginIO
        XDEF    AbortIO

        XREF    _AbsExecBase
```

```
        XLIB    OpenLibrary
        XLIB    CloseLibrary
        XLIB    Alert
        XLIB    FreeMem
        XLIB    Remove
        XLIB    FindTask
        XLIB    AllocMem
        XLIB    CreateProc
        XLIB    PutMsg
        XLIB    RemTask
        XLIB    ReplyMsg
        XLIB    Signal
        XLIB    GetMsg
        XLIB    Wait
        XLIB    WaitPort
        XLIB    AllocSignal
        XLIB    SetTaskPri

        INT_ABLES


        ; The first executable location.  This should return an error
        ; in case someone tried to run you as a program (instead of
        ; loading you as a library).
FirstAddress:
        CLEAR   d0
        rts

;-----------------------------------------------------------------------
; A romtag structure.  Both "exec" and "ramlib" look for
; this structure to discover magic constants about you
; (such as where to start running you from...).
;-----------------------------------------------------------------------

        ; Most people will not need a priority and should leave it at zero.
        ; the RT_PRI field is used for configuring the roms.  Use "mods" from
        ; wack to look at the other romtags in the system
MYPRI   EQU     0

initDDescrip:
                                        ;STRUCTURE RT,0
          DC.W    RTC_MATCHWORD         ; UWORD RT_MATCHWORD
          DC.L    initDDescrip          ; APTR  RT_MATCHTAG
          DC.L    EndCode               ; APTR  RT_ENDSKIP
          DC.B    RTF_AUTOINIT          ; UBYTE RT_FLAGS
          DC.B    VERSION               ; UBYTE RT_VERSION
          DC.B    NT_DEVICE             ; UBYTE RT_TYPE
          DC.B    MYPRI                 ; BYTE  RT_PRI
          DC.L    myName                ; APTR  RT_NAME
          DC.L    idString              ; APTR  RT_IDSTRING
          DC.L    Init                  ; APTR  RT_INIT
                                        ; LABEL RT_SIZE


        ; this is the name that the device will have
subSysName:
myName:         MYDEVNAME

        ; a major version number.
VERSION:        EQU     1

        ; A particular revision.  This should uniquely identify the bits in the
        ; device.  I use a script that advances the revision number each time
        ; I recompile.  That way there is never a question of which device
        ; that really is.
REVISION:       EQU     17

        ; this is an identifier tag to help in supporting the device
        ; format is 'name version.revision (dd MON yyyy)',<cr>,<lf>,<null>
idString:       dc.b    'mydev 1.0 (31 Oct 1985)',13,10,0

dosName:        DOSNAME

        ; force word allignment
        ds.w    0


        ; The romtag specified that we were "RTF_AUTOINIT".  This means
        ; that the RT_INIT structure member points to one of these
        ; tables below.  If the AUTOINIT bit was not set then RT_INIT
        ; would point to a routine to run.

Init:
        DC.L    MyDev_Sizeof            ; data space size
        DC.L    funcTable               ; pointer to function initializers
        DC.L    dataTable               ; pointer to data initializers
        DC.L    initRoutine             ; routine to run


funcTable:

        ;------ standard system routines
        dc.l    Open
        dc.l    Close
        dc.l    Expunge
        dc.l    Null

        ;------ my device definitions
        dc.l    BeginIO
        dc.l    AbortIO

        ;------ function table end marker
        dc.l    -1


        ; The data table initializes static data structures.
        ; The format is specified in exec/InitStruct routine's
        ; manual pages.  The INITBYTE/INITWORD/INITLONG routines
        ; are in the file "exec/initializers.i".  The first argument
        ; is the offset from the device base for this byte/word/long.
        ; The second argument is the value to put in that cell.
        ; The table is null terminated
dataTable:
        INITBYTE        LH_TYPE,NT_DEVICE
        INITLONG        LN_NAME,myName
        INITBYTE        LIB_FLAGS,LIBF_SUMUSED!LIBF_CHANGED
        INITWORD        LIB_VERSION,VERSION
        INITWORD        LIB_REVISION,REVISION
        INITLONG        LIB_IDSTRING,idString
        DC.L    0
```

```
        ; This routine gets called after the device has been allocated.
        ; The device pointer is in D0.  The segment list is in a0.
        ; If it returns non-zero then the device will be linked into
        ; the device list.
initRoutine:

        ;------ get the device pointer into a convenient A register
        move.l  a5,-(sp)
        move.l  d0,a5

        ;------ save a pointer to exec
        move.l  a6,md_SysLib(a5)

        ;------ save a pointer to our loaded code
        move.l  a0,md_SegList(a5)

        ;------ open the dos library
        lea     dosName(pc),a1
        CLEAR   d0
        CALLSYS OpenLibrary

        move.l  d0,md_DosLib(a5)
        bne.s   init_DosOK

        ;------ can't open the dos!  what gives
        ALERT   AG_OpenLib!AO_DOSLib

init_DosOK:
        ;------ now build the static data that we need

        ;
        ; put your initialization here...
        ;

        move.l  a5,d0
        move.l  (sp)+,a5
        rts

;----------------------------------------------------------------------
;
; here begins the system interface commands.  When the user calls
; OpenLibrary/CloseLibrary/RemoveLibrary, this eventually gets translated
; into a call to the following routines (Open/Close/Expunge).  Exec
; has already put our device pointer in a6 for us.  Exec has turned
; off task switching while in these routines (via Forbid/Permit), so
; we should not take too long in them.
;
;----------------------------------------------------------------------


        ; Open sets the IO_ERROR field on an error.  If it was successfull,
        ; we should set up the IO_UNIT field.

