The Commodore 64 User's Encyclopedia

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Preface

The Commodore 64 User's Encyclopedia is your one definitive reference book for your Commodore 64 Computer. By deciding to own it, you have made an investment in your computing future. It will save you hundreds of hours by bringing material from many sources into a single, easy-to-use, alphabetical reference handbook.

Much of the material is not available anywhere else. Here you will find the essential background material you need to answer your questions and solve problems on the Commodore 64 Computer.

Your *User's Encyclopedia* guides you through machine operation, BASIC programming, and what's available in software and hardware. Your *Encyclopedia* will quickly pay for itself through product information alone. And it is a comprehensive source of information about the whole area of microcomputers. The entries are short, clear, self-contained, and understandable. Should you desire additional information, hundreds of cross-references point you to related entries in the *Encyclopedia*. You will find it the most frequently used and most highly treasured book in your personal computer library.

While your *User's Encyclopedia* was written in simple language so beginning users can understand it, you will continue to find it indispensable as your knowledge of computers grows. It does not offer a detailed coverage of the internal electronic details of the Commodore 64 Computer. It does, however, provide a complete reference on BASIC programming, general operation of the computer and its accessories, and available products.

You will usually use your *Commodore 64 User's Encyclopedia* as a quick reference source. You will probably keep it right by your computer, instantly available when you encounter difficulties or want a more complete understanding of what your Commodore 64 Computer is doing. You will also enjoy just browsing through its many short, easy-to-read entries. This will allow you to easily and casually increase your knowledge of the Commodore 64 Computer, and microcomputers in general. *The Commodore 64 User's Encyclopedia* was produced for you by Gary Phillips & Associates. Gary Phillips & Associates also provides *User's Encyclopedias* for the IBM PC, Apple, Atari, TI-99, and many other personal computers. *The Commodore 64 User's Encyclopedia* will serve as your first reference source for most questions. Manuals from Commodore and other books provide a valuable backup to the *User's Encyclopedia*—when you have time to explore a topic in the traditional book presentation. But when time is pressing and you want information fast, you will rely on *The Commodore 64 User's Encyclopedia. The Commodore 64 User's Encyclopedia* is organized alphabetically, with numbers and special symbols following "Z." Here are some special pointers for understanding the format of the *Encyclopedia*:

Variable types in various statements and commands are placed between arrow brackets. For example, <line number> means you would use a specific line number from your BASIC program. Similarly, <variable> indicates any variable you are using in your program. For example, the statement to display a variable's value is PRINT <variable>. To print out the contents of the variable Count, you would replace <variable> with Count, giving PRINT Count. Parentheses () around an item in a command or instruction should be typed by the user at the keyboard. However, brackets [] indicate only that the enclosed material is optional; these brackets should not be entered into the computer. Also, q.v. is used after a word or phrase to direct you to other entries that you may want to see for additional information (q.v. from the Latin quo vide, "which see"). The names and addresses of all software and hardware manufacturers are listed alphabetically in the Vendors List at *the end of* the book.

We have made every effort to make your *Commodore 64 User's Encyclopedia* complete, accurate, and up-to-date. The descriptions of products are identified by an "*" following the product name. These may be

either reviews or brief descriptions to help you find products you may want and acquire further information. You will need to check with the manufacturer or a retail outlet to verify the suitability of the product for your needs and to determine its price and availability. Similarly, you should verify any technical information in the *Encyclopedia* before relying on it for a major decision. Neither the authors, Gary Phillips & Associates, nor The Book Company will be liable for any errors or omissions in the *User's Encyclopedia*. If you should find an error, omission, or have any suggestions for improvements or additions to future printings or revisions of *The Commodore 64 User's Encyclopedia*, please write or call:

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Manufacturers of hardware or software who would like to be included in the next revision of *The Commodore 64 User's Encyclopedia* may send review copies and descriptive literature to the same address.

Congratulations on deciding to own the one definitive reference source for the Commodore 64 Computer. We know you will enjoy and profit from it in the months to come.

Gary Phillips
Sanjiva K. Nath
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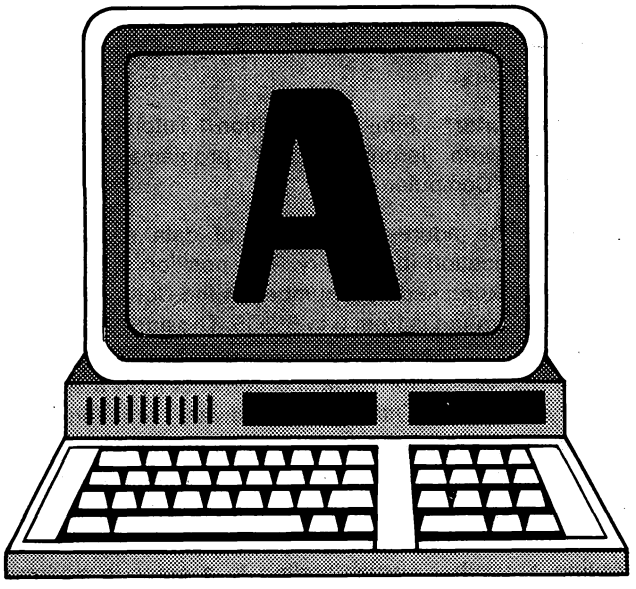

A Codes. ASCII = 65, CBM ASCII = 65 or 193, HEX = 41. a—ASCII = 97, CBM ASCII = 65 HEX = 61. Screen code = 1 or 65. See CBM ASCII.

A Diagram symbol for the Accumulator. Also stands for Address line, and the hexadecimal sign for the decimal integer 10: A base 16 = 10 base 10 = 12 base 8 = 1010 base 2.

A In machine architecture, the symbol A refers to Accumulator.

Å Symbol for angstrom, equaling one billionth of a meter (one nanometer).

A: CP/M keeps an internal record of which disk drive is currently considered the "default disk" or "default drive." When you start a CP/M session, the default disk is always A. To change the default disk to B, enter B: To go back to A as default, enter A: To determine which is the default disk drive, look at the prompt (A> or B>) from CP/M. The CP/M prompt itself specifies the default drive (A> for drive A on the left, B> for drive B on the right). See CP/M.

A> CP/M. A> is a prompt from the disk operating system indicating that the drive A is the current default drive. This prompt is displayed on the screen when CP/M is ready to accept a command from the keyboard. This may occur either when CP/M is first started up, at the completion of any command when A is the default drive, or when the user returns to drive A with the command A:. The disk directory is read only during the initial reference to the disk. Every time a disk is changed in the drive, a warm start should be performed on the system to enable CP/M to read the new disk directory.

A Dollar and Change* Students create change for imaginary customers. Cassette. Micro-Ed.

Abort The process of ending a program which has encountered an error. "Abort" returns the control to an operator or operating system.

ABORT CP/M. Command used to halt the execution of a program. The format is:

ABORT<program>

<program> is the program to be aborted, specified in the argument.

See also CP/M Commands.

Absolute Addressing Mode See Addressing Modes.

Absolute Value This term describes the value of a number expressed as a positive number, denoted by enclosure in vertical bars (|). Thus, if a number is positive or zero, then $|x| = x$. If x is negative, then $|x| = -x$.

A-bus The primary internal source-bus to the arithmetic logic unit in any processor.

AC See ACcumulator.

Access Time The time it takes to get a byte of information from memory.

Accountant, The* A tool for the creation and maintenance of general ledger, balance sheet, and income statements that will be invaluable for your business accounting. Disk; printer required. Powerbyte.

Accounting Software See Accountant, The; Accounts Receivable and Payable; Amortizer, The; Bidder—My Profit Margin, The; Billing Solver, The; Budgeteer; Budgeter, The; Bulletin Board; Business Accounting; Business Calendar—Personalized Database; Business Inventory; Business Man, The; Cash Flow Model; Chartpak 64; Checkbook Manager; Cheque-Check; Client Tickler, The; Present Valve; Profit Sharing Plan; Rule of '78; Sales/Expense.

Accounts Payable/Check Writing See Management Accounting Systems.

Accounts Receivable and Payable* Can be used to create a posting system for accounts receivable or payable, as well as to print the resulting information. Disk; printer required. Powerbyte.

Accounts Receivable/Billing See Management Accounting Systems.

Accumulator This register is located on the microprocessor. It is used to transfer data and to receive the results of logical and arithmetic operations during the execution of Machine Code. All data passing through the microprocessor invariably passes through the accumulator.

ACK ACKnowledge character in ASCII, a 06 base 16. ACK is used in communications (on some computer systems) to complete a handshaking sequence. The ACK signal indicates that the information has been accepted.

Acoustic Coupler A mechanical instrument for connecting the telephone handset to a computer through a modem. The data is converted to tones—usually audible—for transmission over the phone lines.

ACPTR The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFA5, ACPTR will move one byte of data from the serial bus to the accumulator using complete handshaking. The TALK and TKSA kernal routines must be executed prior to using ACPTR to establish which device will be sending data. The READST routine can be used to return the status word and reveal any errors encountered in the routine.

Across the Plains* A historical teaching game in which two players race across the nation in search of California gold. Score is cumulative from section to section. Package of four programs for ages twelve and over. Cassette. Micro-Ed.

A/D Pronounced "A to D." Analog to Digital. Conversion from a sensor's analog voltages and currents to the digital representation used by computer systems. The computer can then process data directly from the external world.

ADC ADd with Carry. An Assembly language instruction for the 6510 that adds the contents of a memory location or literal to the contents of the accumulator plus the carry bit. The result of the addition is placed in the accumulator. The result affects the sign bit, the overflow bit, the zero bit, and the carry bit. The argument addressing mode can be immediate, zero page, zero page X, absolute, absolute X, absolute Y, (Indirect X), or (Indirect) Y. The instruction can be used to add either decimal or binary with the appropriate bit set. See Machine Language Programming.

Add It* Interesting graphics lead the student into addition problems. Recommended for early elementary grades. Cassette. Comm*Data Computer House.

Add On System or circuitry attached to a computer to increase memory or performance. For the Commodore 64, these include ROM cartridges, peripherals (such as disk drive, printer, modem), etc.

Adder A processor unit that performs binary arithmetic.

Adding Fractions* Master the mathematical function of finding the lowest common denominator (LCD) and then adding the fractions together. Disk or cassette. Microcomputer Workshops.

Adding or Subtracting Two and Three Place Numbers in Columns* Students practice adding and subtracting columns of numbers. Computer corrects the answers. Cassette. Micro-Ed.

Adding With Objects* Uses shapes to create addition problems that can be solved by primary grade students. A recap of performance is given at the end of each set of problems. Cassette. Micro-Ed.

Addition with Carry* Increase your ability to add correctly with this program that has nine columns and nine rows of numbers available for problems. Disk or cassette. Microcomputer Workshops.

Addition 1 Tutor* This program helps young students to complete addition problems. Cassette. Comm*Data Computer House.

Addition 2 Tutor* Similar to Addition 1 Tutor*, only more advanced, with larger number problems. Cassette. Comm*Data Computer House.

Address The address of a byte of data refers to its numerical location in memory. The position of a byte in memory is expressed by a number. In the Commodore 64, the address range is from 0 to 65535. The address is used in programs to alter the content(s) of a specific memory location as well as for retrieving contents from a specific memory location. Often the hardware functions are controlled by addressing specific bytes in memory.

Many of the functions performed by the Commodore 64 are memory mapped. Hardware as well as software can be controlled simply by moving data to a particular address. Moving a number corresponding to a color to address 53281 will automatically change the color of the entire screen. Data from an address can be viewed on the screen using a PRINT PEEK (address) command. Addresses are referred to in BASIC commands in decimal (0 to 65535). In Machine Code instructions, addresses are referred to in hexadecimal (0000 to FFFF). See also Hexadecimal, Memory Map.

Address Bus Coming from the microprocessor of the Commodore 64 are 16 separate lines referred to collectively as the address bus. Since each line can either be in a 1 state (with 5 volts on the line), or a 0 state (with 0 volts on the line), there are 65536 different combinations. Each combination is a specific address. All the RAM and ROM chips as well as the interface chips are connected to the address bus.

Each separate combination or address connects one byte from one of the chips mentioned above with the data bus. That byte may be read onto the data bus or written from the data bus, depending on the control signals. If a different combination or address is turned on, the data bus is then connected to the new address. In this way data can be moved from one device to another. When information is POKED into an address, the number entered by the user is placed on the accumulator of the microprocessor. The address lines are set according to the address specified by the user, and the number from the accumulator is moved to the data bus

Address Mark 8-bit code placed at the beginning of specific fields on a disk track, such as the index, identification, data, or deleted data.

Address Mite 2* Will help you maintain files of names and addresses for easy review, editing, and sorting by name/zip. You can perform searches by key or word. Nelson Software.

Address Notation For the Commodore 64. The conventional notations for representing the position of a byte in memory (Address) are decimal (base 10) and hexadecimal

(base 16). The hexadecimal numbers are preceded by a $. See also Decimal, Hexadecimal.

Address/Phone List Software See Address Mite 2; Deluxe Addresser; Ma Bell; Mailfile; Mailing List; Mailing List—Home/Business Program; Mailing List, The; Mailman, The; Mini Jini; Phone/Address List Software; Phone Directory; TOTL Software.

Addressing Modes Many Assembly language instructions perform operations on operands. The location of the operand is specified in the instruction in a number of different ways. Addressing modes are the ways those locations can be identified.

Immediate mode: In the immediate mode the operand itself is listed in the instruction. An example would be: LoaD the Accumulator (LDA) #34 in which the number 34 would be loaded into accumulator.

Absolute mode: In the absolute mode the operand is found at the address that is listed in the instruction. An example would be: LDA $2500 which would load the number located at address $2500 into the accumulator.

Zero page mode: In the zero page mode the operand is found in the address listed in the instruction. However, the address listed must be in the first 256 bytes of memory (zero page). LDA $09 would load the value located at 0009 into the accumulator.

Absolute X mode: In the absolute X mode the address listed in the instruction is added to the value in the X register. The sum is used as the address to find the operand. LDA $2500, X loads the value located at address (2500+X) into the accumulator.

Absolute Y mode: In the absolute Y mode the address listed in the instruction is added to the value in the Y register. The sum is used as the address to find the operand. LDA $2500, Y loads the value located at address ($2500+Y) into the accumulator.

(Indirect X) mode: In the (indirect X) mode the zero page address listed in the instruction is added to the number in the X register. The sum is used as the address of the first of two consecutive bytes whose values are used to calculate the address of the operand. LDA ($09,X) takes the value located at address ($0009+X) and the value of the next byte in memory to make a new address. This new address contains the value to be loaded into the accumulator. The Commodore 64 Programmer's Reference Guide calls this mode "Indexed Indirect Addressing." This addressing mode is generally referred to as "Relative."

(Indirect) Y mode: In the (indirect) Y mode the value of the zero page address listed with the instrucion contains the low byte of a second address. The zero page address +1 contains the high order byte of this second address. This second address is then added to the Y register to find the true address of the operand. If the Y register contains $02, address $09 contains $03, and address $0A contains $25, then LDA ($09), Y would load the byte located at address ($2503+2). The Commodor 64 Programmer's Reference Guide calls this mode "Indirect Indexed Addressing." This addressing mode is generally referred to as "Relative."

Adhesive Tab A disk is write-protected if the write-protect notch is covered over with an adhesive tab. The notch is located about one inch down on the left hand side of the disk (when viewed from the top with the disk in the drive insertion position). Attempts to alter the contents of a write-protected disk result in an error message:

"WRITE PROTECT ON"

You are allowed to use files, load them, or copy from the write-protected disk. The purpose of these limitations is to prevent accidental loss of the only copy of programs or data.

It is a good practice to put an adhesive tab (supplied with boxes of disks) over the write-protect notch of any important disk before you back it up. Then if you ask for the backup in the wrong direction (from the destination disk to the source disk), you will get a second chance to make the backup rather than losing your data.

Adjective* Answer questions and hit the RETURN key to grab points going by in a box in the upper left-hand corner. Get the question right, and the number of points you landed on will be added to your score. Get the wrong answer, and the number is subtracted from your score. Ideal for elementary ages and up. Cassette. Micro-Ed.

Adventure Pack I* This series contains three programs: Computer Adventure, Moon Base Alpha, and Jack & the Beanstalk. Cassette. Victory Software.

Adventure Pack II* This series contains three programs: African Escape, Hospital Adventure, and Bomb Threat. Cassette. Victory Software.

Adverbs* Learn about the adverb by definitions and examples, then test yourself and view your performance. Typing in a question mark (?) displays the answers you missed. Good practice for students in elementary school and up. Cassette. Micro-Ed.

Agreement of Subject and Verb* Race a steam engine against the computer by choosing the correct answers to the blanks in nine to thirteen sentences. Program has a bank of thirty-two different problems. Receive a performance summary at end of the race. Cassette. Micro-Ed.

Algorithm A mathematical or logical process that will return the solution to a given problem. First a problem is stated; then an algorithm is developed for its solution. The solution steps are then flowcharted, and the program is developed from the flowchart.

Allocation of Space Assigning particular areas of memory (internal, disk, etc.) to particular files, programs, or functions. Allocation is sometimes done by a programmer, sometimes automatically by a program such as the Disk Operating System (DOS).

On the 1541 disk drive, each track and sector number used by a file is recorded on a special space on disk called the Block Availability Map. When a file is to be stored on disk, the controller of the drive looks at the Block Availability Map to see if the next sector is free. If it is, the block from the file is moved to that sector, and an update is made in the BAM.

On the Commodore 64, BASIC programs are allocated memory from address 2048 to 40959. The computer actually looks at a pointer located at addresses 43 and 44 to know where to start entering BASIC lines and begin storing data at that location. This pointer can be changed to load BASIC in other locations.

Special sections of memory on the Commodore 64 have both a ROM byte and a RAM byte at the same address. The microprocessor can switch between them to allocate more space. Address A000 to BFFF contains BASIC ROM and RAM, E000 to FFFF contain KERNAL ROM and RAM, and D000 to DFFF contain the character ROM and I/O registers.

Alpha Help* Audio and visual aides help teach four- to six-year-olds the ABCs, giving a final report on ability. Cassette. Comm*Data Computer House.

Alpha Test Site vs. Beta Test Site A test site helps the originators of a hardware or software product test it in a real-world situation.

Alpha test is usually performed by a few companies or individuals who realize that their product is incomplete or may have flaws. Alpha testers often are internal to the originating company or otherwise closely related.

There are more Beta test sites. They expect the product to be complete and correct, and agree to test it in a real world production situation. If errors are discovered, the originators ordinarily attempt to fix them rapidly so the Beta sites can stay "on the air" with the new product. If numerous or serious bugs are found, the product may have to go back to alpha testing until an improved version can be presented for another round of Beta testing.

Alphanumeric A set composed of alphabetic, numeric, and special characters.

Alterable Memory The internal memory of the Commodore 64 is comprised of RAM and ROM. The ROM chips have set patterns on each byte of memory that cannot be changed. When power is supplied to the chips, those unalterable numbers are available to the computer.

RAM chips contain random values. When power is supplied to them, they can be changed by the operating system or the user.

Mass storage media also contain alterable memory. Disks and cassettes can be written to save data from the computer. If there is no write protection on the disk or cassette, the same disk or cassette can be written to again and again.

Alternating Current Any signal not constant is considered alternating current; however, this term usually means that the current continuously changes (alternates) polarity.

ALU **See Arithmetic Logic Unit.**

Amortizer, The* Now you can print your own amortization schedules and review principal and interest totals. Disk; printer required. Powerbyte.

Ampere Measurement of electrical current: the actual number of electrons moving past a stated point per second.

Amplifier A device or circuit that increases the power or strength of a signal.

Analog An electrical signal with a continous range of voltage or current values. Used in contrast with digital.

Analyser/Analyzer Any device that checks or regulates a component, board, or system and presents the data for review.

AND A logical operator used in Boolean operations. The result of an AND operation is 1 only if the value of the two bits tested is 1.

The format is:

<expression> AND <expression>

Example:

20 IF A=B AND C=3 THEN GO TO 100

AND BASIC. Term for a logical procedure defined by the rule: If A and B are 1, then C is 1, other wise C is 0. For logical situations, such as the conditional test in an IF statement, substitute TRUE for 1 and FALSE for 0. For example:

```
  10110111
  10000100
  --------
  10000100
```

AND—Assembler Instruction An Assembly language instruction for the 6510 that performs the logical AND on the contents of the accumulator and the contents of a memory location or literal. The result of the AND function is placed in the accumulator. The result affects the sign bit and the zero bit. The argument addressing mode can be immediate, zero page, zero page X, absolute, absolute X, absolute Y, (Indirect X) and (Indirect) Y.

Animal Zap* A shoot 'em-up program that includes two games: Animal Zap and Number Zap. Cassette. Comm*Data Computer House.

Animation The use of movements in graphics to simulate action. In most computers, animation is created with multiple graphic displays in succession. The microprocessor looks at one RAM area for its screen display and is then commanded to look to another and so on, creating the illusion of movement. The Commodore 64 has a sprite system that facilitates and greatly simplifies animation. A sprite is created once and can be moved using specific addresses. See Sprites.

Annihilator* Defend planets against invaders in this Machine Code program. Cassette. Victory Software.

ANSI American National Standards Institute.

Antonym Machine* This program chooses pairs of words with opposite meanings, shows you one of them, and has you fill in the other. Your performance is evaluated as you go. For elementary level students. Cassette required. Micro-Ed.

Antonym Match* A dozen pairs of antonyms are concealed from sight. Two players, in turn, choose two sections to look at and try to find a set. Good practice for fourth through sixth graders. Cassette. Comm*Data Computer House.

APL A Programming Language (APL) invented by Kenneth Iverson. It is used for algorithmic interactive programming.

Apostrophe* After being introduced to the proper use of apostrophes, the student is quizzed on the material and a final report on ability is given. Ideal practice tool for elementary students and older. Cassette. Micro-Ed.

Append To add to the end of a character string, list, or file.

Apple Loader* A device that helps transfer programs from the Apple computer to the Commodore 64. It only allows the transfer of BASIC language words, not Machine Code or Assembly language. Once transferred, the program must be modified for use on the Commodore 64. Interdesign, Inc.

Applications Software A software package is a group of computer programs, possibly including data files and documentation, that perform a function or group of related functions on the computer. These are called applications software when the programs are devoted to an end user task. Examples are a word processing package or an accounting package. Systems software packages, on the other hand, facilitate the use of the machinery; these include disk operating systems and program development packages.

Arbitration Management of claims by competing systems or processes for a limited resource. Bus arbitration allocates a system bus among the sub-system components, i.e., the CPU, memory, disk controller, and other external devices.

Architecture The special selection, design, and interconnection of the principal components of a system. In a microprocessing unit this could be the number and function of registers, the instruction addressing modes, and the bus structure and timing.

Arctangent BASIC. See ATN.

Area and Perimeter* A graphic program that uses problems to help students learn area and perimeter formulas. Cassette. Comm*Data Computer House.

Area of a Rectangle* Helps elementary students increase their understanding of the formulas for finding the area of a rectangle. Features excellent graphics and different levels of difficulty. Disk or cassette. Microcomputer Workshops.

Argument Data passed from one process or program to another process or program. Similar to a football pass, except that one or more bytes of data replaces the football (and the receiver is a program). The sender may be a program or a person typing the data onto a command line to be "passed" to a program. The two most common examples would be DOS passing parameters from the command line to a program (see Relocating Loader) and a BASIC program passing variables to a subroutine.

Arithmetic Logic Unit (ALU) The element in the central processor which performs the basic data manipulations in the central processor such as add, subtract, complement, negate, rotate, AND and OR.

Arithmetic Operations Arithmetic operations are performed on a priority basis on the Commodore 64. When executing calculations on a particular line, first priority goes to performing exponentiation from left to right. Once those calculations have been done, multiplication and division are performed from left to right on the line. Finally, addition and subtraction are performed. Parentheses can be used to bypass the normal hierarchy of operations.

Arithmetic Statement An instruction specifying an arithmetic operation.

ARQ Automatic ReQuest for repeat. In telecommunications, a device capable of determining whether it has correctly received information transmitted from another source may automatically request a repeat transmission.

Array A group of data items identified by one name. Each item can be located by its subscript; subscripts are a set of numbers indicating the placement of each item in the group.

Array BASIC. An array is a list consisting of identical TYPE data elements. A reference to an array in a program is ordinarily made by the name of the array and the index of the specific element in the array. For more information on Arrays in BASIC see DIM statement.

Arrays BASIC. See DIM.

ASC BASIC Numeric Function. Returns the Commodore ASCII code (a number between 0 to 255) for the first character in the string <string>.

The format is:

ASC (<string>)

<string> is a string constant or variable.

An example is:

READY 10 X$="STRING" 20 PRINT ASC (X$) RUN 83 READY

In this example the ASCII code for "S" is 83. "S" is the first character of the string X$. If X$ is null, the system responds with an error message:

?ILLEGAL QUANTITY.

For a listing of the ASCII codes see ASCII and CHR$ CODES.

ASCII American Standard Code for Information Interchange.

ASCII and CHR$ Codes A Table of ASCII and CHR$ Codes.

PRINTS	CHR$
	0
	1
	2
	3
	4
[WHT]	5
	6
	7
[DISABLES SHIFT] **	8
[ENABLES SHIFT] **	9
	10
	11
	12
[RETURN]	13
[RETURN TO LOWER CASE]	14
	15
	16
[CRSR DOWN]	17
[RVS ON]	18
[CLR HOME]	19
[INST DEL]	20
	21
	22
	23
	24
	26
	27
[RED]	28
[CRSR]	29
[GRN]	30
[BLU]	31
[SPACE]	32
!	33
"	34
#	35
$	36
%	37
&	38
.	39
(	40
)	41
*	42
+	43
,	44
-	45
.	46
/	47

PRINTS	CHR$
0	48
1	49
2	50
3	51
4	52
5	53
6	54
7	55
8	56
9	57
:	58
;	59
<	60
=	61
>	62
?	63
@	64
A	65
B	66
C	67
D	68
E	69
F	70
G	71
H	72
I	73
J	74
K	75
L	76
M	77
N	78
O	79
P	80
Q	81
R	82
S	83
T	84
U	85
V	86
W	87
X	88
Z	90
[	91
#	92
]	93
↑	94
↓	95
**	96
**	97
**	98

PRINTS	CHR$
**	99
**	100
**	101
**	102
**	103
**	104
**	105
**	106
**	107
**	108
**	109
**	110
**	111
**	112
**	113
**	114
**	115
**	116
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	128
	129
	130
	131
	132
f1	133
f3	134
f5	135
f7	136
f2	137
f4	138
f6	139
f8	140
[SHIFT RETURN]	141
[SWITCH TO UPPER CASE]	142
	143
[BLK]	144
[CRSR UP]	145

PRINTS	CHR$
[RVS OFF]	146
[CLR HOME]	147
[INST DEL]	148
	149
	150
	151
	152
	153
	155
[PUR]	156
[CRSR LEFT]	157
[YEL]	158
[CYN]	159
[SPACE]	160
**	161
**	162
**	163
**	164
**	165
**	166
**	167
**	168
**	169
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**	177
**	178
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CODES 192-223 SAME AS 96-127
CODES 224-254 SAME AS 160-190
CODE 255 SAME AS 126

** For Graphics See:
Commodore 64 Programmer's Reference Guide
Published by Commodore Business Machines, Inc.
Howard W. Sams Co., Inc.

ASCII Code to Characters BASIC. See CHR$.

ASCII Codes for Characters BASIC. See ASC.

ASL Arithmetic Shift Left. An Assembly language instruction for the 6510 that shifts the contents of the accumulator or of a memory location to the left one bit. A 0 moves onto the rightmost bit and the leftmost bit moves into the carry. The result of the shift is left on the accumulator or the memory location of the shift. The result affects the sign bit, the zero bit, and the carry bit. The argument addressing mode can be zero page, zero page X, absolute, absolute X, or the argument can be A for accumulator.

ASR Automatic Send Receive. A terminal having not only a keyboard and printer, but also an automatic reading and recording device, such as a cassette tape unit or a paper tape reader and punch.

Assembler Synonym for Assembly, a programming language. See Assembly language.

Assembler 64* A software product for the Commodore 64 with a number of programs for writing, editing, assembling, and loading assembly language programs. The editing program lets the user enter assembly language programs with the same screen editing capabilities as in BASIC. The assembler program converts the program into Machine language and indicates any errors in syntax or compiling. An option for printing is included. A monitor program comes with added capabilities for debugging programs. The package presumes the reader already has some understanding of Assembly language programming, but is an excellent package for Machine Code development. Printouts and can be dumped to most Commodore 64 compatible printers. Disk. Commodore.

Assembly Language Or Assembler language. A programming language closely related. Usually an Assembler program is longer and more difficult to understand (and to code) than a BASIC program to perform the same process. The tedious and time-consuming nature of Assembler programming led to the invention of "high-level" languages, such as BASIC, FORTRAN, COBOL, and Pascal. These languages greatly abbreviate the description of the work to be done by the computer. A complex translation process is required to turn the high-level program into a Machine language program that the computer can use. This translation process is time consuming and usually results in a Machine language program that runs many times slower than a corresponding program written in Assembly language.

The compiled program is also usually many times larger than a corresponding program written in Assembler. Why is this? Because higher level languages simplify the programmer's job by using very general program procedures which can handle all possible circumstances in which the statements might be used. Since, for a particular program, only a small fraction of this generalized code is needed, much of the code produced by the compiler is superfluous. The information required to specify whether or not it is needed is exactly what was left out in simplifying the higher level language.

Interpreted languages (such as BASIC) have an additional performance disadvantage. They do the translation of higher level source code into executable Machine Code every time the program is executed, rather than only once. Assembly language programs can run much faster, use less memory, and access more special machine level functions such as direct I/O devices, than BASIC or other high level languages. Assembler is popular with software houses for writing programs that must run very fast (action games or programs to run fast devices such as disk drives, etc.). But because Assembler is harder to code, few individual users write programs in Assembler. Those who do, ordinarily write only selected time-critical or highly specialized routines. More commonly, a program written largely in, for example, BASIC may use a short section of code written in Assembler to do one particular time-critical or memory-size critical task. The Assembler code will be called as a subroutine by the BASIC program.

In summary, Assembly language is a highly technical language more adapted to the needs of the processor than to the needs of the user. It is invaluable when speed or memory size is critical, for highly specialized applications and for commercial software development. But for most users it is not practical to use Assembler as a regular programming language. They can rely on commercial software packages or write programs in a high level language such as BASIC. If an Assembly language program or subroutine is required for your application, paying an experienced Assembly language programmer would be considered an alternative to learning Assembler. But if you enjoy getting to the nuts and bolts of the computer, Assembly language is the quickest route to the inside workings of the computer.

Assembly Language Debugger* Contains all the standard debugging features. Includes windowing, steps, breakpoints, super-complex conditional breaks, patch, compiled BASIC-like language, and more. Disk or cassette. Pterodactyl Software.

Assignment Giving a value to a variable. In BASIC, a simple assignment would be:

LET X=5

This assigns the value 5 to the variable X.

Asynchronous An event or device which does not have the same timing as the central processing unit.

At Home Inventory* Keep an inventory of all your personal property in case of an emergency. Record serial number, descriptions, purchase price, and other information. Powerbyte.

ATE Automatic Test Equipment. These devices and/or programs (usually ROM resident) automatically perform routine checks on equipment. The tests may occur on a time scheduled basis, or in response to an event, such as powering on or resetting the system.

ATN BASIC Function. Returns the ArcTaNgent of <x>. The format is:

<v> = ATN(<x>)

<x> may be a numeric expression of any numeric type. The evaluation of ATN is always performed in single precision. ATN returns the angle whose tangent is x, b measured in radians in the range -PI/2 to +PI/2, where PI = 3.141593. To convert radians to degrees, multiply by 180/PI.

Atom* Includes tables, graphics, and a book on various aspects of the atom and its composition to aid in learning molecular principles. A quiz picked arbitrarily from a list of thirty follows completion. Good practice for science students. Cassette. Micro-Ed.

Atoms* Learn molecular structure and atomic composition of salt with graphic visuals. Includes short test after completion. Made especially for junior high school students. Disk. Comm*Data Computer House.

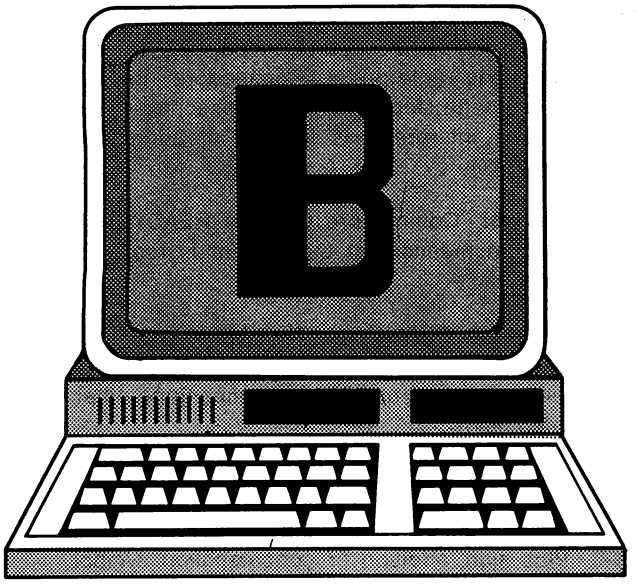
Attack Sound The rate at which the volume of a note rises from the moment it is first struck to the moment it reaches maximum value. Attack is a component of the envelope that the SID chip of the Commodore 64 executes for each note.

Attenuation The reduction in strength of an electrical impulse.

Audio/Video Port The Commodore 64 comes with a 5-pin DIN socket in the rear of the computer that serves as an audio/video port. This port can be used for a monitor or an alternate sound system. Except for the 1701 monitor from Commodore, this port is not generally plug compatible with most monitors. It is, however, possible to use an adapter to convert the 5-pin DIN to the RCA jack used by most monitors. Looking at the back of the Commodore 64, you will see that the bottom plug is attached to the ground of the monitor cable and the rightmost socket (LUM) is attached to the video line of the monitor cable. Remember, on a monochrome monitor it may be necessary to change the background color and character color of the Commodore 64 for high resolution. A higher quality sound system can be used by a similar adapter using the far left DIN pin (looking from the back) for the audio and the bottom pin for ground. The user's guide that comes with the Commodore 64 has a pin configuration in the Appendix.

```
AUDIO/VIDEO
::* * PIN:TYPE:*::*
————————————————————*::*
1:LUMINANCE:**
::*1*
2:GND:*3[—]
::[—]4*
3:AUDIO OUT:*[—]
::5*
4:VIDEO OUT:*[—][—] 2
::**
5:AUDIO IN:*::*
..
```

Auto Clock, The* This menu-driven timing device can be used to turn your system on and off, has 19 user-accessible subroutines, connects into the bus expansion slot, and has 2K CMOS RAM with battery backup. Micro World Electronix, Inc.



B Codes. ASCII = 66, CBM ASCII = 66 or 194, HEX = 42. b—ASCII = 98, CBM ASCII = 66, HEX = 62. Screen code = 2 or 66. See CBM ASCII.

B B is used as an abbreviation for Bytes when referring to memory, or Baud rate when referring to communications. KB = 1000 bytes or baud (technically 1K = 1024 bytes).

B Bus line. Also: the hexadecimal symbol for the decimal number 11.

B: CP/M—Change Default or Current Disk Drive CP/M keeps an internal record of which disk drive is currently considered the "default disk" or "default drive." When you start a CP/M or BASIC session, the default disk drive is always A. To change the default disk drive to B, enter B:. To go back to A as default, enter A:. To determine which is the default disk drive, look at the prompt (A> or B>) from CP/M.

B> CP/M. B> is a prompt from CP/M indicating that the drive B is the default drive. The prompt also indicates that the system is ready to accept a command from the keyboard. To go back to drive A, enter A:.

B-A Disk Command. See Block-Allocate.

Backfire* An action game in which elementary school students try to destroy the divisors of a set number after defining them. Cassette. Micro-Ed.

Backgammon* The old "you against the computer" game with three levels of difficulty and full color graphics. Cassette; 3K RAM. Star Tech, Inc.

Backplane Also called a motherboard, it is the physical area in a system where the boards plug in. It usually contains the buses of the system either in printed circuit or wire-wrap form.

Backup A backup utility that will copy some copy-protected disks but not others.

Backup Copy A duplicate copy of a program or data stored on a second disk or cassette in case of loss or damage to the original.

Backup Devices See Disk Drive, Cassette.

Backup Disks See Write-Protect, Adhesive Tab.

Bad Data An error message from the Commodore 64 indicating that while a program was set up for receiving numeric data it received string data instead. INPUT #5,A indicates that the data being input from the open file referenced by 5 must be a numeric value. If instead an alphabetic character or word is input a "Bad Data" message will appear.

Bad Sector A sector on the disk which will not read/write data correctly. Usually due to a minor physical flaw in the disk. One or two bad sectors will not seriously affect the disk's use;DOS will mark them as bad and avoid using them. If there are more then a few bad sectors, the disk should be used as a frisbee rather than a device for holding your valuable data.

Bad Subscript An error message from the Commodore 64 indicating that the program encountered an element of an array that is outside the range dimensionalized in the program. If you neglect to dimensionalize an array and you attempt to use more than ten elements per variable you receive this error message. For example, the statement:

FOR X=1 to 20:A(X)=X:NEXT

results in a "BAD SUBSCRIPT" error message if you do not first dimensionalize A(X).

Balancing Chemical Equations* Helps high school students gain experience at balancing chemical equations. The problems increase in complexity as the students progress. Disk or cassette. Microcomputer Workshops.

BAM See Block Availability Map.

Bank The 64K of memory in the Commodore 64 is divided into 4 Banks (sections) of 16K each. The VIC-II chip can only access the memory one bank (16K) at a time for video display information. See also Vic-II, Complex Interface Adapter.

Bar Chart* The bar chart format is available for fast and efficient visual exhibition of arithmetical information. Disk; printer required. Powerbyte.

Bar Code The consumer product information code. The bars of various thickness found on many store items represent a bar code that is unique for each product. By reflecting light off this bar code into a photoelectric cell, the bar code is converted into bytes of information in a computer. The computer can then identify the product, its price, number of units left, etc.

Bar Graph* Helps elementary students to better understand bar graphs and the type of information they contain. A review is offered at the conclusion of the practice. Cassette. Micro-Ed.

BASE Alternate business name of Bay Area Systems Engineering—Originators of the *Commodore 64 Users Encyclopedia, The Vic-20 User's Encyclopedia*, and other information resources for the personal computer user.

Base Register The register which contains the longer part of a two-part Assembly language address. The smaller part, called the displacement or offset, is contained in the Assembly language instruction. The data that the instruction is to operate on is located at the "effective address"—the byte of memory whose address is the sum of the number in the specified base register and the offset number given in the instruction. This method of specifying addresses allows data to be located with fewer bits than would a full, explicit address.

BASF Badische Anillin und Soda Fabrik, a manufacturer of magnetic storage media including disks.

BASIC Beginner's All Purpose Symbolic Instruction Code. A popular computer language invented at Dartmouth for educational purposes. Similiar to the FORTRAN programming language, BASIC is easy to use and learn, and is now on almost all microcomputer systems. Some BASICs have just the bare essentials of regular BASIC, which is a form of Dartmouth original BASIC. Super BASICs may have features from other languages. Compatibility problems between various BASICs do exist.

BASIC Compiler Programs written in a high-level language such as BASIC are converted into the Machine Code equivalent by a program called the Compiler. Once compiled, the Machine Code form of the program can be stored and executed at any time with up to 300 times the speed of the original BASIC program. This is different from an Interpreter, which translates or interprets each program instruction as it is executed and every time it is executed. The Commodore 64 has a built-in BASIC Interpreter that converts the "Source Code" (a BASIC program) into an "Object Code" (Machine Code) each time the program is executed.

BASIC—Default or Current Disk Drive CP/M and BASIC keep an internal record of which disk drive is currently considered the "default disk" or "default drive." When you start a CP/M or BASIC session, the default disk drive always is A. To change the default disk drive to B, enter B: or, to go back to A as default, enter A:. To determine which is the default disk drive, look at the prompt (A> or B>) from CP/M.

Basic Disk Operating System CP/M. See BDOS.

Basic Input Output System CP/M. See BIOS.

BASIC Interpreter The interpreter is a Machine language program that uses the "source" program as data—a source of instructions or commands to control its execution. The source program in this case is a higherlevel language (BASIC) program that is converted into Machine language (ML) code line by line as the program is executed.

BASIC Interpreter—CBM BASIC Interpreter The Commodore 64 is equipped with an 8K CBM BASIC Interpreter which converts (interprets) Commodore BASIC into Machine language step by step as it executes the BASIC program. The interpreter is located at address 40960 through 49151.

BASIC Prompt Commodore 64 uses READY, a BASIC prompt, which means that the system is ready for the programmer.

BASIC—Special Characters The following characters have special meanings in the Commodore 64. These characters cannot be used to have meanings other than those stated below:

	Blank—Keyword separation
;	Semi-colon—Formats output
=	Equal sign or assignment symbol
+	Plus sign, addition or concatenation symbol
-	Minus sign, subtraction
*	Asterisk or multiplication symbol
/	Slash or division symbol
↑	Up arrow, exponentiation
(	Left parenthesis, expression evaluation
)	Right parenthesis, expression evaluation
%	Percent sign or integer type declaration symbol
#	Number (or pound) sign, logical file number symbol
$	Dollar sign or string type declaration symbol
,	Comma, separates parameters or format output
.	Period or decimal for floating point constants
"	Double quotation mark or string delimiter
:	Colon, separates BASIC statements
?	Question mark or PRINT abbreviation
<	Less than, relationship test
>	Greater than, relationship test
π	PI, 3.141592654

BASIC Statements Table of Formats.

Statement	Type	Description
ABS(<x>)	F	Returns the absolute value of a number
<expr>AND<expr>	O	Boolean operations bit test Check truth of operands
ASC(X$)	F	Returns ASCII value of the first character of X$
ATN(<x>)	F	Returns arctangent of <x>
CHR$(<x>)	F	Converts ASCII code to its character equivalent
CLOSE<filenum>	S	CLoses file or device channel numbered <filenum>
CLR	S	Erases variables, arrays, GOSUB addresses, FOR...NEXT loops, user-defined functions and files from memory
CMD<filenum> [,<X$>]	S	Switches primary output device from monitor to specified file
CONT	C	Continues program execution
COS(<x>)	F	Computes cosine of angle (x); (x) is in radians)

Statement	Type	Description
DATA <list of expressions>	S-I/O	Data table is created to be read by READ statement
DEF FN<name> <arg list>=<expr>	S	Defines function performed on numeric or string variables
DEF(<n>)	S	Defines starting address for Machine language subroutine
DIM <variable> (<subscripted variables>)	S	Sets up maximum subscript values for arrays and makes available space for them
END	S	Terminates the program, closes all files, and returns you to command level
EXP(<x>)	F	Calculates the constant e raised to the power of the given number <x>
FN<name>(<x>)	F	References DEFined formula specified by name
FOR<variable>=<x> TO <y>[STEP<z>]	S	Used with NEXT statement to repeat program lines a specified number of times
FRE(0)	F	Gives the number of unused spaces (bytes) in memory
GET#<filenum> <variable list>	S-I/O	Character is read from a file or specified device
GET<variable>	S-I/O	Reads information from the keyboard
GOSUB<line>	S	Used with the RETURN statement to execute and return from a subroutine
GOTO<line>	S	Delivers control to a specified line
IF<expression> THEN<clause>	S	If <expression> is true, statement in THEN clause are performed.
INPUT["prompt";] <variable list>	S-I/O	Reads data input from the keyboard
INPUT#<filenum>, <variable list>	S-I/O	Reads data from file <filenum>
INT(<x>)	F	Gives greatest integer that is less than or equal to x
LEFT$(X$,<n>)	F	Gives the leftmost <n> characters of X$
LEN(X$)	F	Returns the number of characters in X$
[LET]<variable>= <expression>	S	assigns the value in <expression> to <variable>
LIST[<line1>] [-[<line2>]]	C	List specified program line(s) to screen
LOAD["<file>"] [,<dev>][,<addr>]	C	Loads a program from a specified device and optionally runs it
LOG(<x>)	F	Returns the logarithm to base e of <x> (natural log)
MID$(X$,<n>,<m>)	F	Returns <m> characters from the string X$ starting at position <n>
NEW	C	Deletes the current program in memory and clears all variables
NOT<expression>	O	Reverse the meaning of a comparison
NEXT<variable>	S	Ends a FOR...NEXT loop
ON(<n>)GOSUB <line>[<,line>]	S	Exits to subroutine <line> specified by <n>—Used with RETURN statement
ON <n> GOTO <line>	S	Exits to <line> specified by <n>
OPEN<File#>, [<Dev#>][,<addr>] [,"<Filename> [<type>] [<mode>]"]	S-I/O	OPENS a channel for I/O to a device
<var>OR<var>	O	Boolean operations bit test tests for truth of either two operands
PEEK(<n>)	F	Reads the byte from the memory position <n>
POKE <n>,<m>	S-I/O	Places a byte in a memory location
POS(<n>)	F	Gives the current cursor column position
PRINT<list of expressions>	S-I/O	Prints data on the screen
PRINT#<filenum> [<list of expressions>]	S-I/O	Writes data to a logical file
READ <variable> [,<variable>]	S-I/O	Reads data from a DATA statement and assigns them to variables
REM <remark>	S	Inserts remarks in a program
RESTORE	S	Allows DATA statements to be reread from a specified (line)
RETURN	S	Returns from a subroutine
RIGHT$(X$,<n>)	F	Gives the rightmost <n> characters of string X$
RND(<n>)	F	Returns a random number between 0 and 1
RUN	C	Executes a program
RUN<line>	C	Executes a program at the (line) specified
SAVE["<File>"] [,<device>]	C	Saves a BASIC program file on disk or cassette
SGN(<x>)	F	Returns the sign of <x>
SIN(<x>)	F	Returns the trigonometric sine function of <x>
SPC(<n>)	F	Formats data <n> spaces to the right on print line
SQR(<n>)	F	Gives the square root of <x>
STATUS	F	Returns a completion STATUS for last I/O operation
[STEP<exp>]	S	Defines increment value for FOR...NEXT loop
STOP	S	Stops program execution and returns to command level
STR$(<x>)	F	Converts the value of <x> to a string value

Statement	Type	Description
SYS<mem-loc>	S	Transfer control to an existing Machine language program
TAB(<n>) / PRINT TAB(<n>)	F	Tabulates to position <n>
TAN<x>	F	Gives the trigonometric tangent of <x>
TI	S	Reads internal interval timer
TI$	F	Returns a Time $tring of six characters: hours, minutes, and seconds
USR(n)	F	Calls a Machine language subroutine with the argument (arg)
VAL(X$)	F	Returns the numerical value of the string X$
VERIFY	C	Verifies that the contents of storage medium is the same as memory
WAIT<location>, <mask1> [,<mask2>]	S	Suspends program execution while monitoring the status of a given memory address

Type:

C = Command

S = Statement (not input/output)

S-I/O = Input/Output Statement

F = Function

O = Operator

BASIC Statements—Multiple On One Line You can put a colon (:) at the end of one statement and continue entering another statement on the same linewithout giving a new line number. All statements on one line, however, should not exceed 80 characters. In the event of an overflow, all the extra characters will be ignored. The line number at left refers to all statements on the line. Here are two examples of multiple statements on one line.

```
40 LET X = 1:REM Comment
50 LET X = 1:LET Y = 2
```

BASIC Variable Names. See Names.

BASIC 2.0 The Commodore 64 utilizes a version of microsoft BASIC 2.0.

Basketball Stats* A statistical management package for basketball players, consisting of three program files on the system disk and an accompanying manual. The files are 1) Customizer—used at the beginning of the season to personalize all reports with the team name, coach's name, and the season year; 2) Stat Aid—a statistical program that will produce at summary reports for single games, season totals, and the team win-loss record; and 3) League Totals—this file allows the coach to print a statistical summary of player performance in league games only. Midwest Software.

Batch Processing A program or a series of programs is run to completion or aborted, prohibiting interaction between the user and the program.

Battery Backup Batteries provide auxiliary power to the processor so that information is not lost during a power failure.

Baud See Baud Rate.

Baud Rate Input/Output Parameter. Rate of data transfer between devices measured in bits per second. For example, the Commodore 64 transfers data through the VIC 1600 modem at a rate of 300 Baud. In addition to the 8 bits transmitted for every byte, there is also a start and a stop bit associated with each byte, thus resulting in a transfer of 30 characters per second.

Baud Rate Generator An oscillator, usually adjustable, providing clock signals for connection of a peripheral. Typical rates are 110, 300, and up to 9600 baud.

Baudot An older communications code, named for the man who invented it, and used for 5-level (hole) teletypewriter and telex machines. Other codes used are ASCII and EBCDIC, which are 8-level codes.

B-bus The second source-bus to the arithmetic logical unit in a 2- or 3-bus processor.

BCC Branch on Carry Clear. An Assembly language instruction for the 6510 that tests the carry bit. If the carry bit is 0 the next instruction performed is found by adding the current address with the signed displacement found in the argument. The displacement must be between -128 and +127. None of the flag bits are affected.

BCD Binary Coded Decimal. A 4-bit binary representation of the 10 decimal digits 0 through 9. Six of sixteen possible codes are unused, requiring the use of a "Decimal Adjust" instruction for correct binary addition. 1 is encoded as 0001, 9 as 1001. Two BCD digits are usually packed in a byte.

BCP Byte Control Protocol. A protocol for communications between two computers or devices. The start of a message is marked by a special character, which is followed by a count of the number of data bytes, and then the data bytes themselves. Also called byte count oriented protocol.

BCS Branch on Carry Set. An Assembly language instrucion for the 6510 that tests the carry bit. If the carry bit is 1 the next instruction performed is found by adding the current address with the signed displacement found in the argument. The displacement must be between -128 and +127. None of the flag bits are affected.

BDOS CP/M: Basic Disk Operating System (one of the three functional components of CP/M). It manages disk files, file storage, retrieval, and allocation. See also CP/M.

Bell Laboratories Research laboratories in New Jersey which made many major discoveries in the electronic and computer field, including the invention of the transistor.

Bell Ringer* A carnival atmosphere helps motivate students to learn fractions and their equivalent percent values. Cassette. Micro-Ed.

Benchmark Program A specific program written to calibrate the speed of a computer in a well defined situation, or type of computation, e.g., scientific "number crunching," sorting, or compilation. Benchmark programs are used to compare performance of one computer to another.

BEQ Branch if EQual to zero. An Assembly language instruction for the 6510 that tests the zero bit. If the zero bit is 1 the next instruction performed is found by adding the current address with the signed displacement in the argument. The displacement must be between +127 and -128. None of the flag bits are affected.

Beta Test Site vs. Alpha Test Site See Alpha Test Site vs. Beta Test Site.

B-F Disk Command. See Block-Free.

Bidder—My Profit Margin, The* A program that will accurately cost out jobs with true mark-up and profit calculations. Recommended for use by businesses that must do estimate and sales projections as a part of their proposal work. Disk; printer required. Powerbyte.

Bi-Directional Data flows in either direction on a wire. At each end there are transceivers to both receive and transmit. Common bidirectional buses are tristate or open collector Transistor-Transistor Logic (TTL).

Bi-Directional Printing Alternately printing in either direction. A line printed left to right is followed by a line printed right to left, avoiding a carriage return delay and increasing printing speed.

Bigital Clock* Turn your Commodore into a giant digital clock with twelve and twenty-four hour displays. The format can be changed while running. Micro Software Systems.

Billboard* Use your computer as a promotional tool with a message moving continuously across the screen. Disk or cassette. Micro Software Systems.

Billing Solver, The* A method to record information about clients and business transactions, categorized for easy access. Disk; printer required. Powerbyte.

Binary Counter Outputs a sequence of ascending or descending binary numbers.

Binary Number An integer as a sum of powers of 2, using a sequence of 0s and 1s. The binary representaton for the number 8 would be 1000. This can be computed by taking (1 * 2(power of 3)) + (0 * 2(power of 2)) + (0 * 2(power of 1)) + (0 * 2(power of 0)) = 8.

BIOS CP/M: Basic Input Output Operating System (one of the three functional components of CP/M). It facilitates exchange of data and status information between the CCP (Console Command Processor) and a peripheral device. See CP/M, CCP.

Bipolar A technology of integrated circuit fabrication using transistor switching elements based on majority carriers for switching and amplification. See MOS.

Bistable Multivibrator Active elements able to assume either one or another stable state characterize a flip-flop circuit.

BISYNC Pronounced by-sink. BInary SYNchronous Communications protocol. An IBM character-oriented protocol for synchronous transmission of binary-coded data between two devices. Uses a defined set and sequence of control characters.

BIT Compare memory bits with accumulator. An Assembly language instruction for the 6510 that performs a logical AND between the contents of the accumulator and the contents of the memory location specified by the argument. The argument is addressed in zero page or absolute mode. The result does not change the accumulator or the memory location, but if the two numbers compared are identical, the zero flag bit is set. Also, the sign bit of the argument is moved to the sign flag bit and bit 6 of the argument is moved to the overflow flag bit.

Bit A contraction of Binary Digit. A bit is a 0 or a 1. Bits are used in computer systems to code information, instructions, and data. Larger units of bits are: nibbles (4), bytes (8), or words (8, 16, 24, 32, 96 or more).

Bit Map Mode Graphics. Bit map mode in the Commodore 64 allows the programmer to address each bit or pixel on the screen individually, thereby increasing the resolution to 320 x 200 bits in high resolution mode or 192 x 200 in multicolor mode. This mode facilitates creation of highly detailed images or graphics. The bit map mode is turned on by setting bit 5 of the VIC-II control register to a 1 at location 53265 (HEX D011).

Bit-Parallel Data transmission method by which every digit of a binary number is sent over a separate wire simultaneously.

Bit-Slice A vertical slice of a computer. This component constitutes an n-bit slice of a traditional CPU, minus control. Usually n = 4. A bit-slice implements a complete data path across the CPU, including multiplexers, ALU, shifters, registers, and accumulators.

Blackjack* A computerized version of this famous casino game. Cassette. RAK Electronics.

Blanking Leaving a space on the monitor screen. The entire screen of the Commodore 64 can be blanked by clearing bit 4 address 53265.

Blends and Ends* Mix two-letter beginnings (blends) and three-letter ends (ends) to create words. Designed for one or two players between ages eight and eleven. Cassette. Comm*Data Computer House.

Block Within a logical record, information is stored in units or blocks. On the 1541 Disk Drive a block refers to a group of 256 bytes. It is essentially synonymous with sector

except that a sector is generally associated with a specific location. Block is also sometimes used to mean a collection of logical records, as in blocked records or blocking factor. Block size is usually expressed in bytes.

Block Availability Map A checklist of used blocks on a disk. Physically located on track 18 sector 0 of the disk, it is updated every time a file is SAVEd or CLOSEd.

When a file is to be SAVEd onto disk, the controller checks the BAM to see *if* there is enough space for the file. If there is enough space, the data is copied onto disk and the BAM is updated to indicate that the space is no longer available.

Block of Memory A series of consecutively numbered bytes in a memory device (usually internal).

Block-Allocate Disk Command. The Block-Allocate command, when sent through the command channel, checks to see if a block on the disk is free to be used. It does not destroy data on the block, but if the block is already in use an error condition will be revealed on the command channel. Used only on random files. The format is:

OPEN15,8,15
PRINT#15,"BLOCK-ALLOCATE:"<drive>, <track>,<block>

<drive> is the disk drive number. 0 if only one drive.

<track> is the track number on block being checked on disk.

<block> is the sector number of block being checked on disk.

Block-Free Disk Command. The Block-Free command, when sent through the command channel, will change the Block Availability Map (BAM) and thereby make a block that may or may not have data on it available on disk. It effectively scratches that block. Used only on random files. The format is:

OPEN15,8,15
PRINT#15,"Block-Free:"<drive>,<track>,<block>

<drive> is the disk drive number. 0 if only one drive.

<track> is the track number on disk to be freed.

<block> is the sector number on disk to be freed.

Block-Read Disk Command. The Block-Read command, when sent through the command channel, will move one block of data from the track, sector, and drive specified by the user to a channel assigned by the user. The command is only applicable to random files. The format is:

OPEN15,8,15
PRINT#15,"Block-read:"<channel>,<drive>,<track>, <sector>

<channel> is an arbitary channel 2 through 14, previously opened, in which data will be sent

<drive> is the drive number. 0 if only one drive.

<track> is the track number on disk to be read.

<sector> is the sector number of block to be moved.

Block-Write Disk Command. The Block-Write command, when sent through the command channel, will move one block of data from a channel previously opened to a location on the disk specified by the user. The command is used only for Random Access Files. The format is:

OPEN15,8,15
PRINT#15, "BLOCK-WRITE:" <channel>,<drive>,<track>, <sector>

<channel> is an arbitrary channel 2 through 14, previously opened by the user, in which data is first entered.

<drive> is the number of disk drive being used. 0 if only one drive.

<track> is the track number on disk where block of data will be sent.

<sector> is the sector number on disk where block of data will be sent.

BMI Branch on MInus. An Assembly language instruction for the 6510 that tests the sign bit. If the sign bit is 1 the next instruction performed is found by adding the current address to the signed displacement found in the argument. The displacement must be between -128 and +127. No flag bits are affected.

BNE Branch on Not Equal to zero. An Assembly language instruction for the 6510 that tests the zero flag bit. If the zero flag bit is 0 then the next instruction performed is found by adding the current instruction to the signed displacement found in the argument. The argument must be between -128 and +127. None of the flag bits are affected by this instruction.

BNPF Representation An older data encoding format for PROM programmers using the characters B = beginning, F = finish, N = negative (1), P = positive (0). For example, the byte 10010110 is represented as BNPPNPNNPF. See PROM (Programmable Read-Only Memory).

Board, Breadboard Fiberglass or pressed paper sheet containing the integrated circuits. Interconnections may be wire-wrapped, soldered, or printed on the board. The term breadboard refers to a prototype circuit and dates from the time when radios were made on mother's breadboard. Also called a card when referring to smaller boards that plug into the "motherboard."

Board-Tester A computer-controlled device that performs electronic tests on printed circuit boards.

Bonus Pack* A useful tool for programmers, assisting you with cursor positioning, data definition, and screen designs. Commodore.

Boolean Logic Named after George Boole, who defined an algebra of logical operations such as And, Or, and Not, on the two values true and false. See Logical Operators, AND entries, OR.

Boot To use a bootstrap. Generally used to describe starting up a computer.

Bootstrap A program used for starting the computer, which usually clears memory, sets up I/O devices, and loads the operating system from ROM, disk, or cassette.

BOP Bit-Oriented Protocol. A protocol for communications between two computers or devices which causes a special bit pattern to separate groups of data bits. See also Byte Control Protocol.

Bouncing Short intermittent conduction from vibration of switch contracts after closure. Usually present in keyboard input and eliminated by special hardware or software (debouncing).

Bound Processor-bound or I/O-bound, indicating which component of a system is the bottleneck preventing faster performance.

B-P Disk Command. See Buffer-Pointer.

BPI Bits Per Inch. Used to specify the density of data recorded on tape or disk.

BPL Branch on PLus. An Assembly language instruction for the 6510 that tests the sign flag bit. If the sign flag bit is 0 then the next instruction performed is found by adding the current address with the signed displacement found in the argument. The argument must be between -128 and +127. None of the flag bits are affected by the instruction.

B-R See Block-Read.

Branch A programming instruction which transfers control to another program sequence. In BASIC, for example, the GOTO statement.

Branch BASIC Statement. See GOTO.

Branded* Riding trail with a herd of cattle gives you the opportunity to learn fractions by keeping track of the animals that have yet to be branded. Cassette. Micro-Ed.

Break Flag Bit See Status Register.

Breakpoint A point at which the processor will stop a program sequence and display the current machine status, implemented through hardware, software, or a combination of both. See Debug or Test a Program.

BRK BReaK. An Assembly language instruction for the 6510 microprocessor that functions like an interrupt. The program counter is pushed onto the stack; then the status register is pushed onto the stack. The contents of memory location FFFE and FFFF are moved to the program counter. Only the break flag bit is set.

Bubble Memory Memory utilizing microscopic magnetic domains in an aluminum garnet substrate. Present memories have 92K bits per device. Future devices should boast better than one million bit storage density per chip.

Bubble Sort A sorting technique that sorts a list by comparing the first two elements, putting them in the desired order, comparing the second and third elements, and so on, until the last element is reached. This is called a pass. This series of steps is repeated until the whole list is in the desired order.

Budgeteer* A budgeting program with a wide variety of features, including: variable number of rows and columns, automatic yearly totaling, over forty categories of expenses and income, and bar graphs for visual impact. Abacus Software.

Budgeter, The* Helps you set up a bugeting system for keeping a record of expenses and making projections. Disk; printer required. Powerbyte.

Buffer In software, any memory structure provided for the temporary storage of data. In hardware, a device which restores logic drive signal levels in order to drive a bus or a large number of inputs.

Buffer, Printer A printer buffer is a device which connects the printer to the computer and stores any incoming data from the computer into its own memory, thereby freeing the computer for other processing. The data stored in the buffer memory is then fed to the printer. This way the user doesn't waste time waiting for a text or a program to finish printing before he can start processing again. It takes a few seconds for the buffer to download data from the computer and return control to the user. Printer buffers may also be used for connecting modems with computers.

Buffered Parallel Cable & Driver* This interface is compatible with almost any printer that has a Centronics type connection and configuration. It is fully buffered and very reasonably priced. Can be expanded with other Commodore cartridges or disks and comes with good documentation. Micro Ware.

Buffering The delaying and temporary storage of data in a data communications path.

Buffer-Pointer Disk Command. The Buffer-Pointer command, when sent through the command channel, allows you to selectively access individual bytes of information from a random file buffer. Used in random files only. The format is:

OPEN15,8,15
PRINT#15,"Buffer-Pointer:",<channel>,<location>

<channel> is an arbitrary channel number 2 through 14, previously opened by the user, to send or receive data. Effectively this is a buffer since data in this channel must be moved to or from the disk one block at a time.

<location> is the byte number 0 through 255 within block in channel.

Bug Errors in a program. A programmer must ensure that a program will correctly process all of the types of data for which it is intended. Samples of the data are prepared (test data) and the program is executed using this data (a test run). The program's outputs (reports, screen displays, files, etc.) are then verified to be as specified. An error in the processing logic of a program is called a "bug," hence the terms "debug" and "bug-free."

Bulk Storage Large capacity data storage, generally long term.

Bulletin Board* Records personal and business messages to be accessed when needed. Disk; printer required. Powerbyte.

Bunny* A full-color, high-resolution game in which a rabbit must avoid the traffic on a busy highway, then cross a river filled with flesh-eating fish. Truly a HARE-raising experience. Cassette; joystick required. Star Tech, Inc.

Burn-In A phase of component testing where basic flaws or early failures are screened out by running the circuit for a specified length of time at high temperatures in some sort of oven. Also, when referring to PROMs, burn-in means to load with data.

Bus Path for signals having a common function. Essentially, a bus is a group of wires that connect to a portion of a computer. The most significant of these are the Address Bus and the Data Bus. See Address Bus, Data Bus, Control Bus.

Bus Controller The unit in charge of generating bus commands and control signals.

Bus Extender A device which allows additional cards to be plugged into a computer's bus. Also known as an expansion chassis.

Bus Termination An electrical means of preventing reflections at the end of a bus. Necessary in high-speed systems and some specially designed low-speed systems.

BusiCalc* A spreadsheet for the Commodore 64 that allows the user to set up the size of the sheet. The user can create a spreadsheet from 20 to 99 rows with any number of columns limited only by memory availability. The width of the rows is from five to eighteen characters. BusiCalc has the basic features required of a spreadsheet with the ability to enter labels, numbers, and formulas at the intersection of any row and column. If a formula is changed, the user must request a recalculation of affected values. If the formula references a value following the formula, a second recalculation is necessary. Rows and columns can be moved conveniently to other locations on the spreadsheet and output can be formatted prior to being sent to a printer. The documentation is adequate. Skyles Electric Works.

Business Accounting* This accounting software package has an accounts receivable section that keeps track of the balance owed by each customer, as well as keeping track of inventory sold. Invoice slips are printed and records updated simultaneously. The user can obtain a list of all invoices and accounts receivable transactions at any time. The package includes an accounts payable section that keeps track of vendors and the amount owed to each of them. It also keeps track of expenses and each check paid. The program prints purchase orders and updates the inventory on hand simultaneously. When a payment is made or received from an account, all the pertinent information is updated. At any time the user can obtain a list of all accounts showing the amount owed by or to an account. The user can obtain an inventory and sales report to see what is on hand and what is on order. The package is very comprehensive and the documentation easy to read. TOTL Software, Inc.

