commodore

COMPUTING international

February 1983 £1.00

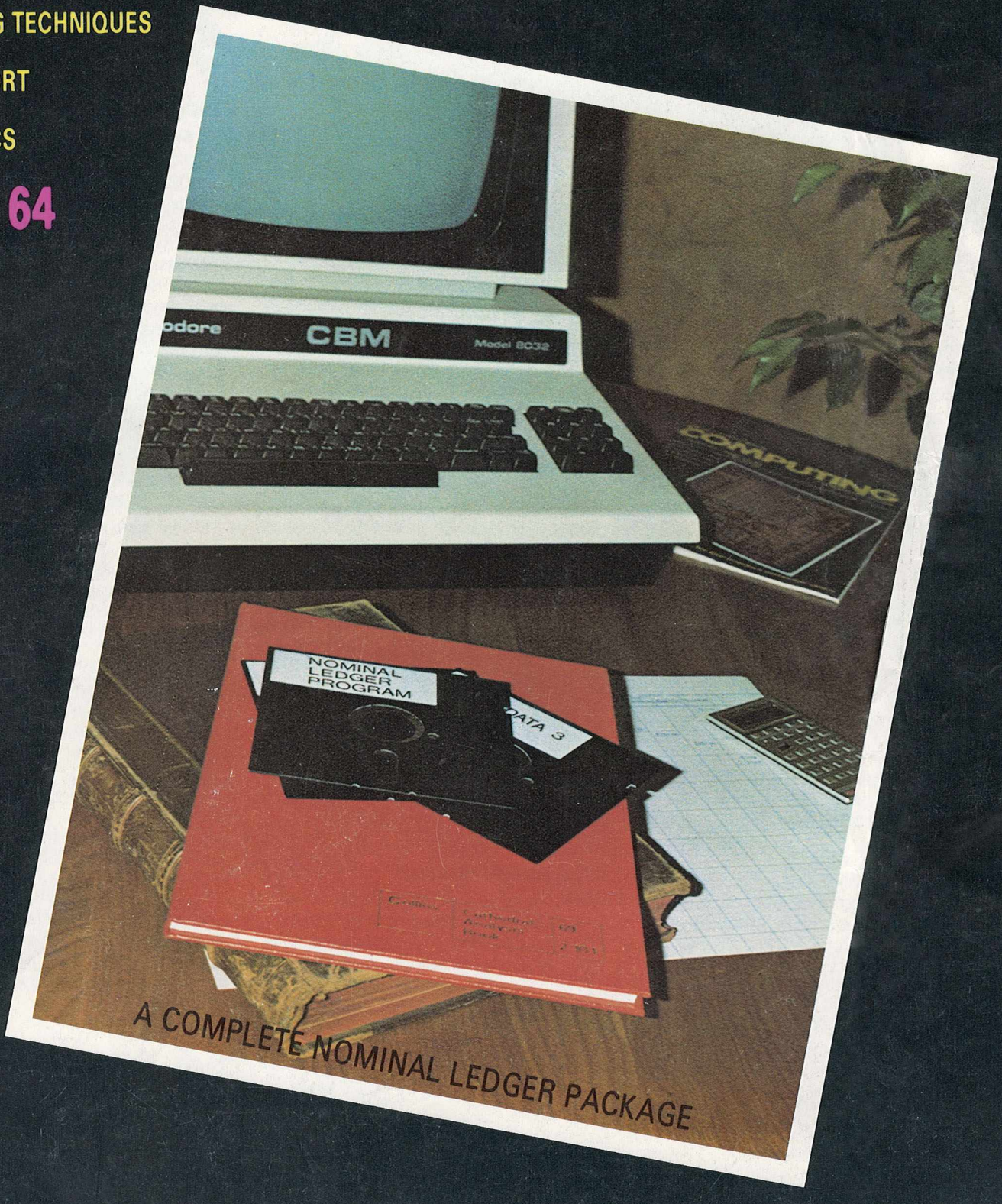
USA $2.50

INTERFACING TECHNIQUES

FAST M/C SORT

VIC GRAPHICS

WIN A 64

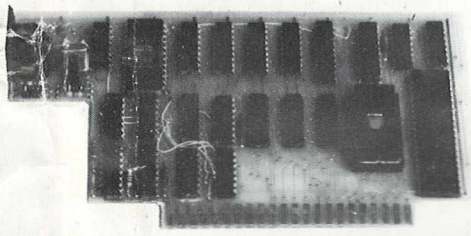


A COMPLETE NOMINAL LEDGER PACKAGE

The independent magazine for Commodore computer users

We turn your VIC into a real computer for only £ 99.95

Computer World offers you its sensational videocartridge. Just plug it in, connect a video monitor with your VIC-20 and enter the world of professional computing. Discover word-processing, accounting etc.