Open:           ; ( device:a6, iob:a1, unitnum:d0, flags:d1 )
        movem.l d2/a2/a3/a4,-(sp)

        move.l  a1,a2           ; save the iob

        ;------ see if the unit number is in range
        moveq   #MD_NUMUNITS,d2
        cmp.l   d2,d0
        bcc.s   Open_Error      ; unit number out of range

        ;------ see if the unit is already initialized
        move.l  d0,d2           ; save unit number
        lsl.l   #2,d0
        lea.l   md_Units(a6,d0.l),a4
        move.l  (a4),d0
        bne.s   Open_UnitOK

        ;------ try and conjure up a unit
        bsr     InitUnit

        ;------ see if it initialized OK
        move.l  (a4),d0
        beq.s   Open_Error

Open_UnitOK:
        move.l  d0,a3           ; unit pointer in a3

        move.l  d0,IO_UNIT(a2)

        ;------ mark us as having another opener
        addq.w  #1,LIB_OPENCNT(a6)
        addq.w  #1,UNIT_OPENCNT(a3)

        ;------ prevent delayed expunges
        bclr    #LIBB_DELEXP,md_Flags(a6)

Open_End:

        movem.l (sp)+,d2/a2/a3/a4
        rts

Open_Error:
        move.b  #IOERR_OPENFAIL,IO_ERROR(a2)
        bra.s   Open_End

        ; There are two different things that might be returned from
        ; the Close routine.  If the device is no longer open and
        ; there is a delayed expunge then Close should return the
        ; segment list (as given to Init).  Otherwise close should
        ; return NULL.

Close:          ; ( device:a6, iob:a1 )
        movem.l a2/a3,-(sp)

        move.l  a1,a2

        move.l  IO_UNIT(a2),a3

        ;------ make sure the iob is not used again
        moveq.l #-1,d0
        move.l  d0,IO_UNIT(a2)
        move.l  d0,IO_DEVICE(a2)

        ;------ see if the unit is still in use
        subq.w  #1,UNIT_OPENCNT(a3)
```

```
        bne.s   Close_Device

        bsr     ExpungeUnit

Close_Device:
        ;------ mark us as having one fewer openers
        subq.w  #1,LIB_OPENCNT(a6)

        ;------ see if there is anyone left with us open
        bne.s   Close_End

        ;------ see if we have a delayed expunge pending
        btst    #LIBB_DELEXP,md_Flags(a6)
        beq.s   Close_End

        ;------ do the expunge
        bsr     Expunge

Close_End:
        movem.l (sp)+,a2/a3
        rts


        ; There are two different things that might be returned from
        ; the Expunge routine.  If the device is no longer open
        ; then Expunge should return the segment list (as given to
        ; Init).  Otherwise Expunge should set the delayed expunge
        ; flag and return NULL.
        ;
        ; One other important note: because Expunge is called from
        ; the memory allocator, it may NEVER Wait() or otherwise
        ; take long time to complete.

Expunge:        ; ( device: a6 )

        movem.l d2/a5/a6,-(sp)
        move.l  a6,a5
        move.l  md_SysLib(a5),a6

        ;------ see if anyone has us open
        tst.w   LIB_OPENCNT(a5)
        beq     1$

        ;------ it is still open.  set the delayed expunge flag
        bset    #LIBB_DELEXP,md_Flags(a5)
        CLEAR   d0
        bra.s   Expunge_End

1$:
        ;------ go ahead and get rid of us.  Store our seglist in d2
        move.l  md_SegList(a5),d2

        ;------ unlink from device list
        move.l  a5,a1
        CALLSYS Remove

        ;
        ; device specific closings here...
        ;

        ;------ close the dos library
        move.l  md_DosLib(a5),a1
        CALLSYS CloseLibrary

        ;------ free our memory
        CLEAR   d0
        move.l  a5,a1
        move.w  LIB_NEGSIZE(a5),d0

        sub.w   d0,a1
        add.w   LIB_POSSIZE(a5),d0

        CALLSYS FreeMem

        ;------ set up our return value
        move.l  d2,d0

Expunge_End:
        movem.l (sp)+,d2/a5/a6
        rts


Null:
        CLEAR   d0
        rts


InitUnit:       ; ( d2:unit number, a3:scratch, a6:devptr )
        movem.l d2/d3/d4,-(sp)