Business Application Systems See Accounting Software; Database Management Software; File Management/ Handling Software; Financial Planning Software; General Ledger Software; Inventory Control Software; Payroll System; Personal Planning/ Productivity Software; Sales/ Business Applications Software; Stock Market Software.

Business Calendar Personalized Database* An easy way to retrieve dates and appointments from your datebook using key words. Disk; printer required. Powerbyte.

Business Inventory* Allows you to set up a database which records all inventory by inventory number or key word. Disk; printer required. Powerbyte.

Business Man, The* Lets you set up practice files using data included in the package. All standard accounting and financial operations can be performed. Disk; printer required. Southern Solutions.

Busmaster* This expansion chassis is fuse protected, switch selectable, has a six slot expansion, LED power indicator for each slot, and a cable connection. Random Access Marketing.

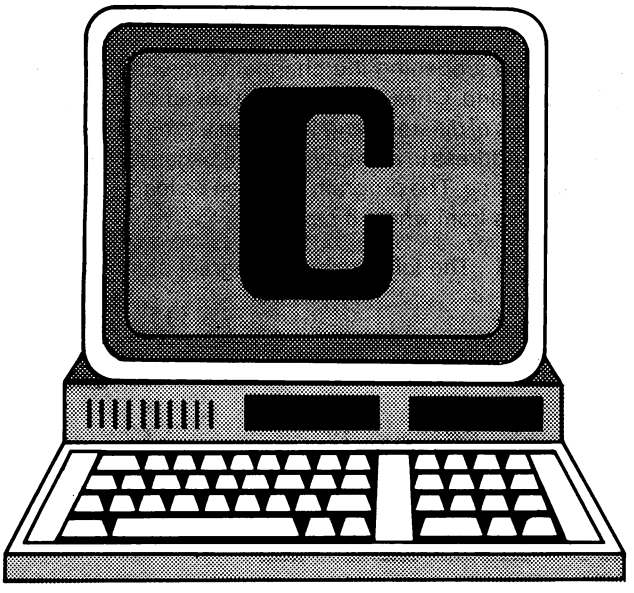
Busmaster-II* This is the same as the Busmaster*, but has software enabled slots and memory paging of up to 6 x 64K. Random Access Marketing.

BVC Branch on oVerflow Clear. An Assembly language instruction for the 6510 microprocessor that tests the overflow flag bit. If it is 0 the next instruction performed is found by adding the current instruction to the signed displacement found in the argument. The argument must be between +127 and -128. None of the flag bits are altered by this instruction.

BVS Branch on oVerflow Set. An Assembly language instruction for the 6510 microprocessor that tests the overflow flag bit. If the overflow flag bit is 1 then the next instruction performed is found by adding the current instruction to the signed displacement found in the argument. The argument must be between +127 and -128. None of the flag bits are altered by this instruction.

B-W Disk Command. See Block-Write.

Byte Byte, abbreviated B, is the storage capacity needed to hold one character (letter, digit, etc.) in computer memory, internal or external. A group of 8 bits is a byte. A thousand bytes is a K byte, abbreviated KB, or simply K. (Actually, 1K = 1024 bytes because this is an even power of 2.) The Commodore 64 has 64K (or 64KB) of internal memory, or 64,000 bytes (to be precise, 64K = 64 x 1024 = 65,536 bytes).



C Codes. ASCII = 67, CBM ASCII = 67 or 195, HEX = 43. c—ASCII = 67, CBM ASCII = 67, HEX = 63. Screen code = 3 or 67. See CBM ASCII.

C Symbol for the Carry bit, the Clock, and the hexadecimal notation for the decimal number 12. C base 16 = 12 base 10 = 14 base 8 = 1100 base 2.

C, The Commodore Key The special key with the Commodore logo located at the bottom left of the keyboard. In addition to upper and lower case letters the Commodore 64 can display a set of PET graphic symbols. When the system is powered on, any letter from the keyboard is in upper case. If a character is pressed in conjunction with the shift key, the graphic symbol to the right of the key is displayed. If the special key is pressed in conjunction with the shift key the display mode changes to lower case. Pressing any key in conjunction with the special Commodore key displays the graphic symbol to the left of the key.

The special key can also be pressed in conjunction with any of the color keys to change the color of the cursor and any subsequent characters entered.

C64* Allows you to use such commands as DELETE, ADD, CHANGE, LOAD, etc. Includes various labeling abilities, data tape (both manual and blank), and printer routine. Disk and cassette. RAK Electronics.

C-1526 Printer* An 80-column, bi-directional, dot matrix impact printer. It contains its own microprocessor, RAM, and ROM. It can print up to 124 lines per minute in 20 columns. Commodore.

Cables and Adapters See Buffered Parallel Cable & Driver; Busmaster; Busmaster-II; Monitor Link; Supplies.

Cache A cache is a high speed buffer used between the central processor and main memory. Filled at medium speed from main memory, instructions and programs can operate at high speed if found in the cache. A new instruction sequence is loaded from the main memory if not found in the cache.

CAD Computer-Aided Design.

CAI Computer-Assisted Instruction.

Calc Result* A superior spreadsheet with features not found in similar programs. The screen is formatted into rows and columns. The user can enter numbers, labels, or formulas into any intersection of a row and column. Formulas can perform arithmetic operations on any of the other numbers entered into the spreadsheet. If a number previously entered is changed by the user, all the affected formulas automatically change their values. A spreadsheet can be saved as a "page" and compared against other "pages." Calc Result can split the screen horizontally or vertically so that different pages can be compared simultaneously. A window can be placed on a page to compare a separate page and the window can be split to have four separate "pages" compared at the same time. The formulas can involve addition, subtraction, multiplication, division, or exponentiation. They can determine the maximum or minimum values of a set of numbers. The formulas can utilize the logical functions AND, OR, or NOT, as well as the IF THEN statements. Inequalities such as > or <> can be used in formulas. Calc Result can calculate mean values for columns and rows. The spreadsheet can be output to the printer in a number of formats. The user can print just what is on the screen or specify a range of rows and columns to be printed. Output can be varied when the user specifies how many characters he wants printed for each entry. Lists of numbers can be printed as a bar graph with the user entering upper and lower limits for the graph. Calc Result manages this spreadsheet with a cartridge inserted into the expansion port, as well as a work space on disk. Pages can be saved on separate data disks. It is hard to imagine a more complete spreadsheet for the Commodore 64. The documentation is clear and concise. The only item limiting the use of this spreadsheet is the printer. Calc Result is compatible with the 1520 printer plotter or the 1525 printer. Using any other printer can result in unpredictable results. Handic Software AB.

Calendar* Test your knowledge of the calendar using any year between 1901 and 2099. Comm*Data Computer House.

Calendar My Appointments* For any year, this program can produce a calendar and load all your important appointments or messages on the proper date. You can make changes without any problem. Powerbyte.

CAM Content Addressable Memory. Associative memory, addressed by contents rather than location.

CAMAC Computer Automated Measurement And Control. An application where a computer measures a process and automatically controls, based on the measurements taken, one or more devices that affect the process. Also called Process Control.

Can't Continue An error message from the Commodore 64 indicating that you can not use the CONT command at this time. If you have not run the program yet and you inadvertently enter CONT this message will appear.

Capitalization Series* The first part of this program is educational and the second helps elementary age and older students get used to the testing style of the standardized achievement exams. A fifty-item pre-test is given to help you decide which areas to review. Cassette. Micro-Ed.

Card "?" Card/Print* This parallel printer interface can be used to connect your system to just about any parallel printer. Cardco.

Card Cage Support rack for the printed-circuit boards in a computer.

Cardco A company manufacturing popular interfacing equipment for the Commodore 64 and VIC 20. Included in their product line are interfaces necessary for connecting parallel printers to the Commodore 64, interfacing to enable ordinary cassette recorders to store data from the Commodore 64, and a five-card expansion interface that enables up to five cartridges to be connected to the Commodore 64 at one time.

Cardette* This interface will connect any standard cassette player to your system. Cardco.

Carriage Return In the program mode of BASIC operation, the carriage return <CR> is used to enter each program line (containing one or many statements, but not exceeding 80 characters). The line is sent to the interpreter to be tokenized and stored in the program. Similarly, when editing a program listing, <CR> is used to replace the existing line with the modified line in the program memory. When in direct mode of BASIC operation, any BASIC statement(s) entered on the screen are executed upon carriage return.

Carrier A frequency which is modulated to denote 0 or 1, used to "carry" information.

Carry A carry is a flag bit in the status register of the central processor which indicates an operation overflow by the arithmetic logic unit. The carry is also used during shifts.

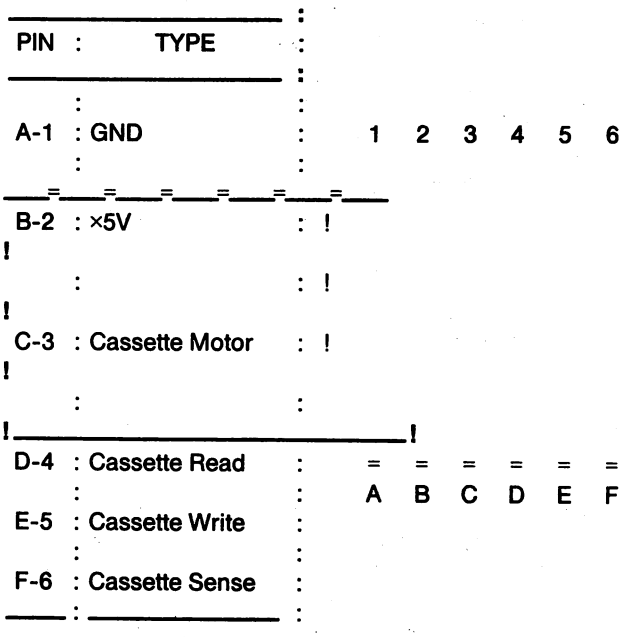
Carry Flag Bit See Status Register.

Carry Look-Ahead A circuit which uses partial adders to predict the final carry from propagate and generate signals. Binary addition is speeded up significantly by eliminating the carry propagation delay.

Cash Flow Model* Gives you an instant summary of your financial situation. Disk; printer required. Powerbyte.

Cassette If information from the Commodore 64 is to be saved permanently, it must be transferred from the internal memory to a mass storage device. The C2N Datasette Unit model 1530 from Commodore is one such device. Data is saved sequentially on magnetic tape. Data is transferred at about 50 bytes per second. The cassette has a device number of 1. The load and save commands are used to LOAD and SAVE program files. Sequential files can be saved after first opening the channel to the cassette. See OPEN command. Ones and zeros are saved on tape using square waves of different lengths. When a program is saved on tape the address in memory where it began is saved into a header on tape. The program can then be loaded in to the exact address from where it came.

Cassette Port The following is a diagram of the cassette port on the C 64:



Cassette LOAD Instruction See LOAD.

Cassette SAVE Instruction See SAVE.

Catch the Rhyming Fish* A fun game for elementary children to recognize rhyming words. For each word that appears at the top of the screen, the child must choose the one that rhymes with it from the three words the fish are towing across the screen. Cassette. Micro-Ed.

Caterpillar 500* You control the progress of a caterpillar as it races around a track trying for the best time. Suitable for elementary children. Cassette. Micro-Ed.

CBM ASCII Alphanumeric characters and symbols are stored in computer memory as numbers. The designers of a computer decide which number will represent which character. One very common standard of representation is the American Standard Code for Information Interchange (ASCII). When a computer uses ASCII values, the upper case letter A is stored as the number 65 and a lower case letter a is stored as the number 97. Commodore deviates slightly from conventional ASCII values. Commodore has a text mode where characters can be viewed as upper or lower case letters and an upper case/graphics mode where letters are viewed only as upper case letters. In upper case/graphics mode (used for entering BASIC programs) the letter A is stored as the number 65. In upper/lower case

mode (used for entering text) the upper case A is stored as the number 193 and the lower case a is stored as 65. Which characters the numbers 65 and 193 represent on the screen depends on the mode during display. To make it even more confusing, the characters represented by the numbers 192-223 are the same for the numbers 96-127. To determine the CBM ASCII value for a character, enter the command PRINT ASC (<x>) where <x> is the letter. To obtain the character represented by a CBM number enter the command PRINT CHR$ (<x>) where <x> is the number.

CCD Charge Coupled Device. A storage device using Metal Oxide Semiconductor (MOS) capacitors. It transfers charge from one cell to another in a recirculating pattern.

CCP CP/M. Console Command Processor is the "intelligent" component of the three functional modules (BIOS, BDOS, and CCP). It is user-interactive (interprets commands typed at the keyboard) and performs internal processing using BIOS and BDOS as sources for status and data information. See CP/M.

CDC Control Data Corporation, a manufacturer of large computer systems, peripherals, and disks.

CDILP Ceramic Dual In-Line Package. See DIP.

Cell A repeated unit in a RAM chip storing one unit of information and returning it in response to a particular address signal.

Central Processing Unit The CPU of a computer is essentially the "brain" of a system. It serves to fetch and execute each instruction from memory. It also performs all of the arithmetic and logical functions of the system. It contains a control unit, an ALU, and other related facilities with registers, clocks, or drivers. In some systems it may be comprised of several chips. In the Commodore 64, the 6510 microprocessor serves as the CPU.

Chaining Executing programs larger than the main memory of a computer by sequentially loading and executing modules of the same program.

Channel Logical connection from a CPU to an I/O device. Channels may be multiplexed, have dedicated ports, or a dedicated channel processor, to optimize communications.

Channel Disk Drive There are sixteen channels available on the 1541 drive. They are buffers through which information is passed to and from the disk. Data is not transferred directly from the disk to the user, but instead from the disk to the channel. The user can then INPUT# or GET# information from the channel.

Channels 0 and 1 are reserved by DOS for LOAD and SAVE commands and are not available to the user for data. Channel 15 is the command channel used to send disk commands to the controller and obtain error messages from the disk drive. Channel 15 is also unavailable as a data channel.

Channel Selector A small switch in the back of the Commodore 64 allows you to switch between channels 3 and 4. In areas where one of those stations is extremely strong you are likely to experience interference while using your computer, and you should switch to the other channel. You must also make the appropriate change on your television.

Character Base See Character Generator.

Character Generator A section of ROM occupying memory locations 53248 to 57343, containing the data that will actually create a character on the screen. Any character on the screen is comprised of small dots or pixels in particular patterns. Eight bytes of data are required to create any character on the screen. All characters and PET graphic symbols are kept in the character generator. The VIC II chip makes use of ROM imaging to gain access to the character generator, even though it may be accessing a bank of memory not containing 53248 through 57343.

Character ROM See Character Generator.

Character Set The collection of characters available for display or processing on a particular computer or peripheral.

Character String A one-dimensional array or sequence of characters, encoded as bytes. Character strings have a length field, or are terminated by the zero byte.

Characters, Programmable Usually the data required to form the image of a character on the screen is brought from the character generator, a list of values in ROM that defines each character. The Commodore 64 allows the user to provide an alternate set of values to redefine the structure of characters. In this manner, the user can create his own character set.

CHAREN The name of a control line that banks a 4K byte of ROM containing the character generator in and out of the microprocessor's memory. When CHAREN is low, the microprocessor sees the character generator at address $DOOO to $DFFF. When it is high, a group of I/O registers appear in that location.

Chartpak 64* With eight chart formats, you can perform various commands to/from disc, and develop a wide selection of charts in high-resolution. Disk; printer required. Abacus Software.

Check Manager* Records and balances bank transactions, files to tape, searches and extracts specific information, and prints hard copy. GoSub International.

Checkbook Booky* A program developed with the checkbook scrambler in mind. Now you can make sense of it all. Disk; printer required. Powerbyte.

Checkbook Manager* The ideal way to follow accounts until they are closed by using over twenty expense categories. Micro Spec.

Checksum A field of one or more bytes appended to a block of n words. It contains a truncated binary sum or some other function value based on the contents of that block. The sum is used to verify the integrity of data.

Cheque-Check* The kind of checkbook helper that can save you time and aggravation. Balances even the most difficult records. Disk or cassette. Micro Software Systems.

Chip A rectangular silicon die cut from a wafer. See entries by number for each commonly used chip.

Chip Select Most large scale integration chips normally have one (or more) chip selects. These activate the chip to examine the rest of its pins, for example, the address bus. This information will in turn specify a location/register within the chip. Multiple chip-selects can replace decoders external to the chip, but do require extra pins.

CHKIN The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It sets up a previously opened file as an input channel. If the file is any device other than the keyboard, the file must first be opened with the OPEN routine. The X register must be loaded with the number of the logical file before using this routine. See KERNAL.

CHKOUT The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFC9, CHKOUT will set up a previously OPENed file as an output channel. If the file is any device other than the keyboard, the file must first be opened using the OPEN routine. The X register must be loaded with the number of the logical file before using this routine. See KERNAL.

Choplifter* Your mission is to rescue diplomats that are being held for ransom in unfriendly territory. You must use all the military might at your disposal to assure peace. Features graphics and joystick control. Broderbund Software.

CHR$ BASIC Function (string). This function is used to obtain the character equivalent of a Commodore ASCII code. The "?Illegal Quantity" error message results when the value is outside the specified range. The format is:

CHR$(X):REM (RANGE= 0 LE X LE 255)

Example:

READY PRINT CHR$(65) A READY

(the Commodore ASCII code 65 corresponds to the character A).

For a listing of all the Commodore ASCII codes and their equivalent characters, see ASCII and CHR$ Codes.

CHRGET This is the label for the subroutine used by Commodore to get the next byte of BASIC. When a BASIC program is executed, the computer takes each byte of the program, determines if it is part of a token or data or simply a space, and branches to the proper subroutine.

CHRIN The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFCF, CHRIN will move one byte of data from a channel already opened to the accumulator. If the CHKIN has not previously set up another input channel, then the data must come from the keyboard. See KERNAL.

CHROUT The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFD2, CHROUT will move one byte of data from the accumulator to an already opened channel. The OPEN and CHKOUT routines are used prior to this command to set up the output channel. The accumulator must be loaded with the byte of data prior to jumping to this routine. If the OPEN and CHKOUT routines are not used the data is sent to the screen. See KERNAL.

CIA See Complex Interface Adapter.

CINT The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FF8A, CINT initializes the 6567 video controller and the KERNAL screen editor. See KERNAL.

CIOUT The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFA8, CIOUT moves one byte of data from the accumulator to the serial bus. The LISTEN and SECOND routines must be used prior to this to set up a listening device. The byte to be moved is loaded into the accumulator before this routine is used. See KERNAL.

Circle World* You must help an alien subculture save their world from certain doom. Cassette. Aardvark.

CLALL The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFE7, CLALL closes all previously opened files and resets input/output channels. See KERNAL.

CLC CLear Carry flag. An Assembly language instruction for the 6510 microprocessor that clears the carry flag bit. None of the other flag bits are altered.

CLD CLear Decimal mode. An Assembly language instruction for the 6510 microprocessor that clears the decimal flag bit. This sets the binary mode for the ADC and SBC commands. None of the other flag bits are altered.

Clear Signal to place a device or a circuit in an initial (usually zero) state.

Clear Screen Commodore control key SHIFT <CLR/HOME> is used to clear the screen. This may also be accomplished in a BASIC program by using either PRINT statement PRINT "<CLR/HOME> or PRINT CHR$ (147). Either statement will clear the screen of any text/graphic display (standard character mode) and place the cursor on the top left corner of the screen.

CLI CLear Interrupt disable bit. An Assembly language instruction for the 6510 microprocessor that sets the interrupt mask bit to 0. This enables the interrupt and does not alter any other flag bits.

Client Tickler, The* A database program that allows you to determine what is being done for whom in a rapid, organized fashion. Disk; printer required. Powerbyte.

CLK CLocK.

Clock* Teaches primary graders to tell time with a review at the end of the lesson. Cassette. Micro-Ed.

Clock Frequency The oscillation rate of a clock, usually expressed in megahertz. Also known as Clock Rate.

CLOSE The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFC3, CLOSE closes a logical file following the completions of all input/output operations on that file. The logical file number is loaded into the accumulator prior to executing this subroutine. See KERNAL.

CLOSE BASIC statement. CLOSE statement is used to close data files, or channels that are used for communication with external devices, such as the disk drive or the printer. The CLOSE operation frees up any data channels no longer in use and stores any incomplete buffers to the storage device (disk drive or cassette). Any files written to the disk that are accidentally left open are unreadable by the Disk Operating System (DOS), and are scratched by the VALIDATE command. See Validate, DOS.

The format is:

CLOSE<lfn>

<lfn> is a logical file number.

Clowns* A wonderful visual display of tricks and antics performed by graphic circus clowns. Commodore.

CLR BASIC Statement. This statement clears all the variables, arrays, files, user-defined functions, and GOSUB addresses, while keeping the main program intact in RAM memory. It is used to make additional space available for new variables by clearing the ones that are no longer needed.

An example is:

```
10 FOR I=1 TO 10: A(I)=2*I:NEXT:CLR
```

CLRCHN The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the Kernal. It is used to handle input/output operations. By jumping to address $FFCC, CLRCHN clears all open channels and restores the I/O devices to their default values of 0 and 3 for keyboard and screen.

CLR/HOME This key moves the cursor immediately to the upper left corner of the screen. If pressed in conjunction with the SHIFT key the cursor moves to the same place and the screen is cleared.

CLV CLear oVerflow flag bit. An Assembly language instruction for the 6510 microprocessor that sets the overflow flag bit to 0. None of the other flag bits are altered.

CMD BASIC. The CMD statement prepares the specified output device to receive the object of PRINT statements. All data that would normally go to the screen in a PRINT or LIST statement gets diverted to the previously opened device and referenced in the CMD statement. To redirect data back to the screen it is necessary to send a PRINT# command. The format is:

CMD<ref>,<string>

An example is:

10 OPEN<ref>,4 20 CMD<ref>,<string> 30 PRINT "dat"

<ref> is a number from 1-127, arbitrarily set by the user to reference the file opened.

<string> is optional and can be any string within quotes or CHR$ code.

CMOS Complementary Metal Oxide Semiconductors. Technology characterized by extremely low power consumption. Widely used in portable applications and battery-assisted memory systems. CMOS requires both p-channel and n-channel transistors, with speed and density characteristics intermediate between NMOS and PMOS. CMOS devices may operate from 3v to 12v and have ideal noise immunity characteristics. See MOS.

CMP CoMPare memory and accumulator. An Assembly language instruction for the 6510 microprocessor that subtracts the contents of the argument, or the contents of the address in the argument, from the accumulator. The result is not stored nor does it change the accumulator or memory, but the result does affect the sign flag bit, the zero flag bit and the carry flag bit. The addressing mode of the argument can be immediate, zero page, zero page X, absolute, absolute X, absolute Y, (indirect X), or (indirect) Y.

CMR Common Mode Rejection. The devices' ability to handle multi-input terminal voltage.

Coax Coaxial cable. A transmission line with an inner conductor and an outer shield conductor.

COBOL COmmon Business Oriented Language. A high level programming language with statements based on English, developed for business applications.

Code Synonym for Program Instructions language statements, or a symbolic representation for data in any language including BASIC or Machine language. See Program.

CODEC COder-DECoder. A chip providing the essential translation of analog to digital conversion.

Colon (:) CBM BASIC. Used to separate multiple BASIC statements on one line. The line number at left refers to all the statements on that line. The maximum number of statements on one line should not exceed 80 columns because all statements or fractions of statements that are deleted by the interpreter.

Color Accountant* A personal management program that helps you maintain budgets, appointments, mailing lists, income reports, etc. Contains complete documentation. Disk or cassette; printer required. Programmer's Institute.

Color Adjustment All adjustments of color intensity and hue are performed on the color TV. With the Commodore 64 some color combinations result in very poor resolution. It is possible to change the background color by POKEing different numbers from 0 to 15 in address 53281. The character colors can be changed by changing the cursor color from the keyboard.

Color Code The Commodore 64 is capable of generating sixteen colors. The colors can be generated by POKEing the code for a color into the appropriate memory location. The colors and codes are as follows:

black	0	white	1	red	2
cyan	3	purple	4	green	5
blue	6	yellow	7	orange	8
brown	9	light red	10	gray1	11
gray2	12	light green	13	light blue	14
gray3	15				

Color Craft* A unique graphics animation tool which gives the user five screen sizes and 25-200 pages associated with each screen size (a larger screen will have fewer pages available). The command line at the top of the page helps the user through the modes of the program (Form, Edit, Copy, Save, Run, and Load). Once the screen size is selected using the Form command, the user can enter the Edit mode and create any combination of text and block-graphic images on the screen. Cursor colors may be selected to add color to the characters and six directions are available for cursor movement. Each page holds a picture and the program's built-in timer allows the user to display these pages in sequence. By varying the display time of each page, special animation effects can be created on the screen. Disk SAVE and LOAD commands are available to store and retrieve these files respectively. COPY command copies a picture from one page to another. The program comes with an easy to follow documentation that includes a Glossary at the end for quick reference. Sim Computer Products, Inc.

Color Keys The color of the cursor and subsequent characters printed on the screen can be altered from the keyboard. The colors can be implemented using the CTRL key and the color keys along the top row simultaneously. A second set of colors can be implemented using the special Commodore key in the bottom left part of the keyboard with the color keys along the top row.

Color Memory or Color RAM A section of RAM from address 55296 to 56295. In the standard character mode these addresses contain the color value of the characters displayed on the screen. POKEing different values at these addresses will change the color of the characters displayed. In the multicolor character mode, four values can be placed in each address to give four possible colors for each character.

Column Addition* Helps third through eighth graders with math skills, especially dealing with columns of numbers. Cassette. Comm*Data Computer House.

Combinational Logic A circuit with Boolean logic functions and no memory.

Comma (,) CBM BASIC. A delimiter used to separate the input and output of variables and constants.

Command A statement which causes the computer to carry out a specific action. Commands differ from instructions in several ways. A command is usually a complete specification of an action, while instructions are usually combined in dozens or hundreds to make a useful program. Commands are usually acted upon immediately by the computer, while instructions are saved for later execution in a program. Commands are acted on by the basic operating system of the computer, while instructions must be processed by a particular program such as the BASIC interpreter.

Command Channel See Channel Disk Drive.

Command Processor A program which accepts a command (usually from a keyboard), and causes it to be carried out. Some command processors, including the Commodore 64's, contain the programming required for all commands they process. Others do not carry out any commands directly. Instead, these examine the command, determine what other program (if any) can carry it out, locate the program, and start it running. Still another type of command processor carries out some commands directly (internal commands), but locates and runs other programs for some commands (external commands).

Comment Field A field within an instruction, for explanations or remarks, that is ignored by the interpreter.

Comments BASIC. See REM.

Commodore Pilot 64* With this package you can run Common Pilot programs on the Commodore 64 without any modification, as well as enhanced Commodore 64 programs. You can define your own characters and sprites and create sounds and music. Commodore.

Commodore 64 DOS Wedge* This program gives you some short cuts in loading, saving, and using directory commands in BASIC. Permits easy use of disk storage. Commodore.

Compack* A complete terminal control package that allows you to record, read to and from disk, convert files, and print incoming data. Microtech.

Compatible, Upward (Versions of Programs) The term upward compatible indicates that programs developed for one version of a programming language, operating system, application software package, or computer will work without alterations on an expanded, more powerful version of the same language, system, or package.

In hardware, upward compatibility refers to the possibile building up to more powerful models without reprogramming.

Compile Time The point in the processing of a program when it is being translated from source code to object code by a translator (compiler or assembler).

Compiler A translation program which converts high-level instructions into binary instructions for direct processor execution. Any high-level language, such as BASIC or COBOL, requires a compiler or an interpreter.

An interpreter translates each statement of the program each time the statement is executed, whereas a compiler translates the complete program once, producing object code that can be executed repeatedly. Any change in the program requires recompilation. The code produced by compilers may be longer and/or slower than the code generated by Assembly language source code.

Complementing The action of changing each 1 to a 0, and each 0 to a 1.

Complex Interface Adapter The Commodore 64 contains two Complex Interface Adapter (CIA) chips that serve as mediating devices between the microprocessor and peripheral devices. All data from the disk drives, users port, or the keyboard first moves into registers within the CIA chips. When the CIA chips receive a signal from a peripheral device indicating that data is ready, (through interrupt sequences), the CIA sends its own interrupt Machine Code (IRQ or NMI) to the microprocessor. The 6510 microprocessor finishes executing whatever instruction it is working on and then looks to the CIA chips to see where the interrupt is coming from. Once the microprocessor receives that information it jumps to the operating system to see what to do next. The operating system will tell the microprocessor where to get the in-coming data and where to put it. The CIA maintains several registers that can be addressed directly by the user to set up input/output ports and handshaking operations.

Compound Words* This program tests a student's ability to discern the two words that make up a compound word. The program comes with 25 compoundwords from which the student selects one. After ten problems, his ability is rated. Elementary level. Cassette. Micro-Ed.

Compuserve Compuserve is one of the largest subscription information networks in the country. It is accessible to personal computers over the phone line through the use of modems. It provides a wide variety of information and allows communications among other personal computer users. It also provides programming areas for serious programmers interested in using higher-level languages (such as FORTRAN) that are not readily available for microcomputers.

Computer A general purpose data processing system, incorporating a central processing unit, memory, input/output facilities, power supply, and cabinet.

Computer System A complete system including the MPU, keyboard, CRT, and other peripherals, such as printers, disks, tapes, etc. The term is often used to include programs.

Comstar F/T Super-10" Printer* This machine includes all the features of the Comstar, plus a 10" carriage, high resolution bit image, 2.3K buffer, block graphics, true lower descenders, 2K of user definable characters, and more, for a remarkable set-up. Protecto Enterprizes.

Concatenation of data (or programs) Adding one item on at the end of the others to produce one longer data or program item.

Concentration* An easy to learn game of skill and recall for all ages. Cassette. Aardvark.

Condensed A print function available on some dot matrix printers. When the appropriate control code sequence is sent to the printer, the size of subsequent characters to be printed is reduced to seventeen characters per inch from ten characters per inch in the standard mode. In the Gemini, this function is accessed by sending ASCII code sequence CHR$(27) CHR$(66) CHR$(3). On an Epson printer, use ASCII code 143 to turn it on and 146 to turn it off.

Connection, The* Printer Interface. The connection is an intelligent printer interface for the Commodore 64 which allows the user to hook up a Centronics-type parallel printer. It emulates the Vic printer, and allows the user to print the complete set of Pet graphic characters available on the Commodore 64. It supports the standard printer formatting features and serious applications such as word processing, database management, spreadsheets, and graphics. Many versions of the Connection download data files from the computer and give the controls back to the user for further processing, while simultaneously feeding the data to the printer. Micro-Ware Distributing, Inc.

Console The terminal that has the most control in a system. For a microcomputer, the keyboard or the front panel is the console.

Console Command Processor CP/M. See CCP.

Consonant-Vowel-Consonant (C-V-C)* Word creation made enjoyable for elementary school children. Smiling faces appear with correct connections of consonant to vowels and a sad face appears when the wrong choice is made. Disk or cassette. Microcomputer Workshop.

Constant An explicit value in a program instruction or statement, rather than a symbolic value (variable). The value is fixed throughout a program.

Constellations* The zodiac configurations are displayed, then each constellation appears on the screen with clues for identification. For ages nine through thirteen. Cassette. Comm*Data Computer House.

CONT BASIC Command. This command causes the program execution to resume after being halted by a STOP or END statement or the RUN/STOP key. The program execution will begin at the exact place where it had stopped. This command is a useful tool for debugging programs to examine the status of variables or check the flow of the program. If the program interrupt occurred due to

an error, the error message "CAN'T CONTINUE" will result when the CONT command is used to re-start the program, or when an attempt is made to change the program.

Contractions* The student's job here is to make the word on the screen the opposite of the contraction form as presented. For example: If the word shown is contracted, he must make it into an uncontracted form, or if the word is uncontracted, he has to contract it. There's a reward for the student who makes no mistakes! For elementary students. Cassette. Micro-Ed.

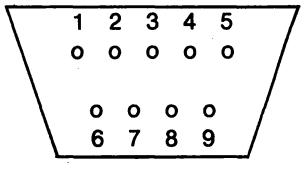
Control Bus The set of control lines in a computer system to carry the necessary synchronization and control information throughout the system. Examples of signals carried on these lines are orders such as READ or WRITE and sync signals such as Interrupt, Hold, or Acknowledge.

Control Characters Characters having specific system-dependent meanings.

Control Port Also referred to as the game ports, they are located on the right edge of the Commodore 64. Labeled control ports 1 and 2, they can accomodate most standard joysticks, game paddles, certain light pens, and some A to D converters. Data from the ports can be accessed through address 56320 for port 1 and 56321 for port B.

CONTROL PORT

PIN	TYPE	NOTE
1	JOYA0	
2	JOYA1	
3	JOYA2	
4	JOYA3	
5	POT AY	
6	BUTTON A/LP	
7	+5V	MAX. 100mA
8	GND	
9	POT AX	



Control Program for Microcomputers See CP/M.

Control Registers A control register generally refers to an identifiable and programmable byte or series of bytes that control some function of a computer. For example, the byte located at 53265 can be POKEd with appropriate data to turn on the high resolution mode.

Control Unit The module which fetches and decodes instructions. The CU requires an instruction register and a program counter. It generates control signals and manages the control bus.

Controller A circuit board or boards that interface a peripheral to the computer, having complex circuitry to maintain device control.

Coordinate* Helps students in grades seven through eleven learn the fundamentals of the Cartesian Coordinate system. Disk or cassette. Microcomputer Workshops.

Copymaker* A fast and easy way to backup floppy disks on one drive. Microtech.

Copy-Writer* Professional word processing program that offers all the standard features, plus some extras. Microtech.

Core A small magnetic torus (or doughnut) of ferrite used to store a bit of information. Cores can be strung on wires so that memory organizations of 32K 18-bit words can be packed into space with dimensions of ½ x 6 x 6. One advantage of core is that it is nonvolatile. Also, as a holdover from the days when nearly all computer internal memory was core, the word is still sometimes used as a synonym for internal memory: core-image, in core, etc.

COS BASIC trignometric function which calculates the cosine value of an angle. The format is:

COS (<x>)

<x> is angle in radians.

An example is:

```
READY
PRINT COS(X)
```

The value of <x> must be converted to radians in the argument before using the COS function.

Count 'Em* Count the train engines on the screen and either answer, or let the computer reveal the correct number. For elementary level students. Cassette. Micro-Ed.

Counter Binary counter.

CP/M Control Program for Microcomputers.

CP/M—Cold Start A cold start is performed when the system is first turned on. The start-up operation, sometimes referred to as bootstrap, involves an automatic loading of the CCP, the BIOS and the BDOS from the system disk into the main memory. The control at this point is transferred to the BIOS.

CP/M—Commands The following is a table of CP/M commands, each followed by its format and a brief description.

COMMAND	FORMAT (<argument>)	DESCRIPTION
ABORT	ABORT<program>	Halts the execution of a program specified in the argument.
DDT	DDT<filename>	A debugger program available in CP/M that allows the user to load and alter and/or test the program specified in filename.
DIR	DIR<filename>	Obtains a list of all files that have the same filename or specified filetype.
DUMP	DUMP<filename>	Displays the contents of disk file (specified in the argument) in hexadecimal notation on the screen.
ERA	ERA<filename> or (filetype)	Erases file(s) on disk that have the same filename or filetype as the argument.
PIP	PIP<new filename> =<old filename>	Performs one or multiple copy operations.
REN	REN<newfilename> =<oldfilename>	Renames disk files.
SAVE	SAVEp<filename> p=page(256-byte segments).	Saves a file in TPA on disk. p (pages) to be saved are calculated via the DDT.
STAT	STAT<device> or <filename> <filetype> or <disk>	Displays the status of device assignments or available disk space.
SYSGEN	SYSGEN	A program on system disk that loads the system into memory and makes a copy of the system disk for safekeeping.
TYPE	TYPE<filename>	Displays the contents of the file specified on the screen.

CP/M—Control Characters Following is a table of the control character commands and their functions.

KEY	FUNCTION	REMARKS
Control-C	Warm Start	Performed to abort program execution or replace disk in a drive.
Control-H	Delete Character	Cursor backup to previous character.
Control-U	Erase Line	To cancel current and begin a new line.
Control-E	Type a long command line	Move cursor to next line without executing command.
Control-J	Execute Command	Executes current command moves to a new line.
Control-M	Terminates PIP	Control is returned to CCP.
Control-X	Delete Line	Restart a new line.
Control-R	Retype Current Line	Used to reprint an edited/ corrected line.
Control-P	On/Off Switch for Printer	Toggle switch to turn the printer on/off.
Control-S	Freeze Scrolling	Toggle switch to freeze the display.

CP/M—Operating System A popular single-user operating system for 8080, Z80, and 8085-based microcomputers, created by Digital Research. It is a collection of programs available on the system disk which, once loaded into the system using either a bootstrap loader or the resident monitor, will take over the system operation, communications with peripheral devices (such as the drives or the printer), and all management of computer memory space as well as disk files. The main advantage of using this operating system instead of the computer's operating system lies in the universal nature of CP/M (it can run on any microcomputer and has an extensive software support from third party vendors). It also operates with considerable speed and efficiency as compared to an operating system that is built around a higher-level language such as the Commodore's BASIC on the Commodore 64. BASIC offers simplicity and ease of handling to the beginning user. However, for most serious applications, it tends to be too slow and takes up too much memory. CP/M on the other hand fully uses the computer's resources and is more versatile, using less memory. It can be executed on the 6502 based systems (such as the Commodore 64) with the aid of a plug-in cartridge and a system disk (to be available soon from Commodore.)

CP/M—Organization CP/M is organized in computer memory in the form of logical components or software modules. The three functional modules are called BIOS (BASIC Input/Output System), BDOS (BASIC Disk Operating System), and the CCP (Console Command Processor). See BDOS, BIOS, CCP.

CP/M—Warm Start A warm start is performed to interrupt the system and start over again. It is also performed when a disk is replaced with another in a drive that was previously read by BDOS, and the new disk directory *needs to be* logged in place of the old. Warm start differs from cold start only in that the BIOS memory image remains unaltered during a Warm start. A control C is used to warm start the CP/M. See also CP/M Cold Start.

CPS Characters Per Second or Cycles Per Second.

CPU See Central Processing Unit.

CPX ComPare to X register. An Assembly language instruction for the 6510 microprocessor that subtracts the argument or the contents of the address in the argument, from the contents of the X register. It does not store the result, nor does it alter the contents of the X register or the accumulator; but it does affect the sign flag bit, the zero flag bit, and the carry flag bit. The addressing mode of the argument can be immediate, zero page, or absolute.

CPY ComPare to Y register. An Assembly language instruction for the 6510 microprocessor that subtracts the argument, or the contents of the address in the argument, from the contents in the Y register. It does not store the result, nor does it alter the contents of the Y register or the accumulator; but it does affect the sign flag bit, the zero flag bit, and the carry flag bit. The addressing mode of the argument can be immediate, zero page, or absolute.

Craps* A computer version of the popular dice game. Cassette. RAK Electronics.

Crash A situation where the system becomes inoperative due to a hardware or software malfunction. A head crash refers to the accidental impact of the read/write head upon the disk surface.

CRC Cyclic Redundancy Check. A binary polynomial used to check information in blocks of data. All single-bit errors are detected. When used with an additional Longitudinal Redundancy Check (LRC), all two-bit errors are detected and all one-bit errors are corrected. The two check sums (CRC and LRC) are calculated based on the data and appended to it. When the data is received or reread, the CRC and LRC are recalculated and compared to the earlier CRC and LRC. Any difference indicates that a bit has changed. The CRC and LRC act like parity bits, except that they work on a whole block of data rather than one byte.

Cribbage* A computerized version of this classic card game. Disk or cassette. Abacus Software.

Crosstalk Two signals interfering with one another.

CRT Cathode Ray Tube. A computer terminal using a CRT that displays characters or pictures. Also called a monitor, screen, terminal, etc.

CRTC CRT Controller. A chip or circuit which provides necessary control signals to interface a CRT to the input/output bus of an MPU.

Crunch A term used to describe the process of removing redundant information in a program and thus reducing the amount of memory required to store it. Removing remark statements, spaces between words, and putting multiple commands on one line are examples of crunching.

Crystal Quartz crystal that issues an extremely accurate piezoelectric frequency for clock timing.

CS Chip Select or Code Segment.

CTE/VTE Terminal Emulator* Converts your system into a terminal so that you can select the baud rate that will work best with your modem. Micro Systems Development, Inc.

CTRL Key This key is used with the numbered keys to a change the cursor color. It can be used in combination with key 9 to produce reverse character image of subsequent characters. The reverse character image mode can be turned off using the CTRL key with key 0.

CTS Clear To Send. Control line from the modem to the terminal stating the data may be sent because the carrier is present. RS-232C is standard.

Cursor* Choose from over twenty-five programs, all containing color, sound, and sprites. Most of the packages include three BASIC programs per cassette. Many of the games have become classics. Cursor 64.

Cursor On the Commodore 64 the cursor is a flashing square. Actually produced by setting the reverse character image mode on and off. The cursor is the location of the next character to be entered.

Cursor Movement The cursor on the Commodore 64 can be moved down and to the right by pressing the CRSR keys in the bottom right of the keyboard. The same two keys can be used with the shift key to move the cursor up and to the left. If the cursor keys are held down the cursor will scroll across the screen.

The CLR/HOME key will return the cursor to the upper left corner of the screen.

The INST/DEL key can be used to move the cursor to the left and to delete any character the cursor encounters. Pressing the INST/DEL key in conjunction with the shift key will leave the cursor in the same position, but will move all the text on the right side of the cursor to the right.

The space bar at the bottom of the keyboard will move the cursor to the right and erase any character it encounters.

The RESTORE key, pressed in conjunction with the RUN/STOP key, will clear the screen and move the cursor to the upper left corner or to the home position.

The RETURN key will return the cursor to the left side of the screen and move it down one line.

If you try to move the cursor down off the screen, it will remain on the last line and all text entered previously will move up one line.

The cursor can also be moved with basic programming using the PRINT command followed by the appropriate CHR$ code. For example:

PRINT CHR$ (17)

followed by a carriage return, will first move the cursor to the left and down one line (as a result of the RETURN) and then move the cursor down one line (as a result of CHR$(17)). The CHR$ codes affecting the cursor are listed below.

RETURN CHR$(13)
Clear HOME CHR$(19)
CURSOR right CHR$(29)
CURSOR up CHR$(145)
CURSOR down CHR$(17)
INST/DEL CHR$(20)
SPACE CHR$(32)
CURSOR left CHR$(157)

CW Control Word.

CW Morse* Your computer can be used as a Morse terminal with your radio station. With certain hardware modifications, your terminal becomes a 25 wpm sending and receiving station. Package includes software, documentation, a diagram for interface, and connector. RAK Electronics.

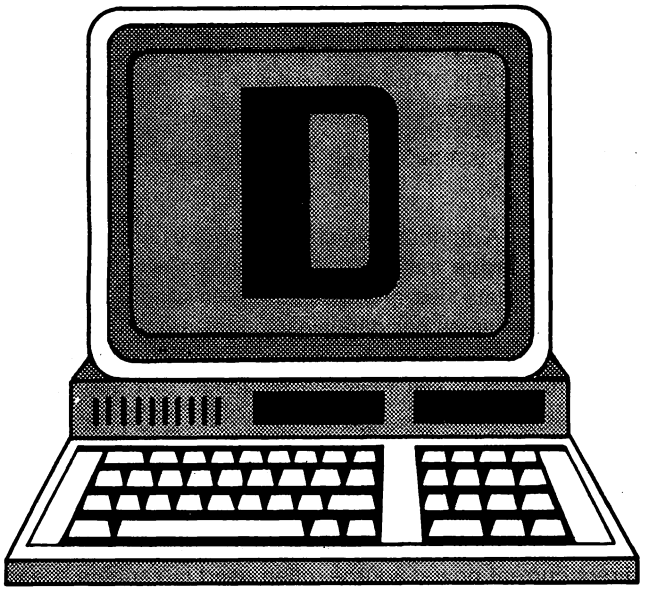
CX-6401 Interface* This module allows you to connect your Commodore to any standard parallel printer. The module connects to the serial/port bus, keeping the user port free for use by RS-232C devices. Comes with connecting cables. Xitel, Inc.

CX-6402 Interface* This is an RS-232C interface which connects to the user port of the Commodore. All RS-232C devices can interface with this module. Comes with cable for connection to printer. Xitel, Inc.

Cyber-Farmer 64* An easy-to-use set of programs designed to help farmers keep an exact and up-to-date record of their financial situation. Names and numbers for accounts are included, but may be changed. Disk; printer required. Cyberia, Inc.

Cycle Time Total time a device needs to complete one internal cycle before becoming available again.

Cycle-Stealing Another processor gains access to a microprocessor bus for one cycle. The second processor may be an internal subsidiary processor, as in DMA.



D Codes. ASCII = 68, CBM ASCII = 68 or 196, HEX = 44. d—ASCII = 100, CBM ASCII = 68, HEX = 64. Screen code = 4 or 68. See CBM ASCII.

D Data line or the hexadecimal symbol for the decimal number 13.

D flip-flop Flip-flop circuit with a delayed reaction. The output is determined by previous input.

D/A Pronounced "D to A." Digital to Analog. Conversion from the digital representation used in computers to the analog signals used to drive speakers, motors, etc.

DAC Digital to Analog Converter. A device which converts digital signals (such as a computer's I/O bus) to analog signals, which could control an external device through ranging voltage or current levels.

Daisy Chain Method for prioritizing interrupts. Units capable of interrupting the system can either pass on a processor acknowledge signal or block it. The highest priority is given to the unit electrically closest to the processor.

Daisy Wheel Printer An impact printer which has a wheel with radial spokes bearing type to produce letter quality output.

DAS Data Acquisition System.

DATA BASIC Statement. DATA is a nonexecutable statement used in conjunction with the READ statement. It stores the numeric and string constants that are accessed by the program's READ statement(s). The format is:

DATA <constant>,<constant>...

<constant> may be a numeric or string constant. String constants in DATA statements do not need to be surrounded by quotation marks, unless the string contains commas, colons, or significant leading or trailing blanks.

DATA statements are nonexecutable. They can be placed anywhere in a program. A DATA statement may contain as many constants as will fit on a line, and any number of DATA statements may be used in a program. The READ statements access the DATA statements in line number order. The information that is in a group of DATA statements can be thought of as one continuous list of items, regardless of the number of items on one line.

If the variable type is defined in the READ statement as numeric, the corresponding constant in the DATA statement must be numeric as well. If the variable type is defined as string in the READ statement, the corresponding constant in the DATA statement must be string. For examples see READ.

DATA statements can be "reread" through the use of the RESTORE statement. See RESTORE.

Data Acquisition The collection of data from external sensors, usually in analog form.

Data Bus The set of lines which carry data. All system components are normally connected to the data bus. When data is ready to be moved into the accumulator the address bus is set to the specific address from which the data will come. The location is connected to the data bus. It is the only location connected to the data bus at that time. The byte of information thus moves from the accumulator through the data bus to the addressed memory location. The first address may then be disconnected and a second address where the data in the accumulator is to be moved is set onto the address bus. This connects the second location. In this manner information is moved under the control of the microprocessor to and from the different devices and peripherals. See DMA.

Data Communications Multiplexer A device which allows several communications processes (or "conversations") to operate concurrently over a single channel (such as one phone line). This can work through 1) time-division multiplexing, which oscillates the channel rapidly from one conversation to another; 2) frequency-division multiplexing, which uses shifts around two different frequencies to simultaneously transmit two different conversations; and 3) other, more complex methods.

Data File A named collection of information usually stored on magnetic media.

Data Separator A circuit in disk controllers which separates the data from the carrier in the signals read from the disk surface.

Data Set File or a group of related data elements.

Data Tablet A graphic input peripheral which digitizes the position of a stylus on a special sensory surface.

Data Transfer Rate The rate at which data is transfered from one place to another, such as from disk to memory or from memory to memory.

Data Types A specific interpretation applied to binary data, such as integer, floating point, or string.

Database A program that facilitates information storage and retrieval. Generally, databases are designed to accept data from the user in a user-defined format. Data storage is accomplished by creating files on disks, and the information to be stored is packaged in the form of records. All records in a file have the same format. Retrieval of the information involves selecting and sorting the type of information desired, and processing the selected records for display or printing. Most databases available for the Commodore 64 are general purpose packages that can be used for anything from mailing lists to recipes. Depending upon the sophistication of the particular database, a user can perform sorts and searches at many levels. Many operations may be performed on the selected records, including statistical summaries and routine arithmetic operations. These records may be printed in a user-defined format or saved in another file for futher processing. For a review of a specific database for the Commodore 64, refer to its product name.

Database Management Software See Database Manager; Datalog Database; Date Due; Easy Mail; Filing Assistant, The; Infomast; M'File; Powerfile; and Research Assistant 2.0.

Database Manager* A database management system that comes with a well-documented user's manual and a tutorial on each of its functions. The program is written in Machine language for speed and efficiency, is menu driven, and makes full use of the cursor keys, thereby making it easy for the user to enter/edit records. Other features are free-form design and input, sort on any field or level, and calculated fields. The maximum number of records per file is 65,535. Maximum record size is 2,000 characters, maximum fields per record 200 characters, and maximum field size 250 characters. These features make the database very versatile for use as an information management system. The program uses four different file structures in its operation. They are 1) Data dictionary file—a sequential file that contains information such as record size of the database file, form of the record displayed on the screen and the position of each field in the record; 2) Number of records file—a sequential file that keeps track of the number of records in a file; 3) Database file—a relative file containing the information for each database record; and 4) Sorted index file—a sequential file that contains the beginning record number and the character representation of the sorted field. Merge capability is also available with some of the most popular word processors to create personalized form letters. Mirage Concepts, Inc.

Datalog Database* A general-purpose database management system. The package comes with easy to follow documentation and sample data files to help you learn to use the system. The program uses relative files to store and retrieve data elements. It is capable of maintaining up to 1000 records per disk with up to twelve fields per record. Record format is user-defined and search option is available for every field in the record. Records may also be displayed on the screen or dumped on the printer in user-defined format. Other special features are the facility for merging (to create form letters), printing page titles, setting printer parameters and creating backup copies of data files. The last option is only available if you have dual disk drive. Midwest Software.

Datasette Cassette player made by Commodore. See Cassette.

Date Due* A database which helps library personnel keep track of overdue materials. The program allows periodic updating of data files, and it is possible to keep track of over 200 overdue items per data file. Options are also available for generating reports containing specified fields. The program uses a fast Machine language sort subroutine. Midwest Software.

D-bus Internal destination bus in a CPU, from the ALU to the registers.

DC Motor A type of motor designed to operate with a direct current power source, often used in variable speed applications.

DCE Data Communications Equipment. Equipment used to interface with a data communications network. See modem.

DCM Data Communication Multiplexer.

DCO Digitally Controlled Oscillator. An oscillator using a digital circuit to control frequency, rather than the analog circuit used by normal oscillators.

DDT CP/M. A debugger program (the Dynamic Debugging Tool) supplied with standard CP/M. The program is loaded from disk into the CCP or the TPA (depending upon whether a program has been specified for debugging). The format is:

DDT<program>

<program> is the program to be debugged, specified in the argument.

See also CP/M Commands.

Deadlock A situation in which two processes wait indefinitely for each other.

Dear Diary* Keep an electronic diary of events and information. Can be used for any type of database maintenance. Powerbyte.

Debouncing Eliminating the rapid signal fluctuations which accompany a change of state in mechanical switches. Mechanical springs bounce repeatedly until the contact is finally closed or opened. Typical debounce time is five to ten milliseconds for stable contact. Debouncing may be performed by hardware (latch) or software (delay).

Debug or Test a Program A programmer must insure that a program will correctly process all of the types of data for which it is intended. Samples of the data are prepared (test data), and the program is executed using this data (a test run). The program's outputs (reports, screen displays, files, etc.) are then verified to be as specified. An error in the

processing logic of a program is called a "bug," hence the terms "debug" and "bug-free."BASIC includes debugging aids for BASIC programs.

Debugger An essential program for software debugging. At a minimum, it provides breakpoints, dump facilities, register and memory examine/modify, preferably in symbolic form. See Debug or Test a Program.

DEC Digital Equipment Corporation, manufacturers of the PDP family of computers.

DEC DECrement memory by one. An Assembly language instruction for the 6510 microprocessor that decrements by one the contents of the address specified in the argument. The result is then placed into the same address in the argument. The result of the decrement affects the sign flag bit and the zero flag bit. The addressing mode of the argument can be zero page, zero page X, absolute, and absolute X.

DEC MON* This programming aid allows the inspection or editing of memory contents, and the conversion of numbers from one system to three others (Binary, Hexadecimal, and Octal). GoSub International.

Decade Counter A counter advancing in increments of ten.

Decay-Sound The rate at which the volume of a note falls from peak value to a midrange value where it is maintained for the duration. Decay is one of four components of the envelope that the SID chip executes for each note.

Decimal Standard notation for representing numbers. Each number is represented to the base 10. Other decimal notations are Octal (base 8) and hexadecimal (base 16).

Decimal Equivalents of Fractions* A lesson in fractions for elementary students. Work is reviewed at the end of the lesson. Cassette. Micro-Ed.

Decimal Flag Bit See Status Register.

Decimals* Combines decimal problems with a series of tutorials that can assist fourth through eighth graders with their rounding off skills. Cassette. Comm*Data Computer House.

Decode (cycle) Second cycle of the fetch-decode-execute sequence of instruction execution. The instruction, contained in the IR, is decoded into a set or a sequence of control signals to all the required elements of the system, such as register gates, ALU functions, or external devices.

Decoder A logical unit which decodes two, three, four, or more inputs into mutually exclusive outputs. A 3-bit decoder will have eight outputs because a 3-bit number can have eight

Dedicated Register A register used exclusively to contain a specific item.

DEF FN BASIC Statement. Defines and names a numeric expression or equation. The format is:

DEF FN<name> <variable> = <expression>

<name> is a valid variable name. This name, preceded by FN, will be the name of the function.

<variable> represents a variable name in the function definition that will be replaced with a value when the function is called.

<expression> defines the return value of the function. It can be numeric or string, but must match the type that was declared by the <name>.

The function type determines whether the function returns a numeric or string value. The type of function is declared by <name>, in the same way as variables are declared. If the type of <expression> does not match the function type, a "Type mismatch" error is displayed. If the function is numeric, the value of the expression is converted to the precision specified by <name> before it is returned to the calling statement.

A DEF FN statement must be executed to define a function before you may call that function. If a function is called before it has been defined, a "Undef'd Function" error message is displayed. On the other hand, a function may be defined more than once. The most recently executed definition is used.

Default See Default Value.

Default Disk Drive or Current Disk Drive* CP/M keeps an internal record of which disk drive is curently considered the "default disk" or "default drive." When you start a CP/M or BASIC session, the default disk drive is always A. To change the default disk drive to B, enter B: or to go back to A as default, enter A: to determine which is the default disk drive, look at the prompt (A> or B>) from CP/M.

Default Parameters The parameter values supplied by a computer system or a program when no explicit values are provided by a program or a programmer.

Default Value Or, Default. A value for a parameter or variable which will be supplied by a program or system, if you do not specify a value.

Definder* Find and rescue adjectives from adverbs, and other letters from the Alphaword. Bring them to the safety of your Mothership. Gain points by blasting adverbs. Great teaching aid for ages nine through twelve. Cassette. Comm*Data Computer House.

Delay Loop Used to Freeze or Hold Screen Display. To freeze the screen briefly while the operator using your program reads a message, just write a delay loop after you print the message:

1000 FOR Y = 1 TO 2000 1010 NEXT Y

To freeze the screen until the operator is done with it, put in a dummy input statement and instruct the operator to press ENTER to proceed. The input variable need not be used in your program:

1000 INPUT "Press ENTER to continue";A$

Delete Character BASIC. Pressing INST/DEL will delete the character the cursor is under.

Delimiter A character which indicates the end of a sequence of characters. A space is the common delimiter in English to indicate the end of a word.

Deluxe Addresser* Create a data file to hold over 250 addresses that you can update and sort. Cassette. Briley Software.

Deluxe Comstar F/T Printer* A versatile machine that offers bi-directional printing, standard 96 ASCII character set, block graphics, long character life, and programmable line feed. Protecto Enterprizes.

Demultiplexer A logical circuit which can route digital signals from one source to several destinations. The unit distributes information to many locations or devices in the system.

Depreciator, The* Calculates the depreciation on particular items and even determines their salvage value. Disk; printer required. Powerbyte.

Derelict* You must recover the bounty from an ancient starship in this dangerous mission where you are the invader. Cassette. Aardvark.

Descenders The parts of printed or displayed characters which extend below the baseline of the type.

Designer Screens* Designer Screens is a graphics utility package for the Commodore 64 that allows the user to draw high-resolution pictures on the screen using joysticks. These pictures can be saved without reloading the program. Two sizes of print copies can be made of the graphic pictures. Includes automatic line plotting, text-mode to add captions, reverse images, and horizontal/vertical axis expansion of the printed image. Midwest Micro Associates.

Develop—64* A package of five software development tools and an extensive explanation of terms and possible applications. The tools are Assembler, Loader, Editor, Decode, and Monitor. Cassette or disk. French Silk.

Development System A system with the capabilities for efficient hardware and software application development for a given microprocessor. Such a system typically includes a microcomputer, monitor, printer, mass-storage (often disks or hard disk), PROM programmer, and an in-circuit emulator. Software is often developed on a system totally different from the system it will run on, either because the target system does not have enough memory or other resources to support development, or because the system is not yet available.

Development Tools Hardware and software aids for developing programs and/or hardware systems.

Device Names Names which may be used in place of a file name in many DOS or BASIC commands to specify that data is to come from or go to a device (keyboard, CRT, printer, etc.), rather than a disk or cassette file.

Device Not Present A message indicating the device specified in a OPEN, CLOSE, CMD, PRINT#, INPUT# or GET# statement was not available. Often it indicates that you forgot to turn on your printer or disk drive. Occasionally, poor cable connection or a faulty circuit in a peripheral will cause this message.

Device Number A device number is a number written into the RAM of the disk drive which is used to select a particular disk drive from other peripherals or drives. It is referenced in load and save commands (usually 8 unless changed by user). The number is written into RAM each time the drive is powered up, and comes from a hardwired jumper in the drive. The number in RAM can be changed using the following command:

```
OPEN15,8,15
PRINT#15,"M-W:"CHR$(119)CHR$(0)CHR$(2)CHR$(n+32)
CHR$(n+64)
```

n is the drive's new number assigned by the user.

Devices and Ports A port is an address providing a connection between the computer's internal processor and an external device. Ports are used to attach input and output devices.

DEX DEcrement X register. An Assembly language instruction for the 6510 microprocessor that decrements by one the contents of the X register. The result is stored into the X register and affects the sign flag bit and the zero flag bit.

DEY DEcrement Y register. An Assembly language instruction for the 6510 microprocessor that decrements by one the contents of the Y register. The result is stored in the Y register and affects the sign flag bit and the zero flag bit.

Dictionary Guide Words* Teaches elementary school children to use dictionary guide words. Each word given must be matched with the guide words between which it falls. Cassette. Micro-Ed.

Die/Dice The circuit elements built of small rectangular pieces of silicon on a wafer. Each wafer has several dozen to hundreds of dice. Once mounted in a package, they are called a chip.

Diffusion* Combines a graphic demonstration with a written definition to teach the principles of diffusion, gradient concentration, and final concentration. Before and after illustrations are used. The student answers questions on the material. For seventh grade and above. Cassette. Microcomputer Workshops.

Digital Having discrete states. Digital logic may have from two to sixteen states. Most logic is binary logic, with two states, on or off.

Digital Analyzers—Logic or Timing Troubleshooting tools which allow the user to locate timing or logic errors.

Digitizer A device that converts analog information to its digital equivalent. Often used for devices obtaining input from a plotting surface and providing coordinates as output, such as a graphics tablet.

DIM BASIC Statement. Any subscripted variable (e.g., A(1)) assigned by a user is automatically given a location by the Commodore 64. When a program is running, if it encounters a variable it goes to the assigned location to find its value. The Commodore 64 can only accomodate 10 subscripted variables without first setting up special locations for the variables. The DIM statement is used to set up this space. The format is:

DIM <var><sub>[,<var>(<sub>)]

<var> can be any normal variable with only the first two characters seen by the computer. They can be integers, string, or floating point, with the appropriate variable signs ($,%).

<sub> is the subscript. It can be any number from 0 to 255 as long as there is enough memory in RAM to accomodate it.

Diode A device which allows current to flow in only one direction.

DIP Pronounced "dip." Dual In-line Package. A standard IC package with two rows of pins 0.1" apart.

DIP Switches A collection of small switches on a DIP, used to select options on a circuit board without modifying the hardware.

DIR CP/M. Command used to obtain the complete disk directory. It may also be used to search for files by filename or filetype as specified in the argument, and display a listing of those files. The format is:

DIR<filename or filetype>

See also CP/M Commands.

Direct Addressing (Short Addressing) An addressing technique which allows short instructions with the address field limited to eight rather than sixteen bits. Used in Assembly language programming.

Direct Mode BASIC commands can be executed in one of two ways:in direct mode or program mode. In direct mode a BASIC command is entered without a line number preceding it. When the user follows the entry with a carriage return, the line is immediately executed.

Direction and Distance* Teaches children the eight directions and the concepts of distance. Cassette. Micro-Ed.

Directory Disk drive. A list of all programs and files on a disk. Each directory entry on the 1541 contains the name of the file assigned by the user, the type of file, a list of blocks used, and the starting block location for the file. The format for obtaining a list of files in the directory is:

```
LOAD"$",8
READY
LIST
```

DIRECTORY ERROR An error message from 1541 disk drive generated when there is a problem with the Block Availability Map. The Block Availability Map (BAM) keeps track of the blocks used on the disk where it is stored. It is also kept in disk memory when the drive is on. If the BAM becomes corrupted on disk memory this error may be generated. It is necessary to use the INITIALIZE command to correct the situation.

Disk A flat, circular, magnetic storage medium which is rotated while in use.

Disk A mass-storage device using a flexible (floppy) mylar disk to record information. The disk is sealed in a square plastic jacket lined with a soft material which cleans the disk as it rotates. A cut-out slot provides access for the moving head which must actually come in contact with the disk surface in order to read or write. Other holes in the jacket provide access to sector index holes in the disk. Disks are hard-sectored if the sector start points are marked by holes in the disk. Soft-sectored disks have only one (or a few) holes to mark the start of the track. The sector start marks are placed on the soft-sectored disk under software control in a process known as formatting the disk.

Disk—Commodore 8050* A Commodore disk drive unit capable of interfacing through an IEEE interface with the Commodore 64. It actually houses two separate drives, each formatting a 5-¼" floppy disk for 509K bytes of storage. This results in a total of nearly 1 megabyte of storage. It contains its own controller with 16K ROM for Disk Operating System and 4K ROM for a buffer. It is capable of copying from one disk to the other.

Disk—1541 Disk Drive* The upgraded 1540 disk drive manufactured by Commodore. It is directly compatible with the Commodore 64 and connects with the 6-pin DIN socket in back of the Commodore 64. It is compatible with the VIC 20 after sending the USER Command UI. See UI, User Command

The 1541 accepts standard 5-¼ inch single sided, single density disks. It has a capacity of storing up to 170K bytes of information and up to 144 different programs and/or files on a single disk. The drive contains its own controller and includes 16K of ROM and 2K of RAM memory. Two ports in the back of the drive enable you to daisy chain up to five drives and one printer.

Following the NEW command the drive formats the disk into thirty-five tracks, 683 blocks, with seventeen to twenty-one sectors per track (depending on distance from center) and 256 bytes per sector.

Information is accessed one bit at a time and transmitted serially to and from the computer, which greatly reduces its relative speed. Its internal ROM and RAM are efficient since some commands can be executing while the computer continues to work.

The disk drive has green and red LEDs in front with the green indicating that power is on. When the red LED is on, data is being exchanged, and the disk should not be removed. If the red LED is flashing, there is an error.

The 1541 stores four types of files: program files, sequential files, random files, and relative files. See each for specific information.

Disk Controller Card A printed circuit board which interfaces disk storage drives to the CPU of a computer.

Disk Data Manager* Assists you in managing information and stores over 1000 records on a disk. Micro Spec.

Disk File A file residing on a disk. Also refers to the complete disk drive.