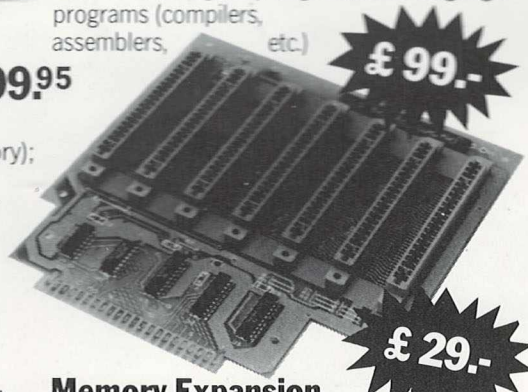
Our new videocartridge has remarkable features for only £ 99.95

- 40 or 80 colum display (switchable from BASIC, without losing any program in memory);
- VIC and CBM/PET graphics;
- BY adding this board you can expand your VIC to 32K RAM, instead of 27.5K. (Note: you only need the expansion card with 3, 8 and 16K RAM cartridges).
- Upper and lower case characters with true decenders;
- Full cursor control;
- Program editing in 40 and 80 column mode;
- No alternations needed to your VIC;
- No external power supply needed;
- Fits in ARFON or Commodore expansion box;
- Now you can LOAD every Commodore or VIC program and adjust it to 40 or 80 columns;
- Operates with all ROM cartridges, except those working in the area AØØØ Hex to CØØØ Hex.;

64K RAM BOARD

Imagine your VIC-20 to be a 64K computer! Our board turns your dreams into reality... The 64K RAM unit fits directly into the back of any VIC or in an expansion box. When your VIC is switched, in it reports 27.5 Kbytes free. The upper RAM area consists of 6 blocks of 8K RAM each. The blocks can be switched by means of instruction POKE into the highest available 8K RAM area. This feature makes it possible to access a data area of 48K RAM. The 6 blocks can also be placed into the ROM area, so it will form a continuous 64K RAM area, which can be used to store e.g. very large machine language programs (compilers, assemblers, etc.)

£ 99.-



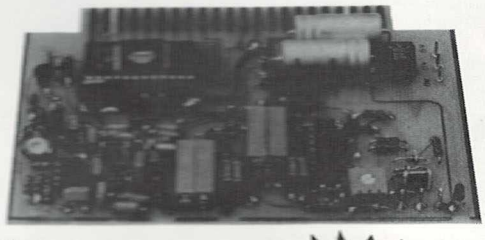
£ 29.-

Memory Expansion

If you want to expand your VIC with more memory you'll need this unique expander. Now you can have 7 more slots for programmers aid, RAM packs, etc. Computer World offers you this expander (with 1 slot completely tested) for £ 29.- (Add. £ 4.- for each extra connector).

Great news for HAM's... Now you can see what you hear!

The TDK-20 'HAM interface' is a complete RTTY and MORSE code system fot the VIC-20 computer. It comes in a single cartridge which you can plug in either a standard VIC-20 or in an expansion box. The cartridge includes two converters, one for MORSE reception and the other for RTTY. Just plug it in and you can read what's in the air on your VIC-monitor!



£ 89.-

Features:

- RTTY transmit/receive;
- Audio input;
- 8 buffers to store text;
- LED tuning indicator;
- MORSE transmit/receive 6 Wpm tot 60 Wpm;
- Every Baudrate i.e. 45, 50, 57, 75, 110, 150, 200, 300 Baud;
- Every shift, 170, 225, 425, 850 Cs.;
- Old or New tones, 1275 or 2125 Cs.;
- WRU mode; CD ID; PTT

VIC EPROM PROGRAMMER (2716/2732)

£ 65.-

This EPROM programmer makes it possible for you to burn your own 4K EPROMS, so it won't be necessary anymore to load your programs into memory again, every time you had to switch of your VIC. This unit can be attached to any VIC, by just plugging the board into the expansion slot. A socket in which you can place your own EPROMS, is also available on the board!