        ;------ allocate unit memory
        move.l  #MyDevUnit_Sizeof,d0
        move.l  #MEMF_PUBLIC!MEMF_CLEAR,d1
        LINKSYS AllocMem,md_SysLib(a6)

        tst.l   d0
        beq     InitUnit_End

        move.l  d0,a3
        move.b  d2,mdu_UnitNum(a3)      ; initialize unit number

        ;------ start up the unit process.  We do a trick here --
        ;------ we set his message port to PA_IGNORE until the
        ;------ new process has a change to set it up.
        ;------ We cannot go to sleep here: it would be very nasty
        ;------ if someone else tried to open the unit
        ;------ (exec's OpenDevice has done a Forbid() for us --
        ;------ we depend on this to become single threaded).
        move.l  #MYPROCSTACKSIZE,d4     ; stack size
        move.l  #myproc_seglist,d3      ; segment list
        lsr.l   #2,d3                   ; change to bcpl pointer
        moveq   #MYPROCPRI,d2           ; pick out its priority
        move.l  #myName,d1              ; name is the device's
        LINKSYS CreateProc,md_DosLib(a6)

        tst.l   d0
        beq     InitUnit_FreeUnit

        ;------ set up the unit structures for the new process
        move.l  d0,mdu_Process(a3)
```

```
        move.l  d0,a0
        lea     -pr_MsgPort(a0),a0
        move.l  a0,MP_SIGTASK(a3)
        move.b  #PA_IGNORE,MP_FLAGS(a3)

        ;------ send a startup message to the new process
        lea     mdu_Msg(a3),a1
        move.l  a3,mdm_Unit(a1)
        move.l  a6,mdm_Device(a1)
        move.l  d0,a0                   ; message port is new process port
        LINKSYS PutMsg,md_SysLib(a6)

        ;------ mark us as ready to go
        move.l  d2,d0                   ; unit number
        lsl.l   #2,d0
        move.l  a3,md_Units(a6,d0.l)    ; set unit table


InitUnit_End:
        movem.l (sp)+,d2/d3/d4
        rts

        ;------ got an error.  free the unit structure that we allocated.
InitUnit_FreeUnit:
        bsr     FreeUnit
        bra.s   InitUnit_End

FreeUnit:       ; ( a3:unitptr, a6:deviceptr )
        move.l  a3,a1
        move.l  #MyDevUnit_Sizeof,d0
        LINKSYS FreeMem,md_SysLib(a6)
        rts


ExpungeUnit:    ; ( a3:unitptr, a6:deviceptr )
        move.l  d2,-(sp)

        ;------ get rid of the unit's task.  We know this is safe
        ;------ because the unit has an open count of zero, so it
        ;------ is 'guaranteed' not in use.
        move.l  mdu_Process(a3),a1
        lea     -(pr_MsgPort)(a1),a1
        LINKSYS RemTask,md_SysLib(a6)

        ;------ save the unit number
        CLEAR   d2
        move.b  mdu_UnitNum(a3),d2

        ;------ free the unit structure.
        bsr     FreeUnit

        ;------ clear out the unit vector in the device
        lsl.l   #2,d2
        clr.l   md_Units(a6,d2.l)

        move.l  (sp)+,d2

        rts
;----------------------------------------------------------------------
```



```
;
; here begins the device specific functions
;
;----------------------------------------------------------------------

; cmdtable is used to look up the address of a routine that will
; implement the device command.
cmdtable:
        DC.L    Invalid         ; $00000001
        DC.L    MyReset         ; $00000002
        DC.L    Read            ; $00000004
        DC.L    Write           ; $00000008
        DC.L    Update          ; $00000010
        DC.L    Clear           ; $00000020
        DC.L    MyStop          ; $00000040
        DC.L    Start           ; $00000080
        DC.L    Flush           ; $00000100
        DC.L    Foo             ; $00000200
        DC.L    Bar             ; $00000400
cmdtable_end:

; this define is used to tell which commands should not be queued
; command zero is bit zero.
; The immediate commands are Invalid, Reset, Stop, Start, Flush
IMMEDIATES      EQU     $000001c3

;
; BeginIO starts all incoming io.  The IO is either queued up for the
; unit task or processed immediately.
;

BeginIO:        ; ( iob: a1, device:a6 )
        move.l  a3,-(sp)

        ;------ bookkeeping
        move.l  IO_UNIT(a1),a3

        ;------ see if the io command is within range
        move.w  IO_COMMAND(a1),d0
        cmp.w   #MYDEV_END,d0
        bcc.s   BeginIO_NoCmd

        DISABLE a0

        ;------ process all immediate commands no matter what
        move.w  #IMMEDIATES,d1
        btst    d0,d1
        bne.s   BeginIO_Immediate

        ;------ see if the unit is STOPPED.  If so, queue the msg.
        btst    #MDUB_STOPPED,UNIT_FLAGS(a3)
        bne.s   BeginIO_QueueMsg

        ;------ this is not an immediate command.  see if the device is
        ;------ busy.
        bset    #UNITB_ACTIVE,UNIT_FLAGS(a3)
        beq.s   BeginIO_Immediate

        ;------ we need to queue the device.  mark us as needing
        ;------ task attention.  Clear the quick flag
```