Disk Full* An error message from the 1541 disk drive generated if the user tries to add to a disk that does not have enough room for the entry or tries to create more than 144 files.

Disk ID Mismatch An error message from the 1541 that occurres when the drive tries to access a disk that had not been formatted. It can also occure if the disk is defective.

Display Sending graphic and/or alphanumeric information to a device such as a CRT or a seven-segment LED.

Division by Zero Division by zero is not mathematically possible and causes this error message on the Commodore 64. Be careful with variables that might end up with zero after some computation; if you divide by that variable you will get this message.

Division Derby* Five players race a mathematics derby by correctly solving math problems. For upper elementary students. Cassette. Comm*Data Computer House.

DLC Data Link Control. Control characters in data transfer used to initiate and terminate communications, as well as for error checking.

DLE Data Link Escape. Communications control characters in a data link are distinguished from data characters by the escape character that preceeds them.

DMA Direct Memory Access. A method used to provide high-speed data transfers between a peripheral and the main memory. Data is exchanged at maximum memory speed. Several ways of accessing the memory are possible. DMA is performed under the control of a DMAC.

DMAC Direct Memory Access Controller. A device available as a single chip, used to automate DMA transfers. A DMAC is a specialized blocktransfer processor which can take bus control away from the MPU and transfers one or more memory words. A typical DMAC can connect to four or eight devices.

DMM Digital Multi-Meter. A volt/Ohm meter with digital readout instead of the older needle meter.

DO-loop A feature of a high-level language (e.g., FORTRAN) which allows a segment of a program to be executed repeatedly while or until a certain logical or arithmetic condition is fulfilled.

DOS Pronounced "D-O-S" or "doss." Disk Operating System. A program or collection of programs functioning as an operating system whose main secondary storage medium is disk. It usually supplies facilities such as symbolic files, automatic space allocation, dynamic memory allocation, program relocation and loading, utilities, etc.

Dot Matrix A method of forming characters by using a matrix of small dots. Usually the matrix consists of 5 by 7, or 7 by 9 dots. For very high quality characters, patterns of 11 by 13 dots or more are required. Dot *matrix applies* to displays, printers, and other output devices.

Double Density The techniques used to store data at double bit density on a magnetic storage medium.

Double Precision Arithmetic Arithmetic operations which double the precision by using twice as many bits to represent numbers.

Double-Sided Disk or Diskette A type of disk with both surfaces (sides) used for data storage.

Double Strike Type Format A print function available on some high quality dot matrix printers. On the Gemini-10X, when the appropriate control code sequence is transmitted to the printer, the characters are printed once, then the paper is moved up 1/144 inch and the characters are reprinted. It is analogous to bold-face printing.

Format of the ASCII code sequence for the Gemini 10X:

CHR$(27) CHR$(71) turns "on" double strike. CHR$(27) CHR$(72) turns "off" double strike.

(This function can be used on the Gemini with any other print-style command.)

Download The process by which a device such as a modem or a buffer receives the data or text file from another device (a computer, modem or I/O device). See also Modem, Upload.

DP Data Processing.

DPDT Double Pole Double Throw switch. A two-polarity switch with two different "on" positions.

DPM Digital Panel Meter.

DPSK Digital Phase Shift Keying. Encoding digital data with phase differences on a carrier. See Phase.

DPST Double Pole Single Throw switch. A two-polarity switch with one "on" position.

Drive—Device A mechanical and electrical/electronic device which operates a tape transport or a floppy disk. It may include several motors for rotation, head positioning, etc., as well as position sensors, control circuits, lights and switches.

Drive, Destination The disk drive to which information/data is going. The source drive is the disk drive from which information/data is coming.

Drive, Source The disk drive from which information/data is coming. The target drive is the disk drive to which information/data is going.

Driver An amplifier circuit required to reshape the signals on a bus when more than one TTL load is in use.

Dropping the Final E* Beginning with a base word, the student must first add an -ed or -ing ending to that word. Then, working from an -ed or -ing ending, he puts in the base word. There are fifty words to draw from. Elementary level. Cassette. Micro-Ed.

Drum Rotating magnetic memory similar to disk but using the surface of a cylinder.

DS Data Strobe. Enters data into a holding register.

DSR RS-232C standard. Data-Set Ready. A line on a modem indicating to the data terminal that the received carrier is normal. See RS-232C, CTS.

DTE Data Terminal Equipment. Equipment which receives or originates data, as opposed to Data Communications Equipment, which merely transmits data from one device to another.

DTL Diode Transistor Logic. A logic circuit in which input diodes drive output transistors.

DTR RS-232C standard. Data Terminal Ready. A line on a terminal indicating to the modem that it is ready to send data. See RS-232C, DSR, CTS.

Dual Intensity A printer or display device which can reproduce symbols in regular, bold-faced, or highlighted formats.

Dual Processors A computer with two CPUs. Provides redundancy for increased reliability or throughput, with a division of tasks which can proceed independently.

Dual-Port Memory Memory equipped with dual data and address connections, plus a binary priority circuit. Primarily used for simple communication between multiple processors. Available in single-chip form for small memory sizes.

Dumb Terminal A low-cost data terminal, ordinarily a CRT, which does not have editing keys or local processing.

Dump Transfer the contents of one memory device to another. Internal registers may be dumped to memory, memory can be dumped to disk, printer, or screen.

DUMP CP/M. This command displays any file specified, in hexadecimal notation, on the screen. The format is:

DUMP<filename>

See also CP/M Commands.

Duplex Bidirectional communication method allowing simultaneous data transfers in both directions. May use separate lines or multiplex a single line.

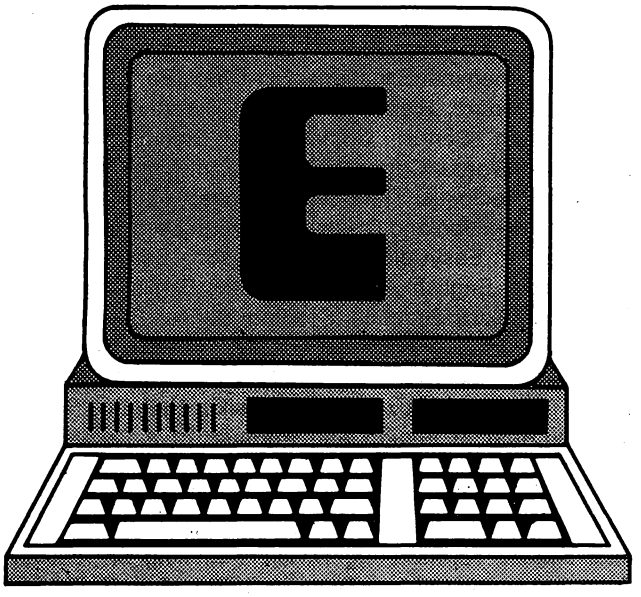
DXCC Record* Maintains DXCC records with a summary of totals. RAK Electronics.

Dyadic An operation with two operands, such as addition or multiplication, as opposed to a monadic operation with one operand, such as negation.

Dynamic Circuitry which stores information as charges on MOS capacitors; usually volatile and requiring periodic refreshing.

Dynamic Memory MOS RAM memory using dynamic circuits. Every bit is stored as a charge on a single MOS transistor. This allows very high density (only one transistor is used per bit). Since the stored charge leaks, a typical dynamic memory must be refreshed every 2 milliseconds by rewriting its entire contents. This does not slow down the system, but does require additional memory-refresh logic. Dynamic memory chips are cheaper than static ones, and are generally preferred for memory sizes over 16K. Dynamic memory is also volatile—the data stored is lost when power is turned off or interrupted.

Dynamic Memory Allocation Varying allocation of memory to multiple concurrent programs according to their needs, and a strategy for optimizing performance.



E Codes. ASCII = 69, CBM ASCII = 69 or 197, HEX = 45. e—ASCII = 101, CBM ASCII = 69,HEX = 65. Screen code = 5 or 69. See CBM ASCII.

E Enable. Also: The hexadecimal symbol for the decimal number 14.

e Exponential Function. See EXP.

EA Electronic Arrays.

Earthquake* Earn points by saving victims of an earthquake. A refreshing change from destructive games. Cassette. Aardvark.

Easy Graphics 64* An extension of Commodore BASIC, this program allows quick and easy graphics programming. Commodore.

Easy Mail* Easy Mail is a mailing list database for home or small business use. It is capable of managing up to 700 individual names and addresses. The manual contains a tutorial section that guides the user through the program's operations. Commodore.

EasyCalc 64* A worksheet package that can do calculations, analysis, and other operations on formulas and numbers. Disk. Commodore.

EasyFile* A database with storing, editing, and reviewing capabilities. Includes multi-level sorting, resident memory, and a version of FileFax. Disk. Commodore.

EasyFinance* A series of business programs that can help with most financial needs. Disk. Commodore.

Easylesson* The user can draw from seven categories of questions to create exams. The end product is written to either disk or printer. Commodore.

EasyPlot 64* A graphics program that generates graphs, charts, and diagrams on a plotter. Disk. Commodore.

Easyquiz 64* Offers exams in either "multiple choice" or "flash card" format. Questions may be rearranged before the test. Grades are administered after completion. Disk. Commodore.

EasySchedule 64* Helps plan your schedule and review small or large blocks of time. Disk. Commodore.

Easyscript* An effective, low-cost word processor in Machine language. It supports a number of letter quality and dot matrix printers and has many special features that allow for efficient editing and printing. For example, it can display 40-260 columns of text on the screen (on the 40 column Commodore 64, this is accomplished by horizontal scrolling). This is useful for formatting inventories with wide printers. The documentation includes step by step instructions on getting started and training exercises for editing, formatting, and printing text. The program supports full text entering and editing measures and has advanced file handling capabilities (linking files, global search/replace, and output operations). In the word processing mode, a status line displayed on top of the screen guides the user through the operation modes. Users can enter the disk mode for disk file management without losing the text in memory. It can use special printer functions such as italics, underlining, boldface, and enhanced print. The program can print capital letters while leaving all other keys in lower case, and numeric and disk modes on. These functions are controlled by the Commodore special function keys (F2 - F8). The program has facilities for changing the text/background/border colors as well as resetting the system (changing the start-up options) while still in text entering/editing mode. Commodore.

E-Beams Electron Beams.

Echo A character received from the keyboard is sent to the printer or screen for display.

Echo Hardware Testing. A loop-back or "Echo" technique is used to test the circuits of an input/output device by "looping" whatever is output back into the computer, as if it were input. In this way the circuits inside the computer are tested in isolation from the circuits in the external device to help isolate where a fault lies.

"Echo-keyboard to screen Echo" describes the process of sending characters keyed on the keyboard to the screen for a visual confirmation of what has been typed. There are no hardwired connections between the keyboard and the screen. The keyboard simply enters characters into memory.

ECL Emitter Coupled Logic. Bipolar Transistor—Transistor Logic (TTL) device using variations in the current, rather than voltage levels, to control bit and gate switching. ECL writes as much as ten times faster than other TTL or MOS circuits. ECL-TTL circuits consume a lot more power and produce a lot more heat.

ECM Electronic Counter Measures. Using electronic devices to jam or evade an opponent's electronic equipment. Used in military and espionage situations.

Edge Card Connector An edge of a printed circuit board which has DOS or BASIC commands to specify that data is to come from or go to a device (keyboard, CRT, printer, etc.), rather than a disk or cassette file.

Edge Card Connector An edge of a printed circuit board which has exposed conductors ("ways") to form an electrical connection with another board through a slot.

Editor Screen Editor. The Commodore 64 comes with a screen editor that enables the user to enter BASIC lines and to modify and view those lines from the screen.

The screen editor can distinguish between direct mode (which does not have a line number before the entry) and program mode (which has a line number before each BASIC line). Characters entered from the keyboard can be appended by moving the cursor to the incorrect character and entering the correct one. Characters can be deleted to the left of the cursor by pressing the INST/DEL key. Characters can be deleted to the right of the cursor by pressing the space bar. An extra space can be created between words by moving the cursor between words and pressing the SHIFT key in conjunction with the INST/DEL key.

In program mode each line of BASIC is stored in memory. That line can be changed simply by listing the program line, making the appropriate changes, and then pressing the return key (the changes are not made until the return key is pressed). A line can be deleted by entering the line number without any data following it and pressing return. No listing will have the deleted line number.

EDP Electronic Data Processing. Processing data with electronic machines such as adding machines, calculators, and computers.

Educational Software—Primary* See Dollar and Change, A; Add It; Adding or Subtracting Two and Three Place Numbers in Columns; Adding with Objects; Addition with Carry; Addition 1 Tutor; Addition 2 Tutor; Alpha Help; Catch the Rhyming Fish; Caterpillar 500; Clock; Color Craft; Consonant-Vowel-Consonant (C-V-C-); Constellations; Contractions; Coordinate; Count'Em; Hard and Soft C; Hard and Soft G; Matching Capital Letters; Matching Small with Capital Letters; Matching Words; Math Man; Matho!; Math Work; Medal Winner; Multiplication Race; Multiplication Tutor; Munchword; My ABC's; Number Jumper; Numbers I; NumBowl; Pre-Fractions Math Package; Presidents; Prime Fishin'; Prime Number; Pumping Iron; Putting Fiction Books in Alphabetical Order; Remember; Roman Numerals; Run-On Sentences; Shapes; Sit/Set; Slam Dunk; Spelling Quiz; State Capitals; States & Capitals; Story Problems in Addition & Subtraction; Subtract It; Subtracting with Object; Subtraction; Sum-It Mountain; Tachistoscope; Target Math; There/Their/They're; Tic-Tac Math; To/Too/Two; Tutti Fruiti; Two-Minute Warning; Ups 'N Downs; Vowel Kong; What Number is Missing?; Which Letter Comes Next?; Witch Number; Word Fun I; Words in Context Spelling Series; Wordspot; Working with Basic Addition Facts; Working with Basic Multiplication Facts; 1 2 3 Digit Multiplication.

Educational Software—Secondary* See Across the Plains; Adding Fractions; Adjective; Adverbs; Agreement of Subject and Verbs; Antonym Machine; Antonym Match; Apostrophe; Area and Perimeter; Area of a Rectangle; Atom; Atoms; Balancing Chemical Equations; Bar Chart; Bar Graph; Bell Ringer; BillBoard; Blends and Ends; Branded; Calendar; Capitalization Series; Color Craft; Column Addition; Compound Words; Concentration; Decimal Equivalents of Fractions; Decimals; Definder; Dictionary Guide Words; Diffusion; Direction and Distance; Division Derby; Dropping the Final E; EasyCalc 64; Easylesson; Easyquiz; End Punctuation; English Achievement I-V; English Invaders; Equations; Extra Practice Spelling Series; Fat Chance; Flash Spell Helicopter; Fractions Package; Genetics; Geography Smash; Gotcha Math; Greater Than/Less Than; Guess That Word; Guzinta Hotel; Haiku; Hangbug; Hat in the Ring;Heat of Fusion and Formula of a Compound; Homonym Machine; Identifying Complete Sentences; Integers I; Inventions and Inventors; Its/It's—Your/ You're; Last of the Ninth; Lawn of the Lost Rings; Lay/Lie; Letter Mite; Library Terms; Long Division; Making an Outline; Maps and Globes; MasterType; Math Bid; Math Golf; Math IQ; Math Shootout; Math Spin; Math Sports Package; Maxi-Calc; Meta Music I; Metric Brain, The; Misplaced or Dangling Modifiers; More Prefixes; More Suffixes; Multiplying Fractions; Music Composer; Music Machine; Nations; Noun; Oil Well; On the Line; Pail Green; Parting Shots; Parts of Speech; Pinball I.Q.; Potato Factory; Prefixes; Punctuation Series; Reducing Fractions I; Simple Machines I; Social Studies Word List; Regions; Solving Quadratic Equations; Speed Reading; Square Root; Starfinder; Subject & Predicate; Suffixes; Synonym; Time Zones; Touch Typing Tutor; Toystore; Triangles; Troublesome Pronouns; Usage Boners; Verb; Visible Solar System; Vocabulary Series.

EFL Emitter-Follower Logic. A transistor circuit in which the base element is common to the output and input circuits.

EIA Electronic Industries Association.

EIA-RS-232C The EIA standard for serial data transmission interfaces for asynchronous communications. Data is sent in 10- or 11-bit serial bundles. The first bit is called the start bit. It signals the beginning of the data. The data bits follow, from least to most significant. The stop bit follows the last data bit.

Electron The elementary unit of negative electrical charge, often conceived of as a particle circling around the nucleus of an atom. The flow of electrons is an electrical current.

Electron-Beam A collimated beam of electrons used in manufacturing ICs and in CRT display systems.

Electronic Communications The ability of a computer to communicate with other computers over phone lines. Modems make electronic communications feasible.

Electronic Disk Same as RAM Disk (q.v.).

Elephant Floppies* The EMS #2 is a 5-¼ inch floppy disk that is single sided, double density, and soft sector with hub ring certified 100% error free. Leading Edge Products, Inc.

ELINT ELectronic INTelligence.

Eliza* Eliza is a non-directive psychotherapist that examines statements in detail as they are typed in, and responds with its own questions or comments. Created at MIT in 1966, Eliza is designed to run on a large mainframe. Up to this time, it has not been available to personal computer users except in condensed versions, which lacked the sophistication of the original program. This new microcomputer version possesses all the power and range of expression of the original. Artificial Intelligence Research Group.

EMI Electro-Magnetic Interference. Interference caused by electrical fields. The fields are produced by capacitive coupling, magnetic fields produced by mutual inductance, or electro-magnetic fields (radio waves).

Emphasize A print function available on some dot matrix printers. When the appropriate control code sequence is sent to the printer, it prints each character twice, moving the position of the print head slightly the second time so that the character printed appears to be in boldface. This function is accessed in the Gemini 10x printer by sending ASCII code sequence CHR$(27) CHR$(69). To turn this mode off, use control codes CHR$(27) CHR$(70). In the Epson printer, use ASCII code 155, 197 to turn the emphasized mode on and 155, 198 to turn it off.

Emulation Simulation in real time. One computer emulates another by executing an emulator program that makes it interpret the same instruction. See Pet Emulator.

Enable To make a device ready or available to function. Opposite of disable.

Encoded Keyboard See Keyboard.

END Statement marking the end of a program in several programming languages.

END BASIC Statement. Used to terminate program execution, close all files, and return to command level. The format is:

END

END statements may be used anywhere in a program where you wish to terminate execution. END differs from STOP in that it does not cause a "Break" message to be printed, and it closes all files. An END statement at the end of a program is not imperative.

END has a different function with the BASIC Compiler. See your Compiler Manual for more information.

End Punctuation* Grade school children increase their ability to use the period, question mark, and exclamation point properly while completing this lesson. Progress report is given at the end. Cassette. Micro-Ed.

Engineering—Mechanical—Scientific Applications Software See Metric-Calc; Motion Problems I and II; Predictor-Linear Regression, The; Ratios; Statistics Sadistics.

English Achievement I-V* Helps students with English grammar rules. Groups of sixteen sentences with various errors are shown for correction. After completion, each sentence is marked either correct or incorrect, then the error is highlighted and the correction is made. An explanation follows. After each group is completed, a summary of the types of mistakes and resulting score is shown. Each program contains thirty-two to forty-five sentences. Disk or cassette. Microcomputer Workshops.

English Invaders* Earn points by gunning down nouns, verbs, and adjectives with the correct laser ray. Lose points when you miss, use incorrect shots, or lose your laser base when a word drops to the bottom of the screen. Good practice for second through sixth graders. Cassette. Comm*Data Computer House.

ENQ ENQuiry control character.

Environment The condition of all registers and memory locations in a system. Also used to refer to a software environment such as DOS (Disk Operating System).

EOB End Of Block.

EOC End Of Character. Also End Of Conversion for an ADC.

EOF End Of File.

EOR Exclusive OR (XOR). Gathering information through electrical and optical surveillance. Used in scientific studies, military, and espionage applications.

EOR—Assembler Exclusive-OR with accumulator. An Assembly language instruction for the 6510 microprocessor that performs the exclusive OR function between the contents of the accumulator and the contents of the argument. The addressing mode of the argument can be immediate, zero page, zero page X, absolute, absolute S, absolute Y, (indirect) S, and (indirect) Y. The result of the Exclusive-OR function is then placed in the accumulator and can alter the sign flag bit and the zero flag bit.

EOT End Of Transmission.

Equations* Assists high school students learn about equations, integer values, and algebraic axioms. Disk or cassette. Microcomputer Workshops.

ERA CP/M. This command ERAses all files specified by filename or filetype in the argument. The format is:

ERA<filename or filetype>

See also CP/M Commands.

Erase All BASIC Program Lines To start a new program type:

NEW

This completely erases all lines now in BASIC's memory, so if it's something you want to keep and haven't already saved on disk, SAVE it first. If you don't erase the program in memory before starting on another, you will usually wind up with an unusable combination of mixed lines from *your old* and new programs.

Erase BASIC Program Lines (DELETE) To delete a BASIC program line enter the line number and press Return.

Erase Disk File See Scratch.

Erase Screen To clear the screen, press <shift> <CLR/HOME>. When in a program, press <RUN/STOP> <RESTORE> to halt execution and clear screen.

Error Channel See Channel Disk Drive.

Error Correcting Code A data storage or transmission code using extra bits which will automatically detect and correct single or multiple-bit errors.

Error Correction Methods used to correct erroneous data produced by defective or unreliable data storage and transmission systems.

Error Message A statement or code printed out or displayed on the screen by the operating system or a program to let you know what is happening. Error messages tell you something about what went wrong.

Error Messages The Commodore 64 and 1541 disk drive produce a number of error messages. The following is a list of those messages with an explanation of the problem.

BAD DATA indicates that while a program was set up for receiving numeric data, it received string data instead. INPUT#5,A indicates that the data being input from the open file referenced by five must be a numeric value. If an alphabetic character or word is input, the BAD DATA message will appear.

BAD SUBSCRIPT indicates that the program encountered an element of an array that was outside the range dimensioned in the program. If you neglect to dimensionalize an array, and you attempt to use more than ten elements per variable you will receive this error message. For example:

FOR X = 1 to 20:A <X> = X:NEXT

BAD SUBSCRIPT will appear if you do not first dimensionalize A<X>.

CAN'T CONTINUE indicates that you can not use the CONT command at this time. If you have not run the program yet, and you inadvertently enter CONT, this message will appear. The CONT command cannot be used after an error has caused program execution termination or after you have edited program lines.

DEVICE NOT PRESENT appears when the device specified in an OPEN, CLOSE, CMD, PRINT#, INPUT#, OR GET# statement was not available. Often it indicates that you forgot to turn on your printer or disk drive. Occasionally a poor cable connection or faulty circuit in a peripheral will cause this message.

DIVISION BY ZERO is not mathematically possible. Be careful with variables that might end up with zero after some computation. If you divide by that variable you will get this message.

EXTRA IGNORED appears if the INPUT statement is expecting only one variable (INPUT A), and the user enters two. The second is ignored.

FILE NOT FOUND appears if you attempt to load a file, by name, from disk or cassette and the file can't be found. Be careful when specifying the file name. A name with a capital letter is different from one with a lower case letter, and an extra space between words will change the name. Be precise.

FILE NOT OPEN indicates that the user has tried to use the commands CLOSE, CMD, PRINT#, INPUT# or GET# with a file that was not already properly opened.

FILE OPEN indicates that the user attempted to open a file using a number that had already been used to open a file. Remember to keep file numbers, device numbers, and channel numbers unique.

FORMULA TOO COMPLEX indicates that the expression encountered has too many characters for the computer to deal with. It can also indicate that too many parentheses are being used in a formula.

ILLEGAL DIRECT indicates that the user attempted to use the INPUT statement in the direct mode. INPUT can only be used in program mode (with a line number).

ILLEGAL QUANTITY appears if the number used as the argument of a statement is out of the Commodore 64's allowable range. Be careful with variables in a program, during computation they may exceed limits.

LOAD appears when there is a program with a program on tape.

NEXT WITHOUT FOR appears when a variable with the NEXT statement doesn't correspond to the variable in the FOR statement.

NOT INPUT FILE indicates that a program is trying to INPUT or GET data from a file that was specifically opened as an output file.

OUT OF DATA indicates that a program is attempting to READ from a DATA statement and there is not a one to one correspondence between the number of READs and the amount of data.

OUT OF MEMORY indicates that there is no more RAM memory available. It also occurs when too many FOR loops are used, or when there are too many GOSUBs used. Remember arrays, though they may only take one line to dimensionalize, often occupy vast areas in RAM.

OVERFLOW indicates that a value computed has exceeded the maximum value allowable on the C 64, 1.70141884E+38.

REDIM'D ARRAY indicates that an attempt was made to use the same variable to dimension two arrays. If a variable is used in a program before it is dimensioned, the computer automatically gives it a dimension of ten. If the program then attempts to dimension the array, the error message will appear. It is best to use the DIM statements in the beginning of a program.

REDO FROM START is encountered when the user enters string data into an INPUT when the computer was expecting numeric data. If, in a program, the statement reads INPUT A, the program will prompt for input. If the user enters a word at this point, the error message will appear (A is a floating point variable). The user can reenter the correct input and the C 64 will continue.

RETURN WITHOUT GOSUB is encountered when a program reads a RETURN statement and has no GOSUB to which to return.

STRING TOO LONG appears when a string greater than 255 characters is read. Be sure that when you are inputing multiple variables that you include delimiters (commas, semicolons, returns) between variables.

SYNTAX ERROR appears when the computer reads a line and does not recognize the BASIC command. Even the slightest variation from the format listed in the Users Guide or Reference Guide will result in a syntax error. Be sure to include commas and parenthesis where shown.

TYPE MISMATCH appears when a variable designated as either numeric or string is equated with the wrong type. If you attempt to equate A = "G" you are trying to make a floating point variable equal to a character. Be sure and use quotation marks around string data.

UNDEF'D FUNCTION appears when an FN statement is used without first having a DEF FN statement.

UNDEF'D STATEMENT is encountered when the computer is programmed to read a line number that does not exist. If you have a GOSUB statement to a line number that does not exist this message will occur.

VERIFY is encountered when the VERIFY command was used to compare the data in the memory with the data on a tape or disk, and an inconsistency was found. Attempt to load or save the program again.

READ ERROR is encountered when the 1541 drive is unable to correctly read data on the disk. The 1541 drive is capable of being more specific by reading the error channel (#15) and decoding the error number. The following numbers correspond to the particular error.

20: The disk drive is unable to find the header of a block due to an illegal sector number or corrupted data.

21: The disk drive finds the beginning of a sector by reading a synchronization mark at the beginning. This message appears if the drive can't find that snyc mark. It can result from not having formatted the disk (using NEW command) or if the disk is absent or not seated properly. Hardware failures can also give this message.

22: If the disk drive has been given a BLOCK command using random files and the block can not be found, this number appears on the error channel. The user may have tried to read or verify a track or sector number that does not exist.

23: The disk drive has a method of verifying data as it is read from the disk using a checksum. This message indicates corrupted data or a hardware problem.

24: If a byte read from disk reveals an invalid bit pattern this error will develop. It can be from a hardware problem.

27: The disk drive has a method of verifying the header information as it is read from disk using a checksum. If there is an error in the header, this message may appear. It can also result from hardware failure.

WRITE ERROR results if there is an inconsistency between the data that is written onto disk and the data that should be written onto disk. Two specific write errors are shown below:

25: If the data written on disk does not equate with the data in Disk RAM from where it was just written, this error appears.

28: At the beginning of sector a synchronization mark is written. When writing to disk the drive attempts to read these sync marks. If one does not appear, this error is incurred. It happens with a bad disk, unformatted disk, or a hardware problem.

WRITE PROTECTION ON is the result of attempting to write to a disk that is write-protected. Either there is an adhesive tab over the write-protect notch, or there is no write-protect notch on the disk.

DISK ID MISMATCH is incurred when the 1541 drive attempts to access a disk that has not been formatted. It can also result from a bad disk.

SYNTAX ERROR indicates that the 1541 drive could not understand one of the commands sent to it. Specific syntax errors can be determined by reading the error number off the error channel (#15). They are as follows:

31: The drive does not understand the command sent. Make sure the command is in the correct format.

32: The command sent has exceeded the 58 characters allowable in a command.

33: The user has attempted to use pattern matching incorrectly in the LOAD or SAVE commands.

34: A file name is missing from a command, or a colon is absent.

39: The disk does not recognize a command sent through the command channel (#15).

RECORD NOT PRESENT is displayed by the 1541 drive when the user attempts to INPUT# or GET# data beyond the last record in a file. It can also occur if the user attempts to use the position commands beyond the last record of a relative file.

OVERFLOW IN RECORD PRINT# is displayed by the 1541 drive when more than the defined or allowable number of characters if PRINT#ed to the drive. Remember the carriage return is included in the characters sent.

FILE TOO LARGE is displayed by the 1541 drive to indicate that a disk overfow will occur.

WRITE FILE OPEN is displayed by the 1541 when an attempt is made to open a write file that has not been closed.

FILE NOT OPEN is generated by the 1541 drive when a file is accessed and has not been opened.

FILE NOT FOUND is generated by the 1541 drive when a user attempts to access a file that does not exist on a particular drive or disk. Be sure that the file being accessed is spelled correctly and in the exact format as that on the directory.

FILE EXISTS is sent by the 1541 disk drive when the user attempts to open a file by a name that already exists.

FILE TYPE MISSMATCH is sent by the 1541 disk drive

when the user attempts to open a file by name and type that is stored as a different type.

NO BLOCK is sent by the 1541 disk drive when a user attempts to use the BLOCK-ALLOCATE command to allocate a block that is already in use. The error channel #15 returns this message as well as the track and sector of the next available block.

ILLEGAL TRACK AND SECTOR is sent by the 1541 disk drive when the user tries to access a track or sector that is not available or does not exist.

ILLEGAL SYSTEM T OR S is sent by the 1541 disk drive when the user tries to access an illegal track or sector.

NO CHANNEL is generated by the 1541 disk drive when a user tries to open more than the allowed number of channels. Up to five sequential files or six direct access channels may be opened siumltaneously.

DIRECTORY CHANNEL is sent by the 1541 drive when there is a problem with the Block Availability Map. The BAM keeps track of the blocks used on the disk and is kept on the disk. It is also kept in disk memory when the drive is on. If the BAM becomes corrupted on disk memory the error above may be generated. It is necessary to use the INITIALIZE command to correct the situation.

DISK FULL is sent by the 1541 drive if the user attempts to add to a disk that does not have enough room for the entry, or if the user attempts to create more than 144 files.

ESC ESCape. A character that causes the terminal and/or processor to interpret subsequent characters differently. Escape codes are used to indicate a sequence of control messages in ASCII.

ESF-20/64 Stringy Floppy System, The* A high quality digital mass storage system that can close the gap between cassettes and disks. Uses small tape cartridges, called wafers, that run a lot faster than standard cassettes and have a 64K byte memory. Exatron.

ETB End of Transmission Block.

Ethernet A standard for inter-computer communications networks developed by Xerox Corporation.

ETX End of TeXt.

EUROMICRO European Association for Microprocessing and Microprogramming.

Even Parity A parity bit added to a byte or word that makes the total number of bits even. See Parity.

Excess-3 Code A variation of BCD which uses binary values of 3 through 12 to represent the decimal integers 0 through 9.

Execute BASIC program See RUN, LOAD.

Execute (cycle) The third of three cycles for program instruction execution. During this cycle the actual operation is performed. See Fetch (cycle), Decode (cycle).

Execution Time The time required to execute an instruction, including fetch-decode-execute. Also refers to the point in the program's processing when it is in control of the CPU, as opposed to compile time, link time, and load time.

Executive 64* The Executive 64 is a portable computer designed for the traveling businessman. It weighs about twenty-eight pounds and is briefcase size (5"x14 ½"x14 ½"). It has 64K RAM, a full upper/lower case low-profile detachable keyboard and a built-in single floppy disk drive (170K capacity). A second disk drive is optional.

The Executive 64 is fully compatible with Commodore 64 peripherals and external ports allow full-sized monitor and printer hook-ups. Using a Z-80 cartridge, the Executive 64 can accomodate a CP/M operating system. Also, the Executive 64 can use the large number of game cartridges available for the C 64 and features full music and sound capabilities. Commodore.

Exerciser A test system or program designed to detect malfunctions in memory, disk, tape, or other device prior to shipping to customers, or during a maintenance operation.

EXP BASIC Function. EXP function calculates the exponential function and returns the mathematical number "e" raised to the x power. "e" is the base for natural logarithms. If x is greater than 88.02969, an overflow occurs. The format is:

EXP <number>

Expander Boards* A great selection of expander boards that offer quality construction, reasonable prices, and a growing inventory. Precision Technology, Inc.

Expandoport Series* A series of expansion boards that offer a switch for controlling power to the connector, have a fuse and reset switch that prevent excessive current drain, and protects RAM during restart, which can be done without turning off power. Micro Systems Development, Inc.

Expansion Board A printed circuit board which accommodates extra components or cards to expand a computer. It is called an expansion chassis if it connects an additional cabinet to the system.

Expansion Interface The expansion port of the Commodore 64 is capable of accepting one cartridge. Some companies manufacture expansion interfaces that enable the user to connect more than one cartridge to the Commodore 64 at one time. See Cardco.

Expansion Port Located in the rear of the Commodore 64, the expansion port is a 44-pin port that allows access to the address bus as well as the data bus within the computer. Modules designed to plug into this slot can be pre-programmed in ROM and come up running when the computer is powered on. CP/M modules can be inserted in this slot.

EXPANSION PORT

22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
= =

= =
Z Y X W V U T S R P N M L K J H F E D C B A

The signals available on the connector are as follows:

NAME	PIN	DESCRIPTION
GND	1	Ground
+5VDC	2	(Voltage Pins CARTRIDGE devices can draw no more than 450 mA.)
+5VDC	3	450 mA.)
IRQ	4	Interrupt Request line to 6502 (active low)
R/W	5	Read/Write
DOT CLOCK	6	8.18 MHz video dot clock
I/O1	7	I/O block 1 @ $DE00-DEFF(active low) unbuffered I/O
GAME	8	Active low is TTL input
EXROM	9	Active low is TTCLinput
I/O2	10	I/O block 2 @ $DF00-$DFFF (active low); buffered is TTL output
ROML	11	8K decoded RAM/ROM block @ $8000 (active low); buffered is TTC output
BA	12	Bus available signal from the VIC-II chip unbuffered 1 Is load max.
DMA	13	Direct memory access request line (active low input) is TTL input
D7	14	Data bus bit 7
D6	15	Data bus bit 6
D5	16	Data bus bit 5
D4	17	Data bus bit 4 unbuffered, 1 is TTL load max
D3	18	Data bus bit 3
D2	19	Data bus bit 2
D1	20	Data bus bit 1
D0	21	Data bus bit 0
GND	22	Ground
GND	A	
ROMH	B	RAM/ROM block @ $E000 buffered
RESET	C	6502 RESET pin (active low) buffered TTL out/unbuffered in
NMI	D	6502 Non Maskable Interrupt (active low) buffered TTL out, unbuffered in
02	E	Phase 2 system clock
A15	F	Address bus bit 15
A14	H	Address bus bit 14
A13	J	Address bus bit 13
A12	K	Address bus bit 12
A11	L	Address bus bit 11
A10	M	Address bus bit 10
A9	N	Address bus bit 9
A8	P	Address bus bit 8 unbuffered, 1 is TTL load max
A7	R	Address bus bit 7
A6	S	Address bus bit 6
A5	T	Address bus bit 5
A4	U	Address bus bit 4
A3	V	Address bus bit 3
A2	W	Address bus bit 2
A1	X	Address bus bit 1
A0	Y	Address bus bit 0
GND	Z	Ground

Exponential BASIC. See EXP.

Extended Arithmetic Double-precision floating point operations. Also used to refer to expanded capabilities, such as built-in trigonometric functions.

Extended Background Color Mode The Commodore 64 formats the screen in one of two ways: in a hi-resolution mode or the standard character mode. In the character mode the screen is divided into 1000 squares and formatted as 40 columns by 25 lines. In standard character mode each character must be one of 16 colors and the background is set as one color for the entire screen. In extended background color mode the background for each character can be set independent of the others, and only the first 64 characters are available to the user. This mode is enabled by setting bit 6 of address 53265. See also Character Generator.

External Commands The Command Processor is a program which accepts a command (usually from a keyboard) and causes it to be carried out. Some command processors contain the programming required for all commands they process (internal commands). Others do not carry out any commands directly. Instead, they examine the command, determine what other program (if any) can carry out the command, locate the required external program, and start it running (external commands). Still another type of command processor carries out some commands directly (internal commands), but locates and runs other programs for some commands (external commands).

External Device Port Connections. An address providing a connection between the computer's internal processor and an external device through the computer's ports. Ports are used to attach input and output devices.

External Memory Memory is any device which can store information and allow it to be retrieved when needed. The Commodore 64 relies primarily on Random Access Memory (RAM), Read-Only Memory (ROM), disks, and cassettes. The term Memory, by itself, is usually a reference to RAM. This is the erasable and reusable memory located inside the Commodore 64.

ROM (Read-Only Memory) contains fixed data, usually

programs such as the Commodore 64's operating system. ROM and RAM together make up the internal memory or main memory of the Commodore 64, or any other computer. Data in internal memory is immediately available to programs for processing.

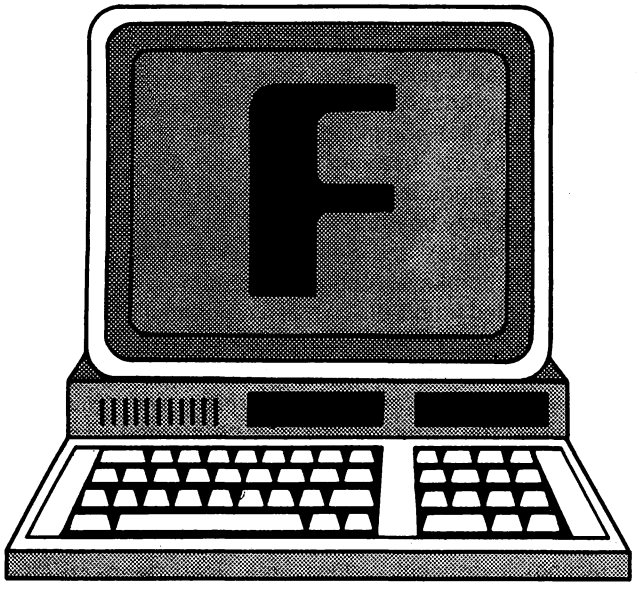
External Memory—such as cassette, disk, and hard disk—requires mechanical retrieval of data and is hundreds or thousands of times slower than internal memory. Data in external memory must be copied into internal memory (INPUT), processed, then copied back out to external memory (PRINT #).

If data has been created, it can be written out to external memory without a READ first. And, if data read in from external memory has not been modified, there is no need to write it back out since the original copy is still there.

While external memory is very slow relative to internal memory, it does have advantages. It is much cheaper per character of data stored on-line (available for processing without manual intervention). In addition, the ability to store external memory data off-line (on disk or cassettes) allows essentially unlimited storage of data. However, this requires manually inserting the disk, cassette, or disk before the data can be loaded into the internal memory for processing. See also Virtual Memory, RAM, Spool, Memory Map, Bubble Memory.

Extra Ignored Following an INPUT statement in a program the user is required to make an entry and press return. If the INPUT statement is expecting only one variable (INPUT A) and the user enters two, the second will be ignored.

Extra Practice Spelling Series* A word is displayed on the screen while the student is asked to key in the word. After he has successfully done so, the word disappears from the screen and he is asked to key in the word from memory. When he has correctly spelled the word from memory, a new word is presented on the screen. After each lesson the student's performance is rated and if he has spelled at least 10 words from memory without error, he is rewarded. There are over 7000 words available. For second through sixth grade. Grade levels may be purchased separately. Cassette. Micro-Ed.



F Codes. ASCII = 70, CBM ASCII = 70 or 198, HEX = 46. f—ASCII = 102, CBM ASCII = 70, HEX = 66. Screen code = 6 or 70

Fabulous L-C-M Machine and the Generous Jackpot Mine, The* Figuring Least Common Multiples is the challenge in this game set in a casino atmosphere. High scoring students get a chance at the big prize. Cassette. Micro-Ed.

Factor Wheel* Select a number and spin the wheel to match it with its factor. Cassette. Comm*Data Computer House.

Family Finances* Gives you access to past and future expenditures, and summaries to help you plan your family finances. Disk. Sophware.

Fan-Fold Paper Continuous sheets of paper joined along perforations and folded in a zigzag fashion. Often used with printers because it is continuously fed and folded without operator assistance.

Farad The unit of electrical capacitance. A 1 volt per second change in voltage across a 1 farad capacitor will require 1 ampere of current flow.

Fast Fourier Transform Application of the Cooley-Tukey algorithm to Fourier transforms. Allows computation of Fourier transforms with dramatically reduced time and storage requirements.

Fat Chance* Elementary students have fun increasing their comprehension of multiples. Cassette. Micro-Ed.

Fatal Error A condition occurring during the execution of a program which requires termination of the program.

Fault-Tolerant A program or system capable of correct operation even when one or more of its components have failed. Also called error-tolerant or fail-soft.

FCB CP/M. See File Control Block.

FCC Federal Communication Commission.

F.C.M.* Filing, Cataloging, and Mailing. A versatile mailing list program that includes custom label formatting and screen design, and allows for special type formats and user-defined field lengths. You can use F.C.M. to organize any kind of information, from business files to recipes. Disk; printer required. Continental Software.

FDM Frequency Division Multiplexing. This technique assists in carrying data from a number of terminals simultaneously by dividing a high bandwidth into several narrow bands of lower frequency.

FDOS CP/M. Full Disk Operating System is the collective name for BIOS (Basic Input Output System) and BDOS (Basic Disk Operating System). See also BIOS.

Feedback One or more outputs of a system is also used as an input in a control loop.

FET Pronounced "fett". Field Effect Transistor. A transistor with an n-type silicon bar for the main conduction path and depletion layering for control.

Fetch Cycle The first cycle in the fetch-decode-execute sequence of instruction execution. During the fetch cycle, the contents of the program counter are placed on the address bus, a Read signal is generated, and the Instruction Pointer is incremented. The data bytes arriving from the memory (the instruction which has been fetched) will be gated into the Instruction Register of the Control Unit.

Fetch-Ahead See Carry-Look Ahead.

FFFF The hexadecimal representation of the maximum simple address value on 8-bit microcomputers: FFFF base 16 = 65535.

FFT A fast computational algorithm for determining the Fourier curve fit to a collection of data points

Field A logical grouping of data. This could be a group of related characters in a record (name field), a work area in memory, or in the CPU a zone within an instruction, such as opcode, address, or comment.

FIFO Pronounced "fife-oh". First-In-First-Out structure. Data is added at one end and removed from the other, like cars lined up at a gas station. A FIFO buffer is used to connect two devices operating asynchronously at different speeds. Each device is connected to one end of the FIFO buffer.

File A logical grouping of information with an identifying name (considered a unit by a user). A file may be divided into records, blocks, or other units as required by the memory device.

File, Fragmented See Fragmentation.

File Control Block An area of memory used by a Disk Operating System to keep track of a file's status, including such information as I/O status, current record, *physical* sector numbers, etc.

File Exists An error message from the 1541 disk drive generated when the user attempts to save a program by a name that already exists on the disk.

File Management Disk Maintenance. File management or disk maintenance is record keeping on disks. This includes creating files, finding them by name, ensuring that adequate free space is available on the disk, maintaining backups, and deleting files no longer needed. These functions are supported by the various DOS functions, but require thoughtful planning by the user to insure proper results.

Some data base management (DBM) systems attempt to automate part of the work of keeping track of files and disks. Some DBM systems maintain files of control and tracking data on other files and disks, and may provide alternatives to DOS functions.

File Management/Handling Software See Solver, The; Media Register; Name Machine, The; Research Assistant 2.0; SuperTerm.

File Not Found An error message from the 1541 disk drive generated when a user attempts to access a file that does not exist on a perticular drive or disk. Be sure the file being accessed is spelled correctly and in the exact format as the on the directory. This message may also be generated when the disk is not in the drive, or when it hasn't been properly initialized.

File Not Open If you attempt to use the commands CLOSE, CMD, PRINT#, INPUT#, or GET# with a file that was not already properly opened, this message will appear.

File Open Indicates that you attempted to open a file that is already open. Remember to keep file numbers, device numbers, and channel numbers straight.

File Separator A special pattern of bits or frequency which separates one file from another on magnetic media such as tape or disk.

File Specification (or Filespec) The complete specification of a file, including file name, drive identifier, and extension.

File Too Large An error message from the 1541 disk drive indicating that a disk overflow will occur if the file you want is placed on it.

File Type Mismatch An error message from the 1541 disk drive incurred when the user attempts to open a file by name and a type other than the type in which it was stored.

Filewriter/Filereader* User can write data files with output on either screen or printer. Cassette. RAK Electronics.

Filing Assistant, The* Database. The Filing Assistant is a general purpose database management system for the Commodore 64. The system package comes with an easy-to-follow manual and a program disk. A series of programs are provided that are required to build the various functions of the system. The software supports a variety of printers, and a special menu option is available to set up the desired printer configuration. A user-defined format is created for all the records in a file. The program uses random files to store records. Each record may contain a maximum of 25 fields and a total of 254 characters. Since field names and formats are stored in a separate file, all of the record capacity is available for data entry. The main program is menu-driven and utilizes the Commodore 64's special function keys to access functions. One of the highlights of the program is the command/option line at the bottom, which prompts the user for a specific command and displays the options available. In the CHANGE/UPDATE mode, records may be Added, Deleted, or Sorted (by user-specified key fields), and Searched, Copied or Browsed using the function keys. A special program for generating reports is loaded from a disk when a report of the entries is desired. This program presents many special features such as automatic page-numbering, headers, and footers. Additional options are available for printing pre-formatted mailing lists. The program files can be merged with the word processor—The Writer's Assistant—to produce customized form letters. Rainbow Computer Corporation.

Finance* Assists you with financial management by calculating investment values and loan terms. RAK Electronics.

Financial Planning Software See Amortizer, The; Business Applications Systems; Business Man, The; Cash Flow Model; Checkbook Manager; Cheque-Check; Color Accountant; Cyber-Farmer 64; Depreciator, The; DXCC Record; Easy Finance; Family Finances; Finance; General Ledger; Home Budget/Finance; Investment Analyst, The; Lease/Buy?; Loan Amortization; Loan Repayer, The; Mortgage Calculator, The; Net Worth Statement; Personal Finance; Present Value; Sales/Expenses; Savings Account Miser, The; Super Budget; Super Checkbook; Super Shopper; Syndicator, The; Taxman-Income and Expenser.

Firmware A program stored in a ROM. Originally, firmware was used only for microprograms inside the CPU. In microprocessors, many kinds of programs reside in ROM, and firmware designates any ROM-implemented program.

Fixed Media for Recording Information The physical devices for recording information, such as programs and data files, are called media. The main medium for the Commodore 64 is disk, but cassette, hard disk, RAM, ROM, and other devices are also used. Media are often classified as:

a) removable media—such as disks, cassettes and some hard disks or

b) fixed media—such as most hard disks. Fixed media are not removable from the device that drives them, so there is no ability to store additional data or backup copies off-line (outside the computing system) for insertion when needed. See also Memory.

Fixed Point Integer representation with the decimal point assumed to be in a fixed position. Contrast with floating point.

Fixed-Head Disk Disk system with a head over each track. Elimination of head positioning delay time provides very high speed access, but at high cost.

Flag Status indicator for a special condition. A flag is normally stored in a flip-flop or in a register. Typically, a microprocessor provides at least the following status flags: carry, zero, sign, overflow, and half-carry or auxiliary carry.

Flag Bits See Status Register.

Flash Spell Hellcopter* Elementary and junior high school students learn to spell any word entered into the data system. The word is flashed on the screen for half a second at a time while the student tries to spell it. For words spelled right the first time, the student receives ten seconds helicopter (game) time. An additional game may be played after earning time in the spelling game. Cassette or disk. Microcomputer Workshops.

Flip-Flop Circuit used to store one bit of information. An FF is bistable with two stable states (0 and 1). Registers are generally assembled out of flip-flops.

Floating Gate Technique used for UV-erasable EPROMs. A silicon gate is isolated inside the silicon dioxide.

Floating Point Constants. The Commodore 64 represents numbers as either integers (whole numbers 1, 2, etc.) or floating point numbers which may contain fractions. A floating point number is expressed in decimal notation or in scientific notation. In decimal notation, nine digits can be displayed on the screen, giving a maximum value of 999999999. If you do not include a decimal point, one is presumed to follow the last digit. Numbers larger than 999999999, or smaller than .01 are printed on the screen in scientific notation. On the Commodore 64, the largest number represented is 1.70141183E+38, and the smallest number represented is 2.93873588E-39.

Floating Point Variables. Variables are names that represent numbers. Any name that is not followed by a symbol % for integer or $ for string variable is assumed to represent a floating point constant on the Commodore 64. It is important to identify integers when possible, as they only take up two bytes in RAM, whereas the floating point takes up five bytes.

Floating Point (Representation) Representation of numbers in a fixed length format. The number N is normalized and encoded as a mantissa field M and an exponent field. The name reflects the fact that the representation remains fixed as the decimal point floats, i.e., the changes in magnitude are reflected by adjustment of the exponent field with renormalization of the mantissa field. The precision of the representation is limited by the number of bits allocated to the mantissa field. Contrast with Fixed Point.

Floppy Disk A mass-storage device. Flexible (floppy) mylar disk (disk) on which information is recorded. The 8 inch disk is sealed in a square plastic jacket lined with a soft material which cleans the disk as it rotates. A cut-out slot provides access for the moving head which must actually come in contact with the disk surface in order to read or write. Other holes in the jacket provide access to sector index holes in the disk. Disks are hard-sectored if the sector start points are marked by holes in the disk. Soft-sectored disks have only one (or a few) holes to mark the start of the track. The sector start marks are placed on the soft-sectored disk under software control in a process known as formatting. See Disk.

Disks are also classified as single or double sided, single, double, or quadruple (quad) density. See these entries.

Floppy Mini Floppy that is 5-¼" square. This is the standard size for the Commodore 64.

Flowchart Symbolic representation of a process. Boxes represent commands or computations. Diamonds represent tests and decisions (branches). A flowchart is a useful step between process specification and program writing. Flowcharts facilitate understanding and debugging a program by segmenting it into logical, sequential steps.

FN BASIC. This statement references a previously defined formula established with a DEF FN statement. The format is:

10 DEF FN <name> (<var>)=<equation> 20 PRINT FN <name> (<num>)

<name> is of one or two characters assigned by the user. It must begin with a letter. It is then referenced by the FN statement.

<var> is any variable assigned by user.

<num> is the number that will be substituted into the formula in place of the variable.

FOR and NEXT BASIC Statements. The FOR statement, used in conjunction with the NEXT statement, performs a series of instructions in a loop a given number of times. The format is:

FOR <variable> = <X> TO <Y>[STEP <Z>]

.

.

.

NEXT [<variable><,variable>...]

<variable> is an integer variable to be used as a counter.

<X> is a numeric expression which is the initial value of the counter.

<Y> is a numeric expression which is the final value of the counter.

<Z> is a numeric expression to be used as an increment.

Within a single FOR ... NEXT loop, all lines following the FOR statement are executed until the NEXT statement is encountered. Then the counter <X> is incremented by the amount specified by the STEP value <Z>. If you don't specify a value for <Z>, the increment is set to one. A check is then done to see if the value of the counter is now greater than the final value <Y>. If it is not greater, BASIC goes back to the statement after the FOR statement and the process is repeated. If it is greater, the first statement following the NEXT statement is executed.

If the value of <Z> is negative, the check is reversed. The counter is decremented each time the loop is executed and execution continues until the counter <X> is less than the final value <Y>.

The statements within the FOR...NEXT loop are not executed if <X> is already greater than <Y> when the STEP value is positive, or if <X> is less than the <Y> when the STEP value is negative. If <Z> is zero, an infinite loop will occur unless you provide some way to set the counter greater than the final value.

A nested loop is one FOR...NEXT Loop placed inside another. A third loop can be placed within the second, and so on. Whenever FOR...NEXT loops are nested, each loop must have a unique variable name as its counter. The NEXT statement for the inner loop must appear in a statement before the NEXT statement for the outside loop. However, if nested loops have the same end point, a single NEXT statement may be used for all of them. The format is:

NEXT <variable1>,<variable2>,<variable3>

which is the same as

NEXT <variable1>
NEXT <variable2>
NEXT <variable3>

The variable or variables in the NEXT statement may be left out. In this case the NEXT statement returns to the most recent FOR statement. When using FOR...NEXT loops, you should include the variable or variables on all the NEXT statements. It is a good rule of thumb to use variable names on all NEXT statements in order to avoid confusion.

When a NEXT statement is encountered before its corresponding FOR statement, a "NEXT without FOR" error is displayed. Here is an example:

```
READY
10 M=2:K=10
20 FOR I=M TO K STEP 2
30 PRINT I;
40 NEXT
RUN
2
4
6
8
10
READY
```

FOR...NEXT statements function differently in Compiler BASIC. For more information see your Compiler Manual.

Foreground Program In a multi-programming environment, a foreground is a higher priority program. It is also a program in charge of interfacing with a user or process.

FORMAT Predesigned arrangement of data. Arrangement of elements of a command or statement, the order of data in a file, or the layout of a printed document.

Formula Too Complex A limited number of characters can be used in a string expression. This error message indicates the encountered expression has too many characters. It can also mean that too many parentheses are being used in a formula.

Fort Apocalypse* Defeat the evil lords and free their prisoners by planning a strategy for your fuel and weapons use. Synapse.

FORTH Programming language and operating system. FORTH is characterized by threaded code and postfix, or reverse Polish notation. FORTH is an extensible language: you can create new commands, defined in terms of the existing commands or in Machine language. Your new commands then become part of the *FORTH language*. This allows you to create your own commands suitable for a specific purpose. FORTH is also highly transportable from one microcomputer to another—more so than BASIC and most other languages. FORTH runs fast (it is closer to Machine Code than to higher level languages like BASIC). Forth may be somewhat harder to master than BASIC, but it offers many advantages.

FORTRAN FORmula TRANslator. One of the first high level languages, still widely used by scientists and engineers. BASIC is largely based on FORTRAN, using statement numbers and a similar set of commands. The differences are slight, mostly dealing with I/O statements. FORTRAN includes the FORMAT statement for formatting printed output. It is rich in mathematical functions and supports an extended precision calculations mode for scentific problems.

FORTRAN is a compiled language, not interpreted like BASIC. A program is edited in a file, then submitted to a compiler for translation into executable object code. FORTRAN and BASIC are so similar that BASIC could be called an interpreted dialect of FORTRAN. Here is a FORTRAN program to sum the first 100 integers:

```
20FOR I = 1 TO 100
30J = J + I
40NEXT I
50END
```

Forty Fathoms* Dive for sunken treasure and encounter the creatures of the deep. Commodore.

Fourier Transform The mathematical analysis of a complex wave-form into harmonic components.

FPGA Field Programmable Gate Array. A device containing an array of AND and OR gates which can be re-connected (programmed) in the field (i.e., without return to the factory).

Fractions Package* Seven of the Micro-Ed math programs at a reduced price. Includes Parting Shots, On the Line, Tutti Frutti, and more. Cassette. Micro-Ed.

Fragmentation When mass memory has been allocated in such a way that it has many unallocated areas (fragments) that are too small to be useful. The remedy is to combine all of the small areas into one large usable area. See Validate.

Frame The necessary underlying structure for a record, file, or other data item. The frame creates an organization within which the data takes its place.

FRE BASIC Function. FRE will return the number of available bytes in memory that are not being used by the operating system. If the number returned is negative, add 65536 to determine the number of free bytes.

The format is:

FRE(0)

Example:

```
Print FRE(0)
-26627
READY
```

Frequency The number of cycles per second. F=1/T, where T is the period, in seconds, over which cycles are counted.

Front Panel A panel with lights and switches to display information and allow direct control or access to memory or registers. A front panel requires a specific interface and a monitor program. Many microcomputers have no front panel, therefore access is from a keyboard and screen.

Front-End Processor A processor which acts as an interface with a user or a process. The front-end may perform pre-processing translations or file handling, while the main processor performs interpretation, execution, or other processing.

Full Duplex Communication technique which allows simultaneous transmission and reception of data.

fullFORTH* This program offers enhanced fig-FORTH complete with conditional assembler, interpreter, floating point, editor, and strings. A target compiler can also be added at an extra charge. Microtech.

Fun Predictions* Calculates your age to the minute and predicts your future in a congenial manner. Comm*Data Computer House.

Function keys Keys located to the right of the Commodore 64 keyboard labeled F1, F2, F3, F4, F5, F6, F7, F8. They are available for user assigned functions. Each key has a separate CHR$ code number (from 133 to 144 inclusive). A user can input a character from the keyboard and compare it to the CHR$ code number. If there is a match, the program will know one of the function keys hasbeen pressed and can branch to an appropriate subroutine. For example:

```
10 GET A
20 IF A=133 THEN GOTO 400
```

400 is a subroutine that may, for example, print hello. If F1 is pressed at this time the word hello will appear on the screen.

Fundamental The base or carrier signal on which a data signal will be superimposed. Usually a pure sine wave with no distortion.

Fur Trapper* You are a mountaineer in the mid-1800's trapping furs

F/V Frequency to Voltage Converter.

G Codes. ASCII = 71, CBM ASCII = 71 or 199, HEX = 47. g—ASCII = 103, CBM ASCII = 71, HEX = 67. Screen code = 7 or 71. See CBM ASCII.

G Ground; also, Generate signal. The output from an adder connected to a carry look-ahead circuit. It requires a propagate signal.

Gain The output to input amplification ratio.

Game Ports There are two 9-pin game ports located on the right side of the Commodore 64, labeled control port 1 and control port 2. They are for compatible joysticks, game paddles, and light pens. Information as to the position of the joysticks or whether a fire button has been pressed is sent through the port to the 6526 CIA chip. That information can be read by accessing memory address 56320 for port A and 56321 for port B. See Complex Interface Adapter.

Game Program Development Kit* Six tools to help you write arcadestyle games. Includes Decoder, Editor, Assembler, Loader, Monitor, and Instruction Guide. French Silk Smooth Ware.

Games See Adventure Pack I; Adventure Pack II; Animal Zap; Annihilator; Backfire; Backgammon; Bigital Clock; Blackjack; Bunny; Checkbook Booky; Choplifter; Circle World; Clowns; Craps; Cribbage; Cursor; Derelict; Earthquake; Fabulous L-C-M Machine and the Generous Jackpot Mine, The; Factor Wheel; Forty Fathoms; Ft. Apocalypse; Fun Predictions; Fur Trapper; Grave Robbers; Great Times Hotel; Gridrunner; Haunted House; High Seas; Jupiter Lander; Kickman; Kongo Kong; Laser Percents; Lights Out; Mansion; Mars; Meteor; Mission 64; Nuclear Sub; Omega Race; Paratrooper; Pedestrian; Pharaoh's Curse, The; Protector II; Pyramid; Quest; Radar Rat Race; Sea Wolf; Sector five; Shamus; Skier 64; Ski-Run; Slots; Sorcerer's Apprentice; Space Sentinel;Star Trek; Survivor; Tooth Invaders; Trail West; Trek (Victory Software); Trek (Aardvark); Vampire Castle; Warrior of RAS.

Gap The space between two records or two blocks of information on a magnetic medium. A gap is usually set to a predetermined value, such as all 1's. It allows blocks to be rewritten in a slightly expanded or reduced format, due to speed variations of the drive.

Garbage Collection Collecting unavailable, unused space in a mass memory and making it available for reuse.

Gate Single logic function. The NAND, NOR, AND, OR, XOR, and NOT functions are examples of gates.

Gauss A unit of flux density (1 Maxwell per square cm.),named for German mathematician Karl F. Gauss.

GCR Group Coded Recording.

GE Greater than or Equal to is represented by ⩾ or =>.

Gemini Printer* Control Characters with BASIC. The following table contains the ASCII codes that are sent to the printer to access print modes and special functions such as Emphasize, Double Strike, Condensed, Dot addressable graphics, etc. The table also includes the ASCII code required to turn the specific function or mode off (return to normal default print mode).

Function/Mode	Turn On	Turn Off
I. Select Font Style		
Standard ASCII	27,53	—
Italic ASCII	27,52	27,53
International Char. Set	27,55,n	—
II. Select Font Pitch Style		
Pica-Sized Mode	27,66	—
Elite-Sized Mode	27,66,2	27,66,1
Condensed Print Mode	27,66,2	27,66,1
Enlarged Print Mode	27,87,1	27,87,0
Double-Strike Mode	27,71	27,72
Emphasize Mode	27,69	27,70
III. Special Printing Effects		
Underline	27,45,1	27,45,0
Superscript	27,83,0	27,83,1
Subscript	27,83,1	27,84
Uni-Directional Mode	27,85,1	27,85,0
IV. Vertical Position Control		
Line Feed (One Line)	10	—
Line Feed (⅛ Inch)	27,48	—
Line Feed (7/72 Inch)	27,49	—
Line Feed (1/6 Inch)	27,50	—
Line Feed (n/72 Inch)	27,65,n	—
Line Feed (n/144 Inch)	27,51,n	—
V. Form Feed Controls		
Advance to Top of Next Form	12	—
Change Page Setting to n Lines	27,67,n	—
Change Form Length Setting to n Inches	27,67,0,n	—
Set Skip-over Perforation n = number of lines left on the page.	27,78,n	27,79
VI. Horizontal Position Control		
Return Print Head to Home Position	13	
Set Left Print Margin	27,77,n n = print position bet 1-255	

Set Right Margin	27,81,N n = print position bet 1-255
Move Print Head to Next Horizontal Tab position	9
Set Horizontal Tab	27,68,n1, n2...0
n1,n2..are horizontal tab positions. 0 ends command.	
Move Print Head Back One Space	8
VII. Graphic Control Commands	
Print Normal Density Graphics	27,75,n1,n2, m1,m2...
Print Double Density Graphics	27,76,n1,n2, m1,m2...
Print Double Density Graphics With Dual Speed	27,121,n1, n2,m1,m2...
Print Quadruple Density Graphics	27,122,n1, n2,m1,m2...
VIII. Download Character Commands	
Define Download Character into RAM	27,42,n1, n2,m1,m2...
Copy Character Font From ROM into Download RAM	27,42,0
Select the Download Character Set	27,36,1 27,36,0

GEMINI-10X* Gemini-10X (and Gemini-15) is a dot-matrix printer that may be used with the Commodore 64 with the aid of a Centronics parallel printer interface. The printer features 120 cps print speed, bidirectional logic seeking carriage control, 9 x 9 dot matrix (with true lower case descenders) and high-resolution bit imaged graphics capability. It has built-in international, block graphic and italic character sets. In addition, 2K RAM memory is available for downloading a user-defined character set. Special printer functions include condensed print, enlarged print, emphasized print, underline, superscripts, subscripts, and double strike print. These functions are available by sending escape code sequences from the program to the printer. For more details on sending control codes to the Gemini-10X for accessing special printer functions, see also Gemini Printer.

General Ledger* Creates an income statement, balance sheet, update report, and other financial records for up to 75 accounts. MicroSpec.

General Ledger Software See Accounts Receivable and Payable; General Ledger.

Genetics* Teaches primary principles of genetics by displaying a three-generation family tree. Includes exams after each section. Corrections include explanations. For ninth graders and up. Disk or cassette. Microcomputer Workshops.

Geography Smash* Teaches world geography from continents to cities. The better you get the harder it gets. Individual progress is charted on a scale at the top of the screen. For junior high school students. Cassette. Comm*Data Computer House.

GET BASIC Statement. This statement is used in a BASIC program to take one character from the keyboard buffer and assign it a name. The format is:

GET <var>

<var> follows variable rules. It can represent a number or a string character. If the variable is identified as a number (it does not have a $ following it) then entry from the keyboard must be a number (an alphabetic character would give an error message.)

GET# BASIC Statement. This statement is similar to a GET statement, except the number or character obtained may be from a device other than the keyboard. The GET# must reference a file already opened and the variable assigned (either numeric or string) must correspond to the one received. The format is:

OPEN <num>,<dev> GET#<num>,<var>

<num> is an arbitrary number from 1 to 127 that is used to reference the open file on device <dev>.

<var> is the variable and follows normal variable rules. It must begin with an alphabetic character and only the first two characters are read. If it is declared as numeric the data that is taken in must be numeric.