Parallel Interface

£ 59.-

A real pro printer for your VIC? Order our printer driver with cable! Please specify EPSON, OKI or BROTHER 8300 printer.

computer world®

99 Hilvertsweg, 1214 JB HILVERSUM, Holland.
Phone: 01031-35-12633 Telex: 43776 INCO NL dealers invited

Terms: Shipment will be made in one week after receivement of your order. VISA, MC, or check accepted. Add £ 5.- for shipping.

commodore
COMPUTING
international
February 1983

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EDITORIAL

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With the new year heralding the start of another round of exhibitions, many computer users may be wondering whether there is any point in attending trade shows. This is especially true of people who own just one particular computer, or organisations that specialise in one company's products.

1983 is bound to see more exhibitions than ever before, and as the computer industry expands so must the variety of machines on display. This, for the committed end-user, means more "waste product". He needs to be more careful about the shows he visits.

Commodore users have a head start over the others, with the International Commodore Computer Show being held every year. Last year, however, the number of visitors to ICCS declined, suggesting that even the dedicated owners were growing wary of the slick, smooth presentation of this type of exhibition.

To coincide with our launch on newsstands, we are turning back the clock to put on the type of show that Commodore used to stage in the early days: a gathering of PET and VIC (but primarly VIC) owners who will be able to share in the kind of informal atmosphere so often missing from the modern exhibition.

On page 4 of this issue you will find details of what, where and when. We look forward to seeing you on February 26.

ANNOUNCING

THE

commodore
COMPUTING
international

VIC & COMMODORE 64 USERS SHOW

WHERE

WESTMINSTER CENTRAL HALL, LONDON

(VICTORIA STREET — OPPOSITE WESTMINSTER ABBEY)

WHEN

SATURDAY 26th FEBRUARY 1983

10 am — 7 pm

WHY

BECAUSE IT'S THE FIRST SPECIALISED EXHIBITION FOR VIC & 64 USERS

ADMISSION £1.00 CHILDREN 50p AT THE DOOR

WIN A 64 COMPETITION—ENTRY FREE

A year of achievement

Commodore sales and profits hit record levels

The success attained by Commodore International Ltd in the fields of microcomputing, semiconductors and consumer electronics is reflected in the group's financial results for the year ended June 30 1982. Net sales in this period totalled a record $304.5 million, 63 per cent more than in fiscal 1981. Net income before extraordinary items also increased by 63 per cent to $40.6 million.

Shareholders' equity was up from $61.6 million to $105.9 million, while earnings per share rose from $1.61 in 1981 to $2.64 last year.

On a world-wide basis, sales of Commodore microcomputers in fiscal 1982 brought in $228.2 million or 75 per cent of overall sales. The group sold $135 million worth of microcomputers outside the United States, as against $100.4 million in fiscal 1981, while US sales were up from $32.1 million to $93.2 million.

Capital expenditure rose from $16.2 million to $25.4 million in a year when gross profit margin reached a record 47.8 per cent. Current assets stood at $182.3 million.

Manufacturing

Commodore microcomputers are designed and/or produced at three facilities: Braunschweig, West Germany, Santa Clara, California, and Tokyo, Japan, where VIC-20 boards, 1540 disk drives and 8023 high-speed printers are manufactured.

Prior to final microcomputer assembly, integrated circuits are shipped from Commodore's US-based semiconductor facilities to a new 66,000 sq ft plant in Hong Kong where the chips are assembled,packaged and tested. The components are then, either in Hong Kong or Tokyo, inserted into the printed circuit boards which are shipped to the three factories.

During 1982, Commodore expanded the capacity of MOS Technology, one of its four semiconductor plants, by 150 per cent. The company produced over 50 million semiconductor devices including microprocessors and ROMs, most of which were sold to outside customers, the balance being used in Commodore's microcomputer systems, software cartridges and other products. Sales to outside customers are likely to decline this year, as the group uses more of its own semiconductors for large-scale integrated circuits.