```
BeginIO_QueueMsg:
        BSET    #UNITB_INTASK,UNIT_FLAGS(a3)
        bclr    #IOB_QUICK,IO_FLAGS(a1)

        ENABLE  a0

        move.l  a3,a0
        LINKSYS PutMsg,md_SysLib(a6)
        bra.s   BeginIO_End

BeginIO_Immediate:
        ENABLE  a0

        bsr     PerformIO

BeginIO_End:
        move.l  (sp)+,a3
        rts

BeginIO_NoCmd:
        move.b  #IOERR_NOCMD,IO_ERROR(a1)
        bra.s   BeginIO_End


;
; PerformIO actually dispatches an io request.  It expects a3 to already
; have the unit pointer in it.  a6 has the device pointer (as always).
; a1 has the io request.  Bounds checking has already been done on
; the io request.
;

PerformIO:      ; ( iob:a1, unitptr:a3, devptr:a6 )
        move.l  a2,-(sp)
        move.l  a1,a2

        move.w  IO_COMMAND(a2),d0
        lea     cmdtable(pc),a0
        move.l  0(a0,d0.w),a0

        jsr     (a0)

        move.l  (sp)+,a2
        rts

;
; TermIO sends the IO request back to the user.  It knows not to mark
; the device as inactive if this was an immediate request or if the
; request was started from the server task.
;

TermIO:         ; ( iob:a1, unitptr:a3, devptr:a6 )
        move.w  IO_COMMAND(a1),d0
        move.w  #IMMEDIATES,d1
        btst    d0,d1
        bne.s   TermIO_Immediate

        ;------ we may need to turn the active bit off.
        btst    #UNITB_INTASK,UNIT_FLAGS(a3)
        bne.s   TermIO_Immediate

        ;------ the task does not have more work to do
        bclr    #UNITB_ACTIVE,UNIT_FLAGS(a3)

TermIO_Immediate:
        ;------ if the quick bit is still set then we don't need to reply
        ;------ msg -- just return to the user.
        btst    #IOB_QUICK,IO_FLAGS(a1)
        bne.s   TermIO_End

        LINKSYS ReplyMsg,md_SysLib(a6)

TermIO_End:
        rts


AbortIO:        ; ( iob: a1, device:a6 )

;----------------------------------------------------------------------
;
; here begins the functions that implement the device commands
; all functions are called with:
;       a1 -- a pointer to the io request block
;       a2 -- another pointer to the iob
;       a3 -- a pointer to the unit
;       a6 -- a pointer to the device
;
; Commands that conflict with 68000 instructions have a "My" prepended
; to them.
;----------------------------------------------------------------------

Invalid:
        move.b  #IOERR_NOCMD,IO_ERROR(a1)
        bsr     TermIO
        rts

MyReset:

        ; !!! fill me in !!!
        ; !!! fill me in !!!
        ; !!! fill me in !!!
        ; !!! fill me in !!!


;
; the Read command acts as an infinite source of nulls.  It clears
; the user's buffer and marks that many bytes as having been read.
;

Read:
        move.l  IO_DATA(a1),a0
        move.l  IO_LENGTH(a1),d0
        move.l  d0,IO_ACTUAL(a1)

        ;------ deal with a zero length read
        beq.s   Read_End

        ;------ now copy the data
        CLEAR   d1

Read_Loop:
```

```
        move.b  d1,(a0)+
        subq.l  #1,d0
        bne.s   Read_Loop

Read_End:
        bsr     TermIO
        rts


;
; the Write command acts as bit bucket.  It clears acknowledges all
; the bytes the user has tried to write to it.
;

Write:
        move.l  IO_LENGTH(a1),IO_ACTUAL(a1)

        bsr     TermIO
        rts

;
; Update and Clear are internal buffering commands.  Update forces all
; io out to its final resting spot, and does not return until this is
; done.  Clear invalidates all internal buffers.  Since this device
; has no internal buffers, these commands do not apply.
;

Update:
Clear:
        bra     Invalid

;
; the Stop command stop all future io requests from being
; processed until a Start command is received.  The Stop
; command is NOT stackable: e.g. no matter how many stops
; have been issued, it only takes one Start to restart
; processing.
;

MyStop:
        bset    #MDUB_STOPPED,UNIT_FLAGS(a3)

        bsr     TermIO
        rts

Start:
        bsr     InternalStart

        move.l  a2,a1
        bsr     TermIO

        rts

InternalStart:
        ;------ turn processing back on
        bclr    #MDUB_STOPPED,UNIT_FLAGS(a3)

        ;------ kick the task to start it moving
        move.l  a3,a1
        CLEAR   d0
        move.l  MP_SIGBIT(a3),d1
        bset    d1,d0
        LINKSYS Signal,md_SysLib(a3)

        rts

;
; Flush pulls all io requests off the queue and sends them back.
; We must be careful not to destroy work in progress, and also
; that we do not let some io requests slip by.
;
; Some funny magic goes on with the STOPPED bit in here.  Stop is
; defined as not being reentrant.  We therefore save the old state
; of the bit and then restore it later.  This keeps us from
; needing to DISABLE in flush.  It also fails miserably if someone
; does a start in the middle of a flush.
;