GETIN The name of a Machine language subroutine within the operating system of the Commodore 64. It is one of the subroutines referred to as the KERNAL and used to handle input/output operations. By jumping to address $FFE4, GETIN moves one byte from a channel to the accumulator. When data is moved from the keyboard queue to the accumulator, a 0 will be loaded if the keyboard queue is empty. See also KERNAL.

Glitch A pulse or burst of noise. A small pulse of noise is called a snivitz. Glitches are more dangerous types of noise pulses which cause crashes and failures.

Global Variable A variable whose name and value are accessible throughout the program or application system: in contrast to a local variable, accessible only within the block where it is defined.

GND GrouND.

Gortek and the Microchips* Learn to program and use your computer with a science fiction story and a four color text. Commodore.

GOSUB BASIC Statement. GOSUB is used in conjunction with RETURN. It is used to branch to and return from subroutines. The format is:

```
GOSUB<line#>
.
.
<line#> ' begin subroutine
.
.
RETURN
```

<line#> is the line number of the first line of the subroutine.

You can call a subroutine using GOSUB any number of times in a program, even from within another subroutine.

The RETURN statement makes BASIC branch back to the statement following the GOSUB statement from which it exited. A subroutine may contain more than one RETURN statement, *if you* want to return from different points in the subroutine. You may place subroutines anywhere in a program.

In order to keep your program from entering a subroutine that should not be executed, it may be necessary to use a STOP, END, or GOTO statement to direct program control around it.

Refer also to ON...GOSUB and ON...GOTO.

Gotcha Math* Based on the one-armed bandit, this teaching game challenges students of different skills in math problem solving. Cassette. Comm*Data Computer House.

GOTHMOG'S LAIR* This adventure game uses full-color animated graphics and sound effects to take you through forests, swamps, a haunted mansion and its dungeon on the way to hidden treasures. On the way you encounter giant spiders, swamp demons, vampires, and many other evil creatures. Comes with an illustrated manual that explains your playing options. A map is included to help guide you through the lair. A demo program on disk provides clues. Progressive Peripherals and Software.

GOTO or GO TO. A branch instruction in a high-level language.

GOTO Basic Statement. Used to exit from the normal program sequence to a specified line number. The format is:

GOTO<line>

<line> is the line number in the program you want to execute next.

<line> specified after GOTO will be executed if it is an executable statement. If <line> is a non-executable statement, such as DATA or REM, then the program will continue until it finds the first executable line after that.

See also ON...GOSUB, ON...GOTO.

GPIB General Purpose Interface Bus. The IEEE 488-1975 interface bus standard. Also called ANSI Standard MC 1.1-1975, or the IEC Bus in Europe.

Grandmaster* Chess game for the Commodore 64 that offers many levels of play for beginners and advanced players. UMI.

Graphics Refers to the generation of pictures or diagrams onto the screen or printer. The quality of a graphic display depends on the available resolution. The Commodore 64 has a high resolution mode in which 320 by 200 dots of light (pixels) are displayed on the screen. Each one of these pixels can be turned on or off to generate high quality graphic images.

Graphics—Pet Characters. Special graphic characters on the Commodore 64. Each character is a small picture that can be combined to create larger more complex pictures or diagrams. The characters can be input from the keyboard or generated in a program using the appropriate CHR$ reference.

Graphics Software See Color Craft; Diffusion; Easy Graphics 64; EasyPlot 64; LOGO; Multi-Color; Quick Chart; Screen-Graphics-64; Sprite Design/Edit Package; Sprite Editor; Sprite-Aid; Spryte Byter.

Grave Robbers* A visually exciting adventure game. Cassette. Victory Software.

Great Times Hotel* Learn math while traveling from floor to floor by elevator in a hotel. Cassette. Micro-Ed.

Greater Than/Less Than* Teaches elementary students to answer statements using less than and greater than symbols. Cassette. Micro-Ed.

Gridrunner* Pilot an air ship and destroy aliens traveling on the grid. Many levels of difficulty and fast action. Human Engineered Software.

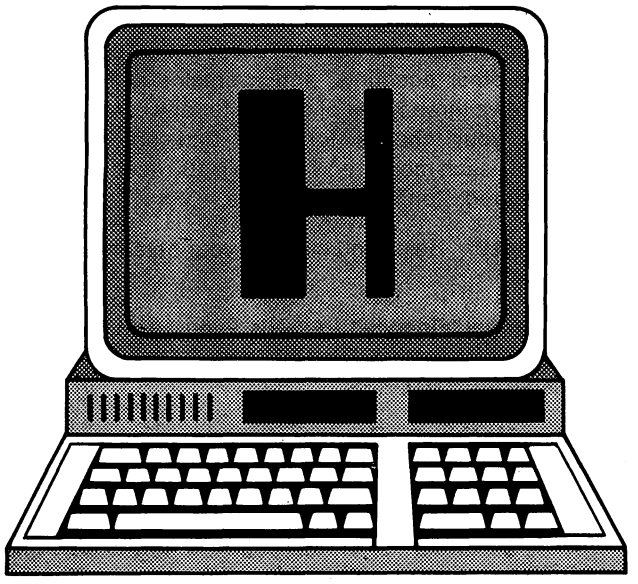
Grizzly, The* Power system that connects directly into any outlet and will help protect your system from power failures for up to twenty minutes. Electronic Protection Devices, Inc.

Ground Point of reference in an electrical circuit (not necessarily the physical ground) which is considered at nominal zero potential. All other potentials in the circuit are compared with it.

GT Greater than (represented by >).

Guess That Word* Provides five lists of words for spelling practice. Also lets you enter words which you have trouble spelling. Instructions included. For elementary students and up. Cassette. Micro-Ed.

Guzinta Hotel* Master the use of elevators to reach your destination in the least number of rides. Leads to a better understanding of greatest common factor. For elementary students. Cassette. Micro-Ed.



H Codes. ASCII = 72, CBM ASCII = 72 or 200, HEX = 48. h ASCII = 104, CBM ASCII = 72, HEX = 68. Screen code = 8 or 72. See CBM ASCII.

Haiku* Study the gracious art of the Japanese by writing Haiku poetry. Cassette. Micro-Ed.

Half-Carry The carry from bit 3 into bit 4 required to add packed Binary Coded Decimal (BCD) numbers correctly, where two BCD digits reside in one 8-bit byte.

Half-Duplex Mode of communication in which data may be transmitted in only one direction at a time.

Ham Antennas* Helps you find the optimum antenna specifications for your location. RAK Electronics.

Hamming Code A 7-bit error-correcting code. Named after the inventor.

Handler Software. Controls or communicates with an external device such as a disk drive.

Handshaking Basic communications synchronizing technique using two signals: 1)ready ? ; 2)yes/no acknowledgment. Carried out when establishing a connection between two data communication devices prior to any data transfer. For example, a CPU will ask the memory:

Is input buffer 1 empty?

If yes, it can be reloaded. If no, the CPU must wait.

Hangbug* Study the correct spelling of insects' names in this hangman type game. Choose letters of the alphabet to build the hangbug's body. When the body is complete the name has been spelled correctly. For fourth to eigth graders. Cassette. Comm*Data Computer House.

Hard and Soft C* Differentiate between a hard C and soft C in words selected from a pool of fifty. At the end of a conversation lesson the student's ability is rated. For elementary students. Cassette. MicroEd.

Hard and Soft G* Similar to Hard and Soft C, the student must tell whether the G in a word is hard or soft. This package contains ten problems and fifty words. Cassette. Micro-Ed.

Hard Copy Printed version of a program or file.

Hard Disk A disk composed of a magnetic coating applied to a rigid substrate, such as aluminum or ceramic. The term is used in contrast with "soft" (floppy) disks, which are flexible. Hard disks are faster and have more storage capacity.

Hard-sectored Describes a disk who's recording surface has been divided into sectors using non-alterable methods, such as a ring of holes in the disk itself. The Commodore 64 uses soft sectoring, done by the DOS NEW command.

Hardware vs. Software Computer programs of all kinds are called software. Usually software is contrasted to hardware—the actual chips, wires, boards, etc which make up the computer. In the special case of Read-Only Memory (ROM), this terminology can be confusing and inadequate. A BASIC ROM, for instance, is a ROM (hardware) containing a copy of a BASIC interpreter program (software). Such ROMs are often called firmware to distinguish them from non-program hardware and from software in changeable media (RAM, disk, cassette, etc.).

Harmonic An integer multiple of a fundamental frequency.

Harmonic Distortion Distortion due to the signal's non-linear characteristics, resulting in output which includes harmonics of a harmonic-free sine input.

Harmonics Sound (Waveform). Harmonics are sine waves that are integer multiples of the fundamental frequency of a given note. Depending upon the harmonics in a wave, it can be classified as Triangular, Rectangular, or Sawtooth. See Triangles, Triangular Waveform, Rectangular Waveform, Sawtooth Waveform.

Hat in the Ring* Two players make campaign decisions for the Republican and Democratic presidential candidates. Helps teach political theory to sixth grade students and up. Cassette. Micro-Ed.

Haunted House* Test your bravery and problem solving ability against the creatures of the haunted house. For young players. Cassette. Aardvark.

Hayes Stack Smartmodem* An RS-232C auto-answer, auto-dial data communications system compatible with virtually all personal computers. Standard features are Touch-Tone or pulse dialing and direct connection to single or multiline telephones. The system can be program controlled by any language through ASCII character strings. Operating parameters are easily changed by a series of unique "SET" commands and 8 configuration switches. Smartmodem's operating level is full- or half-duplex up to 1200 baud. Seven LED indicators on the front panel provide a visual check of system status, and the user can monitor the progress of calls via an audio speaker. The

system features automatic baud rate, parity sense, and word size detection. A two-year limited warranty covers the system. Hayes Microcomputer Products, Inc.

Heat of Fusion and Formula of a Compound* Helps check results of experiments in the determination of the heat of fusion of ice and the copper sulphide formula. Also helps students obtain good specific and scientific data and documentation. Computation instructions are included to help with calculations. For high school students. Cassette. Microcomputer Workshops.

Hes Mon 64 A Machine language monitor for the Commodore 64. Comes with a user's manual intended for people who are unfamiliar with the uses of a Machine language monitor. The program consists of single character commands that may be followed by one or more parameters (such as memory addresses). These commands are available to exit to BASIC (transfer the program control to the BASIC Interpreter) as well as reenter Hes Mon. A simple assembler is included to allow the user to enter short Machine language programs. The monitor allows a programmer to PEEK into the computer's memory and change the corresponding values at these locations, which is useful for Machine language programmers interested in testing/debugging Machine language subroutines. Cartridge. HES.

Hexadecimal Hexadecimal refers to base 16. Frequently abbreviated as hex, this notation is popular with Machine language programmers. It provides the ease of entering address locations in Machine language routines through a monitor.

High Resolution Graphics. The Commodore 64 has two modes of video display: standard character mode and high resolution mode. High resolution mode (Bit Map Mode) on the Commodore 64 is selected by POKEing the appropriate value at address 53265 (the VIC II control register). It may be used to draw highly detailed pictures on the screen. It has useful applications in art or business. In high resolution mode the screen is transformed into 64,000 dots of light (pixels) that are individually programmable. See also Bit Map Mode.

High Seas* Sail the seven seas in search of pirates and treasure. Cassette. Briley Software.

HIRAM The name of a control line that banks an 8K block of memory in and out of the microprocessor's memory. When HIRAM is high the microprocessor sees 8K of KERNAL ROM from $E000 to $FFFF. When it is low the microprocessor sees 8K of RAM in that space.

Holding Register A register that holds data temporarily to bridge a speed or timing gap between two devices.

Home Key Usage. Pressing the Home key will move the cursor to the upper left hand corner of the screen (while in the edit mode). Although this is the normal key, this key may be defined differently by various application programs. The key may also be called from a BASIC program.

Home Accountant, The* Keep track of finances in your home or small business. Handles cash, checkbooks, credit cards and other accounts, and maintains a transaction history. Draws three types of graphs for any category, and can print your checks for you. Can process 1000 transactions each month, and maintain 100 accounts. Disk; printer required. Continental Software.

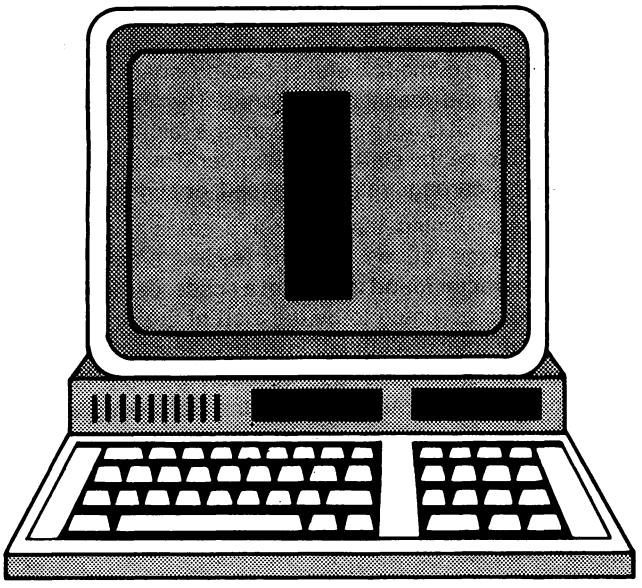
Home Budget* Helps you manage your personal budget. Powerbyte.

Home Budget/Finance* Assists you with financial planning and budgeting. Developed by Carter Jones. Disk or cassette. AdVENTURES.

Homonym Machine* Provides exercises using words that sound the same but have different meanings. For elementary students. Cassette. MicroEd.

Human Engineering Friendly Programs for the Operator (User). When writing a program for others to use you must give clear prompts for every item of input data, freeze the screen long enough for them to read or act on the information displayed, and provide clear error messages for incorrect entries. This is referred to as "human engineering"—making the program easy to use as well as technically correct. Another term for this type of programming is making the program "user friendly."

There are several other guidelines for writing user friendly programs. If a complex series of data items has been typed in but some entries are invalid, the user should be able to re-enter only the bad items. Error messages should indicate not only that an entry is invalid, but also, what's wrong with it, and, if at all possible, some hints as to how to correct it (such as a list of possible correct values)



I Codes. ASCII = 73, CMB ASCII = 73 or 201, HEX = 49. i—ASCII = 105, CBM ASCII = 73, HEX = 69. Screen code = 9 or 73. See CBM ASCII.

I See Initialize.

IC See Integrated Circuit.

Identifying Complete Sentences* Find the complete sentences among the sentence fragments on the screen. For elementary school students. Cassette. Micro-Ed.

IEEE Bus The IEEE 488 Bus, often referred to as a GPIB, is a standardized cable with specific handshaking sequences. This standard cable, agreed upon by an international committee, allows any IEEE device to connect and work with any computer that is also set up for IEEE. The GPIB allows for more than one device to connect to the same cable with some limitations on the cable length. Many of the disk drives and some printers that are compatible with the Commodore 64 are IEEE devices. An IEEE interface is necessary to make that connection. See Interface—IEEE.

IF BASIC Statement. Makes a decision regarding program flow based on the result of an expression. The formats are:

IF <expression>[,]THEN <clause>

IF <expression>[,]GOTO <line>

<expression> may be any numeric expression.

<clause> may be a BASIC statement, a sequence of statements separated by colons, or the number of a line to branch to.

<line> is the line number of a line that exists in the program.

If the value of <expression> is not zero (true), the THEN or GOTO clause is executed. THEN may be followed by a line number for branching or one or more statements to be executed. GOTO is always followed by a line number.

If the value of <expression> is zero (false), the THEN or GOTO clause is ignored and execution continues with the next executable statement.

When you enter an IF...THEN statement in direct mode, it directs control to a line number. If you haven't already entered a line with the specified number an "undefined line number" error message is displayed.

Illegal Direct The INPUT statement can only be used in program mode (with a line number). If you attempt to use it in direct mode, this message will appear.

Illegal Quantity If the number used as the argument of a statement is out of the allowable range, this error message will appear. Be careful with variables in a program; they may exceed limits and interrupt the program execution.

Illegal Track or Sector An error message from the 1541 disk drive incurred when the drive attempts to access a track or sector which is not available or does not exist.

Immediate Addressing Mode See Addressing Modes.

INC INCrement Memory. An Assembly language instruction for the 6510 microprocessor that increments the contents of the memory address in the argument by one. The result of increment is then placed in the same memory address and can alter the sign bit flag and the zero flag bit. The accumulator contents are not altered.

Index Disk Directory. The 1541 Disk Drive maintains an index or directory of all files on each disk. The available space in the directory is what limits the number of files on a disk.

Index Registers The 6510 contains, among others, two 8-bit registers (the X register and the Y register). These are involved in many of the Machine Code instructions. In some instructions they are used as automatic offsets to some specified address and are therefore referred to as index registers. An example is the instruction

LDA $2500,X

In this instruction the address $2500 is added to the contents of the X register. The contents of that new address ($2500+x) is then loaded into the accumulator.

Indexed Sequential Access Method A program or package that supports files organized with one or more indexes. Records may be retrieved from the file either sequentially or randomly by the key used in the index.

Indirect Addressing Mode See Addressing Modes.

Info-Designs, Inc. See Management Accounting Systems.

Infomast* General purpose information control program (database management system) for the Commodore-64. Comes with a database, an integral word processor, and a built-in programmable calculator. The incorporation of these three features in one package make it useful in maintaining records, mailing lists, invoicing, and ledgers. Documentation is included with step-by-step instructions for using the features of the database, the calculator, and the word processor. Information is stored in the form of records, each containing a maximum of 255 characters, with user-defined formats. Storage of each record utilizes relative files, a feature that increases the efficiency of sorts

and speeds up the updating process. Sorts and searches on records may be made by "key" field, partial/full string, or multiple fields. Print options are available to print the records in a user-defined format. The programmable calculator mode has limited applications in accounting and statistics. The user can program calculations to be made on a desired number of records. Save option for the calculator program allows the operation to be repeated at will. The word processor is accessible from the main menu and contains full editing/printing features. Merge option allows merging of records with text in the word processing mode. Rabbit Software, Ltd.

Initialize Disk Command. When sent through the command channel, this returns the disk drive to the same state as when powered up. The command is useful when an error condition prevents you from proceeding with disk operation. Also used to initialize a disk (read the Block Availability Map(BAM)) when it is first accessed. The Commodore 1541 disk drive automatically initializes a disk the first time a program or a file is loaded from it. The format is:

OPEN15,8,15 PRINT#15,"INITIALIZE"

INPUT BASIC Statement. INPUT statement receives input from the keyboard during program execution. The format is:

INPUT["prompt";]<variable>[,<variable>...]

["prompt"] is a string constant which will be used to prompt for the desired input. For example "Press Any Key".

<variable> is the name of the numeric or string variable or array element which will receive the input.

When the program encounters an INPUT statement, it pauses and displays a question mark (?) on the screen to indicate that data is to be typed in. When a "prompt" is included, this string is displayed before the question mark.

The data that is entered is stored in the variable or variables declared in the variable list. Each data item that is typed in must be separated by commas, and the number of data items must match the number of variables in the list. The type of each data item that you enter in must also agree with the type specified by the variable name (string or numeric). Strings entered in response to an INPUT statement don't need to be surrounded by quotation marks unless they contain commas or significant leading or trailing blanks.

Input/Output See Input, and Output.

INPUT# BASIC Statement. INPUT# reads data items from a file and assigns them to program variables. The format is:

INPUT# <filenum>,<variable>[,<variable>...]

<filenum> is the number used when the file was opened for input.

<variable> is the name of a variable that will have an item in the file assigned to it. It can be a string or numeric variable, or an array element.

The file may be located on disk or cassette; it may be a sequential data stream from a communications adapter. The type of data in the file must agree with the type specified by the variable name. No question mark is displayed with INPUT# (unlike INPUT statement).

The data items in the file must appear just as they would if the data were being typed in as responses to an INPUT statement. For numeric values, leading spaces, carriage returns, and line feeds are ignored. The first character encountered that is not a space, carriage return, or line feed is assumed to be the start of the number. The number ends with a space, carriage return, line feed, or comma.

If BASIC is scanning the data for a string item, leading spaces, carriage returns, and line feeds are also ignored. The first character found that is not a space, carriage return, or line feed is assumed to be the start of the string item. If this first character is a quotation mark (") the string item will consist of all characters read between the first quotation mark and the next quotation mark. If the first character of the string is not a quotation mark the string is an unquoted string; it will end with a comma, carriage return, or line feed, or after 255 characters have been read. If end of file is reached when a numeric or string item is being input the item is cancelled.

INST/DEL Pressing the INST/DEL key moves the cursor to the left one space and deletes any character the cursor encounters. Holding the key deletes in rapid succession. Pressing the key in conjuction with the shift key moves all text to the right of the cursor one space to the right and inserts a blank space. Holding the key down does the same thing in rapid succession.

Instruction A statement that causes a computer to carry out a specific action. A command differs from an instruction in several ways. A command is usually a complete specification of an action, while instructions are usually combined in dozens or hundreds to make a useful program. Commands are usually acted upon immediately by the computer, while instructions are saved for later execution in a program. Commands are acted on by the basic operating system of the computer, while instructions must be processed by a particular program such as the BASIC interpreter, a FORTRAN or Pascal compiler, etc. See Command Processor, DOS.

Instruction Register In most MPU's the IR contains the address of the next instruction to be executed. Branches are implemented by loading a new value into the IR.

INT BASIC Function. INT function returns the largest integer that is less than or equal to <x>. The format is:

<variable> = INT(<x>)

<x> is any numeric expression.

For example:

PRINT INT(57.97) returns 57.

PRINT INT(-4.53) returns -5.

Integer Constants An integer is a whole number (1,2,3 etc.) without a fraction or decimal point. Integers are stored on the Commodore 64 as 2 byte binary numbers and can range from -32768 to +32767. They take up two bytes of memory when stored in RAM and should not contain any commas.

Integer Variables A variable is a character or group of characters that are used to represent a specific value. On

the Commodore 64 when a variable is used to represent an integer, the variable must be followed with a percent (%) sign. The variable may be any length but only the first two characters are considered by the Commodore 64. The variable must begin with an alphabetic character and be followed by either a letter or a number. The constant must always match the variable. If you declare the variable as an integer, the constant can not be a decimal number. Variables cannot be any of the keywords, such as a BASIC command.

Integers I* Problem solving in addition and subtraction, including graphs and axis. Tests junior high school students. Cassette. Comm* Data Computer House.

Integrated Circuit A complete electronic circuit with multiple components (translators, diodes, resistors, capacitors, etc.) all constructed on a single small silicon chip.

Interbus Series, The* These three interfaces include the VIE and CIE which are IEEE 488 interfaces. When plugged into the expansion port peripherals can be attached without any interference. The V232 and C232 are serial interface cartridges that will allow you to plug into modems, plotters, and printers. The VPI and CPI are parallel interfaces that provide direct BASIC use of the parallel printer bus and give "invisible" access to the bus. Micro Systems Development, Inc.

Interface The point at which two systems make contact. Most microcomputers have multiple interfaces or "ports," such as a serial port to connect serial devices, a parallel port, and possibly TV or monitor ports, power port, joystick ports, etc. Interface is also used to refer to the type of interconnection, with respect to its size or shape (subminiature 25-pin D connector), its mode of function (serial, parallel, etc.), or its electrical characteristics (RS-232, IEEE, etc.).

Interface—IEEE With a proper interface, the Commodore 64 can be connected with an IEEE device. The interface generally connects with the computer through the serial port or expansion port and contains a cable with one end compatible with the Commodore 64 port and the other end compatible with the IEEE port. The Commodore 64 must be set up with special instructions since a specific handshaking sequence is required in transferring data to an IEEE device. These instructions are either programmed into the IEEE interface or loaded into the Commodore 64. There are many more advanced disk drives and printers from Commodore that require an IEEE interface to connect to the Commodore 64. See Interpod, Link.

Interface—RS-232 The Commodore 64 allows for the connection of RS232 devices (most modems and some printers) through the user port. However, the port cannot be connected directly with such a device. An interface is necessary to alter some voltage discrepancies between the user port and an RS-232 device. There are a number of products available for this, including those from Commodore, Richvale Telecommunications (See Link), and Oxford Computer Systems (See Interpod).

Interface Boards See Auto Clock, The; Card "?" Card/Print; Cardette; Connection, The; CX-6401 Interface; CX-6402 Interface; Expander Boards; Expandoport Series; Interbus Series, The; Minibus; Modem Interface; MW-302-Parallel Printer Interface; Universal Input/Output Board; Universal Tape Interface & Duplicators.

Interference Occasionally a television used as a video display unit is subject to interference—wavy patterns or lines on the screen. This can sometimes be remedied by moving the TV, keyboard, or power supply. The Commodore 64 allows for two channel selections (3 or 4). If one channel is receiving interference you can try the alternate channel with the switch in the back of the Commodore 64.

Interpod* Enables the Commodore 64 to connect with RS-232C and IEEE devices. The Interpod comes with its own power supply and connects to the Commodore 64 through the serial port normally connected to a 1541 disk drive. The Interpod has a second serial port to allow for the connection of a 1541 drive, if desired. The Interpod has its own internal set of keywords to allow the user to set important parameters for RS-232 communications. Included are baud, parity, chrsize (character size), crdelay (carriage return delay), stopbits, break, unbreak, change (to change Interpod's command channel and RS-232 port), clear (to clear buffers), convert (to convert CBM ASCII to standard ASCII), and unconvert (cancel convert). Cables to connect RS-232 devices or IEEE devices are not included. Hardware. Oxford Computer Systems.

Interrupt A signal to an MPU that an event has occured which requires attention. The MPU will save enough information to resume the task it is currently working on, then execute code from an interrupt servicing program. There may be multiple interrupt lines or other ways of distinguishing interrupts, in which case the MPU can tell by which interrupt signal it receives what kind of event has occurred.

Interrupt—Machine Code The 6510 has two interrupt lines, the Interrupt ReQuest (IRQ) line and the Non-Maskable Interrupt (NMI) line. When the IRQ line is activated (and the interrupt flag bit is not set), a series of operations is automatically performed by the microprocessor. The microprocessor first completes whatever instruction it is currently executing. It sets the interrupt flag bit to prevent any further interrupts. It pushes the program counter and the status register onto the stack. The microprocessor fetches the contents of memory location FFFE and FFFF. This memory location contains the address (or interrupt vector) to which the microprocessor will branch. The NMI line works in the same fashion, but the interrupt flag bit can not prevent this interrupt. The NMI line fetches its interrupt vector from FFFA and FFFB. Thereafter, when the microprocessor encounters an RTI instruction, it pops the program counter and status register off the stack and resumes the program where it left off.

Interrupt Flag Bit See Status Register.

Introduction to BASIC I* Allows the first time BASIC programmer to work at his own speed, learning and

developing his skills up to a medium level capability. Quizzes are included. Commodore.

Inventions and Inventors* Match inventors to their inventions to gain points in this word game. Give the incorrect answer and you receive no points and miss your next turn. A good learning tool for third to sixth grades. Cassette. Comm*Data Computer House.

Inventory Control Software* See Business Inventory, Inventory Package.

Inventory Management See Management Accounting Systems.

Inventory Package* Keeps track of all stock on hand, manages sales and pricing information, controls recorders, and generates analysis of sales. MicroSpec.

Investment Analyst, The* Useful for both professional and lay investors. Analyzes investment opportunities, potential profits, and maintains records. Disk; printer required. Powerbyte.

I/O See Input, and Output.

INX INcrement X register.An Assembly language instruction for the 6510 microprocessor that increments the contents of the X register by one. The result is then placed in the X register and can affect the sign flag bit and the zero flag bit. The accumulator is not affected.

INY INcrement Y register. An Assembly language instruction for the 6510 microprocessor that increments the contents of the Y register by one. The result is then placed in the Y register and can affect the sign flag bit and the zero flag bit. The accumulator is not affected.

IOBASE A Machine language subroutine within the operating system of the Commodore 64. It is part of a group of subroutines referred to as the KERNAL and used to handle input/output operations. By jumping to address $FFF3, IOBASE moves the address of the start of memory mapped I/O devices into the X register (lower address byte) and Y register (high address byte). This address can then be used with an offset for accessing all I/O registers. See KERNAL.

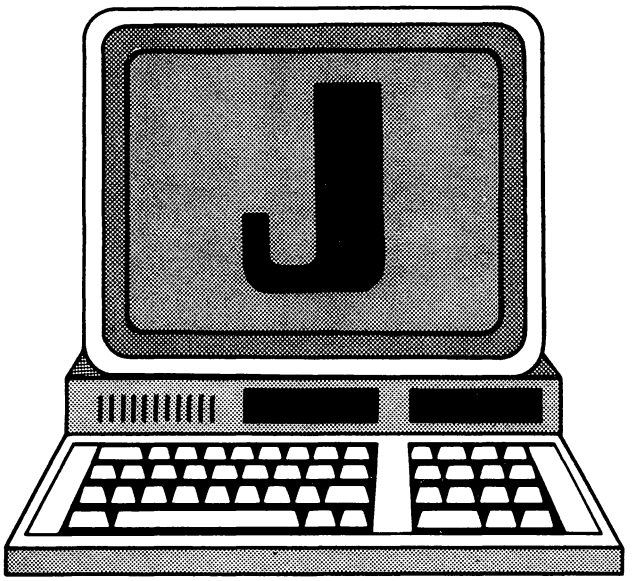
IOINIT A Machine language subroutine within the operating system of the Commodore 64. It is part of a group of subroutines referred to as the KERNAL and used to handle all input/output devices and routines. See KERNAL.

IR See Index Registers, Instruction Register.

IRQ See Interrupt Machine Code.

It's Travel Time* This package helps you budget expenses before you travel. You can project the cost of your anticipated vacations and start saving now. Powerbyte.

Its/It's—Your/You're* Learn the correct uses of these cumbersome homonyms. Cassette. Micro-Ed.



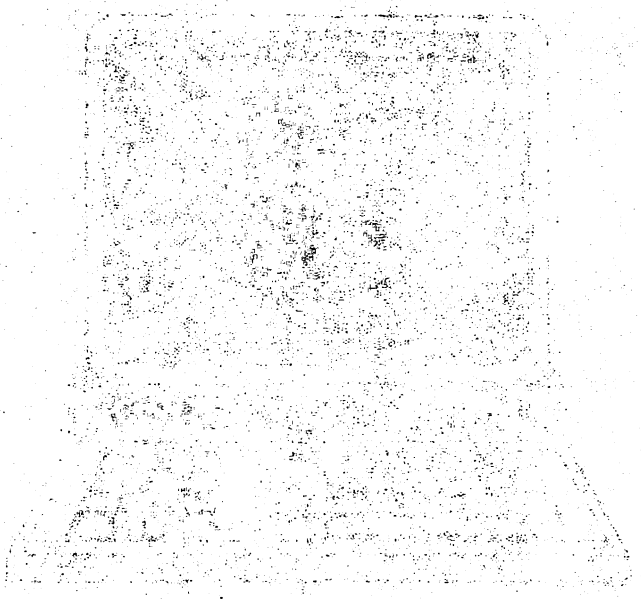
J Codes. ASCII = 74, CBM ASCII = 74 or 202, HEX = 4A. j—ASCII = 106, CBM ASCII = 74, HEX = 6A. Screen code = 10 or 74. See CBM ASCII.

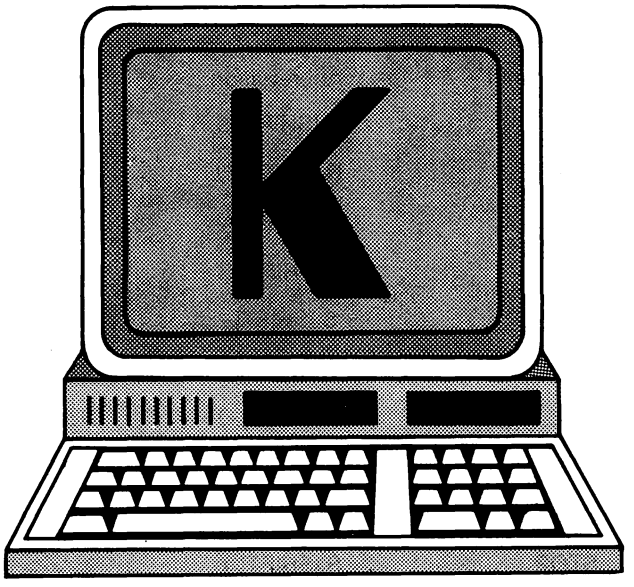
JMP JuMP to address. An Assembly language instruction for the 6510 microprocessor that places the address specified by the argument into the program counter. The next instruction executed will therefore be that which is located by the argument. The addressing mode of the argument can be absolute or indirect. None of the flag bits are altered.

JSR Jump to SubRoutine. An Assembly language instruction for the 6510 microprocessor that saves the current location onto the stack and then loads the address specified in the argument into the program counter. The next instruction executed will be that which is located by the argument. Thereafter, if the program encounters a RTN (return), the address saved on the stack is put back into the program counter and the program returns to the instruction that follows the JSR. The addressing mode of the argument must be absolute and none of the flag bits are altered by this instruction.

Jupiter Lander* Arcade style game that incorporates high-resolution graphics, sprite animation, and sound. Only three landing sites with three levels of difficulty are available as you land your spaceship on Jupiter with controlled thrust and limited fuel. Softness of landing determines the score. Commodore Electronics, Ltd.

Justify To make the edges of a text file line up straight. Left justification is almost universal in English text. Right justification is usually present only in text that has been typeset or processed by a word processor or special typewriter to insert a variable amount of space between words or letters (proportional spacing).





K Codes. ASCII = 75, CBM ASCII = 75 or 203, HEX = 4B. k—ASCII = 107, CBM ASCII = 75, HEX = 6B. Screen code = 11 or 75. See CBM ASCII.

K Byte is a label for storage that holds one character (letter, digit, etc) in computer memory or disk. Abbreviated B or in thousands KB, or simply K. Actually, 1K = 1024 bytes because this is an even power of 2. Commodore 64 often has 64K bytes (or 64KB) of internal memory, or 64,000 (to be precise, 64K = 64 x 1024 = 65,536 bytes).

KB Measurement of Bytes in thousands. See K.

Kentucky Derby* One of the "Inside BASIC series" programs available for the Commodore 64. It is a game incorporating Sprites, high-resolution Bit Map graphics, and Sound synthesis. The object of the game is to bet on a horse and try to win the most money. Bets may be made on a horse to win, place, or show. The odds given for a horse infuence its chances of winning. The Inside BASIC series increases programming skills in BASIC language by showing how each program in the series was developed. The documentation also includes line by line description of the program, suggested changes, a complete program listing and an overview that discusses the step by step developmemt of the program.

Kernal The Commodore 64 is controlledby the 6510 microprocessor manufactured by Commodore. The 6510 is controlled by Machine Code either programmed by a user or internal to the machine in ROM. Even a simple action like hitting a key on the keyboard and having it appear on a screen requires many Machine Code instructions. Since some of the operations occurring between the peripherals and the computers are the same each time, the Machine Code instructions for these operations have been included in ROM and are referred to as the KERNAL. Essentially these are Machine Code subroutines beginning at specific addresses in the memory. One simply jumps to that address and the entire subroutine is executed. As an example, the KERNAL routine called GETIN has a starting address at $FFE4. Jumping to that address in a Machine language program will automatically take any character in the keyboard queue and place the ASCII value into the accumulator. After the process is complete, the counter will return to the next line of the user's program. Often some preliminary routines must be executed before a specific KERNAL can be used.

Key Identification The process of detecting which key has been pressed. The two common techniques are:

1) Row Scanning; and 2) Line Reversal.

Keyboard In general, microcomputers use one of two types of keyboards:

1) The Fully Encoded Keyboard. Supplies the ASCII code that corresponds to the key that has been pressed. Such a keyboard has debounce and multiple rollover protection. See also Rollover, Debouncing.

This type of keyboard is used when a complete set of alphanumeric keys are needed.

2) Non-Encoded Keyboard. Generally the simplest type, it consists of a matrix of rows and columns and is read by the resident software.

Keyboard Interfacing The process of connecting a keyboard to the microprocessor system so that the processor is able to detect which key is pressed. An interface should also be able to send the corresponding code of the key that is pressed to the MPU. See also Keyboard.

Keyword A word which has special significance to a program. It must not be misspelled or used for other purposes, or erroneous results may occur.

Keywords Commodore 64 BASIC keywords.

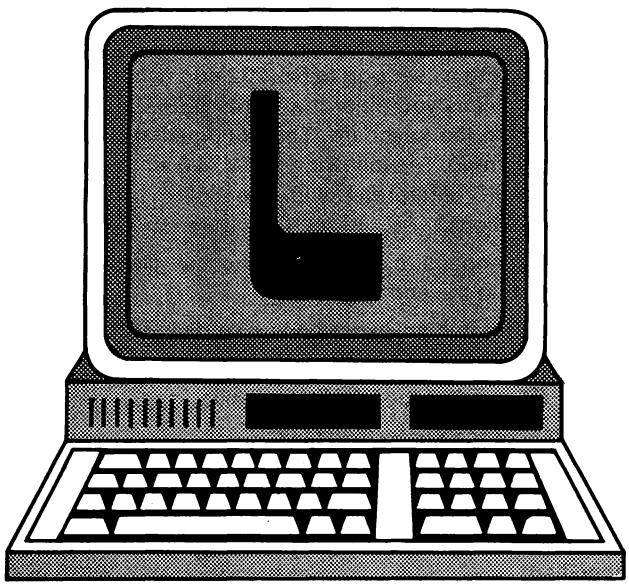
COMMAND	ABBREVIATION	FUNCTION TYPE
ABS	A [SHIFT] B	NUMERIC
AND	A [SHIFT] N	
ASC	A [SHIFT] S	NUMERIC
ATN	A [SHIFT] T	NUMERIC
CHR$	C [SHIFT] H	STRING
CLOSE	CL [SHIFT] O	
CLR	C [SHIFT] L	
CMD	C [SHIFT] M	
CONT	C [SHIFT] O	
COS	none	NUMERIC
DATA	D [SHIFT] A	
DEF	D [SHIFT] E	
DIM	D [SHIFT] I	
END	E [SHIFT] N	

Command	Abbreviation	Function Type
EXP	E [SHIFT] X	NUMERIC
FN	none	
FOR	F [SHIFT] O	
FRE	F [SHIFT] R	NUMERIC
GET	G [SHIFT] E	
GET#	none	
GOSUB	GO [SHIFT] S	
GOTO	G [SHIFT] O	
IF	none	
INPUT	none	
INPUT#	I [SHIFT] N	
INT	none	NUMERIC
LEFT$	LE [SHIFT] F	STRING
LEN	none	NUMERIC
LET	L [SHIFT] E	
LIST	L [SHIFT] I	
LOAD	L [SHIFT] O	
LOG	none	NUMERIC
MID	M [SHIFT] I	STRING
NEW	none	
NEXT	N [SHIFT] E	
NOT	N [SHIFT] O	
ON	none	
OPEN	O [SHIFT] P	
OR	none	
PEEK	P [SHIFT] E	NUMERIC
POKE	P [SHIFT] O	
POS	none	NUMERIC
PRINT	?	
PRINT#	P [SHIFT] R	
READ	R [SHIFT] E	
REM	none	
RESTORE	RE [SHIFT] S	
RETURN	RE [SHIFT] T	
RIGHT	R [SHIFT] I	STRING
RND	R [SHIFT] N	NUMERIC
RUN	R [SHIFT] U	
SAVE	S [SHIFT] A	
SGN	S [SHIFT] G	NUMERIC
SIN	S [SHIFT] I	NUMERIC
SPC(	S [SHIFT] P	STRING
SQR	S [SHIFT] Q	NUMERIC
STATUS	ST	NUMERIC
STEP	ST [SHIFT] E	
STOP	S [SHIFT] T	
STR$	ST[SHIFT]R	STRING
R	STRING	
SYS	S [SHIFT] Y	
TAB(	T [SHIFT] A	STRING
TAN	none	NUMERIC
THEN	T [SHIFT] H	
TIME	TI	NUMERIC
TIME$	TI$	STRING
TO	none	
USR	U [SHIFT] S	NUMERIC
VAL	V [SHIFT] A	NUMERIC
VERIFY	V [SHIFT] E	
WAIT	W [SHIFT] A	

Kickman* Ride through town dealing with assorted obstacles along the way. Commodore Dealers.

KMMM PASCAL* Wilserve developed this new high level language. The device generates Machine Code from Pascal and includes an editor, compiler, and translator. Microtech.

Kongo Kong* You must outwit the giant ape in this Machine Code game. Cassette. Victory Software.



L Codes. ASCII = 76, CBM ASCII = 76 or 204, HEX = 4C. l—ASCII = 108, CBM ASCII = 76, HEX = 6C. Screen code = 12 or 76. See CBM ASCII.

Laser Percents* Five players must determine what percentage of a bar is shaded. Cassette. Comm*Data Computer House.

Last of the Ninth* Solve a series of multiplication problems to save your team from certain defeat. Hit a home run for extra help. Cassette. Micro-Ed.

Lawn of the Lost Rings* Find the lost rings by determining the percent and decimal values of fractions. Cassette. Micro-Ed.

Lay/Lie* Learn the correct grammatical use of these tricky verbs. Cassette. Micro-Ed

LDA LoaD Accumulator. An Assembly language instruction for the 6510 microprocessor that places a number into the accumulator. That number comes from the argument or from the memory location specified in the argument. The addressing mode of the argument can be immediate, zero page, zero page X, absolute, absolute X, absolute Y, (indirect) X, or (indirect) Y. The sign flag bit and the zero flag bit are affected.

LDX LoaD X register. An Assembly language instruction for the 6510 microprocessor that places a number into the X register. That number comes from the argument or from the memory location specified in the argument. The addressing mode of the argument can be immediate, zero page, zero page Y, absolute, or absolute Y. The sign flag bit and the zero flag bit are affected.

LDY LoaD Y register. An Assembly language instruction for the 6510 microprocessor that places a number into the Y register. That number comes from the argument or from the memory location specified in the argument. The addressing mode of the argument can be immediate, zero page, zero page X, absolute, or absolute X. The sign flag bit and the zero flag bit are affected.

Lease/Buy?* Assists the potential buyer with information to help decide whether to lease or purchase materials and property. Disk; printer required. Powerbyte.

Left Justify See Justify.

**LEFT$** BASIC Function. LEFT$ function returns the leftmost <n> characters of X$. The format is:

<string variable> = LEFT$(X$,<n>)

X$ may be any string expression.

<n> is a numeric expression which must be in the range 0 to 255. It specifies the number of characters you want in the result.

If <n> is larger than LEN(X$), the entire string X$ is returned. If <n>=0, a string of zero length is returned.

See also LEN, MID$, RIGHT$.

Lemans* Pass as many cars as possible while avoiding road hazards and collisions with other cars. This Grand Prix racing game requires paddles for steering control and gas. Commodore.

LEN BASIC Function. LEN returns the number of characters in the string expression X$. The format is:

<variable> = LEN(X$)

The count returned includes blanks and unprintable characters.

LET BASIC Statement. LET statement assigns the value of an expression to a variable. The format is:

LET <variable><expression>

<variable> is the name of the variable or array element which is to receive a value. It may be a string or numeric variable or array element.

<expression> is the expression whose value will be assigned to <variable>. The type of expression (string or numeric) must match the type of the variable, or a "Type mismatch" error will be displayed.

The word LET is not necessary in BASIC programs when assigning values to variables. You may simply use the format:

<variable> = <expression>

Letter Mite* Edit and print customized letters. The system works well with Word Mite 2 and Address Mite 2. Nelson Software.

Library Terms* Students match words with their correct definition. Builds vocabulary of elementary students. Cassette. Micro-Ed.

Light Pen* This tool comes with six programs and can give your system greater flexibility. Cardco.

Lights Out* By placing dots in the proper order, the student puts out the lights in an office building on the screen. Cassette. Micro-Ed.

Line Logical Screen Line. Although information displayed

on the screen is a maximum of 40 characters wide, the Commodore 64 stores a line of BASIC 80 characters long. If you begin entering a BASIC program line to the screen, you will see the cursor automatically return to a second line and allow you to enter up to 80 characters. The 80 characters entered are considered a logical screen line.

Line Number Largest in BASIC. The largest possible line number for a BASIC program is 65529.

Line Reversal Identifying which key was pressed on the keyboard by interfacing the keyboard with the processor using the PIO (Parallel Input/Output) Interface.

Lines To display all lines in a BASIC program lines enter:

LIST

To display program lines from start up to line 100 enter:

LIST -100

To display program lines from line 100 to end enter:

LIST 100

To display program lines from line 100 to line 200 enter:

LIST 100-200

To display program line 100 only enter:

LIST 100

Link On the Commodore 64 a BASIC program can be run in one of two modes: direct mode or program mode. In the program mode each BASIC line is stored in memory in a specific format that includes a link address. The link address consists of two bytes located at the beginning of each line of BASIC. The two bytes make up an absolute address that points to the beginning of the next line of BASIC.

Link Time The point in the processing of a program with a language translator (Compiler or Assembler) when the program is tailored for a specific memory location. This occurs after compiling (compile time) but before execution (execution time). Some small systems do not require linking.

Link* This C-64 Link contains a cartridge that inserts into the expansion port and expands the capabilities of the Commodore 64. With the C-64 Link in place, IEEE devices such as the Commodore 4040 or 8050 disk drives and IEEE printers can be used. With the proper cables, two or more Commodore 64's can be connected to a single disk drive or printer. Each computer must have its own Link and special precautions are necessary when users attempt to access a file, but it affords an excellent opportunity for groups of users, such as in an office or school to share a single disk drive or printer. In addition to serving as an IEEE interface, the Link adds fifteen new I/O commands to the BASIC interpreter. The commands, listed below, facilitate I/O operations. The Link also includes a Machine language monitor which you enter by typing MONITOR and pressing a carriage return. You can then display values at specified memory locations, display register values, execute Machine Code programs from selected locations, and load and save programs to and from selected locations. Interfacing with other devices requires special cables not included with the Link. Cables available from Richvale Telecommunications include the Link to IEEE device cable, a user port to parallel port cable, and a user port to RS-232 port cable. To access different devices you enter the words SERIAL, PARALLEL, or IEEE from the keyboard. The documentation is helpful and easy to read. The following BASIC 4.0 words are added to the BASIC interpreter with the Link. Richvale Telecommunications.

APPEND reopens a closed sequential file for adding information to the end.

BACKUP creates an exact copy of a disk on a IEEE disk drive.

COLLECT rewrites the Block Availability Map.

CONCAT concatenates two files.

COPY copies a file from one disk to another or to the same disk with another name.

DCLOSE closes a specified file, or all files, if no file is specified.

DIRECTORY or CATALOG displays the directory of a disk.

DLOAD loads a program from disk.

DOPEN opens any file to read, and a sequential or relative file to write.

DS$ & DS reads the DS$ and DS variables which specify an error message.

DSAVE saves a file to disk.

HEADER formats a new disk.

RECORD positions the disk to a specified record when using relative files.

RENAME renames a disk file.

SCRATCH eliminates a file from disk.

LISP Programming language that is symbol oriented in the way that other languages are number oriented. The type of data item it handles best is ideally suited to the representation of information whose structure cannot be completely specified in advance. LISP permits the building of intermediate structures and discarding of them without causing the user any worries about how to find and later reuse the space necessary for their storage. The syntax of LISP is simple and elegantly defined. The natural method of building programs in LISP by function composition encourages good programming style and facilitates modular programming.

LIST BASIC Command. LIST command displays the program currently in computer memory, on the screen or other specified device. The format is:

LIST [[<line1>][-][<line2>]]

<line1>, <line2> are valid line numbers in the range 0 to 65529. <line1> is the first line to be listed and <line2> is the last.

Three options are available when using the hyphen (-):

1. If you type <line1>-, that line and all higher numbered lines will be listed.

2. If you type -<line2>, all lines from the beginning of the

program through <line2> are listed.

3. If you type both line numbers: <line1>—<line2>; all lines from <line1> through <line2>, inclusive, are listed.

For example:

LIST 200-300,

list lines 200 through 300, inclusive.

List Mite 2* Helps you organize your list-keeping chores. You can develop your own format, write and/or read files on tape/disk, display, edit, and search for information that you need to save. Nelson Software.

LISTEN The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFB1, LISTEN will convert a device number to a specific address and then transmit it to the serial bus. If a device with that address exists on the serial bus it will go into a LISTEN mode and be ready to receive data. The accumulator must be loaded with the device number prior to using this routine. See KERNAL, Serial Bus, CMD.

Listener The Commodore 64 utilizes a serial bus to connect to the 1541 disk drive and some printers. Since more than one device may be present on the serial bus it is important that only the intended device receive data. The Commodore 64 arranges for this by making a particular device a listener by sending appropriate command signals with a specific device number. All data sent across the serial data line are received only by the listener until the UNLISTEN command is sent.

LOAD The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFD5, LOAD moves consecutive data bytes from input device into Commodore 64 memory. Prior to using this routine the Accumulator is loaded with 0 if the routine is to load data into memory or a 1 if the data is to be compared with data already in memory. If the input device was opened with a secondary address of 0 then the X and Y registers must be loaded with the address where data will be stored on the Commodore 64. If the secondary address was not 0, then the data is stored in memory at the starting address contained in the header. At the completion of the load the address of the last RAM location used will be moved into the X and Y registers. The SETLFS and SETNAM routines must be used prior to this routine. See KERNAL, Accumulator.

LOAD BASIC Command. The LOAD command copies a program from a mass storage device such as the cassette or disk into the main memory (RAM). The program loaded will erase any program already in main memory but does not alter the program still in mass storage device. The format is:

LOAD"<name>"[,<dev>,<addr>]

<name> is the name of the program to be loaded. On the disk drive, the drive will attempt to match the name with one already in the directory, and load that particular program. If the symbol * is used in place of a name, the first program on the disk will be loaded. A character followed by * (e.g. B*) will load the first program beginning with B. A question mark can be used for wild card matching (see WILDCARD). When loading from cassette the tape will be advanced until that program is found. On the cassette using a single character (e.g., C) will load the first program on the tape beginning with that character.

<dev> is the device number. For a single disk drive, the device number is 8. For cassette the number is 1. If no device number is entered, the default value is 1.

<addr> is the address. Normally programs are loaded on the Commodore 64 starting at address 2048. If the number 1 is entered here, the program is loaded in the memory space from where it was saved. See Wildcard, Disk, Cassette.

Load Module A file containing object code ready to load into memory.

Load Time The point in the processing of a program when all translation and linking are completed and the program is loaded from disk or tape into memory for execution.

Load—Error Message. This error message from the Commodore 64 that appears when there is a problem with a program on tape.

Loan Amortization* Outputs an amortization chart for any loan or property mortgage. Comm*Data Computer House.

Loan Repayer, The* Reviews the costs of loans and other borrowing before you take the plunge. Disk; printer required. Powerbyte.

LOG BASIC Function. LOG function returns the natural logarithm of <x> (log to the base (e)). The format is:

<variable> = LOG(<x>)

<x> must be a numeric expression which is greater than zero.

Logical File Devices such as a disk drive have a number of types of files on various media. Each file must be opened before data can be sent to it. Files sent to a printer must be treated as if they are being sent to disk. The term logical file describes all these files regardless of the nature of the receiving device.

Logical Operators Logical operators (boolean operators) recognized by the Commodore 64 are AND, OR, and NOT. The result of a logical AND between two bits is 1 if both bits are 1, and 0 if either or both are 0. The result of a logical OR between two bits is 1 if either of the bits is one, and 0 if both bits are 0. The logical NOT operator is performed on only one bit and results in changing a 0 to 1 and 1 to 0. When the logical operators are applied to bytes, the same logic is used one bit at a time over the whole byte.

Logical Screen Line See Line.

Logic-Seeking Some bi-directional printers (such as the Gemini 10X) attempt to make the smallest possible

movement to print the next line. Short lines may be printed either to the left or to the right, whichever is faster. This feature is designed to increase printing speed by minimizing the total travel time of the print head. Often the print head may return at high speed to accomplish this. This feature is known as Logic-seeking.

LOGO* The popular graphics lanaguage adapted for the Commodore 64. The package is produced by the original authors of the language. Includes all normal language features plus exclusive Commodore extensions. Commodore.

Long Division* Brush up on your math with this step-by-step, self instructing program. Disk or cassette. Micro-computer Workshops.

Loop BASIC See FOR, NEXT.

Loop Delay Hold Screen Display in BASIC. To freeze the screen briefly while the operator using your program reads a message; write a delay loop after you print the message:

1000 FOR Y = 1 TO 2000 1010 NEXT Y

To freeze the screen until the operator is done with it, put in a dummy input statement and instruct the operator to press ENTER to proceed. The input variable need not be used in your program:

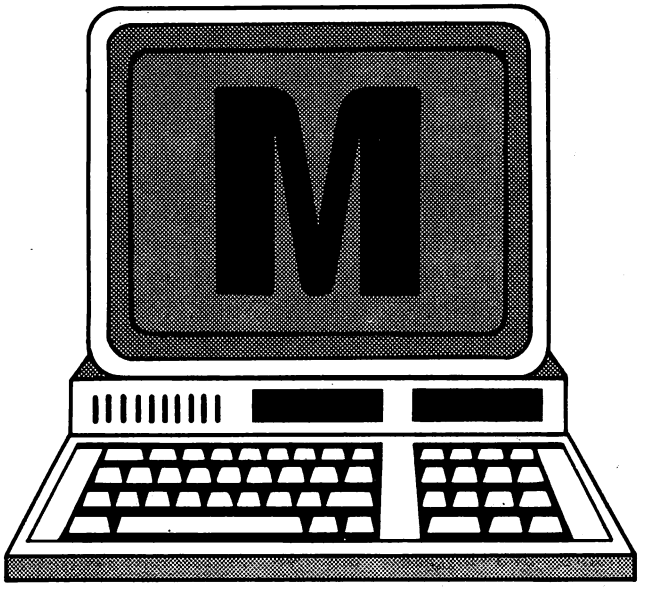
1000 INPUT "Press ENTER to continue";A$

Loram The name of a control line that banks an 8K block of memory in and out of the microprocessor's memory. When Loram is high the microprocessor sees 8K of BASIC ROM from address $A000 to $BFFF. When it is low the microprocessor sees 8K of RAM in that space.

LRC Longitudinal Redundancy Check. See CRC.

LSB Least Significant Bit.

LSR Logical Shift Right. An Assembly language instruction for the 6510 microprocessor that shifts the bit pattern in the location specified by the argument one bit to the right. The result of the shift is placed in the same location. The right most bit is moved into the carry flag bit and 0 enters from the left to be placed into bit 7. The argument may be A for accumulator or refer to a memory location using zero page, zero page X, absolute, or absolute X addressing modes. The sign bit, zero flag bit, and carry flag bits can be altered by the result of this instruction.



M Codes. ASCII = 77, HEX 4D. CBM ASCII = 77 or 205. m—ASCII = 109, HEX 6D, CBM ASCII = 77. Screen code = 13 or 77. See CBM ASCII.

Ma Bell* Helps you keep track of phone calls, times, and costs. May give you a new outlook on the monthly bill. Disk; printer required. Powerbyte.

Machine Language Program The actual controlling device or "brain" of a computer is the microprocessor. On the Commodore 64 it is the 6510 microprocessor manufactured by Commodore. The device itself is controlled by sending specific numbers (called Machine Code) to the device one at a time. This structured sequence of numbers is called a Machine language program. The microprocessor will only respond to these specific numbers and to utilize the computing power of the Commodore 64 it must receive Machine Code (or object code) instructions.

The Commodore 64 has a BASIC Interpreter built into it which will take BASIC language commands and convert them into object code.

When a BASIC program execution is initiated, the BASIC Interpreter looks at the first line of BASIC statements and converts it into object code (Machine Code). Once the computer has finished responding to that line of object code, the BASIC Interpreter translates the next line of BASIC.

It is also possible to translate the entire BASIC program into object code at one time before running the program. This type of translating program is called a compiler. Running a compiled program is generally much faster than using the BASIC Interpreter. See also BASIC Interpreter, Compiler, Object Code.

MAE* This Macro Assembler Editor word processing program was developed by EHS and has become very popular with assembly programmers. Microtech.

Magazines There are several popular magazines containing useful information about the Commodore 64 and available compatible hardware and software. Most computer stores and larger bookstores carry a good assortment of these magazines. *BYTE* is an excellent source for general information on microcomputers, although information specifically relevant to the Commodore 64 is buried amid voluminous ads and articles on other machines and general topics. Commodore publishes a magazine specifically about Commodore computers, which will help you keep abreast of the latest application software. Listed below are magazines that usually include information about the Commodore 64:

Commander, The Monthly Journal for Commodore Computer Users
Micro Systems Specialties
P.O. Box 98827
Tacoma, WA 98498

Commodore, The Microcomputer Magazine
Commodore Business Machines, Inc.
1200 Wilson Drive
West Chester, PA19380

Compute
Small Systems Inc.
P.O. Box 5406
Greensboro, NC 27403

Compute's Gazette
Small Systems Inc.
P.O. Box 5406
Greensboro, N.C. 27403

Micro, The 6502 Journal
Micro Inc.
Chelmsford, MA 01824

Magic Desk* A series of integrated software, animated with pictorial symbols such as a typewriter, a wastebasket, a telephone, a calculator, and a financial journal on a desk. To use a feature of the package, you use the joystick, trackball, or mouse to move a pointing finger to any of the symbolic objects on the screen. Info Designs.

Mailfile* Helps you to develop a listing of names, numbers, and addresses that can be retrieved by various categories. Cassette. Adventures.

Mailing List* Maintains over 1000 records per disk; prints and presorts. Micro Spec.

Mailing List—Home/Business Program* Manages 650 records on each disk; alphabetize and search on various fields. Disk or cassette. Luna Software.

Mailing List, The* Menu-driven programs that can develop complete records of names and addresses, and organize them into small data bases. Other features include alphabetizing, sorting, searching, and printing. Disk or cassette. Galactic Software.

Mailing Lists Computers have become an invaluable tool in the generation of mailing lists. A mailing list is a database, and most database management systems can be tailored to work as mailing lists. Features to consider in choosing a mailing list are its ability to add, delete, and change

information in a mailing list after the list has been started. Some mailing list programs have a fixed format which cannot be altered while others allow the user to create their own fields. Some programs allow the user to sort the list, based on one or more fields, creating an alphabetized list or numerical sequencial list. A search option is sometimes available allowing the user to look through the entire list for all entries with a given value. You may want to select only those entries with a particular zip code, or only those entries starting with a particular letter. Be certain that the program selected is compatible with your printer and determine if the printout can be modified and is suitable for your needs.

Mailman, The* Stores names and addresses of business and personal contacts in an organized manner. They can be accessed by different subjects. Disk; printer required. Powerbyte.

Maintenance, Disk File management or disk maintenance are terms which describe keeping track of files on disks. This includes creating them, finding them by name, insuring that adequate free space is available on the disk, maintaining backups and deleting files no longer needed. These functions are supported by the various DOS functions, but require thoughtful planning by the user to insure proper results.

Some data base management (DBM) systems attempt to automate part of the work of keeping track of files and disks. Some DBM systems maintain files of control and tracking data on other files and disks, and may provide alternatives to DOS functions.

Maintenance for the Commodore 64 The computer itself requires no active maintenance beyond keeping it clean and dry. The integrated circuits may be damaged if the vents under the system are blocked. Avoid repeatedly connecting and disconnecting cables if possible, as this will lead to poor connections.

The disk drive also should be well ventilated and out of direct sunlight. The heads within the disk have a tendency to build up oxide deposits from the disks. Periodic use of a commercially available head cleaner will help remove the deposits.

Making an Outline* Make a rough outline of the subtopics in the order in which they appeared in a given article. Review of this article may be as frequent as needed. For elementary students. Cassette. Micro-Ed.

Management Accounting System* The Management Accounting System (MAS-64) is perhaps the most advanced accounting system available for the Commodore 64. It consists of five separate systems which can be purchased individually. They require, in addition to the Commodore 64, a 1541 drive, a 2031 drive, or a 4040 drive. Two 1541 drives or two 2031 drives can be used. They can be configured to produce reports on the 1525 printer, 4022 printer, 8023P, NEC Spinwriter/Diablo, or any properly interfaced printer. They are in menu-driven formats with excellent documentation. Some knowledge of accounting procedures is necessary, but a video training series and a telephone consulting service are available at some additional cost. The separate systems are:

Accounts Receivable/Billing: Maintains customer billing information. Payments received can be applied by oldest invoice first. Customer files and invoice files are automatically updated at posting. The system can print invoices or credit memos, monthly customer statements, audit trails of all transactions, open item summaries, and summaries of unbilled items. Up to 150 customers, 375 invoices and 40 transactions can reside on one disk.

Accounts Payable: Maintains vendor billing information. Vendor files and invoice files are updated upon posting. Discounts are automatically calculated. The system can automatically print checks as well as vendor activity reports, transaction summaries, open invoice lists, check registers, accounts payable updates and more. Up to 100 vendors, 375 invoices, and 40 transactions can be managed on one disk.

General Ledger: Allows direct posting to the General Ledger. It can be automatically updated when used in conjunction with an accounts payable, accounts receivable, or payroll system. It can produce income statements, balance sheets, lists of transactions, cash receipt, and disbursement journals, as well as a number of other related reports. Up to 300 charts of accounts and 1500 transactions can be maintained on one disk.

Payroll: Maintains a record for each employee including quarterly and yearly totals. It calculates and prints payroll checks with appropriate deductions for federal and state taxes and miscellaneous deductions. It prints reports including W-2s, 941s and payroll journals. It automatically updates general ledger systems when used with that system. Large numbers of employee payroll records can be maintained by assigning separate disks for separate groups.

Inventory Management: Maintains inventory records on stock items. It processes stock receipts, adjustments, and orders. It calculates usage and reorder levels. It prints an inventory summary, reorder reports, shortage reports, stock status reports, price catalog, and sales analysis reports. The system automatically calculates the optimum quantity of an item to purchase based on the cost of ordering versus the cost of holding inventory. The system calculates the number of items to purchase based on how long it takes to obtain the item and the daily usage. Up to 1800 items can be maintained on one disk. Disk; printer required. Info Designs.

Management of Files Disk Maintenance. File management or disk maintenance are terms describing keeping track of files on disks. See Maintenance (Disk).

Mansion* On the estate of a very wealthy tycoon, only the butler knows who stole the loot. It won't be that easy for you to find out. Cassette. Briley Software.

Manual A process done by hand, not automated or programmed.

Manual A reference book, booklet, or other document.

Maps and Globes* A series of programs to be used with the booklet *Skills for Understanding Maps and Globes* by Kenneth Job and Lois Wolf (Follet Publishing Company). Tests the student's knowledge of the geographical world. Micro-Ed.

Mars* You are stranded on a distant planet, and must return home, with or without the help of alien beings. A good beginning game for newcomers to space travel games. Cassette. Aardvark.

Master Grades Program* Assists teachers in keeping track of student grades by keeping track of each students cumulative score and comparing it to a "possible score" when grades are assigned. Grading scale may be designed by the user. Midwest Software.

Master Library Program* A utility that helps the user keep track of disk files. The system disk comes with a series of program files, each set up for a specific function such as Machine language sorting, printing library, search, and expand library. 700 items may be stored in each file and the system is capable of cataloging up to 8,000 entries through the use of multiple files. A Disk-Abetizer routine is included that alphabetizes a disk and recovers scratched files. Sample libraries are also included with the system disk to demonstrate the operations of the system. Midwest Software.

Master Menu A menu is a screen display which lists a number of possible options and asks the user to select one. When a selection is made by keying in an identifying number or letter (or positioning the cursor beside the desired item, using a light pen, etc.), the selected function is performed. This may require either a branch or subroutine call in the code for the function. The program to carry out this function may also have to be loaded into memory to be executed.

Many application packages use a system of multiple menus. A Master Menu lists the major functions allowed. Selection of an option on the Master Menu causes another menu to display, indicating more detailed options for the selected function. This can be followed by even more detailed menus, and so on. Often completion of a function will cause re-display of the Master Menu. Such a system is called menu-driven.

MasterType* Learn to type before the aliens destroy you. Eighteen levels of learning combine games with education and will have you typing in no time. Disk. Lightning Software.

Matching Capital Letters* Teaches recognition of letters. Press the correct letter on the keyboard that is shown on the screen and race against the computer. For pre-schoolers and kindergartners. Cassette. Micro-Ed.

Matching Small with Capital Letters* Tests recognition of lower case letters as shown on the screen by having the student press the same letter in upper case on the keyboard. For kindergartners and first graders. Cassette. Micro-Ed.

Matching Words* Learn word similarities by combining the list of forty words into pairs. Performance report is given at end of the lesson. For pre-schoolers and kindergartners. Cassette. Micro-Ed.