Commodore's MOS facility in Costa Mesa began producing 5 inch silicon wafers where previously only 3 and 4 inch wafers were manufactured. A 5 inch wafer has 782 potentially good 16K ROM circuits as against 496 circuits on a 4 inch wafer.

Research and development

In fiscal 1982, Commodore's research and development expenditure rose by more than 100 percent to a record $17.9 million or 5.9 percent of sales, from $8.4 million, or 4.5 percent of sales in fiscal 1981. Most of this research and development has been in three major areas: hardware systems design, software systems design and semiconductor chip design for advanced large-scale integrated circuits.

Two new products were designed and released to production in 1982: the Commodore 64 personal computer with 64K RAM and the Max, an under $200 home computer/video game machine/music synthesizer.

KINGSLEY COMPUTERS LTD.
132 Desborough Road
HIGH WYCOMBE, BUCKS HP11 2PU

CBM BUSINESS SYSTEMS

VIC HOME COMPUTERS

COMPUTER ACCESSORIES AND SUPPLIES

AGENTS FOR CBM APPROVED PRODUCTS

COMMODORE SERVICE CENTRE

Software clerk

For all those small businessmen who find paperwork time-consuming and less interesting than making money, Superclerk could be a worthwhile investment. Developed by Reprodesign, the facility takes care of the accounts, typing and filing and gives the complete novice helpful advice and information.

To put the new 'employee'' to work, all the businessman requires is a Commodore 8032 or 8096 with disk drives and printer. Because the program is built around the database principle, all the functions are fully integrated.

The programs, which are written in Basic and machine code, can be altered to suit individual requirements. Instructions on how to do this are in the manual which comes with the machine. But there is a drawback in that Superclerk is designed specifically for small firms and therefore it can only handle a limited number of customers', suppliers' and employees' records.

Area: *Business software*
Company: *Reprodesign.*
Address: *Professional Microcomputer Services, 131 Market Street, Chorley, Lancashire PR7 2SG.*
Tel: *02572 78376*

Stylish work-stations

International Data Automation Ltd have launched a series of work-stations priced from £39.75. They come in a light beige colour with a glare-proof surface and are designed for safety. The table top has a PVC edging, the corners are rounded off and the table surface produces a friction to prevent the paper and machinery from slipping.

IDA 8000 work-station

The frame is of solid steel and the whole unit comes with adjustable levelling glides although the castors are optional. That applies to the computer stand, but the systems desk, 8000 model and 256 model have variations like the separate keyboard shelf on the 256. The systems desk and the 8000 both have steel frames which can accommodate the disk drive.

Area: *Software accessories*
Company: *International Data Automation Ltd.*
Address: *11 Station Parade, Virginia Water, Surrey GU25 4AB*
Tel: *Wentworth (09904) 4944*

Programs for security

For those of us who are security minded, Softguard have developed a security system featuring four programs specifically for use with Commodore, except the 2001 series. While the programs are running on loading, the system will eradicate any alien instructions and prevent copied programs from loading.

Whether the program is written in Basic or machine code or even a bit of both makes no difference at all to the system. Any attempt to break through the security system and nab a program is rather self-defeating because the end result will be a scrambled program.

Area: *Security systems*
Company: *Softguard Computer Systems*
Address: *Temple House, 43/48 New Street, Birmingham B2 4LH*
Tel: *021-622 4755/021-643 4577*

Versatile processor

Distributed by Supersoft, the MicroScript word processor can be connected to any CBM printer along with most other popular makes. The program is on a printed circuit which adds 46k to ROM and 2k of RAM, thereby enabling it to double as a software program and a hardware accessory.