Flush:
        movem.l d2/a6,-(sp)

        move.l  md_SysLib(a6),a6

        bset    #MDUB_STOPPED,UNIT_FLAGS(a3)
        sne     d2

Flush_Loop:
        move.l  a3,a0
        CALLSYS GetMsg

        tst.l   d0
        beq.s   Flush_End

        move.l  d0,a1
        move.b  #IOERR_ABORTED,IO_ERROR(a1)
        CALLSYS ReplyMsg

        bra.s   Flush_Loop

Flush_End:

        move.l  d2,d0
        movem.l (sp)+,d2/a6

        tst.b   d0
        beq.s   1$

        bsr     InternalStart
1$:

        move.l  a2,a1
        bsr     TermIO

        rts

;
; Foo and Bar are two device specific commands that are provided just
; to show you how to add your own commands.  The currently return that
; no work was done.
;
```

```
Foo:
Bar:
        CLEAR   d0
        move.l  d0,IO_ACTUAL(a1)

        bsr     TermIO
        rts

;----------------------------------------------------------------------
;
; here begins the process related routines
;
; A Process is provided so that queued requests may be processed at
; a later time.
;
;
; Register Usage
; ==============
; a3 -- unit pointer
; a6 -- syslib pointer
; a5 -- device pointer
; a4 -- task (NOT process) pointer
; d7 -- wait mask
;
;----------------------------------------------------------------------

; some dos magic.  A process is started at the first executable address
; after a segment list.  We hand craft a segment list here.  See the
; the DOS technical reference if you really need to know more about this.

        cnop    0,4                     ; long word allign
        DC.L    16                      ; segment length -- any number will do
myproc_seglist:
        DC.L    0                       ; pointer to next segment

; the next instruction after the segment list is the first executable address

Proc_Begin:

        move.l  _AbsExecBase,a6

        ;------ wait for our first packet
        SUB.L   a1,a1                   ; <my task> = FindTask(0)
        CALLSYS FindTask
        move.l  d0,a0
        move.l  d0,a4                   ; save task in a4
        lea     pr_MsgPort(a0),a0       ; get msg port for my processes
        CALLSYS WaitPort

        ;------ take msg off the port
        move.l  d0,a1
        move.l  d0,a2                   ; save the message
        CALLSYS Remove

        ;------ get our parameters out of it
        move.l  mdm_Device(a2),a5               ; a5 is now our device
        move.l  mdm_Unit(a2),a3

        ;------ Allocate the right signal

        moveq   #-1,d0                  ; -1 is any signal at all
        CALLSYS AllocSignal

        move.b  d0,MP_SIGBIT(a3)
        move.b  #PA_SIGNAL,MP_FLAGS(a3)

        ;------ change the bit number into a mask, and save in d7
        CLEAR   d7
        bset    d0,d7


        ;------
        ;------ OK, kids, we are done with initialization.  We now
        ;------ can start the main loop of the driver.  It goes
        ;------ like this.  Because we had the port marked PA_IGNORE
        ;------ for a while (in InitUnit) we jump to the getmsg
        ;------ code on entry.
        ;------
        ;------         wait for a message
        ;------         lock the device
        ;------         get a message.  if no message unlock device and loop
        ;------         dispatch the message
        ;------         loop back to get a message
        ;------

        bra.s   Proc_CheckStatus

        ;------ main loop: wait for a new message
Proc_MainLoop:
        move.l  d7,d0
        CALLSYS Wait

Proc_CheckStatus:
        ;------ see if we are stopped
        btst    #MDUB_STOPPED,UNIT_FLAGS(a3)
        bne.s   Proc_MainLoop           ; device is stopped

        ;------ lock the device
        bset    #UNITB_ACTIVE,UNIT_FLAGS(a3)
        bne.s   Proc_MainLoop           ; device in use

        ;------ get the next request
Proc_NextMessage:
        move.l  a3,a0
        CALLSYS GetMsg
        tst.l   d0
        beq.s   Proc_Unlock             ; no message?

        ;------ do this request
        move.l  d0,a1
        exg     a5,a6                   ; put device ptr in right place
        bsr     PerformIO
        exg     a5,a6                   ; get syslib back in a6

        bra.s   Proc_NextMessage

        ;------ no more messages.  back ourselves out.
Proc_Unlock:
        and.b   #$ff&(UNITB_ACTIVE!UNITB_INTASK),UNIT_FLAGS(a3)
        bra     Proc_MainLoop
```

```
Proc_Fail:
        ;------ we come here on initialization failures
        bsr     FreeUnit
        rts


;-----------------------------------------------------------------------
; EndCode is a marker that show the end of your code.
; Make sure it does not span sections nor is before the
; rom tag in memory!  It is ok to put it right after
; the rom tag -- that way you are always safe.  I put
; it here because it happens to be the "right" thing
; to do, and I know that it is safe in this case.
;-----------------------------------------------------------------------
EndCode:

        END
```

```
************************************************************************
*                                                                      *
*      Copyright (C) 1985, Commodore Amiga Inc.  All rights reserved.  *
*                                                                      *
************************************************************************/