Math Bid* By estimating your ability to correctly solve math problems, you can win the game and destroy the Bad Math Monster. Cassette. Micro-Ed.

Math Golf* Combines math skills and golf, with the goal of a hole in one. Everything from forming equations to club selection can help your score. Cassette. Micro-Ed.

Math IQ* Learn how good you are at various math operations in this timed package. Cassette. Comm* Data Computer House.

Math Shootout* Speed counts in finishing math problems so you can out draw the villian. A summary can be shown. Cassette. Micro-Ed.

Math Spin* Pits you against the computer in developing multiplication problems that must be solved. Cassette. Micro-Ed.

Math Sports Package* A collection of the math programs offered by Micro-Ed at a reduced price. Includes Medal Winner, Pinball I.Q., Math Golf, Numbowl, and others. Cassette. Micro-Ed.

MathMan* Based on the popular hangman game, you must rescue Mathman with correct answers. Cassette. Comm*Data Computer House.

Matho!* Math refresher that gives the student immediate graphic response to correct answers. Includes problems with fractions. Cassette. Comm*Data Computer House.

MathWork* Math problems for early elementary students. Cassette. Comm*Data Computer House.

Maxi-Calc* Performs advanced computations like a multi-purpose calculator. Contains large program stack. Disk or cassette. Micro Software Systems.

Maxi-Pros Word Processing* An easy to use word processing program that includes good documentation and can be modified to handle most printers. Disk or cassette. Aardvark.

MC Machine Code. Actual Machine language instructions, whether written directly in Machine Code or resulting from translation of a source program.

M-E See Memory Execute.

Mechanical Applications Software* See Engineering-Mechanical Scientific Applications Software.

Medal Winner Students rearrange the digits in a sequence that can boot the computer in this series of math problems. Awards are given for levels of achievement and everybody wins. For elementary students. Cassette. Micro-Ed.

Media Physical Devices for Recording Information such as programs and data files. The main media for Commodore 64 is disk; however, cassette, RAM, ROM, and other devices are also used. Media are often classified as follows:

a) removable media, such as disks, cassettes, and some hard disks, or

b) fixed media, such as most hard disks. Fixed media are not removable from the device that drives them, so there is no ability to store additional data or backup copies off-line (outside the computing system) for insertion when needed. See also Memory.

Media Register* Basic filing program for information storage. Comm*Data Computer House.

Medical Records* Build a medical history for every member of your family. Include immunization records, lists of doctors, medications, etc. Powerbyte.

MEMBOT The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FF9C, MEMBOT can either read or set the bottom of memory. If the accumulator carry bit is 1 when this routine is used the contents of the start of RAM Pointer is returned into the X and Y registers. If the accumulator carry bit is 0 when this routine is called the contents of the X and Y register are moved into the start of RAM Pointer. See KERNAL.

Memory Any device which can store information for retrieval when needed. The Commodore 64 relies primarily on Random Access Memory (RAM), Read-Only Memory (ROM), disks, and cassettes. The term Memory, by itself, is usually a reference to RAM, the general purpose, erasable and reusable memory.

ROM contains fixed data, usually programs like the Commodore 64's BASIC ROMs and its ROM KERNAL. The KERNAL contains the fundamental Machine language programs to run the devices such as the monitor, printer, disk drive, and cassettes, which are attached to the Commodore 64. ROM and RAM together make up the internal or main memory of the computer.

External memory, such as cassettes and disks, require mechanical motion to retrieve data so they are hundreds or thousands of times slower. Data in internal memory is immediately available to programs for processing. Data in external memory must be copied into internal memory (GET or INPUT#), processed, then copied back out to external memory (PRINT#).

If data has been created, it can be written out to external memory without an INPUT first. And, if data read in from external memory has not been modified, there is no need to write it back out since the original copy is still there.

While external memory is slower than internal memory, it does have advantages. It is much cheaper per character of data stored on-line (available for processing without manual intervention). Storing external memory data off-line (on disks or cassettes) allows essentially unlimited storage of data. Of course this requires a manual step of inserting the disk or cassette before the data can be loaded into the internal memory for processing. See also Virtual Memory, Memory Map, Bubble Memory.

Memory Address A number or variable designating a location in memory. See Address.

Memory Card A card containing RAM or ROM memory to expand or enhance the computer's main memory.

Memory—Amount Free BASIC command. See FRE.

Memory—Change with BASIC See POKE.

Memory—Computer Storage in Bytes. Byte is a label for storage that holds one character (letter, digit, etc) in computer memory or disk. Abbreviated B or (in thousands) KB or simply K (actually, 1K = 1024 bytes because this is an even power of 2). Commodore 64 has 64K (or 64KB) of internal memory, or to be precise 65,536 bytes. See Memory Management.

Memory Execute Disk Command. The memory execute command given through the command channel will begin executing any Machine Code instructions in ROM or RAM of disk drive beginning at the address specified. The format is:

```
OPEN15,8,15
PRINT#15,"M-E:"CHR$(LS)CHR$(MS)
```

(LS) is a decimal number for the least significant part of address. LS = Decimal Address MS * 256.

(MS) is the decimal number for most significant part of address. MS = INT(decimal address/256)

Memory Management The internal memory of the Commodore 64 consists of 64K RAM and 20K ROM (Operating System and BASIC Interpreter). Since there are 16 address lines, only 64K addresses are possible at any given time. The Commodore 64 manages this memory scheme by banking blocks of ROM in and out of the configuration. Control of this operation is maintained at address $0000. As an example, the 8K of BASIC memory ROM can be found at address $A000-$BFFF when bit 0 of address $0000 is set to 1. When that bit is set to 0, 8K of RAM are seen at that address $A000-$BFFF.

Similarly; 8K of KERNAL ROM can be banked in and out of the picture as well as 4K of input/output registers. When first powered on, the Commodore 64 sets address $0000 in such a way that the system sees 8K of BASIC, 8K of KERNAL and 4K of I/O registers.

Memory Map A memory map consists of a table of addresses (locations in memory) and corresponding functions of those addresses. Often the hardware of a computer is controlled by a specific memory location. Changing the value in that location will change the settings in the hardware. An address may be specified for an I/O function, it may contain ROM data, or it may be a free program to enter data. For example, the location 53281 controls the color of the screen. POKEing appropriate

numbers into that address will change the color of the screen.

Memory Map

Label	*HEX Addr.*	*Dec. Loc*	*Description*
D6510	0000	0	Data-Direction Register
R6510	0001	1	8-Bit Input/Output Register
	0002	2	Do Not Use
ADRAY1	0003-0004	3-4	Jump Vector to Convert Floating - Integer
ADRAY2	0005-0006	5-6	Jump Vector to Convert Integer - Floating
CHARAC	0007	7	Search Character
ENDCHR	0008	8	Flag for Scan for Quote at End of String
TRMPOS	0009	9	Screen Column From Last TAB
VERCK	000A	10	Flag for 0 = Load 1 = Verify
COUNT	000B	11	Input Buffer Pointer/Number of Subscripts
DIMFLG	000C	12	Flag for Default Array Dimension
VALTYP	000D	13	Data Type Indicator $FF = String $00 = Numeric
INTFLG	000E	14	Data Type Indicator $80 = Integer $00 = Floating
GARBFL	000F	15	Flag for DATA scan/LIST quote/Garbage Collect
SUBFLG	0010	16	Flag for Subscript Ref/User Function Call
INPFLG	0011	17	Flag for $00 = INPUT$40 = GET $98 = READ
TANSGN	0012	18	Flag for TAN sign/Comparison Result
	0013	19	Flag for INPUT Prompt
LINNUM	0014-0015	20-21	Temporary Storage for Integer Value
TEMPPT	0016	22	Pointer to Temporary String Stack
LASTPT	0017-0018	23-24	Last Temporary Storage for String Address
TEMPST	0019-0021	25-33	Stack for Temporary Strings
INDEX	0022-0025	34-37	Utility Pointer Area
RESHO	0026-002A	38-42	Floating-Point Product of Multiply
TXTTAB	002B-002C	43-44	Pointer to Start of BASIC Text
VARTAB	002D-002E	45-46	Pointer to Start of BASIC Variables
ARYTAB	002F-0030	47-48	Pointer to Start of BASIC Arrays
STREND	0031-0032	49-50	Pointer to End of BASIC Arrays (+)
FRETOP	0033-0034	51-52	Pointer to Bottom of String Storage
FRESPC	0035-0036	53-54	Utility String Pointer
MEMSIZ	0037-0038	55-56	Pointer to Highest Address Used by BASIC
CURLIN	0039-003A	57-58	Current BASIC Line Number
OLDLIN	003B-003C	59-60	Previous BASIC Line Number
OLDTXT	003D-003E	61-62	Pointer to BASIC Statement for CONT
DATLIN	003F-0040	63-64	Current DATA Line Number
DATPTR	0041-0042	65-66	Pointer to Current DATA Item Address
INPPTR	0043-0044	67-68	Vector for INPUT Routine
VARNAM	0045-0046	69-70	Current BASIC Variable Name
VARPNT	0047-0048	71-72	Pointer to Current BASIC Variable Data
FORPNT	0049-004A	73-74	Pointer to Index Variable for FOR/NEXT
	004B-0060	75-96	Temporary Storage for Pointer/Data Area
FACEXP	0061	97	Floating-Point Accumulator #1: Exponent
FACHO	0062-0065	98-101	Floating Accum. #1: Mantissa
FACSGN	0066	102	Floating Accum. #1: Sign
SGNFLG	0067	103	Pointer to Series Evaluation Constant
BITS	0068	104	Floating Accum. #1: Overflow Digit
ARGEXP	0069	105	Floating-Point Accumulator #2: Exponent
ARGHO	006A-006D	106-109	Floating Accum. #2: Mantissa
ARGSGN	006E	110	Floating Accum. #2: Sign
ARISGN	006F	111	Sign Comparison Result: Accum. #1 vs. #2
FACOV	0070	112	Floating Accum. #1. Low-Order (Rounding)
RODBS	029D	669	RS-232 Start of Output Buffer (Page)
RODBE	029E	670	RS-232 Index to End of Output Buffer
IRQTMP	029F-02A0	671-672	Holds IRQ Vector During Tape I/O

ENABL	02A1	673	RS-232 Current Enabled Interrupts
	02A2-02FF	674-677	Cassette Temp Data Area
	02A6	678	Flag for 0 = NTSC Video1 = PAL Video
	02A7-02FF	679-767	Not Used
IERROR	0300-0301	768-769	Vector for Print BASIC Error Message
IMAIN	0302-0303	770-771	Vector for BASIC Warm Start
ICRNCH	0304-0305	772-773	Vector for Tokenize BASIC Text
IQPLOP	0306-0307	774-775	Vector for BASIC Text LIST
IGONE	0308-0309	776-777	Vector for BASIC Char Dispatch
IEVAL	030A-030B	778-779	Vector for BASIC Token Evaluation
SAREG	030C	780	Storage for 6502 A Register
SXREG	030D	781	Storage for 6502 X Register
SYREG	030E	782	Storage for 6502 Y Register
SPREG	030F	783	Storage for 6502 SP Register
USRPOK	0310-0313	784-787	USR Function Jump Instr ($4C)
USRADD	0314-0315	785-786	USR Function Jump Address
CINV	0314-0315	788-789	Vector for Hardware IRQ Interrupt
CBINV	0316-0317	790-791	Vector for BRK Instr. Interrupt
NMINV	0318-0319	792-793	Vector for Non-Maskable Interrupt
IOPEN	031A-031B	794-795	Open a Logical File
ICLOSE	031C-031D	796-797	Close a Specified Logical File
ICHKIN	031E-031F	798-799	Kernal CHKIN Routine Vector
ICKOUT	0320-0321	800-801	Open Channel for Output
ICLRCH	0322-0323	802-803	Close Input and Output Channels
IBASIN	0324-0325	804-805	Kernal CHRIN Routine Vector
IBSOUT	0326-0327	806-807	Kernal CHROUT Routine Vector
ISTOP	0328-0329	808-809	Scan Stop Key
IGETIN	032A-032B	810-811	Get Character from Keyboard Queue (Keyboard Buffer)
ICLALL	032C-032D	812-813	Close a Specified Logical File
USRCMD	032E-032F	814-815	User-Defined Vector
ILOAD	0330-0331	816-817	Load RAM from a Device
ISAVE	0332-0333	818-819	Save RAM to a Device
TBUFFER	033C-03FB	828-1019	Tape I/O Buffer
VICSCN	0400-07FF	1024-2047	1024 Byte Screen Memory Area
	0400-07E7	1024-2023	Video Matrix: 25 Lines x 40 Columns
	07F8-07FF	2040-2047	Sprite Data Pointers
	0800-9FFF	2048-40959	Optional Cartridge ROM -8192 Bytes
	A000-BFFF	40960-49151	BASIC ROM -8192 Bytes (or 8K RAM)
	C000-CFFF	49152-53247	RAM -4096 Bytes
	D000-DFFF	53248-57343	Input/Output Devices and Color RAM or Character Generator ROM or RAM -4096 Bytes
	E000-FFFF	57344-65535	Kernal ROM -8192 Bytes (or 8K RAM)

Hex.	*Decimal*	*Bits*	*Description*
0000	0	0-7	Data Direction Register (xx101111)Bit=1: OutputBit=0: Inputx=Don't Care
0001	1		On-Chip I/O Port
		0	/LORAM Signal (0=Switch BASIC ROM Out)
		1	/HIRAM Signal (0=Switch Kernal ROM Out)
		2	/CHAREN Signal (0=Switch Char. ROM In)
		3	Cassette Data Output Line
		4	Cassette Switch Sense 1 = Switch Close
		5	Cassette Motor Control
		6-7	Undefined 1 = OFF 0 = ON
D000-D02E	53248-54271		MOS 6567 Video Interface Controller (VIC)
D000	53248		Sprite 0 X Location
D001	53249		Sprite 0 Y Location
D002	53250		Sprite 1 X Location

D003	53251		Sprite 1 Y Location
D004	53252		Sprite 2 X Location
D005	53253		Sprite 2 Y Location
D006	53254		Sprite 3 X Location
D007	53255		Sprite 3 Y Location
D008	53256		Sprite 4 X Location
D009	53257		Sprite 4 Y Location
D00A	53258		Sprite 5 X Location
D00B	53259		Sprite 5 Y Location
D00C	53260		Sprite 6 X Location
D00D	53261		Sprite 6 Y Location
D00E	53262		Sprite 7 X Location
D00F	53263		Sprite 7 Y Location
D010	53264		Sprite 0-7 X Pos (msb of X coord.)
D011	53265		VIC Control Register
		7	Raster Compare: (Bit 8) See 53266
		6	Extended Color Text Mode: 1 = Enable
		5	Bit-Map Mode: 1 = Enable
		4	Blank Screen To Border Color: 0 = Blank
		3	Select 24/25 Row Text Display: 1 = 25 Rows
		2-0	Smooth Scroll to Y Dot-Position (0-7)
D012	53266		Read Raster / Write Raster Value for Compare IRQ
D013	53267		Light-Pen LatchX Pos
D014	53268		Light-Pen LatchY Pos
D015	53269		Sprite Display Enable: 1 = Enable
D016	53270		VIC Control Register
		7-6	Unused
		5	Reset VIC Chip: 1 = Reset 0 = Normal
		4	Multi-Color Mode: 1 = Enable (Text or Bit-Map)
		3	Select 38/40 Column Text Display: 1 = 40 Cols
		2-0	Smooth Scroll to X Pos (0-7)
D017	53271		Sprites 0-7 Expand 2x Vertical (Y): 1 = Expand
D018	53272		VIC Memory Control Register
		7-4	Video Matrix (Screen) Base Address (in VIC space)
		3-1	Character Dot-Data Base Address (in VIC space)
D019	53273		VIC Interrupt Flag Register (Bit = 1: IRQ Occurred)
		7	Set on Any Enabled VIC IRQ Condition
		3	Light-Pen Triggered IRQ Flag
		2	Sprite Collision IRQ Flag
		1	Sprite vs Background Collision IRQ Flag
		0	Raster Compare IRQ Flag
D01A	53274		IRQ Mask Register: 1 = IRQ Enabled
D01B	53275		Sprite vs Background Display Priority: 1 = Sprite
D01C	53276		Sprites 0-7 Multi-Color Mode Select: 1 = M.C.M.
D01D	53277		Sprite 0-7 Expand 2x Horizontal (X): 1 = Expand
D01E	53278		Sprite Collision Detect
D01F	53279		Sprite vs Background Collision Detect
D020	53280		Border Color
D021	53281		Background Color 0
D022	53282		Background Color 1
D023	53283		Background Color 2
D024	53284		Background Color 3
D025	53285		Sprite Multi-Color Register 0
D026	53286		Sprite Multi-Color Register 1
D027	53287		Sprite 0 Color
D028	53288		Sprite 1 Color
D029	53289		Sprite 2 Color
D02A	53290		Sprite 3 Color
D02B	53291		Sprite 4 Color
D02C	53292		Sprite 5 Color

D02D	53293		Sprite 6 Color
D02E	53294		Sprite 7 Color
D400-D7FF	54272-55295	MOS	6581 Sound Interface Device (SID)
D400	54272		Voice 1: Low-Byte
D401	54273		Voice 1: High-Byte
D042	54274		Voice 1: Pulse Waveform Width, Low-Byte
D403	54275	7-4	Unused
		3-0	Voice 1: Pulse Waveform With, High-Nybble
D404	54276		Voice 1: Control Register
		7	Random Noise Waveform 1 = On
		6	Pulse Waveform 1 = On
		5	Sawtooth Waveform 1 = On
		4	Triangle Waveform 1 = On
		3	Test Bit:1 = Disable Oscillator 1
		2	Ring Modulate Osc. 1 with Osc. 3 Output 1 = On
		1	Synchronize Osc. 1 with Osc. 3 Frequency = On
		0	Gate Bit:1 = Start Att/Dec/Sus0 = Start Release
D405	54277		Envelope Generator 1: Attack/Decay Cycle Control
		7-4	Attack Cycle Duration: 0-15
		3-0	Decay Cycle Duration: 0-15
D406	54278		Envelope Generator 1: Sustain/Release Cycle Control
		7-4	Sustain Cycle Amp Level: 0-15
		3-0	Select Release Cycle Duration: 0-15
D407	54279		Voice 2: Low-Byte
D408	54280		Voice 2: High-Byte
D409	54281		Voice 2: Pulse Waveform Width, Low-Byte
D40A	54282	7-4	Unused
		3-0	Voice 2: Pulse Waveform Width, High-Nybble
D40B	54283		Voice 2: Control Register
		7	Random Noise Waveform 1 = On
		6	Pulse Waveform 1 = On
		5	Sawtooth Waveform 1 = On
		4	Triangle Waveform 1 = On
		3	Test Bit: 1 = Disable Oscillator 2
		2	Ring Modulate Osc. 2 with Osc. 1 Output 1 = On
		1	Synchronize Osc. 2 with Osc. 1 Frequency 1 = On
		0	Gate Bit: 1 = Start Att/Dec/Sus 0 = Start Release
D40C	54284		Envelope Generator 2: Attack/Decay Cycle Control
		7-4	Attack Cycle Duration: 0-15
		3-0	Decay Cycle Duration: 0-15
D40D	54285		Envelope Generator 2: Sustain/Release Cycle Control
		7-4	Sustain Cycle Amp Level: 0-15
		3-0	Select Release Cycle Duration: 0-15
D40E	54286		Voice 3: Low-Byte
D40F	54287		Voice 3: High-Byte
D410	54288		Voice 3: Pulse Waveform Width, Low-Byte
D411	54289	7-4	Unused
		3-0	Voice 3: Pulse Waveform Width, High-Nybble
D412	54290	Voice 3: Control Register	
		7	Random Noise Waveform 1 = On
		6	Pulse Waveform 1 = On
		5	Sawtooth Waveform 1 = On
		4	Triangle Waveform 1 = On
		3	Test Bit: 1 = Disable Oscillator 3
		2	Ring Modulate Osc. 3 with Osc. 2 Output 1 = On
		1	Synchronize Osc. 3 with Osc. 2 Frequency 1 = On
		0	Gate Bit: 1 = Start Att/Dec/Sus 0 = Start Release
D413	54291		Envelope Generator 3: Attack/Decay Cycle Control

		7-4	Attack Cycle Duration: 0-15
		3-0	Decay Cycle Duration: 0-15
D414	54292		Envelope Generator 3: Sustain/Release Cycle Control
		7-4	Sustain Cycle Amp Level: 0-15
		3-0	Release Cycle Duration: 0-15
D415	54293		Filter Cutoff Frequency: Low-Nybble (Bit 2-0)
D416	54294		Filter Cutoff Frequency: High-Byte
D417	54295		Filter Resonance Control/Voice Input Control
		7-4	Filter Resonance:Min 0 Max = 15
		3	Filter External Input: 1 = Yes 0 = No
		2	Filter Voice 3 Output: 1 = Yes 0 = No
		1	Filter Voice 2 Output: 1 = Yes 0 = No
		0	Filter Voice 1 Output: 1 = Yes 0 = No
D418	54296		Filter Mode and Volume
		7	Cut-Off Voice 3 Output: 1 = Off 0 = On
		6	Filter High-Pass Mode: 1 = On
		5	Filter Band-Pass Mode: 1 = On
		4	Filter Low-Pass Mode: 1 = On
		3-0	Output Volume:OFF = 0 Max = 15
D419	54297		Analog/Digital Converter: Game Paddle 1 (0-255)
D41A	54298		Analog/Digital Converter: Game Paddle 2 (0-255)
D41B	54299		Oscillator 3 Random Number Generator
D41C			Envelope Generator 3 Output
D500-D7FF	54528-55295		SID Register Images
D800-DBFF	55296-56319		Color Cntrl RAM (Only Bits 3-0 Present)
DC00-DCFF	56320-56335		MOS 6526 Complex Interface Adapter (CIA) #1
DC00	56320		Data Port A (Keyboard Joystick Paddles): Game Port 2
		7-0	Write Keyboard Column Values for Keyboard Scan
		7-6	Select Paddle Input Port: 01 = Port 1; 10 = Port 2
		4	Joystick-2 Fire Button: 0 = Fire
		3-2	Paddle Fire Buttons: 0 = Fire
		3-0	Joystick-2 Direction: Bit=1 Open Sw, Bit=0 Closed
DC01	56321		Data Port B (Keyboard Joystick Paddles Lightpen)
		7-0	Read Keyboard Row Values for Kybrd Scan
		4	Joystick-1 Fire Button / Lightpen Trigger (0 = Fire)
		3-2	Paddle Fire Buttons: 0=Fire
		3-0	Joystick-1 Direction: Bit=1 Open Sw, Bit=0 Closed
DC02	56322		Data Direction Register -Port A (56320)
DC03	56323		Data Direction Register -Port B (56321)
DC04	56324		Timer A: Low-Byte
DC05	56325		Timer A: High-Byte
DC06	56326		Timer B: Low-Byte
DC07	56327		Timer B: High-Byte
DC08	56328		T.O.D Clock:1/10 Seconds
DC09	56329		T.O.D Clock:Seconds
DC0A	56330		T.O.D Clock:Minutes
DC0B	56331		T.O.D Hours × AM/PM Flag (Bit 7)
DC0C	56332		Synchronous Serial I/O Data Buffer
DC0D	56333		CIA Interrupt Control Reg. (Read Flags/Write Mask)
		7	IRQ Flag (1 = IRQ Occurred)/Mask Set Minus Clear Flag
		4	FLAG1 IRQ (Cassette Read/Serial IEEE SRQ Input)
		3	Serial Port Interrupt
		2	T.O.D Alarm Interrupt
		1	Timer B Underflow Interrupt
		0	Timer A Underflow Interrupt
DC0E	56334		CIA Control Register A
		7	T.O.D Clock Frequency:1=50 Hz 0=60 Hz
		6	Serial Port Mode:1=Output0=Input
		5	Timer A Count:1=CNT Signals0=System 02 Clock

		4	Force-Load Timer A:1=Yes
		3	Timer A Run Mode:1=Once0=Continuous
		2	Timer A Output Mode to PB6:1=Toggle 0=Pulse
		1	Timer A Output to PB6:I=Yes0=No
		0	Start/Stop Timer A:I=Start0=Stop
DC0F	56335		CIA Control Register B
		7	Set TOD Alarm/Clock:1=Alarm 0=Clock
		6-5	Timer-B Mode Select: 00 = Count System 02 Clock Pulses 01 = Count Positive CNT Transitions 10 = Count Timer A Underflow Pulses 11= CountTimerA Underflows While CNT Positive
		4-0	Same as Control Register A: for Timer B
DD00-DDFF	56576-56591		MOS 6526 Complex Interface Adapter (CIA) #2
DD00	56576		Data Port A (Serial IEEE, RS-232, VIC Memory Ctl)
		7	Serial IEEE Data Input
		6	Serial IEEE Clock Pulse Input
		5	Serial IEEE Data Output
		4	Serial IEEE Clock Pulse Output
		3	Serial IEEE ATN Signal Output
		2	RS-232 Data Output (User Port)
		1-0	VIC Chip Bank Select (Default = 11)
DD01	56577		Data Port B (User Port/RS-232 Signals)
		7	User / RS-232 Data Set Ready
		6	User / RS-232 Clear to Send
		5	User -Undefined
		4	User / RS-232 Carrier Detect
		3	User / RS-232 Ring Indicator
		2	User / RS-232 Data Terminal Ready
		1	User / RS-232 Request to Send
		0	User / RS-232 Received Data
		/FLAG	User / RS-232 Receive: Detect Start-Bit (IRQ Flag)
DD02	56578		Datt Direction Register $DHPort A
DD03	56579		Data Direction Register $DHPort B
DD04	56580		Timer A: Low-Byte
DD05	56581		Timer A: High-Byte
DD06	56582		Timer B: Low-Byte
DD07	56583		Timer B: High-Byte
DD08	56584		T.O.D Clock:1/10
DD09	56585		T.O.D Clock:Second
DD0A	56586		T.O.D Clock:Minutes
DD0B	56587		T.O.D. Clock: Hours + AM/PM Flag (Bit 7)
DD0C	56588		Synchronous Serial I/O Data Buffer
DD0D	56589		CIA Interrupt Control Reg. (Read Flags/Write Mask)
		7	NMI Flag (1 = NMI Occurred)/Mask Set-CLear Flag
		4	FLAG2 NMI:Detects Start-Bit on Recv
		3	Synchronous Serial Port Interrupt
		2	Time-of-Day Alarm Interrupt
		1	Timer B Interrupt
		0	Timer A Interrupt
DC0E	56590		CIA Control Register A (Same Format as 56334)
DC0F	56591		CIA Control Register B (Same Format as 56335)
DE00-DEFF	56832-57087		Reserved for Future I/O Expansion
DF00-DFFF	57088-57343		Reserved for Future I/O Expansion

Memory Segment A continuous block of memory addresses, such as 0 to 16K.

Memory-Read Byte from BASIC. See PEEK.

Memory-Read Disk Command. This command through the command channel enables you to read any address in the 16K ROM or 2K RAM within the 1541 Disk Drive. The command itself locates the specific address. The data at that address can be obtained with a GET statement through the error channel. The format is:

```
OPEN 15,8,15
PRINT#15,"M-R:"CHR$(LS)CHR$(MS)
GET#15,A$
```

The address is expressed in decimal and can be computed as follows:

(LS) = decimal address -MS*256;

LS is the decimal number for the least significant part of the address.

(MS) -the high byte = INT (decimal address/256);

MS = decimal number for the most significant part of the address.

Memory-Write Disk Command. The Memory Write command enables you to write into the RAM within the 1541 Disc Drive. The command specifies a starting address for the data to be entered and is followed by the data. Up to 34 bytes of data can be written in one command. The format is:

```
OPEN15,8,15,"M-W:"CHR$(LS)CHR$(MS);CHR$(n);CHR$(d)
```

(LS) is the decimal number for the least significant part of the address (LS=Decimal Address-MS*256).

(MS) is the decimal number for the most significant part of the address (MS=Decimal Address/256).

(n) is the number of characters in data to follow.

(d) is the decimal number for the Machine Code of data.

MEMTOP The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FF99, MEMTOP either reads or sets the top of RAM. If the carry bit of the accumulator is set, the top of RAM pointer is returned into the X and Y registers. If the carry bit of the accumulator is 0, then the contents of the X and Y register are moved into the top RAM pointer. See KERNAL.

Menu Screen display which lists a number of possible options and asks the user to select one. When a selection is made by keying in an identifying number or letter, positioning the cursor beside the desired item, using a light pen, etc., the selected function is performed. This may require either a branch or subroutine call to the code for the function, or the program to carry out this function may be loaded into memory and executed.

Many application packages use a system of multiple menus. A Master Menu lists the major functions allowed. Selection of an option on the Master Menu causes another menu to be displayed, indicating more detailed options for the selected function. This can be followed by even more detailed menus, and so on. Often completion of a function will cause re-display of the master menu. Such a system is called menu driven.

Menu Driven See Menu.

Message A statement or code printed out or displayed on the screen by a program to let you know what is happening. Examples include prompts when the program expects you to input something, error messages which tell you something about what went wrong, and informational messages such as "Copy Complete".

Meta Music I* Compose music and learn the basic elements of musical theory. Teach yourself rhythm, tempo, harmony, melody, and more. Disk. Commodore.

Meteor* You control a starship trapped in a meteor shower. Avoid the metors or destroy them with your laser. Includes sound and full-color, high-resolution graphics. Cassette. Star Tech, Inc.

Metric Brain, The* Learn the metric system with instantaneous conversions between metric and other measuring systems. Excellent tool for teachers and engineers. Powerbyte.

Metric-Calc* A metric conversion system including area, distance, temperature, and weight. Disk or cassette. Micro Software Systems.

M'File* A menu driven data management program. The number of fields and their length is determined by the user, up to 32 fields per record and 78 characters per field. A record can contain up to 250 characters. Fields within a record can contain words, numbers, or formulas with addition, subtraction, multiplication, division, inequalities such as $<$ or $\neq$, and IF THEN statements. There are 10 user-defined interfield formulas, but formulas can reference any other field. Records can be sorted on any field in ascending or descending order. Searches can be performed on any or all fields with a special high speed "keyfield" search. Fields can be added to a record (as long as the maximum number of characters does not exceed 250) after a record has been established. Data can be output in user-defined formats, giving great flexibility in outputs, with escape sequences able to set different options on printers. One menu option allows M'File to be merged into major word processor programs available. The quality of the program is matched by the documentation. It is clear, concise, and comprehensive. M'File is by M'Soft, a product of Double E Electronics, Inc.

Microbuffer In-Line* Computer Peripheral. A printer buffer that may be used with the Commodore 64 and any printer or modem. Both parallel and serial versions are available. The memory can be upgraded from a minimum of 32K to 256K bytes by using expansion modules. Practical Peripherals, Inc.

Microprocessor An integrated circuit that is essentially the "brain" of the computer. It is responsible for fetching

and executing each instruction from a program. It performs the routine arithmetic and logical operations on data. In the Commodore 64, the 6510 Chip is the microprocessor. The chip itself has forty pins that include sixteen address lines for an addressable memory range of 64K bytes and eight bi-directional data lines. The chip is capable of executing fifty-six different Machine Coded instructions and performing both binary and decimal arthemetic. See Machine Language Program.

**MID$** BASIC Function and Statement. When used as a function, MID$ returns the requested part of a given string. The format is:

<stringvariable> = MID$(<X$>,<n>,[<m>])

<X$> is any string expression.

<n> is an integer expression in the range 0 to 255.

<m> is an integer expression in the range 0 to 255.

The MID$ function returns a string of length <m> characters from <x$> starting with the <n>th character. If you leave out <m> or if there are fewer than <m> characters to the right of the <n>th character, all rightmost characters beginning with the (n)th character are returned. If <m> is equal to zero, or if <n> is greater than LEN(X$), then MID$ returns a null string.

When used as a statement, MID$ replaces a portion of one string with another string. The format for the statement form is:

MID$(<X$>,<n>,[,<m>]=<string variable>

Mini Jini* Database management system for the Commodore 64. The program is capable of storing 750 characters per record. Data entry is simplified and a single record or group of records are found using the search option. Options will be available to perform mathematical and relational, (<, >, =, AND, OR), operations on specified records. User-defined reports containing specified records may be printed using this database program. Jini Micro Systems.

Minibus* A three slot expansion card that is fuse protected and switch selectable. Random Access Marketing.

Misplaced or Dangling Modifiers* Recognize dangling modifiers (a clause or phrase modifying a word that it shouldn't modify) from a selection of 20 sentences. Some sentences are correct and others need to be changed. For elementary students and up. Datasette. Micro-Ed.

Mission 64* Travel through space on the look-out for alien spaceships. Cassette; joystick or keys required. Briley Software.

Misspell* Correct all the mispelled words in a displayed story before you can continue to the next page. For ten to thirteen year olds. Cassette. Comm*Data Computer House.

Misspell 2* Similar to Misspell, with scoring afterward. Cassette. Comm*Data Computer House.

Mnemonic A name or abbreviation which is intended to remind you of what it stands for, such as LAX for Load Accumulator into X register.

MOB Moveable Object Blocks. See Sprites.

Modem MOdulator DEModulator. A device to convert the digital voltage level signals of the computer to modulated (frequency or tune) signals for transmission over phone lines. Required at both ends of a phone line for telecommunications. See also Vicmodem.

Modem Interface* Lets you connect almost any direct connect or acoustical modem to your system. It is compatible with the CAT, Microconnection, or DC Hayes modems. Bytesize Micro Technology.

Modulator, RF A computer is designed to connect directly to a monitor. To connect a computer to a television set you need an RF Modulator. It makes necessary corrections on the generated signals. The Commodore 64 comes with a modulator and can be connected directly to any black and white or color TV. Although there is a switch on the module cable to disengage the TV, occasionally the Commodore 64 video display is subject to interference. Moving the computer or TV often eliminates this problem. Extending the cable and wrapping the leads of the cable around a ferrite may solve the problem. There is also an audio/video port to connect directly to a monitor. See Monitor—Video.

Monitor—Program See Assembly.

Monitor—Software A monitor program gives the user direct access to computer memory locations. A good monitor will not only let the user enter and retrieve bytes from specific locations but will let him load and save programs to and from locations specified by the user. Monitors also allow the user to check the contents of the key registers (such as the accumulator) and alter data in those registers. A monitor is often used to debug Machine language programs by allowing the user to locate errors in a program and make specific changes.

Monitor—Video A cathode ray tube which receives signals by cable. A television set receives high frequency radio signals. An RF modulator is used to connect with the computer corrects the signals. A monitor can be connected directly to the computer. A monitor has better resolution with less interference but may not have a built-in speaker. The Commodore 64 has an audio video port in the back to connect to a monitor, and an RF modulator to connect to a T.V.

Monitor Link* Cable assembly that connects your computer to a monitor. Also lets you connect your computer to your stereo for great audio reproduction. Micro Systems Development, Inc.

Monitors* See CTE/VTE Terminal Emulator.

More Prefixes* Another version of the Prefixes game using dis, de, pro, pre, and un. For elementary students. Cassette. Micro-Ed.

More Suffixes* Another version of the Suffixes game using less, ent, able, ible, ous, ful, and ant. For elementary students. Cassette. Micro-Ed.

Mortgage Calculator, The* Does calculations for monthly mortgage payments. Disk; printer required. Powerbyte.

MOS Metal Oxide Semiconductors. A MOS device contains transistors and other electronic components created on small pieces of silicon. They utilize the fact that the conductivity of some materials can be altered in the presence of an electric charge. This kind of technology allows for the developement of tens of thousands of microscopic circuits on a single chip.

Mother's Recipes* Keep your recipes in the computer instead of on cards or in books. Powerbyte.

Motherboard The main printed circuit board in an electronic device. It is usually the largest board and has "slots" for smaller boards to plug into. See Board.

Motion Problems I* Teaches the rules of motion through integral value problems. Students set up opposite direction equations. Disk or cassette. Microcomputer Workshops.

Motion Problems II* Similar to Motion Problems I but uses problems based on catching objects and traveling. For high school students. Disk or cassette. Microcomputer Workshops.

Motor Mania* Arcade style game for the Commodore 64. Overcome road hazards and cross traffic while maintaining the maximum speed in the race. Features include full instrument panel, gas station, two standard and one random map sections, a variety of road conditions, and 10 skill levels. Joystick included. UMI.

Moving the Cursor Blinking square that appears on the screen when powered up and during most programs. Pressing a key on the keyboard enters the character on the screen and moves the cursor one square to the right. At the end of the line the cursor automatically returns to the left and moves down one line. Keying in a carriage return (RETURN) will also return the cursor to the left and essentially enter a blank space, erasing any character in the cursor path. The cursor can be moved without affecting data using the CRSR up, down, left, and right keys on the lower right of the keyboard. The cursor can be moved left and used to delete characters using the INST/DEL key. The cursor can be immediately returned to the upper left corner hitting the CLR/HOME key.

MPU Micro Processor Unit. The actual chip containing the processor.

M-R See Memory Read.

Multi-Color* Multi-color, high resolution character editor with the following features: auxiliary and screen color commands, 8 power magnification, cursor controls, Saves and Loads set to all input and output devices. Just Another Software Co.

Multi-Color Character Mode The Commodore 64 has two possible screen formats: hi-resolution mode or character mode. In character mode the screen is divided into 1000 squares (40 columns by 25 lines). In standard character mode each character must be one of sixteen colors. Multi-color character mode allows four different colors for each character. The multi-color character mode is enabled by setting bit 4 of address 53270. The four colors are established using address 53281 to 53283. Multi-color character mode sacrifices some resolution since colors are set in pairs of pixels.

Multilanche* Solve problems correctly to avoid being smashed by falling objects. Cassette. Comm*Data Computer House.

Multiplex Use the same component for several distinct functions, either sequentially or simultaneously. The address lines of an MPU are often used as the data lines at another point in time—an example of multiplexing.

Multiplication Race* Solve math problems to put your horse in the winner's circle. Cassette. Comm*Data Computer House.

Multiplication Tutor* Teaches multiplication with graphics. Cassette. Comm*Data Computer House.

Multiplying Fractions* Practice this tricky mathematical function, with step-by-step assistance. Disk or cassette. Microcomputer Workshops.

Munchword* You have four minutes to gobble as many nouns as possible, but don't munch on any verbs! For second to sixth graders. Cassette. Comm*Data Computer House.

Music Composer* Use your computer like a piano to create music and record it for future enjoyment. Commodore.

Music Machine* Uses the music synthesizing capability of the Commodore 64 to transform it into a versatile synthesizer. The top two rows of the keyboard are used for playing the notes. As each key is pressed, its corresponding note is also displayed on the screen in musical notation. The function and control keys are used to change the musical settings and special effects such as waveform, octave, and percussion (rhythm select), and will also adjust the pitch to accompanying instruments. Commodore.

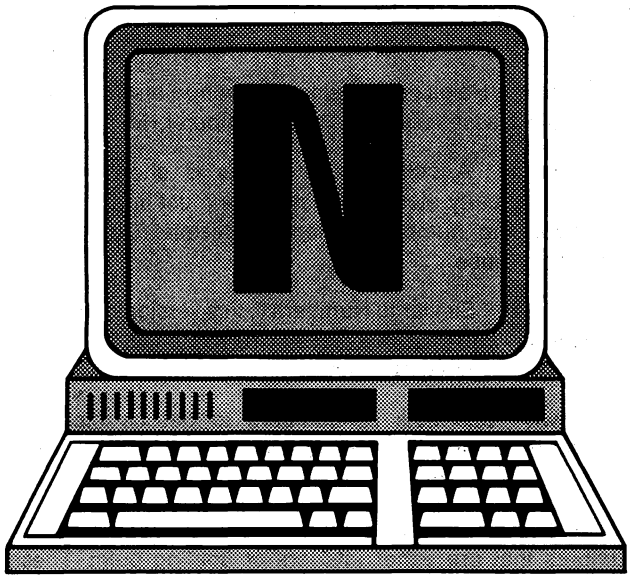
Musicom* Allows the user to compose for three different instruments at the same time. Accents, pitch, and timbre are adjustable. Musicom also presents printed lyrics. Computer Alliance.

M-W See Memory Write. Disk Command.

MW-302—Parallel Printer Interface* A hardware driven interface that connects centronics type parallel printers and plotters. It also has switch selectable options such as 7- or 8-bit output; device 4, 5, 6, or 7; and ASCII. Micro World Electronix, Inc.

My ABC's* Helps youngsters learn language skills understand computers. Cassette. Adventure.

My Credit Cards* Helps manage your credit cards. Automatically generates a letter to your creditor when a card is lost or stolen. Powerbyte.



N Codes. ASCII = 78, CBM ASCII = 78 or 206. HEX = 4E, n—ASCII = 110, HEX = 6E, CBM ASCII = 78. Screen code = 14 or 78. See CBM ASCII.

N See NEW. Disk Command.

Names The rules governing variable names in BASIC for the Commodore 64 are:

a) must start with a letter;

b) can be any length, but only the first two characters are used;

c) cannot use any keywords, including any BASIC command or the variables TI, ST or TI$. See Reserved Words;

d) end with a type declaration:

$ for String variables
% for Integer variables
no type declaration means Floating Point to the program.

NAND Not-AND logical.

Nand Gate Hardware device which implements the NOT-AND logical function.

Nations* Tests knowledge of nations and their capitals in a scrabble-like format. Points are given for correct answers and wrong answers are penalized by a missed turn. For fourth and fifth graders. Cassette. Comm*Data Computer House.

Native Code Machine-dependent language synonym such as assembler.

Native Compiler Compiler for the processor on which it runs.

Natural Logarithm BASIC. See LOG(x).

NBS National Bureau of Standards.

NC No Connection.

NDAC Not Data ACcepted.

NE Not Equal, symbolized by ≠.

Negative Logic Normally, true state voltage in the computer system represents a logically false state. A normally false state voltage in the computer system represents a logically true state.

Nested Subroutine A subroutine which is within another subroutine. The inner subroutine (nested) is completed first.

Net Worth Statement* Helps you prepare financial information for getting a bank loan or other credit. Disk; printer required. Powerbyte.

Network Computers can be connected to form a system which is called a network.

NEW BASIC Command. Deletes the program currently in computer memory and clears all variables. The format is:

NEW

It is used to clear the memory of any previous statements or variables before entering a new program. If the NEW command is not used you will end up with an unusable combination of lines from your old and new programs.

NEW—Disk Command. When sent through the command channel, the NEW command erases the entire disk, puts timing and block markers on the disk, and creates the directory and BAM. The format is:

OPEN15,8,15 PRINT#15,"NEW0:<name>,<ID>"

<name>is arbitrary, assigned by the user.

<ID>is an arbitrary identification made by the user consisting of two characters. <ID> is placed on directory and all blocks on disk.

Next End of FOR...NEXT loop in BASIC. See FOR...NEXT.

Next Without For This is an error message that appears on the Commodore 64 when a variable with the NEXT statement doesn't correspond to the variable in the FOR statement.

Nibble Half a byte or 4 bits.

NMI See Interrupt Machine Code.

No Block An error message from the 1541 disk drive incurred when you try to use the BLOCK-ALLOCATE command on a block that is already in use. The error channel #15 returns this message as well as the track and sector of the next available block.

No Channel An error message from the 1541 disk drive incurred when a user tries to open more than five sequential files or six direct access channels simultaneously.

Noise Interference on a system communications line or random unknown signals.

Non-Destructive Read-Out The memory contents are not erased or displaced when other data is read.

Non-Encoded Keyboard See Keyboard.

NOP or NOOP NO OPeration. An Assembly language instruction for the 6510 microprocessor that does nothing for 2 cycles. It can be used in a delay loop but does not affect any flag or any registers.

NOR Condition of being Not-OR.

Normal Size Print To return to normal 10-character-per-inch print size, you must turn off all non-standard print options.

NOT Negative operation which changes every 1 in a byte to a 0 and every 0 in a byte to a 1. In many languages it is also used as a logical operator to reverse the outcome of a conditional test.

NOT-AND Logical Operator A NOT-AND B is a synonym for NOT (A AND B).

Not Input File This is an error message from the Commodore 64 encountered when a program attempts to INPUT or GET data from a file that was specifically opened as an output file.

Notch, Write-Protection A disk is write-protected if it does not have a notch about one inch down on the right side. The notch may be absent or covered with an adhesive tab, in which case it is mechanically impossible to write to the disk. The disk can still be read and files loaded from the disk to the computer. Attempting to write to a protected disk will give a WRITE-PROTECTION ON error.

It is a good idea to put an adhesive tab over the notch of any disk containing important data or programs, particularly prior to using Backup. If you inadvertently mix the original and backup copy, no data will be lost.

Noun* Learn about general and specific nouns by examples and definition; then test your comprehension and see a performance summary. Cassette. Micro-Ed.

Nuclear Sub* Bring your damaged sub to the surface before your air runs out, or worse. Cassette; extended BASIC required. Aardvark.

Null Detector Circuit which registers when current is not flowing or when voltage is not present.

Null String or File A string or file with no contents.

Number Crunching The performance of complex arithmetic operations and computations.

Number Jotto* One of the "Inside BASIC series" for the Commodore 64. Guess a four-digit number that the computer has selected using logic. Hints are provided by the computer. The Inside BASIC series is designed to increase programming skills in BASIC language by understanding how each program in the series is developed. The documentation also includes a line-by-line description of the program, suggested changes, a complete program listing, and an overview that discusses the development of the program. For more details on the series, see also Inside BASIC. Sim Computer Products, Inc.

Number Jumper* Add a series of numbers that will let a runner jump hurdles and win a race. Cassette. Micro-Ed.

Numbers I* Helps early elementary schoolers work better with digits. Cassette. Comm*Data Computer House.

Numbers II* A collection of things is shown on the screen, and early elementary students must figure out the corresponding number of items. Cassette. Comm*Data Computer House.

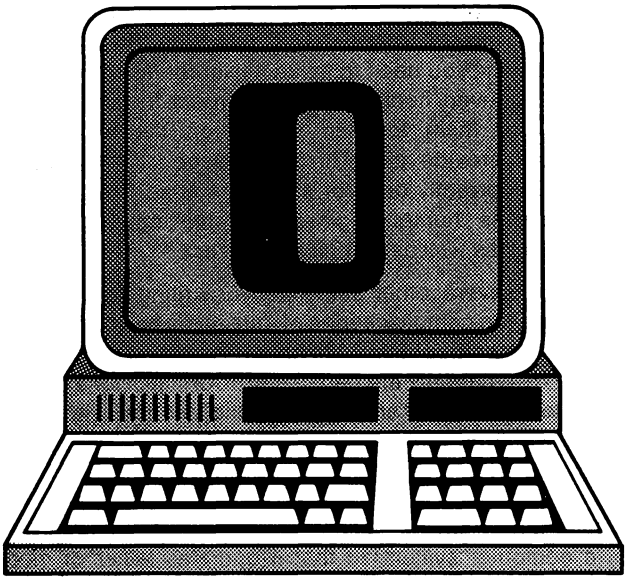
Numbers III* Similar to Numbers II, this version offers time restrictions and various levels of difficulty. Cassette. Comm*Data Computer House.

Numbowl* Use sets of numbers to get as close as possible to certain preset totals. Based on a bowling format. Cassette. Micro-Ed.

Numeric Data Numeric variables and constants are numbers that are either integers or floating point. These numbers can be added, subtracted, multiplied, divided, compared, etc. Numeric variables have a % symbol following the variable for integers and no symbol for floating point. String data have a $ symbol following a variable or have constants in quotation marks. String data can also be comprised of numbers, but the computer sees them only as symbols and cannot perform arithmetic operations on them. The expressions A=27 and A$="27" are viewed by the computer as two completely different expressions.

Numeric Value of String BASIC. See VAL.

Numeric Variables Floating point. A variable is assumed to be floating point if it does not have the symbol % (for integer) or $ (for string) following the variable. Floating point variables can be positive or negative and are assumed positive if there is no "-" symbol before it. A floating point may include a decimal point. If it doesn't have one, it is assumed to be at the far right of the number.



O Codes. ASCII = 79, CBM ASCII = 79 or 207, HEX = 4F. o—ASCII = 111, HEX = 6F, CBM ASCII = 79. Screen code = 15 or 79. See CBM ASCII.

O Stands for Output or Overflow.

Object Code The code produced by a compiler or an assembler program. Generally represented by hexadecimal numbers, each number representing a particular operation of the microprocessor. It is in fact the only code that can be directly executed by the computer.

Object Program A program written in Machine language. Most programs are written first in a higher-level language such as BASIC. This program is referred to as a source program. A microprocessor such as the 6510 in the Commodore 64 does not recognize BASIC words, so they must be translated into a Machine language program. This translated version, ready to be executed by the microprocessor, is called the object program. The process of translating is called compiling. BASIC programs are usually interpreted, which means the instructions in the source program are used by a BASIC interpreter to control a series of subroutine calls. In this case no permanent object program is produced. See also BASIC Interpreter, BASIC Compiler.

Odd Parity The parity bit is added to a word so that the total number of "1" bits becomes odd. Even parity means the total number of "1" bits becomes even.

Off-Line A device or media that is outside of or disconnected from the computer system is off-line. On-line means that a device or medium is inside of or connected to the system.

A disk is on-line when it is in a working disk drive. A printer is on-line if it is attached, powered on, and ready to print. The printer is off-line if it is disconnected, powered off, or switched to its "off-line" state by an on-line/off-line switch. See Memory.

Offset Address The smaller part of a base register offset/pair. The data to be processed is located at: (effective address)=(contents of base register)×(offset).

Oil Well* Pretend you're an oil barron by reducing numbers to their prime factors and increasing your chances for a gusher. For elementary students. Cassette. Micro-Ed.

Omega Race* Command a starship and control an arsenal of weapons as you travel throughout the galaxy in search of adventure. Commodore.

On the Line* Learn about mixed numbers and improper fractions while coaching a game of football. For elementary students. Cassette. MicroEd.

One Line Multiple BASIC Statements. You can put a colon (:) at the end of a statement and enter another statement on the same line without giving a new line number. A maximum of 80 characters may be used in the form of multiple statements on one line. The line number at left refers to all statements on the line.

ON...GOSUB and ON...GOTO BASIC Statements. ON... GOSUB and ON...GOTO are used to branch to one of several specified line numbers, depending on the value of an expression. The formats are:

ON <n> GOTO <line>[,<line>...]

ON <n> GOSUB (line>[,<line>...]

<n> is a numeric expression which is rounded to an integer, if necessary. It must be in the range 0 to 255.

<line> is the number of a line you wish to branch to.

The value of <n> determines which line number in the list will be used for branching. If the value is 4, the fourth line number in the list will be the destination of the branch.

In the ON...GOSUB statement, each line number in the list must be the first line number of a subroutine. This means that at some time it will be necessary to have a RETURN statement to bring you back to the line following the ON...GOSUB.

If the value of <n> is zero or greater than the number of items in the list (but less than or equal to 255), BASIC will continue with the next executable statement.

On-Line A device or medium inside or connected to the computer system is on-line. Off-line means that a device or media is outside of or disconnected from the computer system.

A disk is off-line when it is in a box, and on-line when it is in a working disk drive. A printer is on-line if it is attached, powered on, and ready to print. The printer is off-line if it is disconnected, powered off, or switched to its "off-line" state by an on-line/off-line switch. See Memory.

OPEN BASIC Command. Establishes a channel through which data can be sent and received from a peripheral device It is essentially the command that makes the connection with a peripheral such as a cassette, disk, modem, or printer. Once a channel has been opened with a

device, the commands PRINT#, GET#, and INPUT# can be used to send and receive data to and from the device. The format is:

OPEN <lfn>,<dev#>,<add#>, ["<fname>,<type>, <mode>"]

<lfn> is the logical file number that is used to reference PRINT#, GET# and INPUT# commands so data is sent to the right channel.

<dev#> is the device number of the peripheral to which data will be sent. For a single disk drive, device number 8 is used; for a printer on the serial port, device number 4 is used. If the device number is left out, the computer will assume device number 1 (which is cassette).

<add#> is the secondary address has different meanings depending on the device you are opening. In disk files <add#> may be 2-14 and refer to channel numbers set by the user. For a cassette, a number 1 opens the cassette for writing, and a 2 places an end of tape marker when the file is closed. In the VIC 1525 printer, a 7 will tell the printer that the upper and lower case letters are to be printed.

<fname> is the file name up to 16 characters. This is optional for printers or cassette.

<type> is used in disk files—either "S" for sequential, "R" for relative or "P" for program.

<mode> is used to distinguish between a sequential read (R) or sequential write (W). In opening an RS-232 channel, a slightly different format is used. See RS-232 for the Commodore 64.

Open Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFCO, OPEN will open a logical file that has been set up using the SEFLFS and SETNAM routines. See KERNAL.

Operand Operations are performed upon entities called the operands. For example, the statement LET A=B+C specifies that the operation of addition is to be performed on the operands B and C.

Operating System The software and hardware responsible for organizing the memory of a computer and orchestrating its activities. It is built into the ROM of the Commodore 64, and contains the BASIC Interpreter, the KERNAL, and the Screen Editor.

Operating System Utilities* See Commodore 64 DOS Wedge; PET Emulator; Smart 64 Terminal, The; Terminal Pak Series.

Operation Action of a program resulting in a defined instruction being executed.

Operation Code Part of the Assembly or Machine language program which specifies what operation is to be performed.

Operator Symbols within a program such as * (for multiply), - (for subtract), or + (for add), which specify what operation is to be performed.

Operator—User Person using a program. You will often be the only user of programs you write, but if others will use your program, you need to make it user friendly. Give clear prompts for every item of input data, freeze the screen long enough for them to read or act on the information displayed, provide clear error messages if anything is entered incorrectly or error situations arise. This is often referred to as "human engineering"—making the program easy to use as well as technically correct. "

There are several other guidelines for writing user friendly programs. If a complex series of data items has been typed in but some entries turn out to be invalid, the user should be able to re-enter only the bad items. Error messages should indicate not only that an entry is invalid, but how it is invalid and, if at all possible, some hints as to how to correct it (such as a list of possible correct values).

Optimization Changing either the software or the hardware of a computer system so that it operates faster or more efficiently.

Options Choose from Menu. A menu is a screen display which lists a number of possible options and asks the user to select one. When a selection is made by keying in an identifying number or letter, positioning the cursor beside the desired item, using a light pen, etc., the selected function is performed. This may require either a branch or subroutine call to the code for the function, or the program to carry out this function may be loaded into memory and executed.

OR BASIC Logical Operator. A logical operation performed between two numbers. The result of a logical OR between two bits is 1 if either of the bits is 1. The result is 0 if both bits are 0. When the logical OR is performed between two bytes, each pair of corresponding bits is ORed to yield a resulting byte. For example, if the binary number 10001001 is ORed with 10010001 the result is 10011001. The logical OR is often used to set a single bit in a byte without altering any of the other bits. ORing the first number with 01000000 will result in 11001001. The format is:

<operand> OR <operand>

An example is:

20 IF A$="Y" OR B=3 THEN GOTO 100

OR OverRun. The status flag of the Universal Synchronous/Asynchronous Receiver/Transmitter (UART) goes to 1 if a new character is written on top of an old one.

ORA OR with Accumulator. An Assembly language instruction for the 6510 micro processor that performs the logical OR function with the accumulator and data in the argument. The result of the logical OR is placed into the accumulator. The addressing mode of the argument may be immediate, zero page, zero page X, absolute, absolute X, absolute Y, (indirect X), and (indirect Y). The sign flag bit and the zero flag bit can be altered by the result.

Order Entry Software See Order Tracker.

Order Tracker* Deals with customers and their purchase orders to help clarify your business operation and give easy access to important data. Disk; printer required. Powerbyte.

OS Stands for Operating System.

Out of Data This is an error message from the Commodore 64 encountered when a program READing from a DATA statement runs out of data. Remember to separate data properly in a DATA statement and make sure there is a one-to-one correspondence between the number of READs and the amount of data.

Out of Memory This is an error message from the Commodore 64 indicating that there is no more RAM memory available. It also occurs when too many FOR loops are used or when there are too many GOSUBs used. Remember that arrays which take up one program line often occupy a lot of RAM.

Output Information coming out of a program. It may be going to a screen, printer, disk, speaker, etc.

OV OVerflow. When the number of digits that result from a mathmatical operation exceeds the number of registers available to hold them, this is called overflow.

Overflow An error message indicating that a value computed has exceeded the maximum value allowable on the Commodore 64 (1.70141884E+38).

Overflow When performing arithmetic operations in Machine language, if the results involve the movement of a "1" in bit 6 to bit 7, the Overflow Status Flag is set.

Overflow Flag Bit See Status Register.

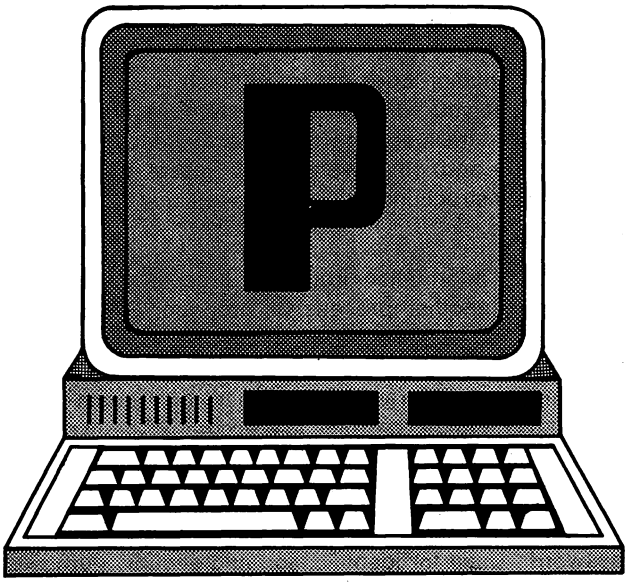
Overflow In Record Print# An error message in the 1541 disk drive incurred when more than the defined or allowable number of characters is PRINT#ed to the drive. Remember, the carriage return is included in the characters sent.

Overlay Different routines within a program which occupy the same memory location. They are loaded as needed during the operation of a program. Conflict can occur if two routines with different overlays try to use the same location at the same time.

Over-Run Error The previous character in a register hasn't been completely read when a new character is loaded into the register.

Over-Striking The printer returns to a position where a previous character was struck and strikes a new character on top of it, producing a combination character. Also called boldfacing.

Over-Voltage Protection The computer's circuitry is protected from undesirable increases in the AC power line voltage.



P Codes. ASCII = 80, CBM ASCII = 80 or 208, HEX = 50. p—ASCII = 112, CBM ASCII = 80, HEX = 70. Screen code = 16 or 80. See CBM ASCII.

P See Parity, POSITION.

Package Software. A software package is a group of computer programs, including data files and documentation, that perform a function or group of related functions on the computer. These are called applications software when the programs are devoted to an end user task. Examples are a word processing package, an accounting package, etc. They are called systems software packages when they aid in the use of machinery, such as a data base management package, a disk operating system, or a program development package.

Packed Decimal Two or more binary coded decimal digits are present in every byte. The ten decimal digits 0 through 9 are stored in a 4-bit representation. 1 is coded as 0001, 9 as 1001, etc.

Packet A short set of data of a predetermined length that fits into a particular location. The set is then transferred in a network of devices.

Pad The rectangular base where the wire of a computer chip is connected.

Page Length The number of lines that can be printed onto a sheet of paper. On a standard sheet, 66 lines of data can be typed using a standard 1/6-inch line format.

Pagination Automatic page numbering performed by some word processor programs.

Paging To switch from one full screen of information to another, especially in a word processing program; you can page either backward or forward. In memory, a page is a logical set of storage used for the management of memory; in a paging system, the memory location is designated by a page number or address and an address within the page.

Pail Green* Learn about fractions while you accumulate money from the well. Recommended for elementary grades. Cassette. Micro-Ed.

Panorama, 64* A graphics utility package that lets you create high-resolution graphics on the screen and dump onto the VIC 1525 printer. Use joysticks to control the 64000 pixels on the screen in the hi-res mode to draw straight or curvy lines and create background patterns. Uses the full graphic features of the Commodore 64. Comes with a library of 19 digitized pictures to illustrate the graphics capability of the C 64 and the drawing power of the 64 Panorama. Cassette. Midwest Micro Associates.

Parallel Simultaneous handling of processes, transmissions, or data storage. In most microcomputers, parallel I/O conections have 8 wires to carry 8 bits of a byte simultaneously (or in parallel). This is in contrast with a serial interface, where only one data wire is available. The 8 bits of a byte are transmitted one after another (or serially). The I/O device must collect all 8 bits for each byte.

Parallel Cable* Interface cable. Parallel Cable is an interface cable designed to hook up any Centronics-type printer to the Commodore 64. The package includes driver programs which, when executed by a SYS argument in a BASIC program, will send the output (or program listing) to the printer. The driver programs are Machine language subroutines that are POKEd into the Computer's RAM memory outside of the BASIC program area. Microware Distributors, Inc.

Parameter A definable variable in a program or system which can be used to send information to and from a subroutine or procedure. A parameter may take on various values which are used in subsequent processing by a program.

Paratrooper* You are in charge of a squadron of helicopters that must drop their load of skyjumpers behind enemy lines. In this fast-paced military games high-resolution graphics and sound add to the excitement. ComputerMat.

Parity Error detection technique that uses a one-bit indicator at the end of a word. Odd parity sets the parity bit to make the total number of bits odd. Even parity sets the parity bit to make the total number of bits even.

Parser A routine that analyzes a program instruction to set up its tree structure according to the programming language's syntax.

Parting Shots* Remove a random number of items from each of nine squares and convert what remains into fractions. For elementary students. Cassette. Micro-Ed.

Parts of Speech* Students must identify the highlighted sections of sentences. Cassette. Comm*Data Computer House.

Pascal A structured computer language descended from ALGOL 60. It has new features, such as "records" (data structure definition) and "sets." It has a well-defined

standard—the Report portion of the book, *Pascal: User Manual and Report* by Kathleen Jensen and Niklaus Wirth. It is a language suitable for a wide variety of chores, from systems to application programming. It is designed so relatively naive readers and those other than the original programmer understand the functioning of a Pascal program.

Structured languages represent a major improvement for programmers who want to predict the behavior of a program. It is much easier to understand the function of an IF...THEN...ELSE structure in Pascal than to trace GOTOs and statement labels to remote, unpredictable places. Some of the dialects of Pascal implement all the structures necessary to eliminate GOTOs. It allows for more complete structuring than FORTRAN 77 or the (semi) structured dialects of COBOL.

Pascal is strongly typed. The "type" (floating point, integer, set, record) of a variable is traced even through procedure calls, where a language like FORTRAN only checks the type through the current local routine. This helps to point out a major class of programming errors. Pascal, like other recent languages, requires the explicit definition of all variables as a guard against introducing a misspelled variable. This is otherwise difficult to spot.

The Pascal standard includes an input/output package (this is important for a language intended to be used in textbooks), but fixes the possible style of I/O.

Pointers and records give the high-level language programmer access to powerful techniques for handling complicated data structures, like linked lists and trees, formerly only available to assembly language programmers. In a language like FORTRAN these structures must be "simulated" inside an array with the structure only diagrammed in documentation or the inside of the programmer's head.

The p-System is an operating system written primarily in Pascal. The P-System is available on a wide range of computers, making programs written in Pascal more portable. See UCSD p-System and Pascal MT+.

Pascal MT+ This is a version of the Pascal programming language marketed by Digital Research, the company that brings you CP/M. It was originally developed for 8-bit computers and now works in a 16-bit environment under CP/M-86 or Concurrent CP/M. Pascal is a structured programming language developed by Niklaus Wirth in the late 60s. Although Pascal was originally developed as a teaching language, it has become popular with computer professionals as well as beginners.

Recent versions of Pascal MT+ have been enhanced with a Speed Programming Package, which adds a full-screen editor and a syntax checking program. Many simple errors can be identified and corrected before running the compiler, saving you time and effort.

Pascal MT+ includes many useful extensions to the original language definition. Byte, word, and string data types have been added along with procedures to manipulate them. Dynamic array handling and the ability to include in-line Assembly language have also been added. A modular compilation system is useful for assembling large programs with separately compiled modules.

The documentation does not try to teach you Pascal, but assumes that you will use other reference and tutorial books to learn the language. It covers differences between Pascal MT+ and other version of Pascal, as well as operational instructions on how to use Pascal MT+. Digital Research, Inc.

Pass Make information from one process or program available to another process or program. Similar to a football pass, except that one or more bytes of data replaces the football. Also, the receiver is a program. The sender may be a program or a person typing the data onto a command line to be "passed" to a program. The two most common examples would be DOS passing parameters from the command line to a program (see Relocating Loader) and a BASIC program passing variables to a subroutine.