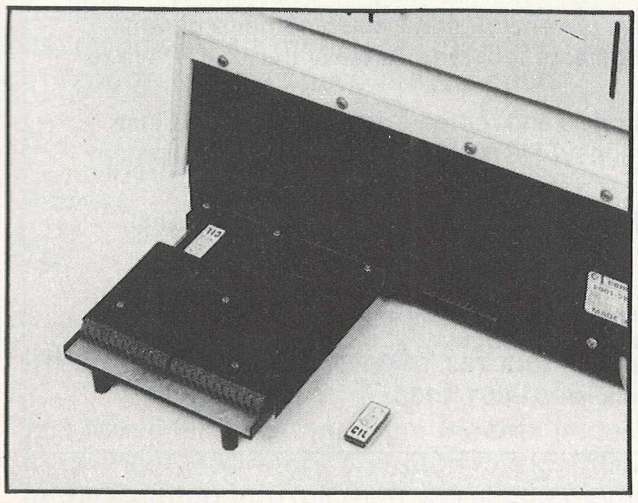
Although the text is automatically justified, the format for the output varies a great deal and the word pro can either print from memory or disk. It is operational on any of the Commodore 8000 series using disk drives CBM 3040/4040/8050.

Area: *Word processors*
Company: *Supersoft.*
Address: *10/14 Canning Road, Harrow*

A NOTICE TO ALL

PET LOVERS

INTRODUCE YOUR PETS TO OURS
AND SOLVE YOUR INTERFACE PROBLEMS



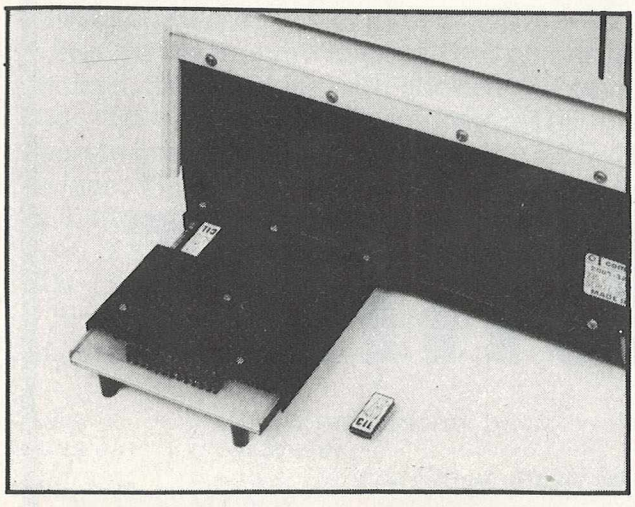
Only £195.00

ANALOGUE/DIGITAL I/O

THE PUPI

- **4 ANALOGUE INPUTS (12BIT)**
- **2 ANALOGUE OUTPUTS (12 BIT)**
- **4 RELAY OUTPUTS**
- **4 LOGIC INPUTS**

When connected to the "PET" User Port the PUPI gives you all the above features together with an operating system in EPROM, which interacts with Basic's variables, giving extremely simple operation. Inputs and outputs are ±10V and relays are rated at 10VA. Logic inputs can be used for microswitch sensing etc.



Only £195.00

HIGH SPEED A/D CONVERTER

THE PUSSI

- **4 ANALOGUE INPUTS (12 BIT)**
- **50 MICROSECOND CONVERSION**
- **STOP AND START TRIGGERS**
- **DATA ACQUISITION SOFTWARE**

Using an operating system in EPROM, the PUSSI provides a high speed A-D Converter with 4 multiplexed inputs, which is under control of either software, or remote start/stop triggers. A-D Conversion can be carried out from Basic, or Machine Code, with up to 1500 readings entered directly into memory at a software determined rate.

CIL

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SUSSEX BN14 8ND.
TELEX: 87515 WISCO G ATTMIC
TEL: (0903) 210474

Write, phone or to
obtain further information circle number

BUSICALC COSTS £39!

If your Commodore computer has at least 32K of memory disks, and you're prepared to spend nearly £200 on a 'spreadsheet' program then you really ought to consider VISICALC. It's a superb program.

If however you're not able to run VISICALC on your system, or are not prepared to invest such a large sum of money you ought to take a look at BUSICALC. It not only sounds familiar, it looks much the same and has a similar range of facilities. All you need is 16K of memory and a cassette unit or disk drive. A printer will be useful, but it isn't essential.