************************************************************************
*
* testdev.asm -- test the mylib.asm code
*
* Source Control
* ------ -------
*
* $Header: amain.asm,v 31.3 85/10/18 19:04:04 neil Exp $
* $Locker: neil $
* $Log: amain.asm,v $
*
************************************************************************/

        INCLUDE 'exec/types.i'
        INCLUDE 'exec/libraries.i'
        INCLUDE 'exec/devices.i'
        INCLUDE 'exec/io.i'

        INCLUDE 'asmsupp.i'
        INCLUDE 'mydev.i'


        XDEF    _main

        XREF    _printf
        XREF    _AbsExecBase
        XREF    _CreatePort
        XREF    _DeletePort
        XREF    _CreateStdIO
        XREF    _DeleteStdIO

        XLIB    OpenDevice
        XLIB    CloseDevice

_main:
        move.l  _AbsExecBase,a6

        ;------ make a reply port
        pea     0
        pea     myName
        jsr     _CreatePort
        addq.l  #8,sp

        move.l  d0,Port
        beq.s   main_end

        ;------ get an io request
        move.l  d0,-(sp)
        jsr     _CreateStdIO
        addq.l  #4,sp

        move.l  d0,Iob
        beq     main_DeletePort
```

```
        move.l  d0,a1
        move.l  #myName,LN_NAME(a1)

        ;------ open the test device: this will bring it in from disk
        lea     myDevName(pc),a0
        CLEAR   d0
        CLEAR   d1
        CALLSYS OpenDevice

        tst.l   d0
        beq.s   1$

        ;------ couldn't find the library
        pea     0
        move.l  d0,a0
        move.b  IO_ERROR(a0),3(sp)
        pea     myDevName(pc)
        pea     nodevmsg(pc)
        jsr     _printf
        addq.l  #8,sp

        bra     main_DeleteIob

1$:

        ;------ close the device
        move.l  Iob,a1
        CALLSYS CloseDevice

main_DeleteIob:
        move.l  Iob,-(sp)
        jsr     _DeleteStdIO
        addq.l  #4,sp

main_DeletePort
        move.l  Port,-(sp)
        jsr     _DeletePort
        addq.l  #4,sp

main_end:
        rts

myDevName:      MYDEVNAME
myName:         dc.b    'testdev',0
nodevmsg:       dc.b    'can not open device "%s": error %ld',10,0
testmsg:        dc.b    'function MYFUNC%ld returned %ld',10,0

Port:   dc.l    0
Iob:    dc.l    0

        END
```

```
*********************************************************************
*                                                                   *
* Copyright (C) 1985, Commodore Amiga Inc.  All rights reserved.    *
*                                                                   *
*********************************************************************


*********************************************************************
*
* mylib.i -- external declarations for skeleton library
*
* SOURCE CONTROL
* ------ -------
* $Header: ramlib.i,v 31.1 85/10/13 23:12:51 neil Exp $
*
* $Locker: neil $
*
*********************************************************************


;-----------------------------------------------------------------------
;
; library function definitions
;
;-----------------------------------------------------------------------


    LIBINIT
    LIBDEF      MLFUNC0
    LIBDEF      MLFUNC1


;-----------------------------------------------------------------------
;
; library data structures
;
;-----------------------------------------------------------------------


    STRUCTURE MyLib,LIB_SIZE
        ULONG   ml_SysLib
        ULONG   ml_DosLib
        ULONG   ml_SegList
        UBYTE   ml_Flags
        UBYTE   ml_pad
        LABEL   MyLib_Sizeof


MYLIBNAME       MACRO
                DC.B    'mylib.library',0
                ENDM
```

```
*************************************************************************
*                                                                       *
*       Copyright (C) 1985, Commodore Amiga Inc.  All rights reserved.  *
*                                                                       *
*************************************************************************/

*************************************************************************
*
* mylib.asm -- skeleton library code
*
* Source Control
* ------ -------
*
* $Header: amain.asm,v 31.3 85/10/18 19:04:04 neil Exp $
* $Locker: neil $
* $Log: amain.asm,v $
*
*************************************************************************/
        SECTION section

        NOLIST
        include "exec/types.i"
        include "exec/nodes.i"
        include "exec/lists.i"
        include "exec/libraries.i"
        include "exec/alerts.i"
        include "exec/initializers.i"
        include "exec/resident.i"
        include "libraries/dos.i"

        include "asmsupp.i"

        include "mylib.i"

        LIST

        ;------ These don't have to be external, but it helps some
        ;------ debuggers to have them globally visible
        XDEF    Init
        XDEF    Open
        XDEF    Close
        XDEF    Expunge
        XDEF    Null
        XDEF    myName
        XDEF    MyFunc0
        XDEF    MyFunc1

        XREF    _AbsExecBase

        XLIB    OpenLibrary
        XLIB    CloseLibrary
        XLIB    Alert
        XLIB    FreeMem
        XLIB    Remove

        ; The first executable location.  This should return an error
        ; in case someone tried to run you as a program (instead of
        ; loading you as a library).
```