Password Used for identification and security purposes on a computer system. Each user is assigned a specific set of alphanumeric characters to gain entrance to all or part of the computer system.

Patch For debugging or alteration of a software program, a section of code is inserted into the program which changes its control functions.

Pause For Operator to Read or Respond to Message. To freeze the screen briefly while the operator using the program reads a messae. A delay loop using a FOR...NEXT statement may be used. For example:

1000 FOR Y = 1 TO 2000 1010 NEXT Y

To freeze the screen until the operator is done with it, a dummy input statement is used. It instructs the operator to press ENTER to proceed. The input variable need not be used in the program. For example:

1000 INPUT "Press ENTER to continue";A$

Payroll See Management Accounting Systems.

Payroll Management Software See Payroll System.

Payroll System* A complete system for financial and payroll applications that will even print checks. MicroSpec.

PC See Program Counter, Personal Computer.

PE Parity Error. If the parity status bit goes to 1 in odd parity or 0 in even parity an error is produced, a flag set, and a message displayed.

Pedestrian* Be on your guard for thugs and robbers while walking through this game's park. Cassette. Luna Software.

PEEK BASIC Function. PEEK function returns the byte read from the indicated memory position. The format is:

<variable> = PEEK(<n>)

<n> is an integer in the range 0 to 65535.

The value returned is in the range 0 to 255. See also POKE.

Pennant Drive*This baseball game is played on the true-to-life screen of a baseball field. It uses real world statistical

response and involves management decisions. Players select from a roster of actual league players and the outcome is determined by real American and National League statistics. United Microware Industries.

PerfectData Head Cleaning Kit* Removes contamination from the recording heads of 8-inch or 5-¼ inch flexible disk drives. Single- or double-sided drives can be safely cleaned without assistance. Apply the cleaning solution to the lint-free cleaning disk through the cutout in the disk, and activates the drive. The cleaning solution quickly and safely loosens head contamination, and the non-abrasive disk gently buffs the head dry. Each kit provides cleaning capability for one drive for up to 6 months (26 cleanings). Innovative Computer Products.

PerfectData Micro Maintenance Kit* Provides the necessary cleaning supplies for the small business computer or personal computer. It is intended for periodic, preventive maintenance and cleaning of flexible disk drives, tape drives, CRT screens, printers, and keyboards. The kit includes a flexible disk drive head cleaning disk and special cleaning solution, CRT screen cleaner, cleaning wands, lint-free cloths, a brush, and anti-static spray to protect sensitive circuits from damage caused by static charge. An instruction book explains the use and benefits of each component and describes an effective preventive maintenance program. Innovative Computer Products.

PerfectData Type Element Cleaning Kit* A simple, practical, and inexpensive way to clean the print-wheel type elements on many of today's information-processing printers. Innovative Computer Products.

PerfectData Video Display Cleaning Kit* Recommended for cleaning terminal screens and keyboards. The kit contains two 4-ounce bottles of video display cleaning solution, a pump spray dispenser, and fifty cleaning cloths. The solution contains a static neutralizing agent which prevents build-up of electro-static charges that attract dust and dirt. The cleaning cloths included in the kit are specially designed to remove foreign particles and contaminants without scratching plastic surfaces. Innovative Computer Products.

Peripheral Any external device connected to and controlled by a computer.

Personal Computer Generally, a single user computer system which is inexpensive and can fit on a desktop.

Personal Finance* Can be used at home or by the small business to create an expense account and general ledger. Disk. Luna Software.

Personal Planning/Productivity Software See At Home Inventory; Budgeteer; Budgeter, The; Bulletin Board; Business Calender-Personalized Database; Calender My Appointments; Checkbook Manager; Cheque-Check; Color Accountant; Dear Diary; Easy Schedule 64; Family Finances; Home Budget; Home Budget/Finance; It's Travel Time; Mail List; Mailing List-Home/Business Program; Mailing List, The; Medical Records; Mini Jini; Mother's Recipes' My Credit Cards; Personality Analyzer; Super Shoppe; Tape Worm, The; TOTL Time Manager; Track My Weight; Utility Bill Saver; VIController.

Personality Analyzer* Gives you the inside track on personality, compatibility, career potential, and values. A method for analyzing yourself and those with whom you interact. Disk or Cassette. Psycom Software International.

Pet Emulator* Allows the user to run up to 90% of the available PET software on the C 64. The program emulates PET BASIC and also allows users to write PET BASIC programs on the C 64. Commodore.

Petspeed* One of the most comprehensive BASIC compilers available for the Commodore 64. Generates a Machine Coded program from a BASIC program, considerably speeding up execution. Special care is needed in handling dimensionalized variables and programs using high resolution mode. The BASIC program may have to be altered before it can be compiled. The documentation is poor, and a strong understanding of how variables are stored on the Commodore 64 is necessary to make alterations. Oxford Computer Systems.

PHA PusH Accumulator onto the stack. An Assembly language instruction for the 6510 microprocessor that places the number in the accumulator onto the stack. The stack pointer is updated but the accumulator is left unchanged. None of the flag bits are altered.

Pharaoh's Curse, The* Use all your resources to search for the treasure and avoid the evil that lurks in the tomb of the ancient mummy. Synapse.

Phase The phase is the difference between the 0 crossing point of a reference waveform and that of the measured waveform. It is measured in degrees.

Phase Locked Oscillator PLO. A circuit which is phase locked to recover data in a floppy disk drive controller. The PLO steadies the separate data and clock bits.

Phone Directory, The* Create your own phone book with instant access to any name or number. Powerbyte.

PHP PusH Processor status onto the stack. An Assembly language instruction for the 6510 microprocessor that places the contents of the status register onto the stack. The stack pointer is updated but none of the flag bits or the accumulator are altered.

PIC Priority Interrupt Controller. A chip which manages interrupts and gives vectored interrupt capability to an MPU which does not have this feature built in.

PILOT Programmed Inquiry, Learning, Or Teaching. A higher-level language available for many microcomputers including the Commodore 64. It was developed to allow creation of Computer Assisted Instructions for Beginners. It differs from BASIC in that it has single character commands. It incorporates many features, such as word manipulation and graphics, that are valuable to teachers and novice computer enthusiasts interested in learning to

design their own programs. Depending upon the version, the Pilot interpreter is available with enhanced features such as an Editor (that enables program entry), auto line-numbering, and extension commands that will aid in designing sophisticated programs.

Pinball I.Q.* Learn about division while adding lighted bumpers to a pinball Machine. Cassette. Micro-Ed.

Pin-Compatible Computer systems which have integrated circuits with leads or pins with identical functions.

PIP CP/M. PIP. Peripheral Interchange Program. PIP is available on CP/M system disk. Generally used to copy files; however, it is one of the most versatile tools available in CP/M. PIP, by definition, is a program that transfers files between two devices. Therefore, it may also be used for printing files or sending them to any other device that is capable of receiving them. See also CP/M Commands.

Pipelining Computers which get the next program instruction before finishing the last instruction, thereby increasing the speed of the processor.

Pixel A single dot of light displayed on a CRT screen. The Commodore 64 display is comprised of 64,000 pixels.

PLA PulL Accumulator from the stack. An Assembly language instruction for the 6510 microprocessor that POPs the top word of the stack and places it into the accumulator. The stack pointer is incremented and the sign flag bit and zero flag bit can be altered by the POPped word.

PLA Program Logical Array.

PLOT The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFF0, PLOT will locate the cursor in X Y coordinates (0-79 for X, 0-24 for Y) into the X and Y register. If the carry bit of the accumulator is 0 then the cursor is moved to the position determined by the X and Y register. See KERNAL.

Plotter A computer controlled mechanical device which draws images upon a screen or printer.

PLP PulL Processor status from stack. An Assembly language instruction for the 6510 microprocessor that POPs the top word of the stack and places it into the status register. The stack pointer is incremented and the sign flag bit and zero flag bit can be altered by the POPed word.

Plug-Compatible Devices or components which use the same plugs and therefore can be used interchangeably without modification within the computer system.

Pointer A data item whose contents is the address of another data item.

POKE BASIC Statement. The user may enter specific values or data into a particular memory location. POKE places a byte into a memory location. The format is:

POKE <n>,<m>

<n> must be in the range 0 to 65535. It indicates the address of the memory location where the data is to be written.

<m> is the data to be written to the specified location. It must be in the range 0 to 255.

The complementary function to POKE is PEEK. POKE and PEEK are useful for efficiently *storing data*, loading Machine language programs, and passing arguments and results to and from Machine language subroutines. BASIC does no address checking, so use caution when assigning address locations. You don't want to POKE data in BASIC's stack, BASIC's variable area, or your BASIC program.

Polling Inquiring about the status of each device according to a schedule.

POP A programming instruction where the last word is removed from the top of a stack.

Port A physical I/O connection. An address providing a connection between the computer's internal processor and an external device. Ports are used to attach input and output devices.

POS BASIC Function. Returns the present location of the cursor. Since the screen display line is 40 characters, the numbers 40 through 79 refer to the second screen line. The format is:

POS(<var>)

<var> is a dummy variable (let it be 0).

POSITION Disk Command. The POSITION command, when sent through the command channel, locates a specific record of a relative file. There can be up to 720 records in a relative file and before data can be sent between disk and buffer the specific record must be identified. Used in relative files, the format is:

OPEN 15,8,15

PRINT #15,"P"CHR$(<channel>)CHR$(<recordlow>) CHR$(<recordhigh>)CHR$(<position>)

<channel> 2-14 must be previously opened by the user. data will be moved to and from disks through it.

<recordlow> is the least significant part of the address of the record within the relative file. Since there are 720 possible records, two bytes are required to specify a location.

<recordhigh> is the most significant part of the address of the record within the relative file.

<position> is the byte within the record from 0 to the maximum specified in the open statement.

Positive Logic Voltage level "most positive" in the computer system is the true level; the false level is the voltage level closest to zero.

Postfix Notation system where the operator follows the manipulation symbols used in the program.

Potato Factory* Teaches number bases through a potato distribution business. The loading and shipping of the inventory offers a fast paced way for the student to get

practice working with base ten. For elementary students. Disk or cassette. Microcomputer Workshops.

Power Down The steps a computer takes to preserve the state of the processor and to prevent damage to it or to connected peripherals when the power fails or is shut off.

Power On Turn the power switch to the ON position or otherwise supply electric current to a device.

Power Supply Converts the voltage from the electrical supply to the voltages which the computer elements use.

Power and Supplies and Protectors* See Grizzly, The; Powermaster, The.

Power Up The steps taken by a computer processor when the power is turned on or restored after a power failure. The processor and peripherals are initialized so that program execution may be started.

Power-Fail Restart Detects a drop in the voltage and signals the processor. The processor has several milliseconds to preserve the registers in a battery backup memory, allowing automatic resumption of processing when the power is restored.

Powerfile* A series of programs on the system disk that collectively function as a database filing system. Several sample files are included in the system disk that teach the report writer and file calculation features of Powerfile. The system package comes with an easy-to-follow manual that includes a tutorial for creating and manipulating records, and a glossary to familiarize the user with the terms used in database systems. The main program is menu-driven and it uses the special Commodore function keys to access the options. Uses random files to store and retrieve records. Each record may have up to twenty fields and each field may contain up to seventy-nine characters. The maximum size of each record is 254 characters. In the Direct File Maintenance mode of the program, the user may Add, Change, Delete, Browse, and Copy records. The Report Writer program allows creation of user-formatted hardcopy of the records in a specific file. A special program is available for generating mailing labels. For printing reports, records may be selected by specified fields. Pattern matching is available for each field for searching for specified character strings. The manual includes a section on the advanced features of Powerfile such as file calculations, restructuring, creating sequential files, and linking the Powerfile to other software. Helpful hints are also included to guide inexperienced users through the various error messages generated by the system. City Software.

Powermaster, The* A mobile power supply for your computer that plugs into the cigarette lighter of your automobile. Random Access Marketing.

Practical Applications* A "How To Do It" book with suggestions and ideas on how to make money with your system. Practical Applications.

PractiCalc* Prepare budgets and projections for your business with this financial program. Features include file search, category alphabetizing, graph creation, and other investment and inventory applications. Computer Software Associates.

Predictor—Linear Regression, The* Do analysis, predictions, and model building for many situations using the techniques offered in this package. Disk; printer required. Powerbyte.

Prefixes* Match prefixes to the correct incomplete word. The prefixes used are in, con, com, im, ex, en, and re. The student's performance is rated at the end of each lesson. For elementary students. Cassette. Micro-Ed.

Pre-Fractions Math Package* A series of micro-ed math programs collected and reduced in price, including Backfire and Fat Chance. Cassette. Micro-Ed.

Pre-processor Program or mechanical device which prepares data for further processing.

Present Value* Useful program for making daily financial decisions and calculations. Disk; printer required. Powerbyte.

Presidents* Eight players receive clues to guess the letters in a President's name. Correct answers not only receive points but another chance to guess. For ages seven through ten. Cassette. Comm*Data Computer House.

Prime Fishin'* Assists students with prime and composite numbers in a form that is as much fun as going fishing. Cassette. Micro-Ed.

Prime Number* Using a grid of digits, elementary students decide whether a number chosen by the computer is composite or prime. A review is provided at the end of the lesson. Cassette. Micro-Ed.

PRINT BASIC Statement. Displays data on the screen. The format is:

PRINT <list of expressions>[;] or ?<list of expressions>[;]

<list of expressions> is a list of numeric and/or string expressions, separated by commas, blanks, or semicolons. You must enclose any string constants in the list in quotation marks.

A PRINT statement alone will display a blank line. The question mark (?) may be used as shorthand for PRINT.

The punctuation in the <list of expressions> determines the spacing of the printed items. BASIC divides the screen line into zones of 10 spaces each. In the <list of expressions>, a comma will cause the next item to be printed starting in the first space of the next zone. A semicolon (;) causes the next value to be printed immediately after the last value. Placing one or more spaces between expressions is the same as typing a semicolon between them.

If a comma, semicolon, SPC, or TAB function ends the list of expressions, the following PRINT statement begins printing on the same line, spacing accordingly. If *the list of* expressions ends without a comma, semicolon, SPC, or TAB function, a carriage return is performed at the end of the line and the cursor is moved to the beginning of the next line.

If the length of the value to be printed is more than the number of character positions remaining on the current line, then the value will be printed at the beginning of the next line.

Printed numbers are followed by a space. Positive numbers have a space in front of them and negative numbers have a minus sign in front of them.

PRINT# BASIC. Used to write data to previously opened files. The number with the PRINT# command is used to reference that file. Information being written to a file needs some sort of separation on file so that when it is read it comes off the file in the desired format. When the PRINT# command is used with variables, the variables must be separated either with comma, semicolon, or carrage return. The format is:

```
10 OPEN <num>[<dev>]
20 A$=",":B=27.3:C%=7:D$="TERRY"
30 PRINT#<num>,BA$C%A$D$
```

<num> is an arbitrary number 1 to 127 used to reference the opened file.

<dev> refers to the device. (Note: In disk files on the 1541, opening files requires special treatment.) See OPEN.

Print Lines Spacing in BASIC. To get one or more spaces between fields printed by the BASIC programs, a literal of spaces like " " is used. To get several spaces between the printed values of A$ and B$ use BASIC statement:

```
PRINT A$" ";B$
```

See also Print Zones, SPC, TAB (BASIC Functions).

Print Zone To leave space on the print line between items, put an extra comma (,,) in the print listing. Enter BASIC statement:

```
PRINT A,,B
```

This would print A in print zone 1, nothing in print zone 2, and put B in print zone 3 (col 29).

Print Zones Each group of 10 spaces across the print line is called a print zone. A comma (,) in a PRINT list of items to be printed means, "Start printing the following item at the start of the next print zone." A semi-colon (;) means the next item is to print immediatly after this one, without even a single space between. The print zones begin in columns 1, 10, 20, 30, 40, 50, 60, 70. See also Print Lines.

Printer—Commodore 1525* An impact dot matrix printer that connects directly to the VIC or Commodore 64. It has a 6 x 7 dot matrix and upper and lower case characters without true descenders. It prints unidirectionally, up to 80 columns at 30 cps. It prints 10 characters per inch, or in expanded mode, 5 characters per inch with either 6 lines per inch in character mode or 9 lines per inch in graphics mode. The 1525 uses a tractor paper feed system. The chief advantage is its ability to produce the entire PET graphic character set without any special software.

It contains a 90-byte buffer. In the graphics mode, the user can define special characters. The line and character sizes as well as other modes can be changed by sending specific escape sequences in the form:

PRINT#4, CHR$(<number>)

The following numbers will set the printer to the appropriate mode:

Graphic Mode	8
Line Feed After Printing	10
Return	13
Double Width Character Mode	14
Standard Character Mode	15
Tab Setting	16
Enter Cursor Down Mode	17
Reverse Field On	18
Repeat Graphics Selected	26
Specify Dot Address (must follow Print Head Tab Code)	27
Cursor Up Mode	145
Reverse Field Off	146

Using the printers requires opening a channel to it in the format:

```
OPEN<num#>,<dev#>[,<st#>]
```

<num#> is an arbitrary number 1 to 127 used to reference PRINT# statements.

<dev#> is the device number, set to 4 for the 1525.

<st#> is 0 (cursor up mode) for upper case and some graphic characters and 7 (cursor down) for upper and lower case letters.

Printer Buffer Stores data from the computer in its memory and, when the memory is full, sends the data to the printer or modem. See also Buffer, Printer Interfaces.

Printer Interfaces See Buffered Parallel Cable and Driven; Universal Parallel Interface.

Printers See Comstar F/T Super-10" Printer; Deluxe Comstar F/T Printer; STX-80 Printer, Gemini 10x Printer.

Priority Assigned to sprites (q.v.) to organize the order of their appearance. When sprites encounter each other on the screen, the one with the highest priority will appear in front of the other. Sprite 0 has the highest priority and sprite 7 has the lowest.

Probe An electrical device which, by touching a circuit point, allows a test meter to test the circuit's connection and power.

Procedure Part of a structured program which enhances its readability or reliability. The procedure is a separate function of the program and could be incorporated into a subroutine.

Profit Sharing Plan* Helps businesses with pension and other group financial plans. A social security option is available. Disk; printer required. Powerbyte.

Program A sequence of instructions which specify a process for manipulating data. Programs are written in many languages which have level ratings according to how much additional work the processor must do before the program are executed. BASIC is a high level language which requires that all programs be run through a compiler

or interpreter. A mid-range language is an Assembler or Assembly language which is closer to the binary code of the computer, but still needs some processing through an Assembler before execution. The lowest level are programs written in binary or hexadecimal code which are directly executable by the microprocessor. Before Assemblers were developed, all programs were written in binary code.

Program—Line In the program mode, the Commodore 64 saves each BASIC line in RAM. Each line is stored with the line number (entered by the user), a link pointer (points to the next line of BASIC), tokenized BASIC commands (each BASIC command is converted to a two character representation), and the data entered with the BASIC commands. In addition to this, a zero is used between each BASIC line and two zeros at the end of the program.

Program—Mode BASIC commands can be executed in one of two ways: either in direct mode or program mode. In program mode, a line number must precede the instruction. When the user enters the carriage return after entering a BASIC line, the line is stored in RAM. In program mode the microprocessor begins executing the program lines sequentially after the user enters the RUN command and a carriage return.

Program—Source, Object, Executable, Command All programs that are directly executable on the Commodore 64 are Machine language programs written in the numeric instruction code of the Commodore 64's 6510 micro computer chip. Most were orginally written by a programmer as text files, known as source programs. The source program contains readable statements in a language such as BASIC. These were then translated by a compiler program, producing an object program.

The object program contains the Machine language instructions for the Commodore 64's 6510, which correspond to the instructions of the original source program. BASIC programs work in this way with a BASIC compiler.

Regular BASIC works in a slightly different way. Regular BASIC is a program (in Machine language) which uses your BASIC program as a guide to what it should do. It is therefore an interpreter, processing each line of your source program and interpreting what should be done. Since it must reinterpret your source program each time you run it, interpreted BASIC can be as much as 100 times slower than compiled BASIC.

When you write a BASIC program, you have produced a source program in text form. The BASIC interpreter, itself a Machine language program, uses your source program as data—a source of instructions or commands to control its execution.

To speed up a BASIC source program by compiling it into a faster Machine language program, you will need a BASIC compiler. The Commodore 64 does not come with a compiler, but they are available from Commodore and various other software houses.

Program—Version or Release. Programs and software packages are changed from time to time to correct errors or add new capabilities. To keep them from being in a constant state of flux and to simplify distribution of modified programs to users, a number of changes are made, tested, and packaged as a new version or release of the program.

Versions or Releases are typically numbered:1.0 for the first version, 1.1 for the first minor revision, 1.2 for the second minor revision, etc. When a major change or large number of minor changes have been made, a new number is assigned, making Version 2.0.

Program, Object The Machine language instructions which result from translation of a source program by a compiler or Assembler.

Program Counter A register which holds in memory the address in memory of the next instruction to be executed. The counter is incremented each time an instruction is executed. The counter can be modified through subroutines or calls so that the next instruction executed is not the next one in the program.

Program Development Aids See Bonus Pack; C 64; Chartpak 64; Copymaker; CW Morse; Develop—64; Disk Data Manager; EasyCalc 64; EasyFile; File Writer/File Reader; fulFORTH; Game Program Development Kit; Gortek and the Microchips; Ham Antennas; Letter Mite; List Mite 2; Tape Geni, The; Ultrabasic 64.

Program File Any program created in BASIC in the program mode is saved onto disk as a program file. A program file on disk has with it the location in Commodore 64 memory where it came from and can be returned to that specific location using the load instruction with a 1 in the address argument. The program file is saved on disk one block at a time with the first two bytes of each block pointing to the track and sector of the next block used. Program files are labeled as PRG files in the directory.

Program Integrity Ensuring that programs (or data) cannot be altered improperly. For example, in a payroll system, steps must be taken to insure that employees can not tamper with their pay rates or hours worked. Data security consists of guaranteeing both data integrity and data secrecy or privacy.

Program Lines Listing To display all program lines enter:

LIST

To display program lines from start up to line 100 enter:
LIST -100

To display program lines from line 100 to end enter:
LIST 100-

To display program lines from line 100 to line 200 enter:
LIST 100-200

To display program line 100 only enter:
LIST 100

To freeze the list while it is being displayed so you can read it, press Run/Stop. To slow the display hold CTRL down.

Programmable Characters Usually the data required to form the image of a character on the screen is brought from the character generator. This is a list of values that define each character. With the Commodore 64 you can define your character in RAM memory and instruct the computer to look to RAM instead of to the generator when a key is pressed. In this manner you can create your own characters.

Programmers Reference Guide* Directed at users who already have a firm understanding of the BASIC commands on the Commodore 64. It comprehensively explains each of the BASIC commands and explains fully how variables are stored. Inludes a less comprehensive discussion of Machine Code instructions and how to execute Machine Code routines. There is some discussion of the user's port and setting up the RS-232 channel as well as using KERNAL subroutines. The reference guide expands on how to use sprites and set the system up for high resolution mode graphics. It discusses memory management and explains, in some detail, the locations of important memory maps like screen memory, color memory, sprite, sound and character memory. Commodore Business Machines, Inc. and Howard W. Sams & Co., Inc.

Programming Language A set of rules specifying a language that can be translated into Machine language and cause the computer to carry out functions.

Programming Languages* See Assembly, BASIC, C, COBOL, FORTARN, Pascal.

Programming Utilities See Assembler64, Assembly Language Debugger; Commodore Pilot 64, Compak, Introduction to BASIC I, KMMM Pascal, LOGO, Simon's BASIC, Tiny BASIC Compiler, Vanilla PILOT.

PROM Programmable Read-Only Memory. ROM which can be modified by the user.

PROM Programmer An external device or module used to write user modified ROMs. The programmer may input data through a hex keyboard, binary paper tape, or directly through the micro-processing unit.

Prompt In general, a prompt is a visual signal from a program to "prompt" the operator to do something. Hopefully, the prompt gives some clue as to what the program requires (or allows) the operator to do in response.

Propagate To go from one component in the computer system to another.

Promqueen/64 A ROM software development system which inserts into the expansion port and includes the software necessary for entering and editing Machine Code instructions from the keyboard. You can copy a program from memory onto EPROMs that insert into the Promqueen. Once copied to an EPROM the program no longer must be loaded from cassette or disk. You can insert your "home made" cartridge and run the program without the delay of loading the program from external memory, because of an autoload feature. EPROMs can be purchased separately. The documentation presumes an understanding of memory management of the Commodore 64, but is thorough in its explanations and descriptions. Gloucester Computer Co., Inc.

Propagation Delay The time the processor takes to pass a signal through one device on the system to another.

Proportional Spacing Where the printer allocates horizontal space according to each character's width rather than having a standard width space for all characters. Proportional spacing is more readable than fixed-width type, and appears to be typeset. This is not to be confused with justified type, where spacing is manipulated to produce a flush (even) right margin.

Protected field Some data entry screens have reserved areas that cannot be modified by the user with keyboard entry.

Protector II* Your planet is in danger and a long and difficult conflict is all that can save your people. Synapse.

Pseudo-Instruction A user-defined directive which is interpreted by the assembler as one or more instructions.

Pseudo-Operation (Pseudo-Op) An operation code recognized by an Assembler, but not corresponding to any Machine language instruction. Examples are ORG, which specifies where a program will reside in memory, and SKIP, which specifies a new page in the listing of the program.

PSW Program Status Word. Contains the zero flag, carry flag, and other information relevant to the processor.

Public Domain Programs There are hundreds of programs available in the public domain. The programs are not copyrighted—you can freely copy them and share them with your friends. In most cases these programs have been placed into the public domain, sometimes anonymously, sometimes with the author's name attached. In some cases, the author requests that anyone who finds the program useful send him a "donation" to help pay the costs of development and to finance development of new or improved software. With public domain software, you get a chance to try out the programs extensively without making a commitment to buy. The prices tend to be much lower than commercial software. We urge you to help keep the idea of donation-supported software alive. If you find such a program useful, please send the suggested contribution to the authors, and urge your friends to do the same!

Some of the public domain programs have extensive and excellent documentation. The source code is provided for many of the programs, so you can customize them to suit your needs or preferences. You may encounter a bug in one of the public domain programs. If it is donation-supported, contact the author. Otherwise, you're on your own. Most public domain programs are offered "as is"— if you encounter bugs, it's up to you to fix them.

Pulse A square or gaussian-shaped voltage or current which lasts a short period of time.

Pulser A circuit which, while being tested, delivers a high current signal of short duration.

Pumping Iron* Lift more and more weights as you determine the correct answers in this subtraction program. Recommended for elementary students. Cassette. Micro-Ed.

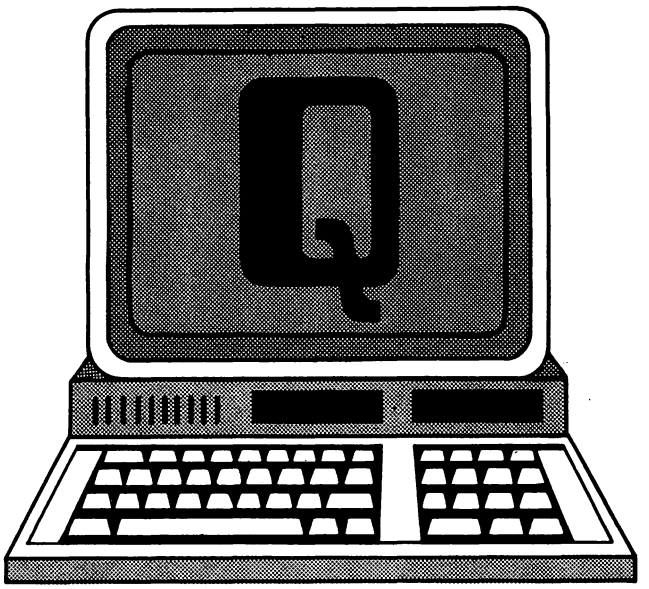
Punctuation Series* Uses sample sentences to cover seven punctuation rules. Answers and explanations are given when students make corrections. Eight programs available. Recommended for elementary school students and up. Cassette. Micro-Ed.

PUSH An assembler instruction used to put a word on the top of a stack.

Pushdown List See Stack.

Putting Fiction Books in Alphabetical Order* Two groups of fiction book names are presented and must be arranged according to a set of sequential rules. Recommended for elementary children. Cassette. MicroEd.

Pyramid* Find the ancient treasure by discovering hidden clues. Cassette. Aardvark.



Q Codes. ASCII = 81, CBM ASCII = 81 or 209, HEX = 51. q—ASCII = 113, CBM ASCII = 81, HEX 71. Screen code = 17 or 81. See CBM ASCII.

Q Register used as an accumulator extension for efficient multiply-divide operations. Usually not found in earlier 8-bit CPUs, which had a combined A register/Q register. Newer 8-bit and 16-bit CPUs usually have a larger set of general purpose registers.

Quad Involving four entities, or a multiple of four.

Quest* You must build an army to search for adventure in this long game. Cassette. Aardvark.

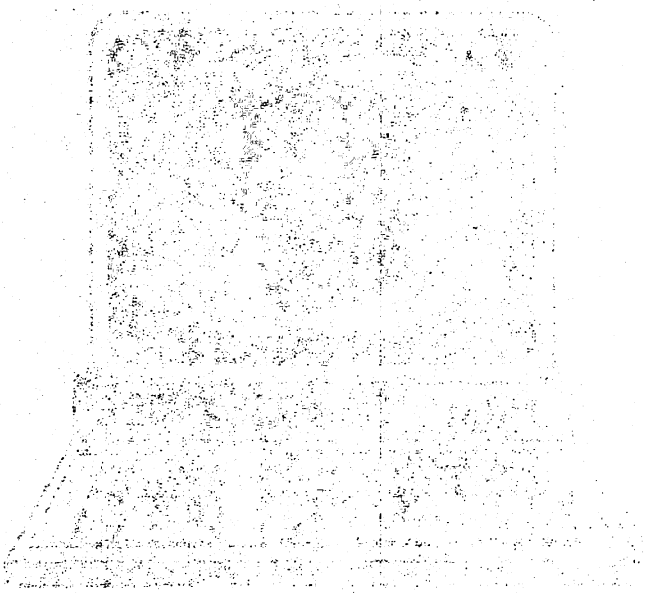
Queue A data structure which contains data or tasks waiting to be processed.

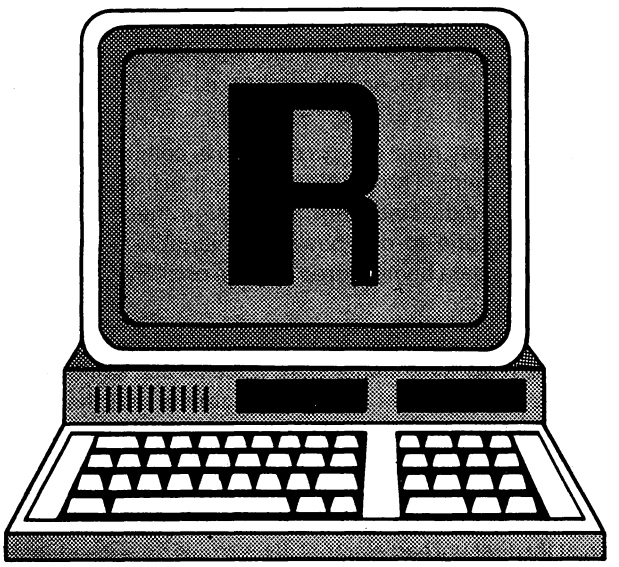
Quick Brown Fox* The Quick Brown Fox is an easy-to-use word processor for the Commodore 64. The manual has an uncomplicated format and step by step training exercises to familiarize the user with word processing. It also points out a few idiosyncracies associated with the hardware. This is aimed at the inexperienced user who might find such problems baffling. The package comes with documentation and plug-in cartridges for both the Vic-20 and the Commodore 64 computers. A demonstration tape is enclosed which contains sample text files. These provide examples of the forms of text that can be created by the Quick Brown Fox. The text entering/editing mode is greatly simplified: a welcome feature for many beginners but tedious for those interested in advanced word processing. For example, the text entering mode is separate from the text edit mode. While entering text, only the previous characters on the same line can be edited. Only in Edit mode can you go to another line and insert or delete characters. Various print and Disk functions are also under strict program control. Quick Brown Fox supports a variety of printers and print formats, and is good for someone unfamiliar with computers and/or word processing. Quick Brown Fox.

Quick Chart* Creates and edits quality data bar-charts. Allows other features such as automatic scaling and specific naming, editing, and reediting values. Disk or cassette. Abacus Software.

QUIP QUad-In-line Package. An integrated circuit package with two rows of pins on each side. It is much smaller than a comparable dual in-line package.

Qwerty The traditional typewriter keyboard layout, in which the keys for those six letters appear in that order in one of the rows.





R Codes. ASCII = 82, CBM ASCII = 82 or 210, HEX = 52. r—ASCII = 114, CBM ASCII = 82, HEX = 72. Screen code = 18 or 82. See CBM ASCII.

R Reset. Also Register, Request, Ring Indicator.

Rack Mountable Describes equipment packaged for installation in a metal cabinet called a rack.

Radar Rat Race* You play the rat and must collect all the cheese while avoiding cats and other rats pursuing you down the corridors. Commodore.

Radiation Hardening A quality assurance process used in the production of integrated circuits to select circuits which are better able to withstand radiation.

Ragged Margin Not justified. See Justify.

RALU Register equipped Arithmetic Logic Units. A bit-slice ancestor produced by National Semiconductor.

RAM Random Access Memory. Memory is any device which can store information and allow it to be retrieved when needed. The Commodore 64 relies primarily on random access memory, Read Only Memory (ROM), disks, and cassettes. The term memory by itself is usually a reference to RAM.

RAM is generally made up of a silicon chip consisting of miniaturized circuits. These circuits are composed of electronic gating structures that behave like transistors and are capable of holding a charge. When the voltage is set at the structure and then looked at later it will still have the charge. In this fashion a RAM chip can serve as a memory device. RAM chips are often referred to by the number of bytes (separate charges) that they can hold—such as a 16K RAM chip that would hold over 16,000. Since RAM relies on voltage to maintain the charges, turning the Commodore 64 off will result in a loss of all memory in RAM.

RAM has the advantage of being programmable (the user can enter and change values in RAM).

RAM Disk A block of RAM memory used by a program to simulate a disk drive. The program must modify or intercept all I/O to the "fictitious" drive and redirect it to the RAM memory. The RAM disk will have its own drive letter and appear in every way like a real disk except that it is much faster.

RAM Memory Card A card containing RAM memory to expand the computer's main memory.

RAM Pack A package containing expansion RAM to mount external to the computer. If mounted inside the computer housing, it would be called a RAM card.

RAMTAS The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL and is used to handle input/output operations. By jumping to address $FF87, RAMTAS tests RAM, sets the top and bottom of memory, clears address $0000 to $0101, clears $0200 to $03FF, allocates memory for the cassette buffer, and sets the screen base to $0400.

Random Access An access method where each data item can be retrieved directly by an address computed from the data.

Random File Disk Drive. A type of disk file in which blocks of data are stored and recalled by drive, track, and sector number. Random files are not given names and essentially are hidden on the disk. The user must keep a record of the track and sector number of data being stored on the disk (often by using a sequential file). Only the Block Availability Map (BAM) has a record of blocks used, and there is no way to know which block is being used by which file.

One can access a block of data within a Random file directly without having to first access the blocks that were written before it. This is much faster and more efficient than accessing information sequentially.

To use a random file safely you must determine which blocks are free to use, or an error message #65 (no blocks) will be displayed. The command channel will also give the next available block.

Once a free block is found, the Block Write command can be used to transfer a block of data from the data channel to the disk.

The format for opening a Random File is:

OPEN <lfn>,<dev#>,<ch#>,"<buf>"

<lfn> is a logical file number arbitrarily assigned by the user. Its value must lie between 1-255.

<dev#> is the device number of disk drive, usually 8.

<ch#> is the channel number (2-14) assigned by user which serves as a buffer. Data is actually written and read from this buffer and moved one block at a time to and from the disk with disk commands. The symbol lets the disk assign a buffer number.

<buf> is the buffer number.

See Block Read, Block Write, Block Allocate, Block Free, Buffer Pointer.

Random Number BASIC. See RND.

Randomize Basic Function. Creates a random floating point number between 0.0 and 1.0 The random number is created by performing a series of operations on a starting number that was created when the system is first powered up. The starting number generated is called a seed and is not directly related to the argument assigned by the user. If the argument is positive the same pseudorandom sequence of numbers is generated each time. If the argument is 0 the random number is generated from the system's internal clock and if the argument is negative a new seed is used to generate a random number each time. The format is:

RND (<num>)

<num> is a dummy number. If this number is negative, a new seed is used to generate a new random number each time the function is called.

Rapidwriter* A word processing program with all the standard features. Disk; printer required. H.D. Manufacturer.

RAS Row Address Strobe. A signal used in dynamic RAMs to reduce the pin count by multiplexing the address.

Raster Register The electron beam of a CRT moves across each row, down a row, and scans again across the next row. It continues this process until the entire screen is displayed. The position of the beam is reflected in a number called the raster count. The raster register can be PEEKed to find the last 8 bits of the raster count. The raster register can be written to with a POKE in order to generate an interrupt when the raster count equals the value on the register.

Raster Scan A standard TV display technique where an image is built from aggregates of dots of varying brightness.

Ratios* Conversion of numeric data to percentages is simplified through this utility program. Disk; printer required. Powerbyte.

R-C Resistor-Capacitor. A circuit connected to an oscillator to define its oscillating frequency. For stable frequencies, a crystal is required.

RD Received Data (RS-232C standard).

RDE Received Data Enable. A status flag in a UART.

RDTIM The name of a machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFDE, RDTIM reads the system clock. Three bytes from the system clock are moved into the accumulator, the X register, and the Y register, sequentially. See KERNAL.

RDY A control signal used with slow memory or devices to indicate valid data is available.

READ BASIC Statement. Reads values from a DATA statement and assigns them to variables. The format is:

READ <variable>[,<variable>...]

<variable> is a numeric or string variable or an array element which is to receive the value read from the DATA table.

A READ statement must always be used in conjunction with a DATA statement. The READ statement will take values read from the data statement and assign them to READ variables on a one-to-one basis. The variable types must agree with the data being stored in them or a "Syntax error" will occur.

One READ statement may access several data statements or several read statements may access the same data statement. If the amount of data available is less than the number of variables allocated for the data, an "Out of data" error occurs. If the number of variables in the READ statements is less than the amount of data items, subsequent READ statements may be used and reading will begin at the first unread element. If there are no subsequent READ statements, the extra data is ignored. Data can be reread using the RESTORE statement. See RESTORE.

READ—Input Data into Memory Data in internal RAM is immediately available to programs for processing. Data in external memory must be copied into internal memory (GET or INPUT), processed, then copied back out to external memory (PRINT).

If data has been created, it can be written out to external memory without a READ first. If data read in from external memory has not been modified, there is no need to write it back out since the original copy is still there.

Read Character from Keyboard BASIC. See INPUT, GET.

Read Data from File BASIC. See GET#.

Read Error An error message from the 1541 drive incurred when the drive is unable to read data on the disk correctly. The 1541 drive is capable of being more specific by reading the error channel (#15) and decoding the error number. The following numbers correspond to the particular error.

20 The disk drive is unable to find the header of a block due to an illegal sector number or corrupted data.

21 The disk drive finds the beginning of a sector by reading a synchronization mark at the beginning. This message appears if the drive can't find that sync mark. It can result from not having formatted the disk (using NEW command) or if the disk is absent or not seated properly. Hardware failures can also give this message.

22 If the disk drive has been given a BLOCK command using random files and the block cannot be found, this number appears on the error channel. The user may have tried to read or verify a track or sector number that does not exist.

23 The disk drive has a method of verifying data as it is read from the disk using a checksum. This message indicates corrupted data or a hardware problem.

24 If a byte read from disk reveals an invalid bit pattern, this error will develop. It can be from a hardware problem.

27 The disk drive has a method of verifying the header information as it is read from disk using a checksum. If there is an error in the header, this message may appear. It can also result from hardware failures.

READST The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFB7, READST moves the contents of the status register into the accumulator. This routine is usually used after an I/O routine to check for any errors. See KERNAL.

Read/Write Describes the nature of an operation, i.e., the direction of data flow.

Real-Time An action or system capable of working at a speed that keeps pace with the occurrence of an actual process.

Real-Time Operating System An operating system capable of real-time task management, including event scheduling, interrupt management, and real-time event counters.

Reasonableness Test A test to determine whether the value of a variable falls within a bracket defined as reasonable. It is used to detect and filter noisy inputs or erroneous outputs.

Record A unit of information, either read, written, or stored, such as a punched card, a disk sector, or a line of characters.

Record Not Present An error message from the 1541 disk drive incurred when the user attempts to INPUT# or GET# data beyond the last record in a file. It can also occur if the user attempts to use the position commands beyond the last record of a relative file.

Rectangular Waveform A rectangular waveform consists primarily of odd harmonics (like the Triangular waveform), but the proportion of the harmonics is reciprocal of the harmonic number. For example, the third harmonic is only 1/3 as loud. See also Harmonic.

Recursive A function, routine, or procedure which calls itself.

REDIM'D Array An error message indicating that an attempt has been made to use the same variable to dimensionalize two arrays. If a variable is used in a program before it is dimensionalized, the computer automatically gives it a dimension of 10. If the program then attempts to dimensionalize the array, the error message will appear. It is best to use the DIM statements in the beginning of a program.

REDO FROM START An error message from the Commodore 64 encountered when user enters string data into an INPUT when the computer was expecting numeric data. If in a program the statement reads INPUT A, the program will prompt for input. If the user enters a word at this point the error message will appear (A is a floating point variable). The user can re-enter the correct input, and the program execution will continue normally.

Reducing Fractions* You battle the computer in an attempt to shrink fractions to their lowest level. Cassette. Comm*Data Computer House.

Redundancy Using more than one of the same item to increase reliability or performance.

Reentrant Programs or routines written in reentrant code. This code can be used by several tasks concurrently.

Reentrant Code A single segment of code and data which is not modified during execution, so that it may be called by multiple programs.

Refresh The logic necessary to rewrite the contents of the dynamic RAM periodically—typically every 1 millisecond (ms).

Refresh Circuitry Electronic circuitry which periodically reads and rewrites the contents of dynamic memory to prevent loss of data. See Dynamic Memory.

Register One word of memory, usually implemented in fast flip-flops, directly accessible to a processor. Most central processing units include a set of internal registers which can be accessed much faster than the main memory.

Register Select One or more lines used to select one register out of a given number within a device. Register select pins are normally connected to the address bus.

Relative Addressing Desired information is located in memory by adding a displacement to a pointer. Addresses are expressed relative to some base address or pointer.

Relative Files Disk file. A type of disk file that allows you to access blocks of information directly. They are similar to random files, but you can alter the record length and name the file. In opening the relative file you assign the record length (up to 255 characters). There can be up to 720 records per file and each record has a position relative to the beginning. This position is assigned using the POSITION command and is in a two-byte format. The format for opening a relative file is:

OPEN <lfn>,[<dev#>],[<ch#>],["<name>,L,"],+<CHR$(<n>)

<lfn> is a logical file number assigned by user and referenced when writing or reading from file.

<dev#> is the device number of disk drive, usually 8.

<ch#> is the channel number from 2-14, assigned by user, serves as buffer for data being moved between disk and program.

<name> is assigned by user for file.

<n> is the number from 1-255 assigned by user to determine length of record.

See POSITION.

Release An edition of a software package. Programs and software packages are changed from time to time to correct errors or add new capabilities. To keep programs from being in a constant state of flux, and to simplify distributing

modified programs to users, a number of changes are made, tested, and packaged as a new version or release of the program.

Release—Sound The time a note takes to go from sustain level to zero level (silence). See Sustain Sound.

Relocatable The load module or object form of a program or routine which does not contain fixed addresses or which is structured so that it can be "relocated" and executed anywhere in the memory.

Relocating Loader Machine Coded programs which can work in any part of memory are relocatable. Most Machine Codes can't do this because the program references specific addresses. A locatable loader goes through the program and changes the relevant addresses so the program can be placed anywhere in RAM.

Rem A unit of radiation.

REM BASIC Statement. REM is used to insert remarks in programs. The format is:

REM <remark>

<remark> can be any string of characters.

REM statements are nonexecutable statements, but are output exactly as entered when the program is listed. However, they do take up extra memory space and slow execution time. REM statements may be branched into by using GOTO or GOSUB statements. Execution continues with the first executable statement after the REM statement.

The remark, if placed at the end of a statement, must be the last entry on that line.

REM functions differently in Compiler BASIC—For more information see your Compiler Manual.

Remember* A game of memory and concentration for four children. Four levels of difficulty. Recommended for second to sixth graders. Cassette. Comm*Data Computer House.

Removable Media for Recording Information Physical devices for recording information which can be removed from the system, such as cassette and disk. The main medium for Commodore 64 is disk, but cassette, and nonremovable media such as RAM and ROM are also used.

Media classifications are:

a) removable media—disks, cassettes and some hard disks, or

b) fixed media—most hard disks. Fixed media are not removable from the device that drives them, so there is no ability to store additional data or backup copies off-line (outside the computing system) for insertion when needed. See also Memory.

REN CP/M. Command used to REName disk files. The format is:

REN<new filename><old filename>

See also CP/M Commands.

RENAME Disk Command. The RENAME command, when sent through the command channel, changes the name of a file in the disk directory. The format is:

OPEN15,8,15
PRINT#15,"RENAME0:<newname><oldname>"

<newname> is the new name of file arbitarily assigned by the user.

<oldname> is the name of the file being changed.

RES RESet signal. An input line into the 6510 microprocessor that STARTS the microprocessor from a power down condition. Memory is retained on BASIC RAM.

Research Assistant 2.0* This filing system is for students writing reports and theses. The program disk comes with a "build" program that creates, updates and prints files and a "cross reference build" program that is used to build a cross reference file using keywords and dates. The programs are written in BASIC and use sequential files to store and retrieve records—features that considerably slow the entering/editing and printing function (in other words the overall performance of the system as an effective, time-efficient record-keeping system). The program is menu-driven and has options to support a variety of printers. The report format for the printer is built into the program and therefore limits its application as a good general purpose database. TOTL Software, Inc.

Reserved Device Numbers The Commodore 64 has assigned certain numbers to specific devices. The numbers must be used when opening a channel to the device. The printer is device 4, the cassette device 1, the screen device 0. A single 1541 disk drive is device 8. If more than one 1541 is used, it is necessary to change the device number of the second drive.

Reserved Words BASIC. Reserved words have particular meanings in BASIC and are used for commands, statements, functions, and operator names. These words cannot be used as variable names, and variable names cannot be reserved words followed by a type declaration character ($, %).

The reserved words are separated with space or spaces around them so that they are easily recognized by BASIC. If you accidentally use one of the reserved words, you may see an error message or have strange results when you execute the program.

The following are reserved words in BASIC for the Commodore 64:

ABS	AND	ASC
ATN	CHR	CLOSE
CLR	CMD	CONT
COS	DATA	DEF
DIM	END	EXP
FN	FOR	FRE
GET	GET#	GOSUB
GOTO	IF	INPUT
INPUT#	INT	LEFT
LET	LEN	LIST
LOAD	LOG	MID

NEW	NEXT	NOT
ON	OPEN	OR
PEEK	POKE	POS
PRINT	PRINT#	READ
REM	RESTORE	RETURN
RIGHT$	RND	RUN
SAVE	SIN	SGN
SPC	SQR	STATUS
STEP	STOP	STR
SYS	TAB	TAN
THEN	TIME	TIME
TO	USR	VAL
VERIFY	WAIT	

Reset To return to zero, or to some arbitrarily selected beginning point. Powering on the Commodore 64 performs a reset.

Reside Be recorded in. A program may reside on adisk or in memory (RAM or ROM).

Resident Software A program which resides in the main memory of the system.

Restart To restart a program after it has been stopped with the run/stop key, hit Shift run/stop or enter CONT and hit carriage return.

RESTOR The name of a Machine language subroutine within the operating system of the Commodore 64. It is part of a group of subroutines referred to as the KERNAL to handle input/output operations. By jumping to address $FFBA, RESTOR restores the default values of system vectors used in BASIC and KERNAL routines. See KERNAL, ST.

RESTORE BASIC Statement. RESTORE lets you reread DATA statements. Following the execution of the RESTORE statement, the next READ statement reads the first item in the first DATA statement in the program.

Restore Key The Restore key, pressed in conjunction with the RUN/STOP key, will halt execution of the program, clear the screen, and return the system to its original state (warm start). It does not alter a program already in memory.

Retrofit To improve or change software or hardware by making additions.

RETURN BASIC Statement. Brings you back from a subroutine. Used in conjunction with the GOSUB statement. See also GOSUB and RETURN.

Return Key Pressing the return key returns the cursor to the left edge of the screen and moves it down one line. In the direct mode (without program line number) a return sends the entire line to the interpreter where it is translated into Machine Code and executed immediately. In the program mode the return tokenizes each of the BASIC commands, sets up link pointers, and moves the line into BASIC RAM. Pressing RETURN while the cursor is on a line that contains a BASIC command, regardless of where the cursor is, enters that line. If there is a program line number with no commands following it, a RETURN on that line will erase any line in the program that has that number. In this way program lines can be deleted from a program. The RETURN can be executed in a program using:

PRINT CHR$ (13).

Return Without GOSUB An error message from the Commodore 64 encountered when a program reads a RETURN statement and has no GOSUB to return to.

Reverse Video The ability of some CRT terminals to display dark characters on a light background as opposed to the standard light on dark. Also called Inverse Video. Obtained by pressing CTRL and RVS On Keys simultaneously.

RF Modulator Encodes a composite video signal, as required for most monitors, into a radio frequency signal for display on a standard television set.

RFI Radio-Frequency Interference. Most electronic devices emit radio frequency waves. These frequencies may interfere with the workings of other devices. The Commodore 64 and its peripherals may generate enough RFI to interfere with a nearby TV or radio.

RI Right In. The right incoming bit to fill the vacancy left by shifting all other bits in the word to the right.

**RIGHT$** BASIC Function. RIGHT$ returns the rightmost <n> characters of string x$. The format is:

<V$ > = RIGHT$ (<x$ >,<n>)

<X$ > may be any string expression.

<n> is an integer expression specifying the number of characters to appear in the result.

If <n> is greater than or equal to LEN(X$), then X$ is returned. If <n> is zero, the null string (length zero) is returned.

See also MID$ and LEFT$

Right Arrow (→) When the right arrow key is pressed the cursor moves one character to the right. This function is common in text entry and in entering commands. This key may be defined differently by various application programs.

Ring Indicator In telephone based applications, such as telecommunications via modem, Ring Indicator is the signal or line which causes the bell to ring.

Ripple-Carry An addition technique where the carry coming out of an adder is propagated to the next adder. A faster method is to use carry look-ahead.

Rise Time The time required to complete the low-to-high transition of a pulse.

RND BASIC Function. RND function returns a random number between 0.0 and 1.0. The format is:

V = RND(<x>)

<x> is a numeric expression which affects the returned value as follows:

The same sequence of random numbers is generated each time the program is run unless the random number

generator is reseeded. If <x> is positive or not included, RND(<x>) generates the next random number in the sequence. RND(0) repeats the last number generated.

To generate random numbers in the range zero through <n>, use the formula:

INT(RND(0) * <n+1>)

RO Right Out. The right output from a shifter.

ROL ROtate Left one bit. An Assembly language instruction for the 6510 microprocessor that shifts the bit pattern of the word specified by the argument one bit to the left. The carry flag bit is moved into the rightmost bit of the word, and bit seven moves into the carry flag bit. The addressing mode for the argument may be zero page, zero page X, absolute, absolute X, or the argument could be the letter A for accumulator. The sign flag bit, the zero flag bit, and the carry flag bit can be altered by the instruction.

Rollover Depressing two or more keys on a keyboard simultaneously. A good keyboard controller will include debouncing and multiple-key rollover protection. See Debounce, Keyboard.

ROM Read-Only Memory. Memory that can be written only once. ROM is generally comprised of Silicon chips composed of electronic gating structures. When powered on, these gating structures are capable of holding a charge. Applying a strong enough charge can irreversably alter these gating structures, so that when the chip is powered up again each structure appears to have the same charge as before it was powered down. In this way the device can serve as a memory device. ROM cannot be altered once the memory has been burned into it. The Commodore 64 comes with over 20K of ROM which contains the operating system, the BASIC interpreter, and the kernal for the system.

ROM Image The ROM responsible for determining the structure of characters is located in the character generator. The actual location of this part of ROM is addresses 53248 to 57343. The VIC-II chip can access 16K of memory at a time. To have access to the character generator the Commodore 64 makes use of ROM image. The Computer assigns a ROM address identical to a RAM address. The user may enter data into the RAM without, of course, changing the ROM. When the computer needs access to the ROM, it disconnects the RAM for a moment and takes the data it needs from ROM. When the user needs data from the RAM, the computer disconnects the ROM.

ROMable Code which will execute properly when placed in ROM is ROMable; segments of ROMable code have no temporary data storage areas and do not use instruction modification techniques.

Roman Numerals* Teaches Roman numerals and how to change them to Arabic. For fourth to eighth graders. Cassette. Comm*Data Computer House.

ROR ROtate Right one bit. An Assembly language instruction for the 6510 microprocessor that shifts the bit pattern of the word specified by the argument one bit to the right. The carry bit moves onto bit 7 of the word and bit 0 moves into the carry flag bit. The addressing mode for the argument may be zero page, zero page X, absolute, absolute X, or the letter A for accumulator. The sign flag bit and the zero flag bit can be altered by the instruction.

ROTATE Shifts the contents of a register or word to the left or right. The bit coming in one end of the rotating word is generally the one falling off the other end. Sometimes, it is the old value of the carry bit (9-bit rotation).

Round-Robin A scheduling technique in which a task list is cycled through from top to bottom and back again. In round-robin scheduling, each process or device corresponding to a task is guaranteed periodic service whatever the actual task traffic may be.

Routine A section of code written to perform an action, such as an input character routine, or a disk write routine.

Row Scanning A technique used in decoding which key of a keyboard has been pressed. Each row is scanned in turn. The output on the columns is examined, resulting in identification of the key. See also Line Reversal.

RPG Report Program Generator. A business-oriented programming language which uses a highly structured system of preformatted commands.

RPM Revolutions Per Minute.

RPN Reverse Polish Notation. See Postfix.

RPROM ReProgrammable Read Only Memory. See PROM.

RS Register Select. A control signal determining which of several eligible registers will be used in an MPU operation.

R-S Flip-Flop A flip-flop using two cross-coupled NAND gates.

RS-232 for the Commodore 64 The Commodore 64 has a built-in RS-232 interface accessed through the user's port. The voltages of the port are not standard RS-232 voltages and an interface is required before connecting to any RS-232 device. Because of hardware constraints, information cannot be received across the RS-232 port while cassette or serial bus activity is occurring.

Information from the RS-232 port can be received into a buffer with the appropriate downloading program and then sent to the cassette or disk with the appropriate software. See Download.

Before an RS-232 port is used, the channel must be opened appropriately. The Baud rate of data that will be transmitted, the parity, the word length of data, the state of duplex, and the stop bits can be sent when opening the channel or by POKEing the appropriate numbers into the appropriate memory locations (referred to as command and control registers).

When an RS-232 channel is opened, two 256-byte buffers are created in memory that are used for data being sent in or out of the channel. An automatic clear is executed when opening the channel, so arrays or variables can only be

created after the channel is opened. If there is an error in the initial transmission to the command or control registers, the system may default to 50 baud. Information sent to the RS-232 channel enters the buffer and is sent out through the port using standard EIA RS-232-C handshaking configuration. Closing the channel eliminates all information in the buffers whether it has been transmitted or not. The format for opening an RS-232 channel is:

OPEN <lfn>,2,0,<chr$(n)><chr$(a)>

<lfn> is an arbitary logical file number (1-127) assigned by user to reference this channel during PRINT# or GET# statements.

<n> will determine the baud rate, word length, and number of stop bits that will be used by the channel. The number is sent to the Control Register 665.

<a> will set the parity and duplex used by the channel. The number is sent to the Command Register 666.

RS-232C Widely used standard for connecting computer system components, especially for serial communication of control and data between computers and serial input/output peripheral devices. RS-232C is an electrical standard for connecting data terminal equipment such as modems or network data concentrators. It allows substantial variation as to what signals are passed.

RTI ReTurn from Interrupt. An Assembly language instruction for the 6510 microprocessor that pops the top word of the stack and moves it into the status register and then pops the next two words and moves them into the program counter. The stack pointer is adjusted and none of the flag bits are affected.

RTOS See Real Time Operating System. An operating system in which data and computer response proceed at the same rate.

RTS Ready To Send (RS-232C standard signal).

RTS ReTurn from Subroutine. An Assembly language instruction for the 6510 microprocessor that pops the top two words from the stack and moves them into the program counter. The program counter is then incremented by one. This instruction can be used to return from a subroutine following a JSR instruction. None of the flag bits are altered.

Rule of '78* Verification and computations of calculations according to the Rule of '78 for money oriented community. Disk; printer required. Powerbyte.

RUN BASIC Command. Causes a program to begin execution. The format is:

RUN [<line>]

<line> is the line number of the program in memory where you wish execution to begin.

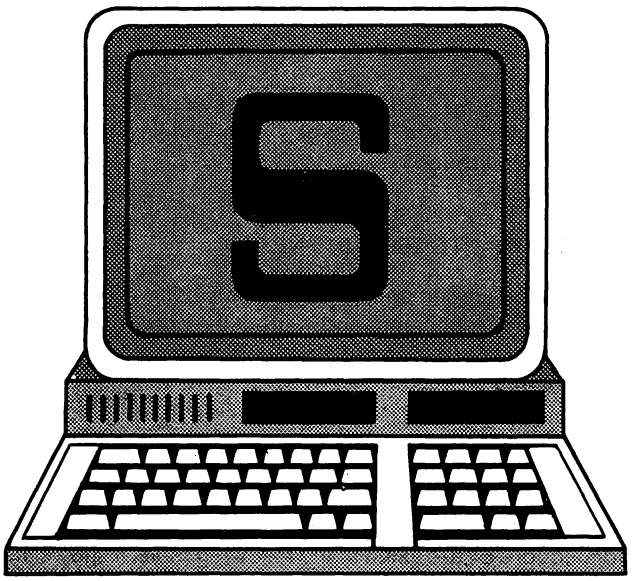
RUN executes the program currently in memory at the lowest line number. RUN <line> will begin to execute the program at the specified line number.

Run-On Sentences* Race against the computer and figure out where the run-on sentences should be divided. Progress report is given upon completion of eleven to sixteen problems. Cassette. Micro-Ed.

Run/Stop Pressing this key interrupts and stops a program execution. If this key is pressed in conjunction with the shift key, the Commodore 64 will load the next program on a cassette tape.

R/W Read/Write.

RZ Return to Zero. A recording technique often used on continuous magnetic media, especially tape.



S Codes. ASCII = 83, CBM ASCII = 83 or 211, HEX = 53. s—ASCII = 115, CBM ASCII = 83, HEX = 73. Screen code = 19 or 83. See CBM ASCII.

S See Scratch.

S Select. Also Strobe.

S-100 An extremely widespread 100-line microcomputer system bus. It was originally developed as the bus for the first 8080-based system, Altair. It has since been standardized as the IEEE696 bus. In its latest form, it can be used with the newer 16-bit microprocessors.

Sales/Business Applications Software* See Bidder—My Profit Margin, The; Inventory Package.

Sales/Expense* Keeps records of financial transactions over specific periods of time. Totals, profits, and other important information can be analyzed and stored for later review. Cassette; printer required. RAK Electronics.

Sample and Hold An analog circuit to capture and retain a signal so that it may be converted by an analog to digital converter.

Sampling Measuring an input value at intervals.

Satellite Processor A computer subordinate to another computer, possibly communicating over large distances, which performs specialized processing related to the master computer. The satellite may also be contained in the same device as the main processor, creating a multi-processor machine.

SAVE The name of a Machine language subroutine within the operating system of the Commodore 64. It is part of a group of subroutines referred to as the KERNAL and used to handle input/output operations. By jumping to address $FFD8, SAVE copies consecutive bytes of data from memory to a device specified. The accumulator and X and Y registers are loaded with the low and high byte of the end of memory being copied. The SETLFS and SETNAM routines must be used prior to using the SAVE routine. See KERNAL.

SAVE BASIC Command. Copies the program currently in main memory onto a mass storage device such as a disk or cassette. The program, after being saved onto tape or disk, still remains in the main memory. The format for the command is:

SAVE"<name>",<dev>,addr

<name> is the name the user assigns to the program file and the one that will be used to load the program at a later time. On the 1541 disk drive, the name is compared with those in the directory to be sure that name isn't already in use. The drive also determines from the Block Availability Map (BAM) whether there is enough space remaining on the disk to save the entire program. On the cassette, the file name is optional.

<dev> is the device number. On a single disk drive this will be the number 8. When saving from cassette the device number is 1. If this number is left out the default value is 1.

<addr> is used for cassette operation. A "1" lets the cassette know the address from which it is being saved so that it can be loaded there at a later time, a 2 will create an end of tape marker at the end of the program being stored, and a 3 combines both functions.

SAVE CP/M. This command saves a program or file on disk in the Transient Program Area (TPA). The pages (p) to be saved are specified in the argument. The format is:

SAVE p <filename>

p = 256 byte segments (pages).

See also CP/M Commands.

Savings Account Miser, The* Helps you analyze various types of savings accounts with compound interest. Can be very useful for computing retirements and IRA yields. Powerbyte.

Sawtooth Waveform A sawtooth waveform consists of all harmonics, each in proportion to the reciprocal of the harmonic number. For example, the third harmonic will be only 1/3 as loud as the fundamental frequency. See also Harmonics.

SBC Single Board Computer. A name applied to a line of board-level products built to Intel specifications and using a common system bus known as the multibus. This bus is standardized as the IEEE 796. National Semiconductor has a compatible board line designated by the letters BLC (Board-Level-Computer).

SBC SuBtract with Carry. An assembly code instruction for the 6510 microprocessor that subtracts from the accumulator the data specified by the argument with borrow. The result of the operation is placed into the zero page X, absolute, absolute X, absolute Y, (indirect S), or (indirect) Y. The sign flag bit, the zero flag bit, and the carry flag bit are affected by the result. SBC may be in decimal or

binary mode depending on the approprate bit setting in the status register.

Scheduling Allocating a non-shareable resource, such as CPU time, or an I/O device to a particular task for a period of time.

Schotky A technology of high-speed circuits.

Scientific Applications Software See Engineering-Mechanical-Scientific Applications Software.

SC/MP Simple Cost-effective MicroProcessor. National Semiconductor's small 8-bit microprocessor.

SCNKEY The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FF9F, SCNKEY checks the keyboard and moves the ASCII value of any key pressed into keyboard queue. Normally the Commodore 64 automatically executes this routine when the keyboard generates a IRQ. The user can utilize this routine if the IRQ is disabled. See KERNAL.

Scope The scope of a variable is comprised of the sections of a program where that variable is available to the user. Also, an abbreviation for oscilloscope.

Scotch A brand of magnetic recording media.

SCR Silicon Controlled Rectifier. A silicon cell which permits current flow in one direction only, thus effectively converting AC current to DC.

SCRATCH Disk Command. When sent through the command channel, the SCRATCH command channel, erases specified files and programs on the disk. Programs can be erased one at a time or in groups using pattern matching. The format is:

OPEN15,8,15 PRINT#15,"SCRATCH0:<name>"

<name> is the name of file to be erased from disk.

Scratchpad A group of general purpose registers without specific function that serve as a high speed workspace for some operations. Usually, it is an internal RAM, faster than the main system RAM.

Screen ECHO Function. This sends keyed characters to the screen for a visual confirmation of what has been typed. There is no hard-wired connection between the keyboard and the screen. The keyboard simply enters characters into memory. The Screen Editor of Commodore 64 copies the characters from memory to the screen, creating a duplication or "echo" of what was keyed.

SCREEN The name of a Machine language subroutine within the operating system of the Commodore 64. It is part of a group of subroutines referred to as the KERNAL and used to handle input/output operations. By jumping to address $FFED, SCREEN returns the format of the screen (number of columns and rows) into the X and Y registers. See KERNAL.

Screen The surface of a monitor or TV set on which characters are displayed.