Whether you use your computer in an office or at home, in industry or at university, BUSICALC can make it an even more powerful tool. It can handle jobs that would otherwise require a specially written program — or hours and hours of tedious paperwork. Just fill in the numbers that you know, then tell BUSICALC how to work out the others by entering simple formulae. BUSICALC can add or subtract, multiply or divide, calculate roots or powers, and perform special functions like totalling or averaging rows and columns. You can enter text on the sheet (for column headings, titles etc) and specify the number of decimal places for each calculated value — so with the help of a printer you can produce really smart reports.

BUSICALC 'sheets' can be saved to disk or tape for subsequent reworking, or access by other programs. It all sounds so simple that you wonder why somebody didn't think of it before. Actually they did — we're just doing it for a quarter of the price!

BUSICALC is availabe now for 40 and 80 column PET/CBM models and for the Commodore 64. At just £39 plus VAT (40.50 on disk) it really is incredible value for money! Please give details of your equipment when ordering.

WE ARE LOOKING FOR OVERSEAS DISTRIBUTORS FOR BUSICALC AND OTHER SOFTWARE FOR BOTH PET AND 64. PLEASE WRITE OR TELEPHONE PETER CALVER ON 01-861 1166 (LONDON).

SUPERSOFT

Winchester House, Canning Road,
Wealdstone, Harrow,
Middlesex, HA3 7SJ, England
Telephone: 01-861 1166

MICROSCRIPT

- more space than any other Commodore word processor

See MicroScript at your Commodore dealer.

In desperation phone SUPERSOFT 01-861 1166

Keeping tabs on finance

Dataview are back on the market again, this time with a new software package entitled the Financial Director, which can produce cash flow reports according to the launch or demise of a particular product, changes in tax and interest rates and projected profit and loss accounts. The package covers trading, financial and control areas of business and can be used on the CBM 8097 and 8050 dual floppy disk and a 132 column printer.

The type of report required is available on two facilities, the first being the screen printing of the development of a model, the other being a full set of reports to accompany presentation.

Area: *Finance and accountancy.*
Company: *Dataview.*
Address: *Marketing Department, Portreeves House, East Bay, Colchester CO1 2XB*
Tel: *0206 869414/868835*

Interfacing equipment

The Microlink Interface from Biodata is designed to connect laboratory and monitoring equipment to the Commodore micro. It will accommodate up to 18 single width modules ranging from analog to digital conversion through to several special purpose modules like the heart rate timer and the millisecond timer.

The mainframe modular cabinet comes in three choices, MF7/12/18 with sockets for seven, 12 and 18 modules respectively. The system operates off 240V and contains the IEEE-488 interface. The mainframes start at £300 and go up to £420 while the cost of the modules ranges from £85 for the Analog Signal Conditioning (AN-1) to £265 for the Heart Rate Timer (HR).

Biodata also offer connecting leads starting at £4. Prices do not include VAT or delivery charges.

Area: *Interface systems*
Company: *Biodata Ltd.*
Address: *6 Lower Ormond Street, Manchester M1 5QF*
Tel: *061-236 1283*

Integrator package

Thanks to a software/hardware package developed by Digital Measurement and Analysis, the PET micro is now convertible to a computing integrator. The package consists of a 4K PROM and a 12 bit 8 stage analog to digital converter and makes the job of the 6502 micro obsolete as it operates like a conventional integrator.

The package costs £995 plus VAT and with parameters like Sampling Rate and Threashold, the integrator responds to input signals from GLC and HPLC to electrophoresis scanners. What's more, the integrator (catalogue no DM1 182) can be controlled via an auto sampler or by the computer itself.

Area: *Integrators*
Company: *Digital Measurement and Analysis.*
Address: *3 Sandfield Road, Arnold, Nottingham NGS 6QA*
Tel: *0602 267007*

Storing programs

For use exclusively with PETs, Microscience Ltd have developed a program storage system called Progstor PPMS-01, which accepts programs written in basic or machine code or a combination of the two. It is mainly for use in areas where environmental conditions, such as the presence of dust and oil, prevent the use of other forms of program storage.

The programs are stored on EPROM and the system has a capacity of 14k in 2k blocks or 28k in 4k blocks. With the inclusion of additional software, the system may also be used as a general purpose EPROM copier.