```
Start:
        CLEAR   d0
        rts

;-----------------------------------------------------------------------
; A romtag structure.  Both "exec" and "ramlib" look for
; this structure to discover magic constants about you
; (such as where to start running you from...).
;-----------------------------------------------------------------------

        ; Most people will not need a priority and should leave it at zero.
        ; the RT_PRI field is used for configuring the roms.  Use "mods" from
        ; wack to look at the other romtags in the system
MYPRI   EQU     0

initDDescrip:
                                                ;STRUCTURE RT,0
          DC.W    RTC_MATCHWORD                 ; UWORD RT_MATCHWORD
          DC.L    initDDescrip                  ; APTR  RT_MATCHTAG
          DC.L    EndCode                       ; APTR  RT_ENDSKIP
          DC.B    RTF_AUTOINIT                  ; UBYTE RT_FLAGS
          DC.B    VERSION                       ; UBYTE RT_VERSION
          DC.B    NT_LIBRARY                    ; UBYTE RT_TYPE
          DC.B    MYPRI                         ; BYTE  RT_PRI
          DC.L    myName                        ; APTR  RT_NAME
          DC.L    idString                      ; APTR  RT_IDSTRING
          DC.L    Init                          ; APTR  RT_INIT
                                                ; LABEL RT_SIZE


        ; this is the name that the library will have
myName:         MYLIBNAME

        ; a major version number.
VERSION:        EQU     1

        ; A particular revision.  This should uniquely identify the bits in the
        ; library.  I use a script that advances the revision number each time
        ; I recompile.  That way there is never a question of which library
        ; that really is.
REVISION:       EQU     17

        ; this is an identifier tag to help in supporting the library
        ; format is 'name version.revision (dd MON yyyy)',<cr>,<lf>,<null>
idString:       dc.b    'mylib 1.0 (31 Oct 1985)',13,10,0

dosName:        DOSNAME

        ; force word allignment
        ds.w    0


        ; The romtag specified that we were "RTF_AUTOINIT".  This means
        ; that the RT_INIT structure member points to one of these
        ; tables below.  If the AUTOINIT bit was not set then RT_INIT
        ; would point to a routine to run.

Init:
        DC.L    MyLib_Sizeof            ; data space size
        DC.L    funcTable               ; pointer to function initializers
```

```
        DC.L    dataTable               ; pointer to data initializers
        DC.L    initRoutine             ; routine to run


funcTable:

        ;------ standard system routines
        dc.l    Open
        dc.l    Close
        dc.l    Expunge
        dc.l    Null

        ;------ my libraries definitions
        dc.l    MyFunc0
        dc.l    MyFunc1

        ;------ function table end marker
        dc.l    -1


        ; The data table initializes static data structures.
        ; The format is specified in exec/InitStruct routine's
        ; manual pages.  The INITBYTE/INITWORD/INITLONG routines
        ; are in the file "exec/initializers.i".  The first argument
        ; is the offset from the library base for this byte/word/long.
        ; The second argument is the value to put in that cell.
        ; The table is null terminated
dataTable:
        INITBYTE        LH_TYPE,NT_LIBRARY
        INITLONG        LN_NAME,myName
        INITBYTE        LIB_FLAGS,LIBF_SUMUSED!LIBF_CHANGED
        INITWORD        LIB_VERSION,VERSION
        INITWORD        LIB_REVISION,REVISION
        INITLONG        LIB_IDSTRING,idString
        DC.L    0


        ; This routine gets called after the library has been allocated.
        ; The library pointer is in D0.  The segment list is in A0.
        ; If it returns non-zero then the library will be linked into
        ; the library list.
initRoutine:

        ;------ get the library pointer into a convenient A register
        move.l  a5,-(sp)
        move.l  d0,a5

        ;------ save a pointer to exec
        move.l  a6,ml_SysLib(a5)

        ;------ save a pointer to our loaded code
        move.l  a0,ml_SegList(a5)

        ;------ open the dos library
        lea     dosName(pc),a1
        CLEAR   d0
        CALLSYS OpenLibrary

        move.l  d0,ml_DosLib(a5)
        bne.s   1$

        ;------ can't open the dos!  what gives
        ALERT   AG_OpenLib!AO_DOSLib

1$:
        ;------ now build the static data that we need

        ;
        ; put your initialization here...
        ;

        move.l  a5,d0
        move.l  (sp)+,a5
        rts

;-----------------------------------------------------------------------
;
; here begins the system interface commands.  When the user calls
; OpenLibrary/CloseLibrary/RemoveLibrary, this eventually gets translated
; into a call to the following routines (Open/Close/Expunge).  Exec
; has already put our library pointer in A6 for us.  Exec has turned
; off task switching while in these routines (via Forbid/Permit), so
; we should not take too long in them.
;
;-----------------------------------------------------------------------

        ; Open returns the library pointer in d0 if the open
        ; was successful.  If the open failed then null is returned.
        ; It might fail if we allocated memory on each open, or
        ; if only open application could have the library open
        ; at a time...