Screen Display To freeze or hold the screen display while the operator reads a message, write a delay loop after printing the message.

Example:
1000 FOR Y = 1 TO 2000 1010 NEXT Y

To freeze the screen until the operator is done with it, put in a dummy input statement and instruct the operator to press ENTER to proceed. The input variable need not be used in your program:

Example:
1000 INPUT "Press ENTER to continue";A$

Screen Display Codes The Screen Codes for the Commodore 64 are listed in the following table. It shows the number to be POKEed into the screen memory (1024-2023) to get the desired characters on the screen at the corresponding locations:

SCREEN CODES

SET 1	SET 2	POKE	SET 1	SET 2	POKE	SET 1	SET 2	POKE
@		0	C	c	3	F	f	6
A	a	1	D	d	4	G	g	7
B	b	2	E	e	5	H	h	8
I	I	9	%		37	**	A	65
J	J	10	&		38	**	B	66
K	k	11	$CQ		39	**	C	67
L	l	12	(		40	**	D	68
M	m	13	)		41	**	E	69
N	n	14	*		42	**	F	70
O	o	15	+		43	**	G	71
P	p	16	,		44	**	H	72
Q	q	17	$DH		45	**	I	73
R	r	18	.		46	**	J	74
S	s	19	/		47	**	K	75
T	t	20	0		48	**	L	76
U	u	21	1		49	**	M	77
V	v	22	2		50	**	N	78

W	w	23	3		51	**	O	79
X	x	24	4		52	**	P	80
Y	y	25	5		53	**	Q	81
Z	z	26	6		54	**	R	82
[		27	7		55	**	S	83
]PS		28	8		56	**	T	84
]		29	9		57	**	U	85
↑UP		30	:		58	**	V	86
]LF		31	;		59	**	W	87
[SPACE]		32	<		60	**	X	88
!		33	=		61	**	Y	89
"		34	>		62	**	Z	90
#		35	?		63	**		91
B		36	**		64	**		92
**	**	93	**	**	105	**		117
**	**	94	**		106	**		118
**	**	95	**		107	**		119
[SPACE]		96	**		108	**		120
**		97	**		109	**		121
**		98	**		110	**	**	122
**		99	**		111	**		123
**		100	**		112	**		124
**		101	**		113	**		125
**		102	**		114	**		126
	:	:						
**		103	**		115	**		127
	:	:						
**		104	**		116			

** For Graphics See:

Commodore 64 Programmer's Reference Guide
Published by Commodore Business Machines, Inc.
Howard W. Sams Co., Inc.

Screen Editor The screen editor is a program that arranges the display of characters entered from the keyboard to the screen. It allows for inserting and deleting characters and is built into the ROM of the Commodore 64.

Screen Generator Helps define CRT screen forms, which are a particular pattern of symbols on a CRT screen, for data entry and display. Screen forms are often displayed in protected fields and consist of prompts to help the user enter data.

Screen Memory A 1,024-byte area starting at address 1024 to 2047 (HEX $0400 to 07FF). Each of these locations is 8 bits wide. Each location can hold any integer up to 255. The location of screen memory can be changed by a POKE to the control register at 53272 ($D018 HEX) addressing the upper 4 bits. For example:

POKE 53272, (PEEK(53272) and 15) or A:.

Screen Size A measure of the amount of information that a CRT screen can display. Screens may be measured diagonally, like TV sets, or by the number of vertical and horizontal dot or character positions.

Screen-Graphics-64* SG-64. Graphics Utility program. A Machine language program that wedges itself into Commodore's BASIC. These commands may be used in standard BASIC programs and are executable if the SG-64 has been loaded into computer memory. The SG-64 Interpreter allows the user to access the high resolution graphics features of the Commodore-64 from BASIC programs using simple commands. The package comes with an easy to follow manual, a demo program that contains samples of graphics images, and a tutorial program that has step-by-step instructions on how to create different types of graphics images on the screen. The program also has facilities to build and animate sprites. Abacus Software.

Screenmaker* An 80-column video board that gives your system a full screen of characters. Includes software to connect the system. 2K video RAM. Microtech.

Script Ease* Script Ease provides the user with elementary training in word processing. It is available in compiled BASIC, offering considerable speed and performance as compared to other programs available in BASIC. The package includes documentation and a disk containing the word processing program and sample text letters. The sample letters illustrate the features of the word processor (including Mail Merge). The simplified documentation and the menu-driven program are easy to learn. The program supports many editing/formatting features and can be used for output of routine correspondence. The program has built-in default values for various print formats so the user can print well formatted hardcopy without defining specific format. It can also access the disk directory without erasing text in current memory. Midwest Software.

Scrolling Moving the entire screen in one direction, one pixel at a time. The VIC-II chip on the Commodore 64 supports scrolling in both the vertical and horizontal

direction. Address 53270 enables scrolling in the X direction and 53265 enables scrolling in the Y direction.

SE Sign Extend. Used during a multiply or divide operation and during some shift operations to insure that negative numbers remain negative when shifted right. The convention is that the bit shifted into the high end of the register will be identical to the bit that was in the high order position when the shift began.

Sea Wolf* You are the captain of a submarine patrolling a dangerous section of enemy coastline. Commodore.

SEC SEt Carry. An assembly code instruction for the 6510 microprocessor that sets the carry flag bit to one. Only the carry bit is affected.

SECOND The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FF93, SECOND sends a secondary address to an I/O device following the LISTEN routine. The secondary address is loaded into the accumulator prior to using this routine. See KERNAL.

Sector A continuous section of a disk track. A block of data on a disk is addressed by its track and sector numbers. Typical disk sector sizes are 128, 256, or 512 bytes of data. Consecutively numbered sectors may or may not be physically adjacent within a track. The 1541 Disk Drive uses 256-byte sectors written 17 to 21 per track.

Sector, Bad A sector on the disk which will not read/write data correctly. Usually due to a minor physical flaw in the disk. One or two bad sectors will not seriously affect the disk's usefulness—DOS will mark them as bad and avoid using them. More than a few bad sectors indicates the disk should be used as a frisbee rather than to hold your valuable data.

Sector Five* You must guess how many attackers there are to send them back to their own planet and save the universe. Cassette. Micro-Ed.

Sectors The 1541 saves data onto a disk in a very specific format. Data is saved in concentricrings called tracks. Each ring or track is divided into sections called sectors. Each sector contains 256 bytes of information. When a new disk is inserted for the first time, the tracks and sectors are labeled using the NEW command. See NEW. Disk Command. This command must be issued before data can be stored on a disk. When data is saved on a disk, the sectors that are used are reported in the Block Availability Map (BAM) located on the disk. Prior to writing to a disk, the disk drive automatically checks the BAM to make sure the sector it is about to write on is available. See Disk.

SED SEt Decimal mode. An assembly code instruction for the 6510 microprocessor that sets the decimal flag bit to one. This allows for decimal operations with the ADC and SBC commands. Only the decimal flag bit is affected.

Seek Time The time needed to position the head of a disk over the specified track.

Segment A continuous block of memory addresses, such as 0 to 64K.

SEI SEt Interrupt disable. An assembly code instruction for the 6510 microprocessor that sets the interrupt flag bit to one. This prevents any further interrrupts. Only the interrupt flag bit is affected.

Semicolon (;) DOS Command Delimiter. Parameters on DOS commands can be delimited (separated) by any of these characters: space, comma, or semicolon.

Sensor A device which translates a physical stimulus into an electronic signal which may be input into a computer.

Sequencer In a bit-slice system, the module in charge of providing the next microprogram address to the micro-program memory. It is essentially a complex multiplexer, but may include stack facilities and a loop counter.

Sequential Access An access method in which items may only be accessed in a fixed order. The standard example of a sequentially accessed medium is magnetic tape. Here, in order to access a particular record, all records before it must be scanned first.

Sequential File A file whose elements may only be accessed in ascending order. To read an element of a sequential file, all of the preceding elements must be read.

Sequential Files 1541 Disk Drive. A file where data is moved through a buffer in the same order each time it is accessed. If there are ten characters to be written into a sequential file, each character is stored onto the disk in order from one to ten. To access any character in that file you have to access each character before it in the same order it was written. Opening a sequential file includes naming the file, indicating that it is a sequential file and declaring whether you are going to write to or read from the file. The PRINT# statement is used to write to a sequential file and it is vital that separate items be delimited with commas, semicolons, or carriage returns. Data from a sequential file is read using the GET# or INPUT# statement. The format for opening a sequential file is:

OPEN <f#>,<dev#>,<channel#>,"0:<name>,<type>,<direction>"

<f#> is an arbitrary number from 1 to 127 assigned by user and referred to any time data is written or read from file.

<dev#> is the number of disk drive. Usually 8.

<channel#> is an arbitrary number 2 through 14 used by DOS for setting up buffer. Only one file per channel at a time.

<name> is assigned by user and recorded in directory.

<type> of file. For sequential enter S.

For the <direction> of a sequential file either W for write or R for read.

Serial For sequential handling of processes, transmissions or storage of data. Serial means moving information one bit at a time, usually where only one data wire is available. The 8 bits of a byte are transmitted one after another in series. The I/O device must collect 8 bits sequentially to make one byte.

Serial Bus The serial bus of the Commodore 64 is accessed through the 6 pin DIN socket on the rear of the computer. It is connected directly to the 1541 disk drive or 1525 printer. Some companies manufacture interfaces which are compatible with the serial bus and convert data transmitted to more common formats, such as the CARDCO interface which converts the serial bus data to a Centronics connection. The serial bus can be used to daisy chain up to 4 disk drives and a printer. Each device must have its own device number from 4 to 31 to avoid confusion when data is transmitted. Common device numbers include 4 for printers and 8 for a single disk drive. When a user opens a file for a device on the serial bus the computer sends the device number to the bus where all devices receive the address simultaneously. The device with the corresponding number responds and begins receiving or transmitting data. The format for opening a device on the serial bus is:

OPEN <f#>,<dev#>,<n>

<f#> is an arbitary number assigned by user to reference PRINT#, GET#, or INPUT# statements.

<dev#> is the number hardwired or programmed into a peripheral device.

<n> is a secondary address number used by some peripherals.

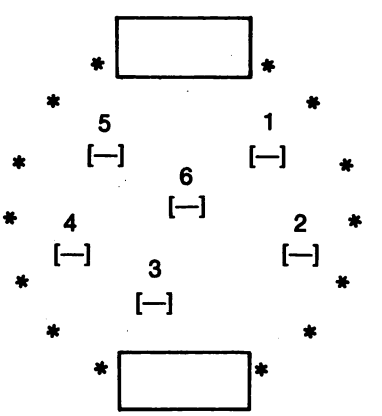
Serial Data Data transmitted sequentially, one bit at a time.

Serial Port An I/O port through which data is transmitted and received serially. The data is sent one bit at a time, as opposed to a parallel port that can send 8 bits at a time. The Commodore 64 utilizes a serial port to connect to the 1541 disk drive or some printers. The port is a 6 pin DIN socket located in the back of the Commodore 64. The port gives access to the serial bus which connects to the CIA (Complex Interface Adapter). Five drives can be connected to each other with the last one connected to the port in a daisy chain configuration. Each drive must have a different programmed device number. Data sent to the serial bus is available to all the drives but only the ones with the device number specified in an open statement will receive or transmit data. Since there is essentially only one line in which data is being transmitted the microprocessor must control whether data is to be sent or received. It does this by sending a command to a device and specifying that the device is to TALK or to LISTEN. All data being transmitted is synchronized from a clock in the system and clock signals are also transmitted through the serial bus. When serial data is received in the CIA, it is converted to parallel data and made available to memory and the microprocessor. Likewise data from internal memory starts as parallel data and is converted to serial data in the CIA. See CIA.

A table of the Serial Port follows:

SERIAL I/O

PIN	TYPE
1	SERIAL SRQUIN
2	GND
3	SERIAL ATN IN/OUT
4	SERIAL CLK IN/OUT
5	SERIAL DATA IN/OUT
6	RESET



Serial Printer Any printer that receives data serially is called a serial printer. Although there may be more than one line to the printer, data is sent one bit at a time. The 1525 printer is a serial printer.

Series Circuit elements connected so that the output of one is the input of the next.

Servo Short form of servo-mechanism (q.v.).

Servo-Mechanism A device which converts electrical signals to mechanical or physical actions. Servo-mechanisms range from simple relays to robots.

SETLFS The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFBA, SETLFS sets up a logical file number, a device address, and a secondary address. It is used prior to many of the other KERNAL routines in establishing a file table. Prior to using this routine, the accumulator must be loaded with the logical file number, the X register with the device number, and the Y register with a secondary address. The Y register should be loaded with 255 if there is no secondary address.

SETMSG The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle Input/Output operations. By jumping to address $FF90, SETMSG can enable error and control messages. If bit 7 of the accumulator is 1, error messages from the KERNAL are enabled. If bit 6 is set, control messages are enabled.

SETNAM The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle Input/Output operations. By jumping to address $FFDB, SETNAM sets up a file name to be used by the OPEN, SAVE, and LOAD routines. Prior to using this routine, the accumulator must be loaded with the length of the file name and the X and Y registers must be loaded with the address of the start of the file name.

SETTIM The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle Input/Output operations. By jumping to address $FFDB, SETTIM sets the system (jiffy) clock. The clock increments one every 1/60th of a second and uses three bytes to count the increments. The clock is set by loading the accumulator with the most significant byte, the X register with the next most significant byte, and the Y register with the least significant byte. These registers must be loaded prior to using this routine.

SETTMO The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle Input/Output operations. By jumping to address $FFA2, SETTMO sets a timeout flag for an IEEE device on an IEEE interface card. Bit 7 of the accumulator is loaded with a 0 to enable the timer, a 1 to disable the timeout. With the timeout enabled, a IEEE device must respond within 64 milliseconds with a "Data Address Valid" signal or an error condition will occur.

Setup Time The time required before a signal can be changed from its prior state. Also, the time required to set up the preliminary conditions necessary to run a program.

SGN BASIC Function. Gives the sign (positive or negative) of (x). The format is:

v = SGN(<x>)

<x> may be any numeric expression.

If <x> is positive, SGN(x) will return 1.
If <x> is zero, SGN(x) will return 0.
If <x> is negative, SGN(x) will return -1.

Shamus* A computerized version of the well known adventure game. You must take clues from the trail left by the suspect and locate him before anything else happens. Synapse.

Shapes* Teaches elementary students the names of shapes. Cassette. Comm*G Data Computer House.

Shell The name for the command interpreter running under the UNIX operating system.

Shift Most keys on the Commodore 64 are capable of displaying two characters, upper and lower case, and two graphic symbols. Pressing the shift key while the computer is in upper/lower case mode gives the upper case letter. In the upper case/graphic mode it gives the PET graphic symbol to the right of the key.

Shift Moving the contents of a register left or right by one bit or more. The bit falling out goes into the carry bit of the status register or is lost. The bit coming in is usually a 0, except in some special circumstances.

Shift Register A register whose contents can be moved left or right by one or more bit positions.

Shifter Hardware device which implements the shift instruction. It moves all bits in a register left or right one bit.

SI Serial Input.

Side Effect An unintentional change to the value of a global variable by a function, procedure, or subroutine. Structured programming languages discourage side effects by limiting the scope of global variables.

Sign Plus or Minus. In two's complement notation, the sign can be determined by examining bit 7, the Most Significant Bit (MSB).

Sign Flag Bit See Status Register.

Sign Magnitude A binary representation for integers where the Most Significant Bit (MSB) acts as the sign (0 for +, 1 for -) and the rest of the bits contain the magnitude, or absolute value, of the number.

Signed Binary A binary representation of signed integer numbers which sets aside one bit, usually the high-order or leftmost bit, to indicate the sign of the number.

Silicon Valley The area around Sunnyvale, in the Santa Clara Valley south of San Francisco, California, where many semiconductor manufacturers are located. It contains the greatest concentration of electronics industries in the U.S. It is also called The Silicon Gulch, but please, never Silicone Valley.

Silicon-gate The MOS (Metal Oxide Semiconductor) technology using silicon for the gate of the transistor. An alternative is the aluminum gate.

Simon's BASIC* An extended BASIC for the Commodore that adds over 100 new commands to your system. Helps you draw, write music, and define sprites much more easily. Commodore.

Simple Machines I* Using drawn graphics and a book, you can learn the basic ideas and uses of three uncomplicated tools—the inclined plane, wedge, and screw—followed by a comprehensive quiz of ten to thirty questions. Cassette. Micro-Ed.

Simplex Data transferred in one direction only.

Simulator A program which simulates some of the functioning of a device or process for testing purposes. A CPU is easily simulated, Input/Output cannot be precisely simulated because of timing considerations.Thus so only the logic of a program can be tested with a simulator.

SIN BASIC Function. The SIN function calculates and returns the numeric value of sine. The format is:

v = SIN(<x>)

<x> is the angle in radians.

To convert degrees to radians, multiply by PI/180.

Single Board Computer A complete computer on one printed circuit board includes the CPU, ROM, RAM, and interfaces. Single board computers are often used for industrial control applications.

Single Density How close the tracks on the drive are spaced. Double density would place the tracks twice as close as single density and therefore store twice as much data as a comparable single density drive.

Single Precision Arithmetic Regular arithmetic, i.e., arithmetic on single-word integers, as opposed to double or multi-precision arithmetic.

Single-Sided The internal mechanism of the drive can only access one side of a disk for a read or write operation. Double-sided drives can access both sides of the disk, therefore they can store twice as much information per disk.

Single-Stepping The execution of a program or statement one step at a time. It is useful for debugging. See also Debug.

Sink Current A logic family's current drive capability. Sink current is 1.6 milliamperes for one standard Transistor-Transistor Logic (TTL)often used.

Sit/Set* Increase your ability to use these verbs properly. Cassette. Micro-Ed.

Size In Blocks Of Files The size of a file in blocks is revealed in the disk directory. Loading the directory and listing will show you the size of each file (not including random files) and the total available blocks on the disk. The available blocks on the disk reflects the total remaining free space and takes random files into consideration.

Skier 64* It's winter in the mountains—practice your talents on the slopes. Disk or cassette. Abacus Software.

Skip Over Print Zones Use of Double Comma. To leave space on the print line between items, put an extra comma (,,) in the print list.

Enter BASIC statement: PRINT A,,B

This would print A in print zone 1, nothing in print zone 2, and put B in print zone 3, (col 29).

See also Print Zones.

Ski-Run* A package including Downhill, Slalom, and Giant Slalom. Different skill levels, trees, and snowdrifts make this a game of skill. Cassette. Star Tech, Inc.

Slam Dunk* Subtraction game within a basketball framework. It's the consistent shooter against the slam dunk. Cassette. Micro-Ed.

Slave Any device under the control of another device, or imitating its operation.

Slew Rate A fast signal response measured in volts per second. Used in operational amplifier specifications.

Slice See Bit-Slice.

Slot A multiple-way connector allowing one printed circuit board to be attached to another. Typically, an accessory board is plugged into a slot in the motherboard.

Slots* Computerized version of the well known casino game. Cassette. RAK Electronics.

SLSI Super Large Scale Integration. A technology which holds up to 100,000 transistors per chip.

Small Scale Integration The technology which holds up to ten gates per device.

Smart ASCII Plus* Printer Interface. A software interface for parallel printers that allows the Commodore keyboard graphics to be printed on most dot-matrix printers including the Epson FX-80, Star Micronics Gemini 10, and C. Itoh Prowriter. Smart ASCII Plus is compatible with most application programs such as the WordPro3 Plus. Midwest Micro Associates.

Smart 64 Terminal* Terminal Software. An intelligent terminal emulator for the Commodore 64. It contains many advanced features, such as a 28K buffer for downloading text from another computer; options to extract, save, and print the downloaded text; a disk wedge to provide direct disk control without exiting the program; and facilities to upload sequential text files. The downloaded text may be converted into a BASIC program ready to run on the computer, and a BASIC program may be converted into a sequential file suitable for uploading. All these features may be selected from the main menu. Options are available for changing the default settings on the printer and the modem. The function keys are used to transmit user ID and password, change screen/text colors, and access the disk commands. The second release of the program has been modified to speed up the dump (from buffer to disk) to take approximately 3½ minutes.

With recent improvements, the Smart 64 Terminal program promises to be one of the most sophisticated terminal programs available for the Commodore 64. Micro-Technic Solutions, Inc.

Smoke Test Turning on the equipment for the first time to see if it will operate.

SNOBOL StriNg-Oriented symBOlic Language. A character-string manipulation programming language.

SNR Signal-to-Noise Ratio.

SO Shift-Out bit. The bit lost (or stored in the carry status register) when a word is shifted left or right.

SOB Start-Of-Block.

Social Studies Word List: Regions* Provides practice using frequently encountered vocabulary words that are grouped in specific region categories such as Forest, Ocean, and Desert. There is a graphics display for students who complete a lesson correctly. For elementary students. Cassette. Micro-Ed.

Socket A mechanical electrical connector. Also known as the female connector.

Soft-Fail Techniques which preserve some system operation despite failures.

Soft-Sectored The beginning of every sector on a disk is detected by reading magnetic marks on the disk. This is in contrast to hard-sectored where the beginning of each sector is marked by a physical hole.

Software Computer programs of all kinds are called software. Hardware is the chips, wires, boards, etc., which make up the computer. A special case is Read-Only Memory (ROM), which is hardware that contains a permanent copy of software. Shorthand terminology here could be confusing—"A BASIC ROM" means a ROM (hardware) containing a copy of a BASIC interpreter program (software). Such ROMs are often called firmware to distinguish them from non-program hardware and from software in changeable media (RAM, disk, cassette, etc.) See ROM, RAM.

Software, Applications A Software package is a group of computer programs, possibly including data files and documentation, which perform a function or group of related functions on the computer. These are called applications software when the programs are devoted to an end-user task, such as a word processing package or an accounting package. These programs are called systems software packages when they facilitate the use of the machinery, such as a disk operating system or a program development package.

Software, Operating System The operating system for the Commodore 64 is located in internal ROM. Some systems require loading the operating system from disk. The Commodore 64 allows for loading CP/M, an alternative operating system requiring a CP/M cartridge. See Operating System.

Software Package A pre-written group of commercially available programs which serve a specific need, such as word processing, inventory control, or database management.

Software-Compatible Describes central processing units (CPUs) or computers which execute programs in the same language (i.e., have the same Machine language).

Solving Quadratic Equations* Students can use the computer screen as a worksheet for learning to factor quadratic equations A valuable tool for high school students. Disk or cassette. Microcomputer Workshops.

Sorcerer's Apprentice* A graphics utility package that allows the user to draw high-resolution graphics on the screen in sixteen colors using the joystick or the keyboard (cursor control keys). Comes with easy to follow documentation. Many built-in drawing functions allow one-key control over drawing geometric figures such as circles, triangles, rectangles, and ovals. The FILL function fills any closed shape with the current draw color. Screen graphic images may be magnified, mixed with text (standard character set or user-defined character set), moved around on the screen, and LOADed and SAVEed from disk. Event Horizon Software.

Sort To arrange items according to defined criteria, such as alphabetical or numerical order.

SOS Silicon-On-Sapphire. Integrated circuit technology in which a sapphire substrate is used. Yields high-speed operation.

Sound See Attack-Sound, Sustain-Sound, Decay-Sound, Release-Sound, Sawtooth Waveform, Triangular Waveform, Rectangular Waveform, Harmonics.

Sound Processing Packages See Synthy 64; Ultrabasic 64.

Source The emitter of a transistor.

Source Code See Source Programs.

Source Drive The disk drive from which information/data is coming. Target drive is the disk drive to which information/data is going.

Source Language The original language used by the programmer, on which a translator program operates to produce a version in the language used by the machine.

Source Programs A file which contains data to be processed by a language processor, interpretor or compiler. All programs that run directly on the Commodore 64 are Machine language programs (in the actual numeric instruction code of the Commodore 64 6510 microcomputer chip). Most were orginally written by a programmer as source programs.

A BASIC compiler is a Machine language program which turns a source program into Machine Code. When you run a BASIC program on a system with a BASIC compiler, the compiler translates your source program into an object program. The object program is stored for reuse, and the source program does not need to be compiled again.

You will then use the LINK program to further process the object program (identified by the suffix .OBJ) into an executable file (identified by the suffix .EXE). The resulting program is no longer a BASIC program, but a Machine language program which is based on (is a translation of) your BASIC source program.

The BASIC interpreter is a Machine language program which uses your BASIC program as a guide to what it should do. It processes each line of the source program and interprets an object code instruction. Since it must re-interpret your source program each time you run it, interpreted BASIC can be as much as 100 times slower than compiled BASIC.

Source, The* One of the largest subscription information networks in the country. Personal computer users may access it over the phone lines through the use of a modem. It provides a wide variety of information and allows communication among personal computer users. It also provides programming areas for serious programmers interested in using higher-level languages (such as FORTRAN) that are not readily available for microcomputers.

SP Stack Pointer.

Space Sentinel* You command a battleship in the fight against invading aliens who are trying to melt the north pole. Disk; joystick required. T & F Software Company.

Spacing in BASIC Print Lines To get one or more spaces between fields printed by your BASIC programs, use a literal of spaces like: " ". To get several spaces between the printed values of A$ and B$, enter BASIC statement:

PRINT A$;"";B$

See also Print Zones.

SPC BASIC Function. Causes <n> spaces to be skipped in a PRINT statement. The format is:

SPC <n>.

<n> must be in range 0-255 for screen or tape files and up to 254 for disk files. For printer files, an automatic carriage return and line feed will be sent if SPC is printed in the last character of the line.

Special Characters BASIC. The following characters have special meanings in Commodore BASIC. These characters cannot be used to have meanings other than what is stated below:

	blank, keyword separator
;	semicolon, formats output
=	equal sign or assignment symbol
+	plus sign, addition or concatenation symbol
-	minus sign, subtraction or unary minus symbol
*	asterisk or multiplication symbol
/	slash or division symbol
↑	up arrow, exponentiation
(	left parenthesis, expression evaluation
)	right parenthesis, expression evaluation
%	percent sign or integer type declaration symbol
#	number (or pound) sign, logical file number symbol
$	dollar sign or string type declaration symbol
,	comma, separates parameters or formats output
.	period or decimal point
"	double quotation mark or string delimiter
:	colon, separates BASIC statements
?	question mark or PRINT abbreviation
<	less than, relationship test
>	greater than, relationship test
π	pi, 3.141592654

Speech Module* Plugs into the user port and contains an additional port into which another "talking" or "non-talking" cartridge may be inserted. The module has a built-in vocabulary of 235 words in a realistic female voice that the user can POKE to slow,normal, or fast, and can be programmed from BASIC and/or assembly. The user can program music, graphics, and speech simultaneously and the module supports a separate audio out, enabling connection of speech output directly to a hi-fi system, a television, or a color monitor. Future releases may include spelling, counting, and foreign languages. Commodore.

Speed Reading* After reading a short story the student answers ten questions. Score and time are graphically displayed. Cassette. Comm*Data Computer House.

Spelling, Programs to Check See Spellmaster.

Spelling Programs See Dictionary Guide Words; Dropping the Final E; Educational Software—Primary; Educational Software—Secondary; End Punctuation; English Achievement I-V; English Invaders; Extra Practice Spelling Series; Flash Spell Helicopter; Guess That Word; Hangbug; Misspell; Spelling Quiz.

Spelling Quiz* Save up to twenty words and their definitions for spelling tests. The computer can misspell any of the words for practice correcting. For second to eighth graders. Cassette. Comm*Data Computer House.

Spellmaster* This 50,000 word dictionary helps clean up your text. Features direct screen mistake editing, addition of words with a single keystroke, and Machine language speed, and uses dictionary of Literal Words. Disk. Spellmaster Systems Software.

Spikes Sharp, temporary increases in a signal or voltage.

Spinwriter* A line of thimble printers manufactured by Nippon Electric Corporation (NEC).

Split Screen Division of a CRT screen into two or more separate areas or windows, in which distinct information is displayed.

Spool Simultaneous Peripheral Operating On-Line. Increasing system throughput by allowing programs using slow output devices to complete execution rapidly. Program output data is placed in queues on high-speed mass storage devices, or a part of main memory dedicated to spooling, for low-speed transmission concurrent with normal system operation.

Spread Sheet Assistant* Develops a spreadsheet with 200 rows and 52 columns. Labels, values, and formulas

can be entered into any intersection of a row and a column. The program has some advanced editing features, like global formatting which allows automatic left justifying of all values. It allows the configuration changes necessary to output to an interfaced serial or parallel printer. The documentation is excellent. Rainbow Computer Corporation.

Sprite Design/Edit Package* A package of six programs that assist you in working with sprites. Included are: Spritewriter, Display Mode, Spritewriter-MC, Datasprite, Testsprite, and Storage. Pixel Software.

Sprite Editor* Assists both the novice and the professional in creating multi-colored sprites. Luna Software.

Sprite Pointers Individual bytes that control the location of the programmed definition of each sprite. These bytes (8 bytes for 8 sprites) are located at the end of the screen memory and are relocated every time the screen memory is relocated.

Sprite-Aid* Allows immediate definition of sprites on the screen by using a joystick or the keyboard. Complex sprites can be defined in multicolor or high resolution modes. The sprites you create are saved as DATA statements for later access. Abacus Software.

Spritemaster* Graphics Utility Program. A sprite designer program for the Commodore 64. It allows the user to build single or multicolor sprites on a grid (created by the program on the screen) using either a joystick or the keyboard. The sprites may be loaded or saved on disk as files, each file containing up to 10 sprites. Specific edit features are available to view a sprite and modify its shape, size, or color(s). The program also features animation mode in which sprites are displayed in a sequence of frames to create an animated effect. The most notable feature of the program is its ability to transfer sprite data to any specified program in the form of data statements. This is especially useful for writing games and other graphics-related programs. A special reference section in the back of the manual discusses the registers on the VIC chip that are responsible for sprite graphics. has an example of how to use sprites in a program. Access Software.

Sprites A sprite is a programmable character, also known as MOB (Moveable Object Block). Its color, position, and movement are under the direct control of the VIC-II chip. It may be used in either normal or high resolution graphics modes. A sprite may either be standard or multicolor. Up to 8 sprites may be controlled on the screen simultaneously in the Commodore 64.

Spryte Byter* Sprite development program with over sixty commands. Other features of this easy-to-use program include menu-driven joystick/keyboard option, and Machine language routines. Disk or cassette; 20K. Foxsoft.

Square Root* Teaches junior high school students to find square roots. Cassette. Comm*Data Computer House.

SQR SQR is a BASIC function that returns the square root of the value entered in the argument of the function. The format is:

SQR (<x>)

(x) is any non-negative number.

An example is:

```
10 A = 3600
20 Print "the number is "; SQR(A)
the number is 60
```

SR See Status Register.

SS Solid State.

SSI Small Scale Integration. A technology holding a few gates per element.

SSR Solid State Relay.

ST See STatus.

STA STore Accumulator in memory. An assembly code instruction for the 6510 microprocessor that transfers the contents of the accumulator to the location specified by the argument. The contents of the accumulator are not changed and none of the flag bits are altered. The addressing mode of the argument may be zero page, zero page X, absolute, absolute X, absolute Y, (indirect X), or (indirect) Y.

Stack A LIFO (Last In First Out) structure which preserves the chronological ordering of information and is necessary for subroutines and interrupt management. A stack is manipulated by two instructions, PUSH and POP. Also called a Pushdown List.

Stack Pointer The register in the CPU which contains the address of the top of the stack in memory.

Stand-Alone Any device which will operate by itself, requiring no other equipment.

Standard Character Mode The Commodore 64 formats the screen in two ways, high-resolution mode or standard character mode. In standard character mode the screen is divided into 1000 squares, 40 columns by 25 lines. You can place any character or graphic symbol in any one of the squares by POKEing screen code values into the memory location corresponding to that square (address 1024 to 2023), or by entering values from the keyboard (utilizing the screen editor within the Commodore 64). In standard multicolor character, each character in each square can be set to a single color set independent of the others. The colors can be programmed by POKEing into the screen color RAM (address 55296 to 56295) or using the keyboard.

Star Printer Interface* A special Centronics parallel printer interface for the Commodore 64. Allows the user to connect any parallel printer to the Commodore 64. It provides a system that closely duplicates the programs designed to be used with the Commodore's Vic printer. The manual lists various open commands that can be

used in a program to access various modes such as program listing mode and graphics mode. Cardco, Inc.

Star Trek* Battle the enemy as you venture through space. Cassette. RAK Electronics.

Starfinder* Teaches the constellations and the names of twenty-three important stars. Includes a quiz. For children between the ages of nine and thirteen. Cassette. Comm*Data Computer House.

Start-Bit A bit indicating the beginning of asynchronous serial transmission. See Stop-Bits.

Starting A New Program To start a new program type:

NEW

This completely erases all lines in BASIC's memory. If it's something you want to keep and haven't already got on disk, SAVE it first. If you don't erase the program in memory before starting on another, you will usually wind up with an unusable, unexecutable combination of lines from both your programs.

Starting A Program After Stop If a program has been stopped using the run/stop key, it can be resumed by entering CONT, followed by a carriage return.

STAT CP/M. STAT command is used in CP/M to display the status of device assignments or the available disk space for program storage. It also provides information on the status of the TPA (Transient Program Area). See also CP/M Commands.

State Capitals* Choose an area of the country, then pick out the capital of each state from a list of three cities. For elementary students. Cassette. Comm*Data Computer House.

State Table A list of the outputs of a logic circuit based on the inputs and the previous outputs. Such a circuit has memory and cannot be described by a simple truth table. Also called state-transition table.

Statement A string of characters which is a syntactically complete instruction with respect to a high-level language translator.

States and Capitals* Test your knowledge of capitals and states. Half a dozen wizards are used to make learning more enjoyable. Numbers on their foreheads are erased when questions are answered correctly. At the end, the total score is calculated. For ages twelve and up. Cassette. Micro-Ed.

Static Memory MOS (Metal Oxide Semiconductor) memory which uses a flip-flop as a storage element. It does not need to be refreshed and does not require a clock, and it maintains its contents as long as power is applied.

Static RAM RAM memory circuits which retain their contents as long as power is applied.

Statistics Sadistics* Aids in analyzing statistical information such as median variance, standard deviation, probable error, and so forth. Disk; printer required. Powerbyte.

Status After each input operation, the KERNAL automatically checks for any errors incurred with that operation. The errors are coded and defined with the variable name ST. The user can use ST to check on the status of a peripheral device. See KERNAL.

STATUS A table of STATUS code values for tape, printer, disk and RS-232 file operations is shown below:

ST Bit Position	ST Numeric Value	Cassette	Serial Bus R/W	Tape Verify and Load
0	1		write time out	
1	2		read time out	
2	4	short block		short block
3	8	long block		long block
4	16	unrecoverable read error		any mismatch
5	32	checksum error		checksum error
6	64	end of file	EOI	
7	-128	end of tape	device not present	end of tape

Status Bit Handshaking The delegation of certain bits of a parallel I/O port to coordinate information transfer with a peripheral device. Status bits are used to indicate device read, buffer full, printer out of paper, etc.

Status Register The 6510 microprocessor contains an eight bit register called the status register. Each bit in the register is set independently of the others and is set by the result of particular operations performed by the microprocessor. The bits are also referred to as flags and are as follows:

Zero flag bit—Set when the result of certain operations is equal to zero.

Carry flag bit—Set when an arithmetic operation results in a carry or when a shift moves a bit into the carry flag.

Overflow flag bit—Set when an arithmetic operation results in a carry from bit 6 to bit 7.

Sign flag bit—Set when the result of an operation yields a value where bit seven is set.

Break flag bit—Set when an interrupt is caused by the break command.

Decimal flag bit—Set by the user when the numbers operated on are binary coded decimal.

Interrupt flag bit—Set by the user or by the microprocessor to prevent any further interrupts.

Stepper Motor A mechanical device which rotates by a fixed amount each time it is pulsed. Often used in disk drives.

Stock* Calculates statistics useful to investor in the stock market. The user enters the following data for pre-

vious consecutive years for any stock of interest: net worth before taxes, gross sales, earnings per share, book value, high stock price, low stock price, and dividends. The program then calculates percentages for revenues, earnings per share, pre-tax profit, amount earned annually on invested capital, average payout, the average and current yield, highest and lowest price earnings ratio, the average high and low price earnings ratio, the annual high and low price earnings ratio, and the annual percentage payout and yield. The user is asked to forecast a future high earnings per share, a future low earnings per share, and a future low stock price. From this, the program calculates buy and sell ranges and up-side/down-side ratios. This program only allows for annual statistics and is therefore better suited to "fundamental analysis" than to "technical analysis." The program can output to a printer and actually display bar graphs. Values entered must be in decimal form. Printer required. Custom Software Design.

Stock Market Software See Stock; Stock Ticker Tape, The; Super Broker, The.

Stock Ticker Tape, The* Turns your computer into a tool for collecting information on the stock market and other investments. Also has the potential to tie into large databases for financial updates. Disk; printer required. Powerbyte.

STOP The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle I/O operations. By jumping to address $FFA2, STOP checks to see if the stop key was pressed during a UDTIM routine. If the stop key was pressed, the Z flag is set; if not, the accumulator contains a byte representing the last row of a keyboard scan. See KERNAL.

STOP BASIC Statement. The STOP statement terminates program execution and returns to command level. The format is:

STOP

You may use STOP statements anywhere in a program to stop execution. When BASIC sees a STOP statement, it displays the message:

Break in <xxxxx>

<xxxxx> is the line number where the STOP occurred.

STOP statements do not close files, as do END statements. BASIC will always return you to command level following execution of a STOP statement. By using the CONT command, you can resume execution of the program. See CONT.

STOP statement functions differently in Compiler BASIC. See your Compiler Manual for more information.

Stop BASIC Program see STOP and END.

Stop-Bit In some computers, bytes of data sent to or from the system must be prefaced with blank bits. These bits are called stop bits. Usually either one or two are required. If the Commodore 64 is connected to another system requiring these stop bits for RS-232 transmission, they can be programmed by using the control register address 659.

Storage Synonym for Memory.

Story Problems in Addition and Subtraction* A series of stories in a medieval setting that contain math problems. It takes concentration and understanding to master this program, but the computer can be used for assistance. Cassette. Micro-Ed.

**STR$** BASIC Function. STR$ function returns a string representation of the numeric value in <x>. The format is:

v$ = STR$ <x>

<x> is any numeric expression.

When <x> is positive, the string returned by STR$ contains a leading blank (the space reserved for the plus sign).

Strain Gauge A sensor which produces a voltage or resistance change when a force is applied.

String An ordered sequence of data items, such as characters. For example, the word "string" is a string of six characters. See Character String.

String, Length of See LEN.

String, Numeric Value of See VAL.

String Data String variables and constants refer to groups of characters, either alphabetic or numeric. Though they may contain numbers, they are viewed by the computer as symbols without value. These characters can be concatenated and compared, but cannot have arithmetic operations performed on them. They are recognized by either being in quotation marks or as variables ending in the % sign. The expression "27"*"2" or A$*B$ has no meaning. The expression A$ + B$ will concatenate the two strings to yield a third string. The two strings are equal if they match character per character.

String Handling The ability of a programming language to operate on strings of characters.

String Too Long An error message generated by the Commodore 64 when a string greater than 255 characters is read. Be sure that when you input multiple variables, you include delimiters (commas, semicolons, or returns) between variables.

String Variable BASIC. String variable names (for characters) must start with a letter and can have up to 40 characters (but only the first two are considered). Also they must not use any reserved words, such as: IF,ON, THEN, GOTO, etc, or a reserved word followed by a type declaration character ($,%). String variables can hold 0 to 255 alphabetic, numeric, or special characters. See Reserved Words for a complete list of BASIC reserved words.

**STRING$** BASIC Function. Gives a string of length <n> whose characters all have ASCII code <m> or the first character of x$. The format is:

v$ = STRING$(<n,m>) v$ = STRING$(<n,x$>)

<n,m> must be in the range 0 to 255.

<x$> can be any string expression.

<v$> is a variable.

Strobe A selection signal that is active when data is correct on a bus.

Structured Language A computer language which aids or enforces structured programming. Control structures such as IF...THEN, ELSE, DO, WHILE, CASE and REPEAT, UNTIL, together with provisions for declaring logically separate program modules such as procedures, and limiting the scope of variables, all lend a modular structure to programs. Unconditional control transfer statements are often left unexecuted. Some popular structured languages are Pascal, ALGOL, and BASIC.

Structured Programming A set of techniques that improve the reliability and comprehensibility of programs by increasing programmer discipline. Structured programming involves precise problem specification, top-down or stepwise program design, and block-structured or modular programs.

STTL See Transistor-Transistor Logic.

Studio 64* A word processor for music. The operator copies the notes into the computer straight from the music sheet. The notes will print on the screen as they are copied or as they are played. Bars and notes can be moved around and composition may be saved and recalled at the touch of a button. Three voices of four waveforms each allow for rich harmony and full bass. Entech.

STX STore X register in memory. An Assembly code instruction for the 6510 microprocessor that copies the contents of the X register into the memory specified by the argument. The contents of the X register are not altered and none of the flag bits are changed. The addressing mode for the argument can be zero page, zero page Y, or absolute.

STX-80 printer* A compact, inexpensive thermal printer compatible with most personal computers. Features 80-column characters, true descenders, foreign language characters, and block graphics. Star Micronics, Inc.

STY STore Y register in memory. An Assembly language instruction for the 6510 microprocessor that copies the contents of the Y register into the memory specified by the argument. The contents of the Y register are not altered, and none of the flag bits are changed. The addressing mode for the argument can be zero page, zero page Y, or absolute.

Sub-Harmonic A fractional multiple of the fundamental frequency.

Subject and Predicate* After reading their definitions, the student is to identify the complete subject, the simple subject, the complete predicate, and the simple predicate in twenty sentences. Recommended for elementary ages and older. Cassette. Micro-Ed.

Subroutine BASIC. A program segment identified by name and often bracketed by a "subroutine" and a "return" statement. Execution is transferred to a subroutine when a subroutine call occurs. Subroutines improve program modularity and save memory space at a minimal cost in the overhead required to process the call/return sequence. See GOSUB.

Subroutine Passing parameters (also called arguments or data) makes information from one process or program available to another process or program. Similar to a football pass, except that one or more bytes of data replaces the football. Also, the receiver is a program. The sender may be a program or a person typing the data onto a command line to be "passed" to a program.

Subtract It* The use of big numbers can help early grades with subtraction. Cassette. Comm*Data Computer House.

Subtracting With Objects* Presents a series of problems in which subtraction skills are tested. Recommended for primary grades. Cassette. Micro-Ed.

Subtraction* Borrow sums of your choice, and you can increase your skill with mathematical functions. Disk or cassette. Microcomputer Workshops.

Subtraction 1 Tutor* Helps youngsters master subtraction with visual aids. Cassette. Comm*Data Computer House.

Subtraction 2 Tutor* Advanced version of Subtraction 1 Tutor in which larger numbers and the concept of borrowing are introduced. Cassette. Comm*Data Computer House.

Suffixes* The student is presented with a selection of incomplete words and a selection of suffixes. The student's performance is rated at the end of each lesson. The suffixes used in this program are: ment, tion, ance, sion, ness and ence. Elementary level. Cassette. Micro-Ed.

Sum-It Mountain* You must do a series of addition problems to climb up the face of the mountain. Cassette. Micro-Ed.

Super Broker, The* A less sophisticated version of The Stock Ticker Tape* that gives fast answers based on a small amount of information. Disk. Printer required. Powerbyte.

Super Budget* Helps you manage a yearly budget for your home or office. You can review monthly data and yearly totals, as well as print bar graphs for greater understanding. RAK Electronics.

Super Checkbook* Helps you manage your checkbook with monthly balancing. Data can be saved for yearly records. RAK Electronics.

Super Disk* A disk drive that is compatible with most Commodore computers. Has similar capacities to Commodore disk drives and offers RAM area within the disk unit and an IEEE and serial bus interface. Southwest Micro Systems, Inc.

Super Shopper* Helps you to manage your food budget and avoid impulse buying. Prints your shopping list. Powerbyte.

SuperTerm* A telecommunications package for the Commodore 64 that allows the user to communicate with other computer networks via phone lines. The package incorporates many advanced features such as an 80/132 column display mode (with side-scrolling); eight standard and fifty-two user-defined function keys; a receive, transmit, program and screen buffer; and full-screen editing of the receive buffer. Disk commands are accessible from within the program mode and options are available to change modem and printer settings to adapt to the appropriately interfaced hardware. Midwest Micro Associates.

Supplies See Cables & Adapters; Interface Boards; Monitors; Power Supplies and Protectors; Video Boards.

Support Chips All the components beyond the main device required for complete system operation.

Survivor* Select the crew of your starship to face the gallactic battle. Synapse.

Sustain—Sound The level at which the volume of a note is maintained until it falls off to zero.

SUT Socket Under Test.

SW Status Word.

Switching Regulator A power supply design providing regulation by commuting the input voltage into a filter circuit.

Symbol Table A table constructed by an assembler or compiler to associate symbolic names with actual addresses or values.

Symbolic Describes the use of characters or character strings in a defined syntax to stand for machine-related entities such as instructions or data.

Synchronous Operation controlled by a mutually sensed clock pulse.

Synchronous System A system in which all events are synchronized with a common clock pulse.

Syndicator, The* Helps you make the right investment decisions through advanced calculations. Disk; printer required. Powerbyte.

Synonym Series* Three programs involving matching synonyms in two columns of words and expressions. For high school students and adults. Cassette. Micro-Ed.

Synonyms* You read a sentence with one word underlined then choose one of five other words with a similar meaning. Good practice for fourth to eigth graders. Cassette. Comm*Data Computer House.

Syntax The rules governing proper construction of statements in a language. For programs, the rules include spelling and placement of keywords, spelling and type of data names, and number, type, and order of arguments. Punctuation rules are also usually part of syntax.

Syntax Check A check, performed by a program or person, to ensure that one or more statements in a programming language complies with all syntax rules of the language. A program may pass all syntax checks and still give an error message or erroneous results due to logic, data, or program flow problems.

Syntax Error Message BASIC. An error message from the Commodore 64 that appears when the computer reads a line and does not recognize the BASIC command. Even the slightest variation away from the format listed in the user's guide or reference guide will result in a syntax error. Be sure to include commas and parentheses where shown.

Syntax Error Message From the 1541 disk drive. An error message from the 1541 disk drive first indicates that the drive could not understand one of the commands sent to it. Specific syntax errors can be determined by reading the error number off the error channel (#15). They are as follows:

31 The drive does not understand the command sent. Make sure the command is in the correct format.

32 The command sent has exceeded the 58 characters allowable in a command.

33 The user has attempted to use pattern matching incorrectly in the LOAD or SAVE commands.

34 A file name is missing from a command or a colon is absent.

39 The disk does not recognize a command sent through the command channel (#15).

Synthy-64* Sound utility package that adds special commands to Commodore's BASIC language. These commands are executable in either the direct mode or in the program mode as long as the Synthy-64 interpreter resides in computer memory. The program lets the user enter music, using common notation (*instead of PEEKs* and POKEs in BASIC or addressing sound chip registers in Machine Code). For example: notes are entered by their alphabetic representation, followed by the octave number and the duration of the note. Key signature, flats, sharps, and rests are similarly entered. The volume of a note, as well as the tempo of the composition, can also be altered using single character commands. The Synthy-64 lets the

user exploit the full sound/synthesizer capability of the Commodore 64 without a lot of programming experience or knowledge. Abacus Software.

SYS A statement that transfers control of the microprocessor to a Machine language program located at the address specified. This statement is used in a BASIC program to jump to a Machine Code program somewhere in memory. The format is:

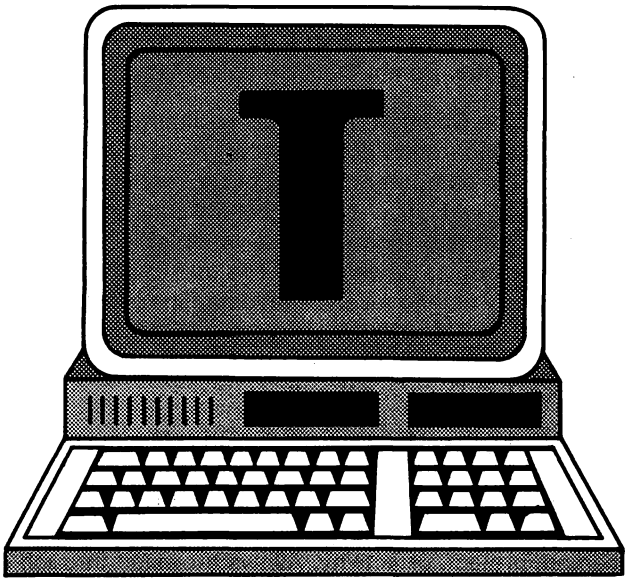
SYS <address>

This is the decimal address of a machine program in ROM or RAM. There must be a return at the end of the Machine Code to bring control back to the BASIC program.

SYSGEN CP/M. The SYSGEN program is available on disk in standard CP/M. It loads the system into memory and makes a copy of the system disk for safe keeping. See also CP/M Commands.

System A group of programs which accomplish some function (e.g., database management system), or a group of interconnected devices (e.g., turn the system off), or both taken together (e.g. a total accounting system).

Systems Software A software package is a group of computer programs, possibly including data files and documentation, which perform a function or group of related functions on the computer. These programs are cal led applications software when they perform tasks not directly serving the functioning of the computer. Examples would be a word processing package, an accounting package, etc. Systems software packages, on the other hand, facilitate the use of the machine; these include disk operating systems and program development packages.



T Codes. ASCII = 84, CBM ASCII = 84 or 212, HEX = 54. t—ASCII = 116, CBM ASCII = 84, HEX = 74. Screen code = 20 or 84. See CBM ASCII.

T An electrical network shaped like the letter "T". It has one input, one output, and one ground lead. It is used with resistors for attenuators and capacitors, and with inductors for filters. Also: True-a logical 1.

TAB BASIC function. Tabulates to position (n). The format is:

PRINT TAB<n>

<n> must be in the range 0 to 255.

If the current print position is already past space <n>, then TAB goes to position <n> on the next line. Space 1 is the leftmost position, and rightmost position is the defined WIDTH. TAB can only be used with PRINT and LPRINT.

Tab, Adhesive See Write-Protect.

Tabbing Moving the CRT cursor or printer head to a predefined column on the screen or paper, called a tab stop.

Table Look-up Method of converting one variable to a corresponding value, or verifying its accuracy by searching a list or table of entries for the known keyword or value. The corresponding values may then be extracted from corresponding positions in the table, much like looking up a name in the phone book to find the corresponding phone number.

Tachistoscope* Tests your memory by flashing words onto the screen and asking you to make an exact copy. Five speeds are available to increase your memory capablilities. Cassette. Micro-Ed.

TALK The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address FFB4, TALK commands a device on the serial bus to act as a talker. Prior to using this routine the accumulator must be loaded with the device number. See KERNAL.

Talker The Commodore 64 utilizes a serial bus to connect to the 1541 disk drive and some printers. Since more than one device may be present on the serial bus at one time it is important that only one be transmitting data at a time. When data is INPUT# from a particular device, the Commodore 64 (using appropriate command signals and specific device number), sets that device as a talker. Only that device can put data onto the data lines until the Commodore 64 sends the unTALK command to it.

TAN BASIC Function. Gives the trigonometric tangent of (x). The format is:

<v> = TAN(x)

(x) is the angle in radians. Multiply by PI/180 to convert degrees to radians. PI = 3.141593

Tape Genl, The* Keeps track of your other programs. Information is stored regarding program name, location on tape, number of cassette and so on. Powerbyte.

Tape, Magnetic An inexpensive mass storage medium which requires a sequential access. It is convenient for large files or archival storage. It is often the only external storage on small systems and used as a backup on larger systems.

Tape Worm, The* Organizes your records and tapes and can search for entries by album title or other key word. Powerbyte.

Target Math* Solve math problems to keep a sky diver on target through multiple levels of difficulty. Performance in each math category is summarized. Cassette. Micro-Ed.

Task A particular execution of a program.

TAX Transfer Accumulator into X register. An Assembly language instruction for the 6510 microprocessor that copies the contents of the accumulator into the X register. The accumulator is left unchanged. The sign flag bit and zero flag bit can be affected by the word being transferred.

Tax Advantage, The* A year-round tax organizer that can prepare your 1040 or keep track of information for your accountant. Prompts you to fill in the 1040, or other form, line by line, with function menu and help readily available. Prints out schedules. Interfaces with The Home Accountant*. Disk; printer required. Continental Software.

Taxman—Income and Expenser* Builds and properly maintains files of income, expenses, and other financial data that are received by the Internal Revenue Service. Disk; printer required. Powerbyte.

TAY Transfer Accumulator to Y register. An Assembly language instruction for the 6510 microprocessor that copies the contents of the accumulator into the Y register.

The accumulator is left unchanged. The sign flag bit and zero flag bit can be affected by the word being transferred.

TBMT Transmitter Buffer EMpTy. One of the five status bits of a standard UART. It becomes true when a buffer may be reloaded. See PE.

TD Transmitted Data (RS-232C standard).

TDM Time-Division Multiple access. A networking, time-sharing technique used for regulating signal flow between terminals.

Teletype One of the oldest peripherals for communication with a computer. At 10 characters per second (or 110 baud), it is quite slow.

Terminal Emulator See Terminal Program.

Terminal Mode A mode of operation of a general purpose computer such that its CRT and/or printer can be used as a terminal for another computer. Also called terminal emulation.

Terminal Pak Series* This hardware and software package is a terminal emulator that will convert your system into a terminal. You can select the baud rate compatible with the modem used. Micro Systems Development, Inc.

Terminal Program Software that allows the user to communicate with other computers through a modem. The program reads from the modem and prints characters typed in via the keyboard. This type of information exchange is called electronic communications. Many sophisticated terminal programs available for the Commodore 64 allow communication with other computers. These programs also provide upload/download facility and options to change modem and printer settings. Other features may also be available depending upon the specific product. Look under its product name for more details on specific products.

Test Data A programmer must insure that a program will correctly process all of the types of data for which it is intended. Samples of the data are prepared (test data) and the program is executed using this data (a test run). The program's outputs (reports, screen displays, files, etc.) are then verified to be as specified. An error in the processing logic of a program is called a "bug," hence the term "debug" and "bug-free."

There/Their/They're Helps children learn the correct uses of these troublesome "sound-alikes". Cassette. Micro-Ed.

Thimble Printer Prints fully-formed characters with a "thimble." The thimble is like a daisy wheel type element with the type petals bent up 90 degrees to form a cup or thimble shape.

**TI$** See Time$.

Tic-Tac Math* Math program based on the old game. Helps elementary students sharpen their math skills. Cassette. Comm*Data Computer House.

Tic-Tac States* Great game to help youngsters learn states and their capitals offering various levels of difficulty. Cassette. Comm*Data Computer House.

**Time$** The Commodore 64 has an internal timer (jiffy clock) to synchronize activity within the system. On powering up the computer, the jiffy clock begins setting the variable TI$ with six characters which correspond to the hour, minute, and second. These variables increase constantly as long as power is on. The user can refer to this variable any time to receive that data. The user can reset TI$ by letting TI$ =000000. Using tape I/O alters TI$. TI$ is a reserved variable and can not be used for any other purpose. See Reserved Words.

Time Management* A scheduling and planning program for the Commodore 64. It records appointments/activities according to responsible person(s), dates, and categories. Reports may be organized and printed based on person, project, or activity. Allows browsing through or sorting reports according to beginning or ending dates. Comes with easy to follow documentation. TOTL Software, Inc.

Time Zones* Teaches elementary students about the time zones of the United States. Cassette. Micro-Ed.

Timeout Some operations performed by a computer or peripheral are given certain amount of time to be completed. If the operation has not been completed in that time a timeout occurs and the computer goes on with another operation. An error message may be shown. For example, when the Commodore 64 microprocessor tries to send information to the disk drive, it begins a series of operations to tell the disk drive that information is about to be sent. The disk drive has one millisecond to tell the microprocessor that it is ready to receive data (it grounds the data line). If the microprocessor doesn't hear from the disk drive then it sends to the screen a "device not present" signal and does not proceed with the data transmission.

Tiny BASIC Compiler* Allows you to increase the execution speed of your BASIC programs. While it does not permit all Commodore BASIC commands, it does permit all floating point and integer arithmetic. Abacus Software.

TKSA The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle I/O operations. By jumping to address FF96, TKSA moves a secondary address from the accumulator to the serial bus. This routine is only used after completion of a TALK routine.

Tooth Invaders* As the protector of teeth you must fight tooth decay with all the products at your disposal. Commodore.

Totl.Label* Generates a mailing list. Allows the user to set up the format, deciding how many lines and how many characters per line, with a maximum of 254 characters per label. The first line can be used to sort, and can be masked

so it will not be printed. The printing instructions can be modified by the user to accommodate most types of labels and printers. The user can pattern match the first line to isolate a single label but the process must be continued manually each time to obtain all the matching labels. Also, the files are kept sequentially and are therefore rather slow. Cassette. TOTL. Software Inc.

Totl.Text* An inexpensive word processing package for the Commodore 64. It can be used with tape or disk and supports a wide variety of printers. The start-up options are menu-driven and easy to understand. The program is written in BASIC, so it is slower than word processors written in Machine language. However, the updated version of Totl.Text (version 2.6) is available with a Machine language program (Chickspeed) that speeds up loading and printing. The program supports many edit and format features as well as a few special print functions such as underline and enhanced and expanded text on certain printers. Text entering and editing is done in blocks of 255 characters, which makes processing slow. The function keys have specific edit functions which makes moving through text blocks easy. The documentation contains special instructions for modifying the main program as well as set-up routines for specific printers. The Totl.Text is capable of handling a variety of word processing tasks and is a good buy for novice users unfamiliar with word processing. It lacks , however, the sophistication and speed of many currently available quality word processors such as WordPro3 Plus or Easy Script. Disk or Cassette. TOTL. Software Inc.

To/Too/Two* Learn the proper grammatical uses of these homonyms. Cassette. Micro-Ed.

Touch Typing Tutor* Learn to type quickly and accurately at your own rate with this nineteen lesson program and twelve page manual. Disk or cassette. Taylormade Software.

Toystore* Teaches math in a toystore setting, by having students keep track of prices and figure out the balance after expenditures. Comm*Data Computer House.

TPA CP/M. Transient Program Area. This is the area of memory in CP/M allocated for loading user programs to be executed. A program often takes up more memory by occupying CCP and related areas used by various CP/M subroutines. When it finishes execution, command is given back to the CCP.

Track The 1541 disk drive saves data onto a disk in concentric rings called tracks. Each ring or track is divided into sections called sectors with each sector containing 256 bytes of information. Since the circumference of the tracks decreases toward the center there are fewer sectors per track in the middle of the disk than on the edge. There are 35 tracks per disk on the 1541 disk drive. When a disk is placed into the disk drive for the first time the tracks and sectors must be labeled or formatted, before the disk can be used to save data.

Track My Weight* Helps dieters keep track of their progress. Shows losses (and gains) with black and white charts to keep you on the road to your objectives. Powerbyte.

Trail West* Hang on to your units as long as you can during your two thousand mile journey to the California gold fields. Cassette. Micro-Ed.

Transient Program Area CP/M. See TPA.

Transistor An electronic device which can use one electrical signal to influence another. The two main uses of transistors are as amplifiers and switches. Used as an amplifier, a transistor uses the changes in a small signal to make large changes in a large signal. Used as a switch, the transistor opens or closes a circuit depending on the state of a controlling signal.

Transistor-Transistor Logic TTL. Logic circuits (AND, OR, NOT, etc.) that use transistors as switching units. TTL is the standard for microcomputers, because of its combination of speed, signal-to-noise ratio, and low-power designation. There are other logic designs that are superior in any one of these characteristics, but not in the combination of all three.

Tree Structure A collection of data organized so that each item is linked to one or more other items, creating a spreading network of linkage analogous to the branches of a tree. Genealogical data provide the classical model—each person has exactly one mother, but may have zero or more daughters. An example of data organized in this way might be the parts list of an airplane. The main entry is for the entire airplane. It is linked to the major components, such as wings, fuselage, tail. Wings, in turn, are linked to their smaller components, such as flaps, engine supports, engines, etc. Each of these can be further linked to smaller and smaller subassemblies, until individual parts such as nuts and bolts are reached.

Trek* An exciting version of the popular story has you commanding the starship and exploring new worlds. Cassette. Victory Software.

Trek* You are the commander and must pull your ship out of a very dangerous orbit. Cassette. Aardvark.

Triangles* Teaches triangle classification and description to junior high school students. Cassette. Comm*Data Computer House.

Triangular Waveform A triangular wave consists of a fundamental frequency and its odd harmonics, each in proportion determined by the reciprocal of the square of its harmonic number. Therefore the third harmonic is only 1/9th as loud, and the fifth harmonic is only 1/25th as loud. See also Harmonic.

Troublesome Pronouns* Students decide if pronouns are used correctly in twenty sentences. Includes performance rating. Datasette. Micro-Ed.

Truth Table A table showing the logical value (true or false) of a compound logical expression, based on the logical value of the simple components of the expression. Example:

A	B	A or B
T	T	T
T	F	T
F	T	T
F	F	F

This table reflects the definition of OR: A or B is true if and only if either A or B or both are true.

TSX Transfer Stack pointer to X register. An Assembly language instruction for the 6510 microprocessor that transfers the contents of the stack pointer into the X register. The stack pointer is left unchanged, but the sign flag bit and the zero flag bit can be altered by the word being transferred.

TTL See Transistor-Transistor Logic.

Tutti Frutti* Addition program for elementary students that can increase their ability to combine mixed numbers. Cassette. Micro-Ed.

Two-Minute Warning* Effectively teaches subtraction through playing football at the goal line with the clock running out. Cassette. MicroEd.

Two-Pass See Pass.

TXA Transfer X register to the Accumulator. An Assembly language instruction for the 6510 microprocessor that copies the X register contents into the accumulator. The X register is left unchanged but the sign and zero flag bits are affected by the transfer.

TXS Transfer X register to the Stack pointer. An Assembly language instruction for the 6510 microprocessor that copies the X register contents into the stack pointer. The X register is left unchanged, but the sign and zero flag bits altered.

TYA Transfer Y register to the Accumulator. An Assembly language instruction for the 6510 microprocessor that copies the contents of the Y register into the accumulator. The contents of the Y register are not altered, but the sign flag bit and zero flag bit are affected by the word being transferred.

TYPE CP/M. Displays the contents of the file specified on the screen. The format is:

TYPE<filename>

Type Declaration Character BASIC. Variable names can end with a type declaration character: $ for string variables and % for integers from -32768 to +32767. Variables can be any length but only the first and second character are used. If a variable is not followed by a true declaration character, then it is assumed to be a floating point.

Type Mismatch An error message from the Commodore 64 that appears when a variable designated as either numeric or string is equated with the wrong type. If you attempt to equate A="g" you are trying to make a floating point variable equal to a character. Be sure and use quotation marks around string data.

Types of Variable Names—Rules in BASIC

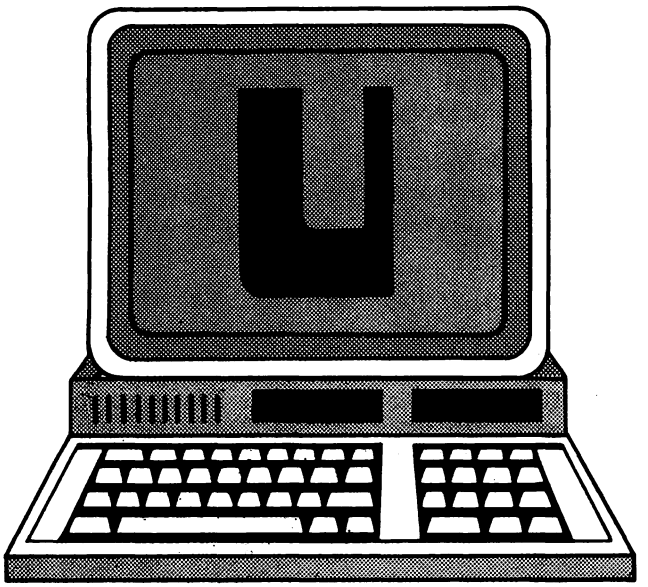
a) must start with a letter

b) can be any length but only the first two are considered.

c) cannot be a reserved word such as IF, ON, THEN, GOTO, etc. or a reserved word followed by a type declaration character ($, %,), !, #). See Reserved Words for a complete list.

d) end with a type declaration character: $ if a string variable (for 0 to 255 letters, numbers, punctuation marks, and other characters); % for numeric integers (whole numbers from -32,768 to +32,767.

Also, the default value for the type of variable is Floating Point, so any variable name not ending in $, %, or ! is automatically a numeric integer variable.



U Codes. ASCII =85, CBM ASCII = 85 or 213, HEX = 55. u—ASCII = 117, CBM ASCII = 85, HEX = 75. Screen code = 21 or 85. See CBM ASCII.

U Underflow. A lower case u is sometimes used to represent the Greek letter mu meaning micro.

U1 See User1. Disk Command.

U2 See User2. Disk Command.

U3 or UC Disk Command. Jump to $0500. See User Commands.

U4 or UD Disk Command. Jump to $0503. See User Commands.

U5 or UE Disk Command. Jump to $0506. See User Commands.

U6 or UF Disk Command. Jump to $0509. See User Commands.

U7 or UG Disk Command. Jump to $050C. See User Commands.

U8 or UH Disk Command. Jump to $050F. See User Commands.

U9 or UI Disk Command. Jump to $FFFA. See User Commands.

U; or UJ Disk Command. Power up vector. See User Commands.

UART Universal Asynchronous Receiver/Transmitter. A serial-to-parallel and parallel-to-serial converter. Usually a particular kind of Integrated Circuit used to interface a byte-parallel port to a bit-serial communications network or processor bus.

UCSD p-System An integrated program development system created by Kenneth Bowles at the University of California at San Diego. It includes an operating system, a full-screen text editor, and compilers for Pascal, FORTRAN, and BASIC. Although originally developed to teach programming, it has been enhanced to provide the tools necessary for large-scale programming projects. The "p" refers to an imaginary "pseudo" computer. The system compilers produce "p" code, which is very compact, and which would run on a "pseudo" computer. An interpreter converts the "p" code into acceptable code for the actual computer on which the program is run. This makes the system very "portable," or easy to move between computers. Only a very small interpreter need be written for each computer on which the p-System runs. The p-System now works on over fifty different computers, with new interpreters being written all the time.

The system is highly interactive and consists of five main parts:

1) The full-screen Editor allows you to write both programs and text. It is easy to learn and to use. There is also an Advanced Screen Editor which has editing capabilities equal to sophisticated word processors.

2) The system Compilers convert the source code which you write into p-code. The Pascal compiler is integrated with the editor. When a syntax error occurs, you can return to the Editor at exactly the point where the error was detected. The Compiler error messages are accurate and informative.

3) The system Filer allows you to format disks, and to list, copy, rename, and remove files. Filenames may be up to sixteen characters long. The Filer will also check for errors on the disk and mark any bad areas located.

4) The system Linker automatically links together separately compiled "Units" of p-code. This allows you to build up libraries of useful procedures which can then be used by many different programs.

5) Finally, the interpreter converts the p-code to executable code. This is done automatically when the program is run.

The system is relatively easy to learn. Since it is highly integrated, it is easy to use. Although expensive, it is useful for beginners, as well as professional programmers. There is also a full range of application programs available which run under the p-System including spreadsheets, word processors, accounting programs, and a host of others. Several well-known programs were developed using the p-System, including VisiSchedule from VisiCorp and MBA from Context.

UDTIM The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address FFEA, UDTIM updates the system clock. Normally this routine is called automatically by the system every 1/60th of a second. See KERNAL.

UHF Ultra High Frequencies.

UI+ Disk Command. A user command to set the speed of the 1541 disc drive to be compatable with the Commodore 64. The 1541 when powered on automatically sets the correct speed for the Commodore 64.

UI- Disk Command. A user command to set the speed of the 1541 to be compatable with the VIC 20. The format is:

OPEN15,8,15,"UI-"

Ultrabasic 64* Adds over fifty commands to your system while offering you a variety of graphics and sound effects. Cassette or disk; printer required. Abacus.

UNDEF'D Function An error message from Commodore 64 BASIC that appears when the program encounters an FN statement without first having a DEF FN statement.

UNDEF'D Statement An error message from Commodore 64 BASIC encountered when the computer is programmed to execute a line number that does not exist. If you have a GOSUB statement to a line number that does not exist, this message will occur.

Universal Input/Output Board* This board is a 16 channel analog to digital converter with features that include an EPROM socket for custom programming, one digital to analog output, and 16 high current discrete outputs. Micro World Electronix, Inc.

Universal Parallel Interfaces* Connects your system to almost any Centronics type printer and also gives you access to the printer through the user port. Micro Ware.

Universal Tape Interface & Duplicator A complete Input/Output device that assists when you load, save, or duplicate tapes. Can be used with two recorders. Micro Ware.

UNLSN The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle input/output operations. By jumping to address $FFAE, UNLSN tells all devices on the serial bus to stop receiving data.

UNSTACK Same as POP. To remove from the top of a stack.

UNTLK KERNAL routine to command serial bus to UNTALK. See KERNAL.

UPI Universal Peripheral Interface.

Upload The process of sending data from one computer to another. For the Commodore 64, the computer receiving the data must have the modem (VicModem) set in the A (Answer) position and the sending computer must have the modem set in the O (Originate) position. See also Download.

Ups 'N Downs* Brush up on adding and subtracting fractions and reducing them to lowest common denominator. For elementary students. Cassette. Micro-Ed.

Upward Compatible See Compatible, Upward (Versions of Programs).

USACII-8 See ASCII.

Usage Boners* Using a form frequently found on standard achievement tests, this program asks you to locate common language errors such as a double negative or lack of subject-verb agreement. The computer points correct out format. Performance is rated. Elementary level and error and explains the higher. Cassette. Micro-Ed.

USART Universal Synchronous/Asynchronous Receiver/Transmitter. A chip which handles all the operations associated with synchronous data communications, such as bisync.

USASCII See ASCII.

User A person who owns or uses a computer.

User Command Disk Commands. Enable a programmer to program the disk controller. U3 through U9 are jump commands each to a separate address. Using memory write commands, Machine language routines can be placed in the RAM within the disk drive. The user commands can be used to jump directly to these routines. See U1 through U9. Also see UI+ and UI-.

The format is:

OPEN 15,8,15

PRINT#15,"U3"

User Friendly Programs that have many prompts and instructions for easy use are called User Friendly. You will often be the only operator of programs you write, but if others will ever use your program, you need to give clear prompts (q.v.) for every item of input data and freeze the screen (q.v.) long enough for them to read or act on the information displayed. You should also provide clear error messages if anything is entered incorrectly or errors arise. This is often referred to as "human engineering"—making the program easy to use as well as technically correct.

There are several other guidelines for writing user friendly programs. If a complex series of data items has been typed in but some entries turn out to be invalid, the user should be able to re-enter only the bad items. Error messages should indicate not only that an entry is invalid, but also in just what way it is invalid and, if at all possible, some hints as to how to correct it (such as a list of possible correct values).

User Group A group or club focused on some aspect of computers. Some clubs direct their attention toward one particular computer—there are many Commodore User's Groups in the U.S. Other groups focus on a language (FORTH User's Group, Pascal User's Group, etc), on an Operating System (such as CP/M), on an area of application (accounting, education, science, or graphics) or other aspects of computing. Many magazines on computing carry lists of clubs/groups and report on their activities.

User groups provide a valuable opportunity for exchange of information on hardware, software, and applications. Often you can talk to someone who used a product you are considering buying. User group newsletters may also offer useful information. If you need a programmer or consultant, you may meet or hear about a good one at a User Group meeting.

User1 Disk Command. Similar to Block-Read command. When sent through the command channel the entire block specified in the command is moved from the disk to the channel specified. The Block-Read command on the other hand only moves that portion of the block that has data in it. The format is:

OPEN15,8,15 PRINT#15,"U1:"<channel>,<drive>,<track>,<block>

<channel> is a number from 2-14 previously opened in which data will be moved from disk.

<drive> is the disk drive number. 0 if only one.

<track> is the track number on disk of block to be read.

<block> is the sector number on disk of block to be read.

User2 Disk Command. When User2 is sent through command channel the result is similar to Block-Write command. One block of data is sent from the data channel to the specified block address on the disk. In Block-Write command the buffer pointer is also sent. Used for Random files. The format is:

OPEN15,8,15 PRINT#15,"U2:"<channel>,<drive>,(track>,<block>

<channel> is the channel number 2-14 previously opened through which data will be moved to disk.

<drive> is the disk drive number. 0 if only one drive.

<track> is the track number on disk where block will be moved.

<block> is the sector number on disk where block will be moved.

Users Guide* *The Commodore 64 User's Guide* comes with the Commodore 64. It is for the novice user and demonstrates some of the capabilities of the computer. It includes instructions for hooking up the system, an introduction to the BASIC 2.0 used on the Commodore 64 and some exercises in creating sprites and music. Commodore Business Machines and Howard W. Sams & Co., Inc.

Users Port Located in the rear of the Commodore 64, the Users port allows the computer to interface with a variety of peripheral devices including RS-232 devices. The bottom row of connectors through the port include 8 lines that can be accessed through address 56577 of memory. You can receive or send data through those lines to any peripheral that is voltage compatable. Each line can be programmed to send or receive data by programming the data direction register address 56579 with the appropriate value.

USR BASIC Command. The USR command enables the programmer to jump to a subroutine and enters a number into the floating point accumulator to be used by the subroutine. The address of the subroutine must be POKEd into address 785-786 before calling the USR command. The result of the USR command is the final value placed in the accumulator by the subroutine when it returns to BASIC. The format is:

USR(<n>)

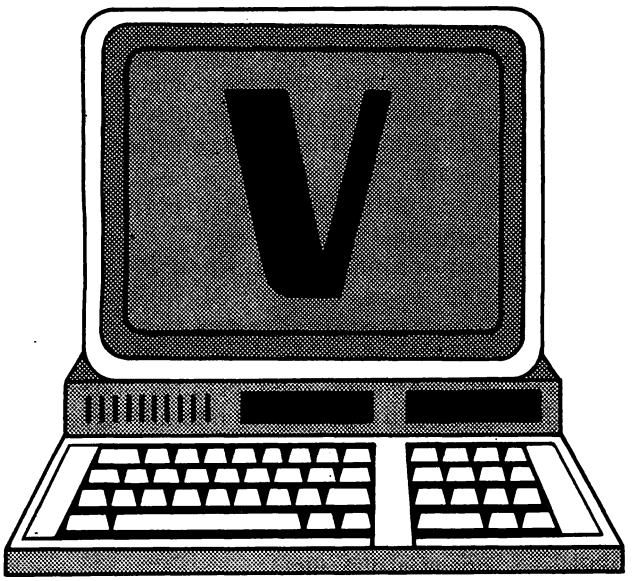
<n> is the value of the argument to be stored into the accumulator.

USR functions differently in the 1541 Disk Drive BASIC. For more information see the USR-Disk manual.

USRT Universal Synchronous Receiver/Transmitter. A serial to parallel converter for high-speed communications.

Utilities The software used for routine tasks. Utilities facilitate or aid the operation and use of the computer for a number of different applications and uses. Examples of utilities are an editor, a sort, a debugger, and a file handler.

Utility Bill Saver* A handy way to keep up with utility usage, double check bill totals, and compare various months of service. Disk; printer required. Powerbyte.



V Codes. ASCII =86, CBM ASCII = 86 or 214, HEX = 56. v—ASCII = 118, CBM ASCII = 86, HEX 76. Screen code = 22 or 86. See CBM ASCII.

V Volt. Also, the oVerflow status flag.

VAL BASIC Function. VAL returns the numerical value of the beginning of string x$. The format is:

<v> = VAL(<x$>)

<x$> is a string expression.

The VAL function strips blanks, tabs, and line feeds from the argument string and selects numeric characters to determine the result. If the first characters of x$ are not numeric, then VAL(<x$>) will return 0. Refer also to STR$.

Example:

PRINT VAL ("52 CASES")

52 READY

Validate Disk Command. The Validate command when sent through the command channel, re-organizes your disk by eliminating gaps and moving files to create larger sections of free space. It also eliminates any files that were opened but not properly closed. The command should not be used on disks that have random files as they will be lost. The format is:

OPEN15,8,15 PRINT#15,"VALIDATE"

Vampire Castle* You are battling Dracula and need all the help you can get. Cassette. Aardvark.

Vanilla PILOT* One of the advanced PILOT language packages available for the Commodore computers. The language comes with a built-in editor that has advanced features accessible by single character commands, such as listing programs, auto line numbering, saving, and loading programs from disk, tracing programs (line by line), replacing, renumbering, inserting, and deleting program lines.

In addition to the standard PILOT commands, the Vanilla Pilot incorporates new commands that use the sound and graphics capabilities of the Commodore 64. The package comes with a 112 page manual that provides an excellent tutorial on PILOT. There is a quiz at the end of each chapter and a quick reference appendix in the back. The documentation is especially useful for programming the Commodore 64 and other Commodore machines. Tamarack Software.

Variable A symbolically named entity which may assume an assigned value or a number of values during the execution of a program.

Variable Names BASIC. See Names.

VDI Video Display Input

VDT Video Display Terminal. The term used in the newspaper community for CRT.

VDU Video Display Unit. The British term for CRT.

VECTOR The name of a Machine language subroutine within the operating system of the Commodore 64 which is part of a group of subroutines referred to as the KERNAL. It is used to handle Input/Output operations. By jumping to address $FF8D, VECTOR reads or sets the systems RAM vectors. If the carry bit of the accumulator is set, VECTOR reads the vectors in RAM and copies them into the memory pointed to by the address placed in the X and Y register. If the carry bit is 0, the vectors listed by the user at the address pointed to by the X and Y registers are copied into the system RAM vector.

Vector Display A CRT which moves the electron beam randomly to trace figures on the screen. Contrast this with a raster display, which sweeps the beam through a fixed pattern, building up an image with a matrix of points. Vector displays are used in many arcade games.

Vectored Interrupt An interrupt scheme where information about the type of event which caused the interrupt is provided by hardware at the time of the interrupt.

Vectoring Automatic branching to a specified address. See Interrupt Machine Code.

Verb* Learn the uses of the verb first by examples and explanations and then test your own skill. Good practice for elementary students and above. Cassette. Micro-Ed.

VERIFY An error message from the Commodore 64 shown when the VERIFY command was used to compare the data in the memory with the data on a tape or disk and an inconsistency was found. Attempt to load or save the program again.

VERIFY BASIC Command. Can be used in program mode or direct mode. The command compares the contents of a BASIC program file on tape or disk with the program that is currently in memory. It is most often used just after the SAVE command to make sure that the program was stored correctly. The format is:

VERIFY <name>,[<dev>]

<name> is the name of the file on cassette or disk to be compared with the file in memory.

<dev> is the device number of the device where the file resides. Eight for disk. If the device number is left out the system assumes device 1 for cassette.

V/F Voltage to Frequency converter.

VHF Very High Frequency.

VIC 20* An inexpensive personal color-output computer from Commodore Business Machines.

Vi-Check* Helps you manage your checkbook. Keeps a current balance, catches duplicate entries, and lists transactions, accounts, etc. United Microware Industries.

VIC-II The VIC-II (MOS 6566 Video Interface Controller) chip is a color video controller device that is responsible for the video output of the Commodore 64 through its forty-seven control registers. The chip is located at address 53248 thru 53294 (HEX $D000 to $D02E). The registers are accessed via a standard 8 bit microprocessor bus. The chip is capable of accessing 16K bytes of memory for its display information. It operates in two modes: the standard character mode and the bit-map mode (standard and multicolor). Its most noteworthy feature is the sprite or (Moveable Object Block) MOB. The VIC chip controls the position, color and the Bit-Mapped description of the sprite. It can be programmed to simulate animation of sprites. Other features of the VIC chip include scrolling, screen blanking, and the Light-Pen registers. See also Sprites, Graphics, Bit-Map Mode, Standard Character Mode, Scrolling.

Vicmodem* A direct connect modem which is directly compatible with the Vic 20 and the Commodore 64. The device utilizes EIA standard RS-232C handshaking signals and is compatible with Bell 103 type modems. The modem is a hardware device to connect your telephone with the computer. It is inserted into the User Port of the Commodore 64 and contains a female socket in which the male end of a modular phone (the part that inserts into the handset) is inserted.

To use the Vicmodem, a program must be running that will open a channel to the device and establish the proper Baud rate, Duplex, parity, word length, and stop bits. These parameters depend on the Computer you are trying to access. Once the parameters are known they are entered into the Control Register and Command Register (Address 665-666) either during an open statement or with the POKE command.

When opening an RS-232 channel, two buffers are created in which data is sent or received. The computer will establish handshaking signals so that data is not lost while trying to send when the other computer is also sending. See RS-232. Commodore.

VIController* A home control system that can maintain lights and appliances, has manual and time control, and uses BSR remote switches. Genesis Computer Corp.

Vic-Tree* Expands the BASIC programming ability of the Commodore 64 by adding a number of BASIC 4.0 commands. As well as providing the commands listed below, Vic-Tree facilitates the use of a printer with a Centronics Standard interface. The added commands available with Vic-Tree are:

APPEND	adds additional information to a sequential file.
BACKUP	duplicates a disk when using dual disk drives.
CATALOG	lists file names of a disk.
CHAIN#	will load a program within a program.
COLLECT	checks files on a disk for format and errors.
CONCAT	joins two smaller files into one large file.
DCLOSE	closes specified disk file.
DIRECTORY	is the same as catalog.
DLOAD	loads BASIC or Machine Code files from disk.
DOPEN	opens a disk file.
DSAVE	saves a file to disk.
EXECUTE	loads a program file from disk *and runs* the program.
HEADER	prepares a disk for use by either formatting it or clearing the directory.
INITIALIZE	prepares a disk drive for use by updating the BAM in memory.
RECORD	locates specific records within a file.
RENAME	changes the name of a file on disk.
SCRATCH	deletes a file from disk.
SEND	transmits a disk command to the disk controller.
USE	changes the default values for drive number, device number, and secondary address.
@@	loads and runs user-defined commands on disk.
AUTO	starts automatic line numbering.
BASIC	enables the BASIC editor.
CHAIN	loads the program from the disk and places it at the end of a program currently in memory.
CHANGE	searches through text for specific words and changes those words according to the user's wishes.
DELETE	removes specified lines from memory.
FIND	searches BASIC of literal text for specific data and prints the line number where that data is found.
LCOPY	copies lines in a program to another location in memory.
LITERAL	enables the user to enter text rather than BASIC commands.
LMOVE	moves a line or lines to a new location in memory.
MERGE	will load a program from disk and merge it by line number with a program in memory.
OFF	disables automatic line numbering.
PAGE	allows user to list just enough lines to avoid scrolling off the screen.
RENUMBER	renumbers lines of a program.

TYPE	lists a word processing document with the line numbers.
DUMP	displays variables which are not part of an array.
HELP	finds errors in programs.
TRACE	executes one line at a time with a delay to allow the user to see the result of the execution.
	Cartridge.

Video Boards* See Screenmaker.

Video Interface Chip Also referred to as the VIC-II chip (MOS 6566) is a video controller device, responsible for the color video output of the Commodore 64. See VIC-II.

Video Pak A device for converting the video output of the Commodore 64 into an 80 column by 25 line screen. See Z-80 Video Pak for additional information. Data 20.

Video Signal An electronic signal containing information specifying the location and brightness of each point on a CRT screen, along with timing signals to place the image properly on the screen.

Video-300* A 12" green phosphor video monitor. It has a non-glare screen for no-strain viewing, 18 MHz bandwidth and 900 lines (center) resolution and compatibility with every computer. Amdek Corporation.

Video-300A* A 12" amber phosphor video monitor with a non-glare screen for no-strain viewing, 18 MHz bandwidth and 900 lines (center) resolution, compatibility with every computer or word processing system and UL FCC approved and composite input. Amdek Corportion.

Video-310A* A 12" amber phosphor video monitor. The TTL input is IBM compatible. The system features a non-glare screen for 18 MHz bandwidth and 900 lines (center) resolution. Amdek Corportion.

Vik Dubber* An interface which allows you to hook up to one or two cassette recorders and clarify the incoming data. Bytesize Micro Technology.

Virtual Address A user- or system-generated address which references objects in a logical address space regardless of the physical memory location where they reside. A virtual address must be translated by the operating system into a valid physical address which may, in turn, involve the movement of data between primary and secondary storage (usually disk).

Virtual Memory The memory address space available to any process running on the processor. It may be larger than the physical memory.

Visible Solar System* An entertaining way to learn about our solar system as you journey from planet to planet. Includes Astro Calc. Commodore.

VLSI Very Large Scale Integration. A technology holding over 10,000 transistors per chip.

VMOS Vertical MOS (Metal Oxide Semiconductor). The technology used to increase, per square inch, the density of components, by cutting a V-shaped groove in the silicon substrate.

Vocabulary Series* Vocabulary exercises using words frequently encountered in news publications. Consists of seventy-two lessons in twenty-four programs. For advanced elementary and high school students. Cassette. Micro-Ed.

Volatile Storage Storage which loses its contents when power is removed.

Volume The volume in the Commodore 64 sound synthesizer is controlled by chip register 24, (i.e. 54272+24). The lower 4 bits set the volume anywhere between 0 and 15.

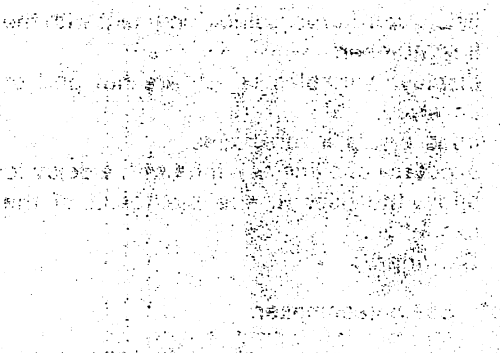
VOM Volt Ohm Milliammeter. A test instrument for measuring voltage, resistance, and current. It is usually portable, with an analog meter or digital display for readout.

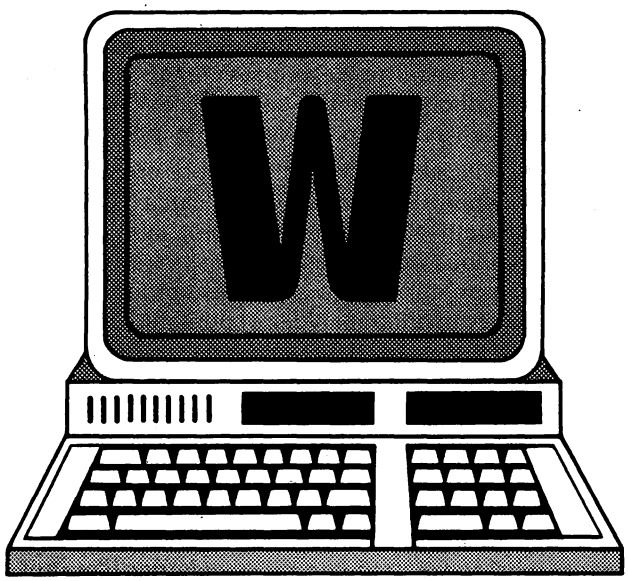
Vowel Kong* Climb the ladder to beat Kong in the search for long vowels. Get the answer wrong and you climb down the ladder. Recommended for third through fifth grade students. Cassette. Comm*Data Computer House.

VSS Voltage for Substrate and Sources. The ground for MOS circuits.

VSYNC Vertical SYNC signal in a TV. It determines the vertical position of the image.

VTR Video Tape Recorder.





W Codes. ASCII = 87, CBM ASCII = 87 or 215, HEX = 57. w—ASCII = 119, CBM ASCII = 87, HEX = 77. Screen code = 23 or 87. See CBM ASCII.

W See Write entries.

Wafer A slice of a silicon ingot on which integrated circuits are fabricated. After testing and fabrication, the wafer is cut up into individual circuits called dice or chips. The dice are packaged, sorted, and tested before being used as finished IC components.

WAIT BASIC Statement. Suspends program execution while monitoring the status of a specific address in memory. The format is:

WAIT <add>,<n>[,<m>]

<add> refers to the address in memory and may be in the range 0 to 65535.

<n><m> are integer expressions in the range 0 to 255.

WAIT suspends execution until a specified machine input port develops a specified bit pattern. The data read at the port is XORed with the integer expression <m> and then ANDed with <n>. If the result is zero, BASIC loops back and reads the data at the port again. If the result is nonzero, execution continues with the next statement. If <m> is left out, it is assumed to be zero.

The WAIT statement allows you to test one or more bit positions on an input port. You can test the bit position for either a 1 or a 0. The bit positions to be tested are specified by setting 1's in those positions in <n>. If you do not specify <m>,the input port bits are tested for 1's. If you do specifiy <m>, a 1 in any bit position in <m> (for which there is a 1 bit in <n>) causes WAIT to test for a 0 for that input bit.

When executed, the WAIT statement loops test those input bits specified by 1's in <n>. If any one of those bits is *1 (or 0 if* the corresponding bit in <m> is 1), then the program continues with the next statement. Thus WAIT does not wait for an entire pattern of bits to appear, but only for one of them to occur.

It is possible to enter an infinite loop with the WAIT statement. You can execute a RunStop/Restore to exit the loop.

Wait State A micro-cycle or internal state entered by an MPU when a synchronizing signal is not present. It is used to synchronize a fast processor with a slower memory.

Wand A stick used to read the optically coded product labels (usually bar codes) found on retail sales items.

Warrior of RAS* A series of programs developed by Randall Don Masteller which gives the player the opportunity to learn warrior skills used from game to game. Games include Dunzhin, Kaiv, Wylde, and Ziggurat. Disk or cassette; 48K RAM required. ScreenPlay.

WAS Record* Maintains Worked-All-States records with summary of totals. RAK Electronics.

Way One of several electrical connectors printed on the connecting edge of a printed circuit board (or "card").

WD Western Digital Corp. A manufacturer of processor and controller chips.

WE Write Enable. A control signal which allows writing to a memory device. Typically used to provide write protection as in disk and cassette drives. Also used in bank switch organization.

WEMA Western Electronics Manufacturers Association.

What Number Is Missing?* Decide which number is deleted from the series shown on the screen. Includes a number of problem sets and help is available from the computer. For early elementary students. Cassette. Micro-Ed.

Which Letter Comes Next?* Teaches the sequence of the alphabet to children in early elementary school. A letter is shown on the screen, followed by a box which is to be filled in with the next letter in order. A race with the computer is created along the bottom of the screen. Cassette. Micro-Ed.

Wildcard Filename Characters. The symbol * is used by Commodore 64 as a wildcard character when loading a program. The ? is used to represent any letter. If the user enters LOAD 4"A??",8 the first program with a three letter name beginning with A is loaded. The command LOAD"$0:A*",8 lists from the directory all the letter files beginning with A.

Winchester Disk A hard disk system characterized by very light read/write heads, low head-to-disk clearence, and complete enclosure of the magnetic media in a dust-free environment to achieve high information density and fast access-time. In the world of microcomputers, hard disk and Winchester disk are essentially synonyms.

Window A section of a CRT screen dedicated to displaying specific types of information. See Split screen.

Wire Wrap Connecting wires in complex circuits. Each wire is tightly wound several turns around square posts to make the electrical connection. This technology is now seldom used except for hardware during system development.

Witch Number* Figure out the enchanted number or become transformed by a magic spell. Recommended for early elementary students. Cassette. Comm*Data Computer House.

WOM Write-Only Memory. Used humourously for parts of the address space of a computer which is not actually populated with memory devices or which must be disabled for some reason.

Word A logical unit of information. It may have any number of bits, but for MPUs, a word is usually 4, 8, 16, or 32 bits. For the Commodore 64, a word is one byte or 8 bits.

Word Fun I* Helps young children increase their vocabulary by having them pick the right word to fill in the blank of a sentence. Correct choices are rewarded by a fisherman catching his fish. Cassette. Comm*Data Computer House.

Word Machine* The Word Machine is an easy-to-use word processor that is operable on any Commodore machine. It is fully menu-driven and allows the user to enter, edit, and print text in any format. The manual comes with a tutorial section and a user's supplement for experienced users. 32K RAM. Commodore.

Word Mite 2* Word processor. Includes line, margin, indent, print or display text with selected page, screen editing, space lengths, write and read named text, and more. Nelson Software.

Word Processor A program that allows the user to create and edit text files on the screen and print a user-formatted hard copy. Word processors have widespread use in business as well as home for preparing letters, reports, contracts, etc. They vary in the features that they incorporate to facilitate editing and formatting of the documents. In choosing a word processor, it is important to know the features that a good word processor should have. (see Word Processors). For a listing of the word processors reviewed in this book, see Word Processors.

Word Processor Plus* An inexpensive yet useable word processing program for home or business. 10K RAM; printer required. William Robbins.

Word Processors See Copy Writer; Easy Script; MAE; Maxi-Pros Word Processing; Quick Brown Fox; Rapidwriter; Script Ease; Totl. Text; Word Machine; Word Mite; Word Machine; Word Processor Plus; WordPro 3 Plus/64; and Writers' Assistant.

Word Processors—Salient Features Following is a brief discussion of the features available in some of the good word processors for the Commodore 64.

DOCUMENTATION includes step training exercises that take the user through the various steps of word processing, from start-up options to creating, editing, saving, and printing text files. These exercises may also include a "special applications" training section that deals with applications such as mail merge and filling in forms.

START-UP OPTIONS are the initial options presented to the user in a menu-driven format. They include the display format (text width 40 columns or more); disk or tape options (for serious word processing, disks are indispensable); setting printer type (a good word processor will support a variety of different types of printers; dot matrix and letter-quality); and setting the most visually pleasant background/text colors.

TEXT EDITING AND FORMATTING is the main body of a word processing program. Numerous features are included to manipulate text while in the entering/editing mode. These features include setting tabs; vertical and horizontal scrolling; inserting and deleting words, lines, or paragraphs; and rearranging and transferring blocks of text from one location to another. Formatting and outputting the text involves setting margins, page length, text length, vertical positioning, line spacing, headers, footers, and automatic page numbering. Options are included for margin release at the beginning of paragraphs, left or right justification, or centering paragraphs.

FILE HANDLING includes saving or loading files on disk or tape. The files may be saved as "fill files," "ranged blocks" or as "linked files."The Load feature may allow "appending", "overwriting" or "merging" text files. These features have applications in linking a number of files on disk (to process large documents) as well as mail merge (which provides an easy way to personalize standard letters for a large number of people). Other features include accessing disk operations while in the program mode, which allows the use of many file manipulation features that are available with the Commodore (VIC 1541) disk drive.

SPECIAL FEATURES are for advanced users, and allow them to use the word processor with other programs such as terminal emulator programs and databases. Other special features include programmable characters and special codes that support specific print features (in some printers) such as "italics," "superscripts," "subscripts," "underlining," "bold face," and double-width character font.

Word Search* After choosing and entering ten words, the elementary student must try to find them as they reappear in a grid of scrambled letters. Performance review follows. Cassette. Micro-Ed.

WordPro3 Plus/64* A versatile word processor for the Commodore 64. It is 100% Machine language for speed and efficiency and supports a variety of dot-matrix and letter quality printers. The documentation includes step by step instructions on getting started and training exercises for editing, formatting, and printing text.

The system disk comes with a sample letter that demonstrates program features. In the word processing

mode, a status line is displayed on top of the screen that guides the user through the operating modes. One of the unique features available on WordPro3 is the extra text mode (which is like having an extra screen). The user can switch between the main text and the extra text using the control key (<control> x <CR>) and create an alternate memory area to store frequently used phrases, variable blocks, mailing addresses, etc. The amount of space available in this mode is established by the user during start-up options. The feature provides special facilities to advanced users such as appending extra text, variable blocks, or groups of lines to create form letters and reports. It can also be used to store outlines of reports that are being created in the main text. Other features of WordPro3 Plus include full editing and formatting capability, advanced file handling (linking files, global search/replace, and output operations), and special characters for accesssing special printer functions. The manual includes a programmer's section that discusses the use of the input/output features of WordPro3 Plus with mailing lists and terminal programs. Disk commands are also accessible in the program mode. Professional Software.

Words, Reserved BASIC. Reserved words have particular meanings in BASIC and are used for commands, statements, function, and operator names. These words cannot be used as variable names and variable names cannot be reserved words followed by a type declaration character ($, %,). If you accidentally use one of the reserved words, you may see an error message or have strange results when you execute the program. See also Debug or Test a Program, Reserved Words.

Words in Context Spelling Series* An educational testing series which reinforces regular classroom instruction. There are 180 lessons for grades two through six. The student chooses the lesson he wants to study. The program displays 10 words which can be recalled to the screen at any time. Now, here's the problem: A sentence that is missing a word is shown on the screen. The student's job is to fill in the missing word with the correct choice of one of the ten words displayed on the screen. The student's performance is rated. Elementary level. Cassette. Micro-Ed.

Wordspot* Distinguish valid words from the first letters which come from the left and the last letters which come from the right. For seven to ten year-olds. Cassette. Comm*Data Computer House.

Wordtalk 64* This package is a telephone communication program able to link the Commodore 64 to almost any other computer via a telephone modem. Data, documents, letters, and messages can be sent and received. Connections with UPI news, the Dow Jones, Compuserve, and other services are possible. UMI

Working With Basic Addition Facts* A series of addition problems that classifies responses by time needed to solve the problem, answers given by the computer, and number of correct answers. Cassette. MicroEd.

Working With Basic Multiplication Facts* A series of multiplication tests to help elementary students increase math skills. Cassette. MicroEd.

Workspace An area of memory allocated for working storage.

WPM Words Per Minute

WRITE Output data from memory. Memory is any device which can store information and allow it to be retrieved when needed. The Commodore 64 relies primarily on random access memory (RAM), read-only memory (ROM), and disks. ROM and RAM together make up the internal memory or main memory of the Commodore 64, or any other computer.

External memory is stored on cassette, disk, and hard disk, and involves mechanical motion to retrieve data. These are hundreds or thousands of times slower than internal memory. Data in internal memory is immediately available to programs for processing. Data in external memory must be copied into internal memory, processed, then copied back out to external memory.

If data has been created, it can be written out to external memory without a READ first. If data read in from external memory has not been modified, there is no need to write it back out since the original copy is still there.

Write Error If there is an inconsistency between the data that is written onto disk and the data that should have been written onto disk this message appears. There are two specific write errors shown below.

25 appears if the data written on disk does not equate with the data in Disk Ram where it was just written from.

28 appears if a synchronous mark does not appear at the beginning of sector. When writing to disk, the drive attempts to read these sync marks. The problem is a bad disk, an unformatted disk, or a hardware problem.

Write File Open An error message from the 1541 disk drive incurred when a write file that has not been closed is opened for reading.

Write Protection On This message appears if you try to write to a write-protected disk. Either the user has an adhesive tab over the write-protect notch or there is a problem with the write-protect system.

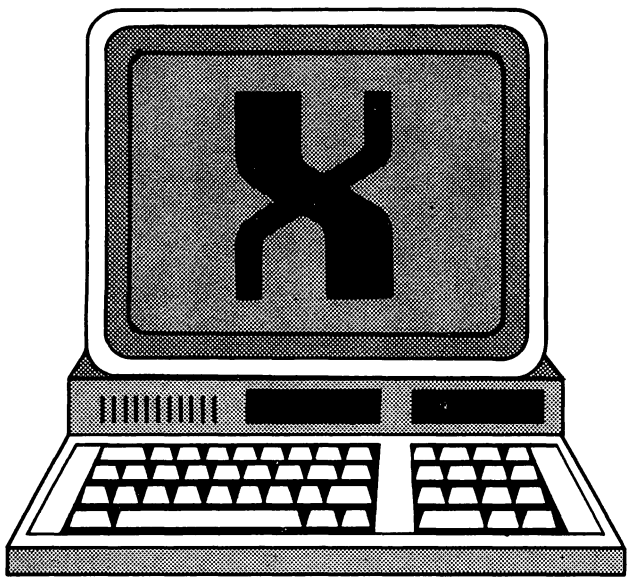
Write-Protect Describes the act of preventing the writing of information onto a storage medium. Floppy disk jackets often have adhesive tabs which can be removed or placed on the disk to write-protect the disk by disabling the disk drive's write circuitry. Cassettes have a similar plastic break-out tab.

Writer's Assistant, The* This word processor features a menu-driven format and easy-to-follow tutorial style documentation. The system disk consists of a series of BASIC programs that perform the functions of the word processor. The programs are automatically loaded from the main program when the user selects the appropriate option. Several files are included in the program disk to guide the user through the special features of the word

processor. The program's main menu allows the user to set up printer configuration, access disk commands, enter/edit text, and print a specified document. A secondary menu is available in the word processing mode that allows text file manipulations. A help command can be accessed at any time to obtain an explanation of the function keys. The program's menu-driven design is very useful for beginners interested in word processing. Rainbow Computer Corporation.

WS WorkSpace.

WV Working Voltage.



X Codes. ASCII = 88, CBM ASCII = 88 or 216, HEX = 58. x—ASCII = 120, CBM ASCII = 88, HEX = 78. Screen code = 24 or 88. See CBM ASCII.

X Index Register.

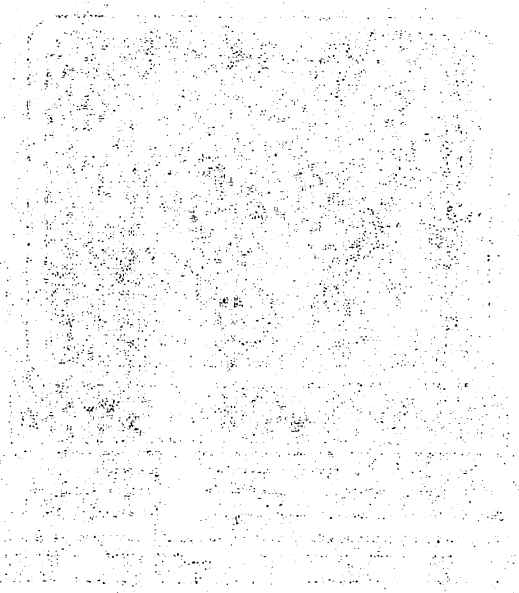
XENIX The Microsoft implementation of the UNIX operating system for microcomputers.

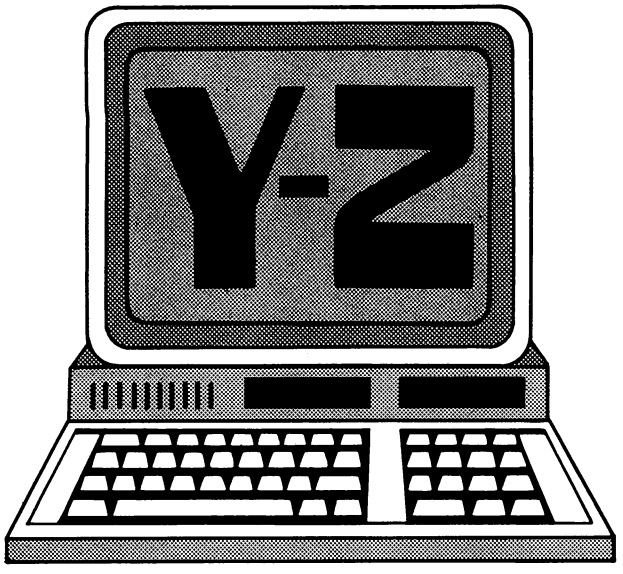
XMIT TransMIT.

XMT TransMiT.

XTAL CrysTAL.

X-Y Plotter A device which draws points or lines on a sheet of paper based on X and Y coordinates from a computer.





Y Codes. ASCII = 89, CBM ASCII = 89 or 217, HEX = 59. y—ASCII = 121, CBM ASCII = 89, HEX = 79. Screen code = 25 or 89. See CBM ASCII.

Z Codes. ASCII = 90, CBM ASCII = 90 or 218, HEX = 5A. z—ASCII = 122, CBM ASCII = 90, HEX = 7A. Screen code = 26 or 90. See CBM ASCII.

Z Impedance measured in ohms. Also: The Zero Flag.

Z-80 Video Pak Includes a cartridge that inserts into the expansion port, an operating system compatible with CP/M 2.2, and the cables necessary for connecting the video output from the Commodore 64 to the video Pak. The output generated by the Video Pak formats the screen into an 80 column by 25 line display. Most standard word processing programs such as Wordpro or Easy Script can not be run with the video pak. A word processor from Data 20 for the 80 column display is available. Some handy features come with the Video Pak, including a screen dump feature that lets the user print what appears on the screen. Portions of a line beyond the cursor can be deleted by pressing a single function key. The screen can be returned to a 40 column mode with a function key. There is a terminal emulator mode that allows easy configuration of the Commodore for data transmission. The documentation is very weak and presumes you have some experience with CP/M. A HELP command does allow you to view available CP/M commands. CP/M based programs that are in Commodore disk format can be executed with this system. Data 20.

Zero Flag Bit See Status Register.

Zero Page The Commodore 64 can reference any of the 64K addresses using two bytes. The first 256 memory locations can be referenced using only one byte. Therefore these first 256 bytes (or zero page) can be used in Machine Code instructions more efficiently than those that follow.

Zero Page Addressing Mode See Addressing Modes.

Zilog Manufacturer of the Z-80 and many other widely used chips. Zilog also publishes technical reference material on the Z-80 and other microprocessors.

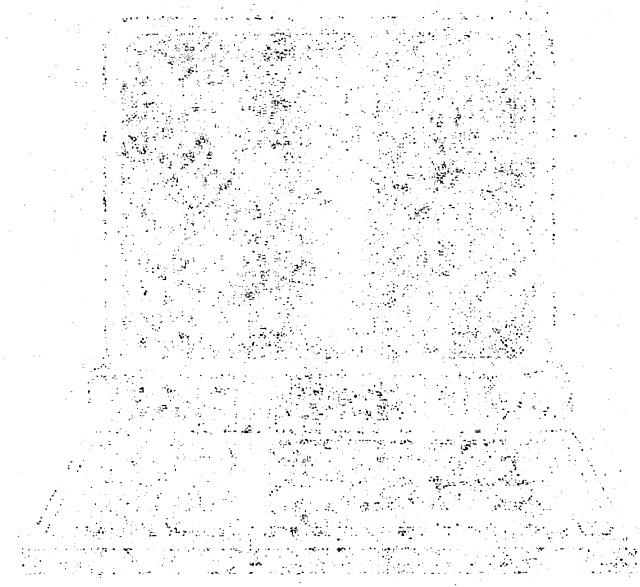
Zone To leave space on the print line between items, put a double comma(„) in the print listing.

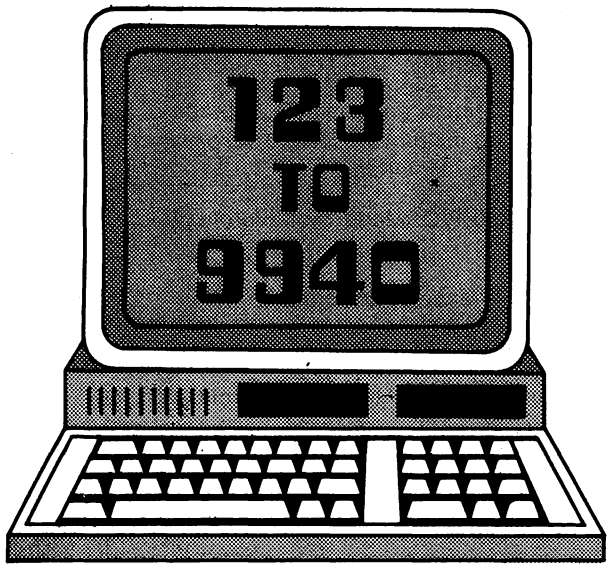
Example:

PRINT A„B

This would print A in print zone 1, nothing in print zone 2 and put B in print zone 3, (column 29). See also Zones and PRINT Lines.

Zones On the printer line, each group of ten spaces across the print line is called a print zone. A comma (,) in a PRINT list of items means "start printing the following item at the start of the next print zone." Contrast this with the semi-colon (;), which means the next item is to print immediately after this one, without even a single space between. The print zones begin in columns 1, 10, 20, 30, 40, 50, 60, 70, and 80.





1 2 3 Digit Multiplication* Allows computations between a three-digit number and a one- two- or three-digit number. For elementary students. Disk or cassette. Microcomputer Workshops.

3D-64 Man* This game is a completely rewritten version of the popular "Vic 20" program. Requires a joystick. Nufekop.

9-Bit Rotation Rotation where the carry bit of the CPU is considered a ninth, high-order bit for the 8-bit register being rotated.

27 ASCII Enter ASCII 27 (escape) for printer control in PRINT statements to set lines per inch and page length.

64K Measurement of Bytes. Byte is a label for the storage required to hold one character (letter, digit, etc) in internal or external computer memory. Abreviated B, or in thousands KB, or simply K (actually, 1K = 1024 bytes because this is an even power of 2).

64 Pencil* A 100% Machine language high-resolution sketch pad that lets you design, store, and print drawings, game backgrounds, maps, and blueprints. The pencil allows single-key command format and documentation, has ten drawing speeds, sixteen pencil and pad colors, and high-resolution block-erase modes for line and color correction. Dungeness Software.

400 Chip 4-bit slice. Made by TI.

481 Chip 4-bit slice. Made by TI.

601 Chip 16-bit chip. Made by Data General.

800K Disk Storage By using the ten sector track format, the 640K per double-sided Quad disk can be further increased to 800K per disk.

1000 Chip 4-bit microprocessor available in several versions. Also called TMS-1000. Made by TI.

1070 See:1000 Chip.

1100 See:1000 Chip.

1200 See:1000 Chip.

1270 See:1000 Chip.

1300 See:1000 Chip.

1600 Chip Set designed for PDP-11/03 emulation. Made by Western Digital.

1702 Chip An ultra-violet erasable PROM organized as 256 words by 8 bits.

1771 Single-density floppy disk controller chip.

1791 Chip Double-density floppy disk controller chip.

1802 Chip Cosmac 8-bit CMOS microprocessor. Made by RCA.

2102 Chip Common static RAM integrated circuit, organized as 1K X 1 bit.

2114 Chip Static RAM organized as 1K X 4 bits.

2650 Chip 8-bit microprocessor. Made by Signetics.

2651 Chip 2650 UART. Made by Signetics.

2652 Chip SDLC chip. Made by Signetics.

2655 Chip 2650 PIO. Made by Signetics.

2702 Chip See 1702 Chip.

2708 Chip An ultraviolet-erasable PROM organized as 1K X 8 bits.

2716 Chip An ultraviolet-erasable PROM organized as 2K X 16 bits Made by Intel.

2716 Chip An ultraviolet-erasable PROM organized as 2K X 8 bits. Not compatible with the Intel part (2716 chip). Made by TI.

2732 Chip An ultraviolet-erasable PROM organized as 4K X 8 bits.

2900 Chip A family of 4-bit slice components widely used to construct special-purpose controllers and micro-processors. Introduced by AMD and available for many other manufacturers.

2901 Chip A 4-bit slice processor. Made by AMD.

2902 Chip Look-ahead carry generator. Made by AMD.

2903 Chip An improved version of 2901. Made by AMD.

2909 Chip Microprogram sequencer. Made by AMD.

2911 Chip Microprogram sequencer. Made by AMD.

2914 Chip PIC. Made by AMD.

3000 Chip Family of 2-bit slice components. Made by Intel.

3001 Chip Microprogram control unit. Made by Intel.

3002 Chip Central processing element 2-bit slice. Made by Intel.

3003 Chip Look-ahead carry generator. Made by Intel.

3850 Chip The F8 family processor chip. Part of an 8-bit two-chip microcomputer. Made by Fairchild.

3851 Chip The F8 family program storage unit used with the 3850. Made by Fairchild.

3852 Chip Dynamic memory interface for the F8. Made by Fairchild.

3853 Chip SMI for the F8. Made by Fairchild.

3854 Chip DMA for the F8. Made by Fairchild.

3861 Chip PIO for the F8. Made by Fairchild.

3870 Chip An 8-bit one-chip microcomputer. Contains 4032 bytes of ROM, and 128 bytes of RAM. Made by Mostek.

3876 Chip An 8-bit one-chip microcomputer. Upgrade of the 3870, contains 4032 bytes of ROM, and 256 bytes of RAM. Made by Mostek.

3880 Chip Mostek Z80.

4004 Chip 4-bit microprocessor. Made by Intel.

4040 Chip 4-bit microprocessor. Upgrade of the 4004, contains more registers and executes a larger instruction set. Made by Intel.

4044 Chip Static RAM organized as 4K X 1 bit.

4116 Chip Dynamic RAM organized as 16K X 1 bit.

4164 Chip Dynamic RAM organized as 64K X 1 bit.

4264 Chip 4040 PIO.

4308 Chip ROM 1K X 8 + I/O ports for the 4040. Made By Intel.

5701 Chip MMI 4-bit slice predecessor of the 2901 mil version.

6100 Chip Intersil 12-bit CMOS microprocessor which emulates the PDP-8.

6502 Chip 8-bit microprocessor. Widely used in mass-marketed computer systems, such as Apple, Pet, and Atari. Made by MOS Technology.

65XX Chip Support chips belonging to the 6502 family. Made by MOS.

6520 Chip PIO. Made by MOS Technology.

6530 Chip RAM, ROM, I/O, and timer made by MOS Technology.

6701 Chip Same as the 5701 in the commercial version.

6800 Chip 8-bit microprocessor. Made by Motorola.

6801 Chip 8-bit one-chip microcomputer.

6802 Chip 8-bit two-chip microcomputer. Upgrade of the 6800, contains functions that were previously in the other 6800 family components. Made by Motorola.

6809 Chip 8-bit high performance upgrade of the 6800. Has an expanded instruction set and 16-bit word handling capability. Made by Motorola.

6820 Chip 6800 PIO. Made by Motorola, Fairchild, and Mostek.

6828 Chip PIC. Made by Motorola.

6845 Chip CRT controller. Made by Motorola.

6850 Chip 6800 UART. Made by Motorola.

6860 Chip Modem. Made by Motorola, Fairchild, and AMD.

6870 Chip Clock. Made by Motorola.

7400 Chip Series of TTL logic. Made by TI.

8008 Chip 8-bit microprocessor. Made by Intel.

8048 Chip 8-bit family of one-chip microcomputers with one-chip RAM and ROM. The 8748 version has an EPROM on the same chip as the processor.

8080 Chip 8-bit microprocessor. Upgrade from the 8008, has a different instruction set but retains a similar architecture to the 8008. The 8080 was the dominant microprocessor of the 1970s. Made by Intel. Because it runs a large library of CP/M code the 8080 is available for the PC or the XEDEX Baby Blue Card.

8085 Chip 8-bit microprocessor. Upgrade of the 8080, contains functions that were previously on other 8080 family chips as well as two extra instructions and four interrupt levels. Made by Intel.

8086 Full 16-bit version of the 8088.

8086 Chip 16-bit byte-oriented microprocessor that resembles the 8085, but has an expanded instruction set and 16-bit arithmetic capabilities. Made by Intel.

8087 Chip Numeric data co-processor for the 8086 and the 8088. Implements proposed IEEE floating point standard.

8088 16 bit processor from Intel. The 8088 is a slightly stripped-down version of Intel's original 1978 8086. The 8088 differs from the 8086 in the following ways:

1)The 8088 uses an 8 bit data bus, as opposed to the 16 bit data bus of the 8086. The 8088 will need about twice as many memory cycles to fetch the same amount of data as the 8086.

2)The instruction "fetch-ahead" queue of the 8088 is 4 bytes, vs 6 bytes in the 8086. The 8088 must wait for instructions to be fetched from memory more often than the 8086.

The 8088 is thus a 16 bit processor internally but with an 8 bit bus structure. Other than this, the 8088 and 8086 are the

same. Even at the Assembly language and Machine Code level, they are interchangable to the programmer.

The 8086/8088 processors have built in provision for being paired with a co-processor which can perform certain functions faster than the main processor. The main example so far is the 8087, which is specialized for floating point operations. When working with the 8087, the 8088 passes all floating point arithmetic to the 8087 and waits for it to signal completion. The result is faster execution (up to 100 times as fast) for programs with extensive floating point calculations.

The 8086/8088 processor can assemble programs for the earlier 8008 and 8080 processors, but the object codes are not compatible.

8089 Chip 16-bit input/output processor. Made by Intel.

8212 Chip Parallel latch and buffer in the 8080 family. Made by Intel.

8224 Chip Clock generator for the 8080. Made by Intel.

8228 Chip System controller for the 8080. Made by Intel.

8251 Chip USART for the 8080 family. Also called a PCI. Made by Intel.

8253 Chip Programmable interval timer for the 8080 family. Made by Intel.

8255 Chip Programmable parallel interface for the 8080 family. Made by Intel.

8257 Chip Direct memory access controller for the 8080 family. Made by Intel.

8259 Chip Interrupt controller for the 8080 family. Made by Intel.

8271 Chip Single density floppy disk controller in the 8080 family. Made by Intel.

8273 Chip Synchronous data link controller in the 8080 family. Made by Intel.

8275 Chip CRT controller in the 8080 family. Made by Intel.

8279 Chip Keyboard and display controller in the 8080 family. Made by Intel.

8291 Chip IEEE 488 bus talker/listener interface chip. Made by Intel.

8292 Chip IEEE 488 bus controller chip. Made by Intel.

8708 See 2708 Chip.

8748 Chip 8048 with EPROM on the same chip as the processor. Made by Intel.

9080 Chip AMD's 8080.

9400 Chip Bipolar Macrologic family. Made by Fairchild.

9511 Chip Arithmetic processing chip. Made by AMD.

9900 Chip 16-bit microprocessor compatible with the 990 series of minicomputers. Made by TI.

9904 Chip 9900 clock. Made by TI.

9914 Chip IEEE 488 bus interface chip. Supports talker/listener and controller functions.

9940 Chip 16-bit one-chip microcomputer.

" BASIC. A special character indicating the double quotation mark or string delimiter. Cannot be used for any other purpose.

"" To get one or more spaces between fields printed by your BASIC programs, use a literal of spaces like "". To get several spaces between the printed values of A$ and B$ enter BASIC statement:

PRINT A$;"";B$

See also Print Zones.

$ BASIC. A special character indicating the dollar sign, or the string type declaration character. Cannot be used for any other purpose.

$ BASIC String Variable. Names in BASIC must end in $. String variable names (for characters) must start with a letter and must not use any reserved words, such as: IF, ON, THEN, GOTO, or a reserved word followed by a type declaration character ($,%). See Reserved Words for complete list.

% BASIC Numeric Variable. Integer (numeric) variables for whole numbers from -32768 to +32767 end in % .

Integer numeric variable names must start with a letter, can have up to 40 characters, must not be any reserved words, such as IF, ON, THEN, GOTO, etc., or a reserved word followed by a type declaration character ($,%,!,#). See Reserved Words for Complete list.

(BASIC. A special character indicating the left parenthesis. Cannot be used for any other purpose.

) BASIC. A special character indicating the right parenthesis. Cannot be used for any other purpose.

* BASIC. A special character indicating the times sign (multiplication).

+ BASIC. A special character indicating the plus sign (addition). Cannot be used for any other purpose.

, BASIC. A special character indicating the comma delimiter. Cannot be used for any other purpose.

,, To leave space on the print line between items, put an extra comma (,,) in the print list.

Enter BASIC statement:PRINT A,,B

This would print A in print zone 1, nothing in print zone 2 and put B in print zone 3, (col 20).

, PRINT Each group of 10 spaces across the print line is called a print zone. A comma (,) in PRINT <list of items to be printed> means "start printing the following item at the start of the next print zone." Contrast this with the semicolon (;), which means the next item is to print immediatly after this one, without even a single space between. The print zones begin in columns 1, 10, 20, 30, 40, 50, 60, and 70.

- BASIC. A special character indicating the minus sign (subtraction). Cannot be used for any other purpose.

. BASIC. A special character indicating the period or decimal point. Cannot be used for any other purpose.

.B Type of File. While using the BLOAD command in direct mode the types of files on tape are displayed. .B indicates BASIC programs in internal format (created with SAVE command).

/ BASIC. A special character indicating the *division* symbol or slash. Cannot be used for any other purpose.

: BASIC. A special character indicating the colon symbol or statement separator for entering *multiple BASIC* statements on one line.

; BASIC. A special character indicating the semi-colon symbol. Cannot be used for any other purpose.

< BASIC. A special character indicating the less-than symbol. Cannot be used for any other purpose.

= BASIC. A special character indicating the equal sign or is an assignment symbol. Cannot be used for any other purpose.

> BASIC. A special character indicating the greater than symbol. Cannot be used for any other purpose.

? BASIC. A special character indicating the question mark or PRINT abbreviation. Cannot be used for any other purpose.

? Prompt. This is program's way of letting you know which program is waiting for you to type in information. ? is the prompt from a program written in the BASIC language which is running and needs you to type in data in answer to a question. In this case it is a good idea to include a descriptive prompt such as "Enter check amount 9999.99" in the program so the operator (or you) will know exactly what should be entered in response to the ? prompt. An example of how to do this:

100 INPUT "ENTER CHECK AMOUNT 9999.99 ",CHECK-AMOUNT

which will give the operator using this program a descriptive prompt on the screen.

\ BASIC. A special character indicating the integer division symbol or backslash.

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1050 E. Duane Ave. Suite 1
Sunnyvale, CA 94086
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Walled Lake, MI 48088
Phone: (313) 669-3110

Abacus Software
P.O. Box 7211
Grand Rapids, MI 49510
Phone: (616) 241-5510

Access
832 East Cameron Avenue
West Covina, CA 91790

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8718A Richmond Highway
Alexandria, VA 22309
Phone: (703) 360-0301

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2201 Lively Blvd.
Elk Grove Village, IL 60007
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Livermore, CA 94550
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Seattle, WA 93111
Phone: (206) 236-2983

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313 Mathewson
Wichita, KS 67214
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Tacoma, WA 98498
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West Chester, PA 19300
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Phone: (416) 499-4292

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Technical Services, Inc.
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Columbus, OH 43220
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Greensboro, NC 27403
Phone: (919) 275-9809

Computer Alliance
21115 Devonshire St.
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Chatsworth, CA 91311
Phone: (213) 379-8686

Computer Camps
Directory HES
150 N. Hill Dr.
Brisbane, CA 94005
Phone: (415) 468-4111

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P O Box 6689 Dept. 806A
Stateline, NV 89449
Phone: (800) 648-3311

Computer Mart
Box 1664 Dept M
Lake Havasu City, AZ 86403
Phone: (602) 855-3357

Computer Outlet
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Place-Upper Level
Las Vegas, NV 89109
Phone: (702) 796-0296

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50 Teed Dr.
Randolph, MA 02368
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Phoenix, AZ 85012

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Los Angeles, CA 90045
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Goleta, CA 93116
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Cursor 64
Box 6905
Santa Barbara, CA 93110
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Coco Beach, FL 32931

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2330 Lincoln Way P.O. Box 784
Ames, IA 50010

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Laguna Hills, CA 92653
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Phone: (503) 295-5890

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Pacific Grove,CA 93950
Phone: (408) 649-3896

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Pomona, CA 91766
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(213) 764-6833

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New York, NY 10028

Exatron See A and J Micro Drive

Foxsoft
Box 507
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P O Box 7426
Minneapolis, MN 55407
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Box 10516
San Jose, CA 95157
Phone: (408) 247-4434

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Chicago, IL 60626

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1444 Linden Street
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1 Blackburn Center
Gloucester, MA 01930

GoSub International
501 E. Pawnee Suite 430
Wichita, KA 67211
Phone: (316) 265-9858

Hayden Book Company
10 Mulholland Drive
Hasbrouck Heights, NJ 07604
Phone: (800) 631-0856

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5923 Peachtree Industrial Bd.
Norcross, GA 30092
Phone: (404) 449-8791

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Leveritt, MA 01054
Phone: (413) 549-3651

HES: Human Engineered Software
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Birmingham, MI 48010
Phone: (313) 540-4010

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Micro Spec
2122 Teakwood
Plano, TX 75075
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Micro Systems Development, Inc.
11105 Shady Trail Suite 104
Dallas, TX 75229
Phone: (214) 241-3743

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3333 South Wadsworth Blvd. #C105
Lakewood, CO 80227
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Port Chester, NY 10573
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Farmington, MI 48024

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Fresno, CA 93711
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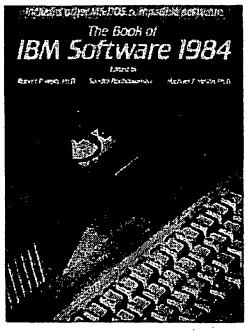

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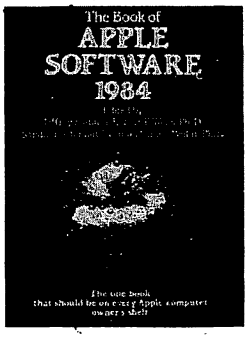

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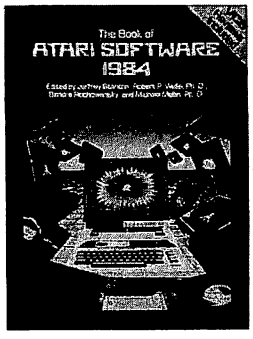

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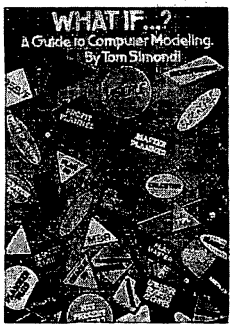

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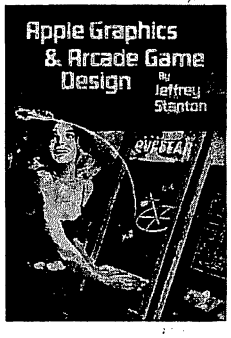

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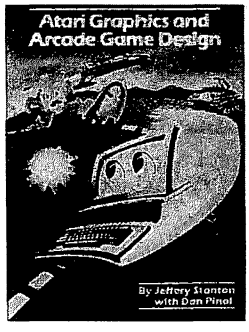

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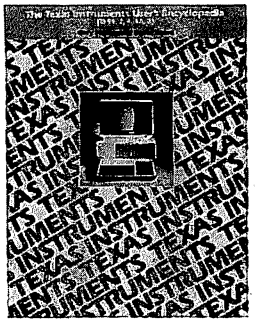

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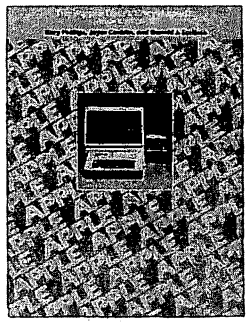

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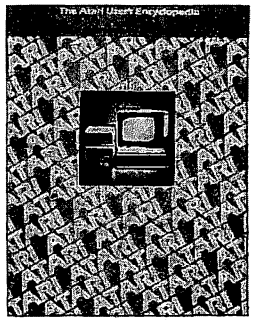

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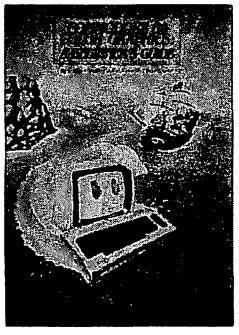

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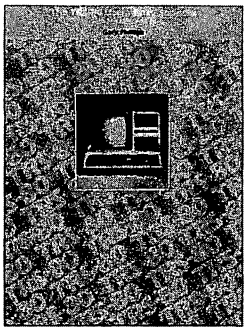

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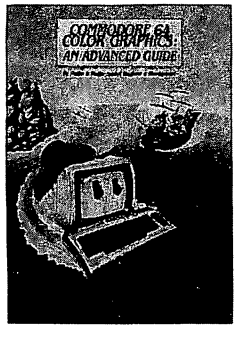

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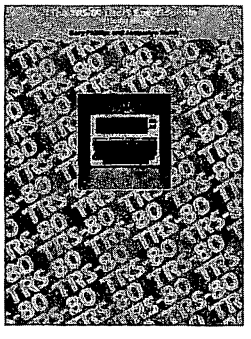

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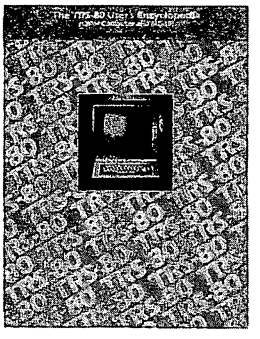

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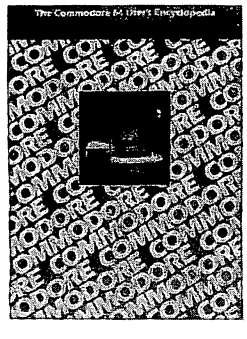

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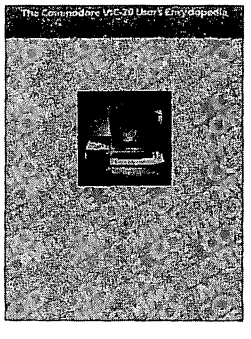

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