Open:           ; ( libptr:a6, version:d0 )

        ;------ mark us as having another opener
        addq.w  #1,LIB_OPENCNT(a6)

        ;------ prevent delayed expunges
        bclr    #LIBB_DELEXP,ml_Flags(a6)

        move.l  a6,d0
        rts

        ; There are two different things that might be returned from
        ; the Close routine.  If the library is no longer open and
        ; there is a delayed expunge then Close should return the
        ; segment list (as given to Init).  Otherwise close should
        ; return NULL.

Close:          ; ( libptr:a6 )

        ;------ set the return value
        CLEAR   d0

        ;------ mark us as having one fewer openers
        subq.w  #1,LIB_OPENCNT(a6)

        ;------ see if there is anyone left with us open
        bne.s   1$
```

```
        ;------ see if we have a delayed expunge pending
        btst    #LIBB_DELEXP,ml_Flags(a6)
        beq.s   1$

        ;------ do the expunge
        bsr     Expunge
1$:
        rts


        ; There are two different things that might be returned from
        ; the Expunge routine.  If the library is no longer open
        ; then Expunge should return the segment list (as given to
        ; Init).  Otherwise Expunge should set the delayed expunge
        ; flag and return NULL.
        ;
        ; One other important note: because Expunge is called from
        ; the memory allocator, it may NEVER Wait() or otherwise
        ; take long time to complete.

Expunge:        ; ( libptr: a6 )

        movem.l d2/a5/a6,-(sp)
        move.l  a6,a5
        move.l  ml_SysLib(a5),a6

        ;------ see if anyone has us open
        tst.w   LIB_OPENCNT(a5)
        beq     1$

        ;------ it is still open.  set the delayed expunge flag
        bset    #LIBB_DELEXP,ml_Flags(a5)
        CLEAR   d0
        bra.s   Expunge_End

1$:
        ;------ go ahead and get rid of us.  Store our seglist in d2
        move.l  ml_SegList(a5),d2

        ;------ unlink from library list
        move.l  a5,a1
        CALLSYS Remove

        ;
        ; device specific closings here...
        ;

        ;------ close the dos library
        move.l  ml_DosLib(a5),a1
        CALLSYS CloseLibrary

        ;------ free our memory
        CLEAR   d0
        move.l  a5,a1
        move.w  LIB_NEGSIZE(a5),d0

        sub.l   d0,a1
        add.w   LIB_POSSIZE(a5),d0

        CALLSYS FreeMem

        ;------ set up our return value
        move.l  d2,d0

Expunge_End:
        movem.l (sp)+,d2/a5/a6
        rts

Null:
        CLEAR   d0
        rts

;----------------------------------------------------------------------
;
; here begins the library specific commands
;
;----------------------------------------------------------------------

MyFunc0:
        CLEAR   d0
        rts

MyFunc1:
        moveq   #1,d0
        rts


        ; EndCode is a marker that show the end of your code.
        ; Make sure it does not span sections nor is before the
        ; rom tag in memory!  It is ok to put it right after
        ; the rom tag -- that way you are always safe.  I put
        ; it here because it happens to be the "right" thing
        ; to do, and I know that it is safe in this case.
EndCode:

        END
```

```
        INCLUDE 'exec/types.i'
        INCLUDE 'exec/libraries.i'

        INCLUDE 'asmsupp.i'
        INCLUDE 'mylib.i'

*****************************************************************************
*                                                                           *
*       Copyright (C) 1985, Commodore Amiga Inc.  All rights reserved.      *
*                                                                           *
****************************************************************************/


*****************************************************************************
*
* testlib.asm -- test the mylib.asm code
*
* Source Control
* ------ -------
*
* $Header: amain.asm,v 31.3 85/10/18 19:04:04 neil Exp $
*
* $Locker: neil $
*
* $Log: amain.asm,v $
*
****************************************************************************/

        XDEF    _main

        XREF    _printf
        XREF    _AbsExecBase

        XLIB    OpenLibrary
        XLIB    CloseLibrary


_main:
        move.l  _AbsExecBase,a6

        ;------ open the test library: this will bring it in from disk
        lea     myName(pc),a1
        CLEAR   d0
        CALLSYS OpenLibrary

        tst.l   d0
        bne.s   1$

        ;------ couldn't find the library
        pea     myName(pc)
        pea     nolibmsg(pc)
        jsr     _printf
        addq.l  #8,sp

        bra     main_end

1$:
        move.l  d0,a2

        ;------ call the first test function
        LINKLIB MLFUNC0,a2
        move.l  d0,-(sp)
        pea     0
        pea     testmsg(pc)
        jsr     _printf
        lea     12(sp),sp

        ;------ call the second test function
        LINKLIB MLFUNC1,a2
        move.l  d0,-(sp)
        pea     1
        pea     testmsg(pc)
        jsr     _printf
        lea     12(sp),sp

        ;------ close the library
        move.l  a2,a1
        CALLSYS CloseLibrary

main_end:
        rts

myName:         MYLIBNAME
nolibmsg:       dc.b    'can not open library "%s"',10,0
testmsg:        dc.b    'function MYFUNC%ld returned %ld',10,0

        END
```

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