Area: *Storage*
Company: *Microscience Ltd.*
Address: *PO Box 14, Bramhall, Stockport, Cheshire SK7 2QS*
Tel: *061-477 3888*

Pinpointing faults

Commodore computers are being serviced by Solartron's Fault Location package which comes fully equipped with Micropods, pre-programmed ROMs, manuals and the locator. As well as detecting faults, the locator has the capacity to measure analog quantities, pulse width and frequency.

When the micros in the 3032, 4032 and 8032 are tested, the micros 'live' in the Micropod. The cable plugs directly into the socket of the microprocessor and thus the program is allowed to run unhampered by any fault that might appear.

Area: *Fault location*
Company: *Solartron Electronic Group Ltd.*
Address: *Victoria Road, Farnborough, Hampshire GU14 7PW*
Tel: *0252 44433*

MASTER

MASTER is a totally new concept... a complete package for program development. Used by top professionals in the USA and Europe, MASTER has everything you need to write your own software, to the highest professional standards... up to 85 new commands that work with CBM Basic IV... and just one command can replace whole paragraphs of Basic code. That's why Master is...

a new concept in CBM Basic

MASTER has 17 DISK HANDLING commands (both keyed and sequential access, masked retrieval, batch operation, existence tests, etc)... 12 INPUT MANAGEMENT commands (input/output screen zones, with alpha, numeric and date formatting, etc)... 8 SCREEN MANAGEMENT commands (with screen pages loadable from disk or memory)... 10 commands for REPORT MANAGEMENT (with disk-loadable report formats)... 18 BUSINESS BASIC commands (with 20-place arithmetic, data compression, automatic date control etc)... and on the CBM 8096, all the features of PM96 (46K for programs, 26K for variables, as well as 17 BASIC UTILITY commands).

MASTER supports the CBM 8032/8096, 8032+CP/MAKER, and 4040/8050/8250 floppy disks, plus CBM 9060/9090 hard disks, and is supplied with a User Reference Manual, Quick Reference Guide, Demo Disk, and with a key for either cassette port. Supplementary RUN-TIME keys are available for multiple users and software houses.

PM 96

At last you can program the full capacity of the CBM 8096, with 53K for programs (up to 15 simultaneously) and 26K for variables (maintained even while editing or loading)... and use 17 new Basic commands as well, including all the TOOLKIT commands, plus PRINT USING, IF-THEN-ELSE, STOP KEY disable, HARDCOPY screen dump, CALL, FETCH, PLOT (50 by 150), WINDOW, and more. PM96 comes with a User Reference Manual, Quick Reference Guide, Disk with demo programs, and UD11 Support Rom.

Superscript

is the ultimate CBM wordprocessor! Wordpro-compatible (except for price)... with up to 20,000 characters of text, and 240 characters screen format... and no Roms or dongles to instal! SuperScript has been adopted by Commodore for their new models... and is now joined by SUPERSPELL, a 30,000 word disk dictionary, which easily verifies the largest Superscript (or Wordpro) document in 80 seconds... and user-defined words can be added. SUPERSCRIPT and SUPERSPELL suit most CBMs, disks and printers, and letter-quality printers.

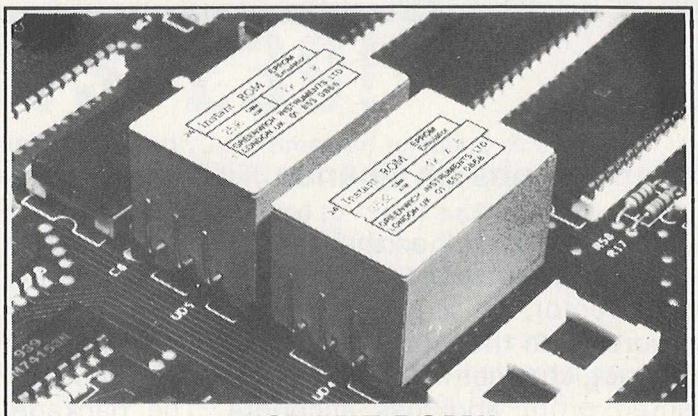
These are just three fine products from our CBM/PET range... please telephone or write for our comprehensive data sheets:

MASTER Program Development System £300.00
MASTER Additional run-time keys £45.00
PM96 96K Memory Management/Basic Enhancement £99.50
SUPERSCRIPT The Ultimate CBM Worprocessor £249.00
SUPERSPELL Disk Dictionary/Spelling Checker £150.00
VIC SCREEN Screen management/Dos Support etc..... £49.50
KRAM Keyed Disk Access (state which disk) £86.95
COMMAND-O (for Basic IV, state which Pet) £59.95
DISK-O-PRO (Adds Basic IV etc to Basic II) £59.95
SPACEMAKER 4-Rom adaptor (not for 8096) £29.95
VISICALC 32K/96K RRP £180.00, less £35.00 ..... £145.00

ORDERING INFORMATION: Add 15% VAT to quoted prices. Order by post, telephone or Prestel, using cheque, ACCESS or BARCLAY card. For same-day service, telephone 01-546-7256. For over-the-counter sales, see your Commodore Dealer. (Ref AD10)

Calco Software

LAKESIDE HOUSE, KINGSTON HILL, SURREY, KT2 7QT. TEL 01-546-7256



"INSTANT ROM"

"Instant Rom" ROM/EPROM EMULATORS contain CMOS RAM with internal battery backup. When the power is switched off, data is retained for up to 10 years.
In the PET, a 4K INSTANT ROM can be fitted in the $9000 or $A000 socket. Machine-code (and Basic) programs can be stored, and are available at switch-on.
INSTANT ROM saves time. It can be used for long periods; when the program is finally "bug-free", an EPROM can be programmed.
4K INSTANT ROM (ROM socket replacement).....£56.00
2K INSTANT ROM (character generator replacement).....£39.00
Adaptor GA1 (essential for PET users).....£6.00

"G-ROM E"

G-ROM E is a 4K EPROM which will Auto-run, at switch-on, any Basic or Machine-Code program stored in INSTANT ROM. Basic programs can be stored with a few quick key-strokes. No skill is needed. Programs can now be run without a tape or disk unit, and can be changed without cost to the user. Diagnostic aids are included.
G-ROM E (specify type of PET).....£25.00

Postage (£1.00) and VAT are extra. Leaflets are available.

"INSTANT ROM" and "PETCLOCK" are COMMODORE APPROVED PRODUCTS.
GREENWICH INSTRUMENTS LIMITED, 22 BARDSLEY LANE, GREENWICH, LONDON SE10 9RF, UK. Tel: 01-853 0868. Telex: 896691 Attn. GIL.

HI-RESOLUTION GRAPHICS

A high resolution graphics board that gives a 64,000 dot (320×200) resolution. Versions available for any dynamic ram Pet, BASIC 2,3,4, FAT40 & 80 columns. No soldering or track cutting required, supplied complete with fast GRAPHIX software in ROM and full fitting & operating instructions. **£149.00**

SUPER ROM-SELECTOR

A high quality printed circuit board giving 64K of utility ROM space, software selectable!!! Allows 16×4K ROMs/EPROMs to reside in the expansion area of your PET. One 'POKE' enables any two ROMs at a time. Suitable for bank-switched software. **£75.00**

PET UPGRADES

WHILE-U-WAIT service! (Dynamic ram pets only).
Memory expansion:
8K-32K.....£59.90
16K-32K.....from £48.70
8K-16K.....£38.26
40 column (12in VDU only) to 80 column conversion.
40-80 column.....£89.00
40-80 column switchable (two machines in one!).....£105.00
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Tel: 01-953 8385

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Hooked in to one CBM 8032 or 8096, four other CBMs can make enquiries and print reports leaving the creation and updating of files to the master computer. The multi-user system, developed by Anagram Systems, enables the five CBMs to run simultaneously and is aimed for use in the warehouse and the sales office. According to Dick Simmons, "it is an ideal low-cost unit for stock control where machines are needed to handle telephone orders."

Each terminal costs £300 in addition to the cost of the normal single-user package, although nothing in the form of interfaces/black boxes or additional hardware needs to be added.

Area: *Stock control*
Company: *Anagram Systems.*
Address: *60A Queen Street, Horsham, West Sussex RH13 5AD*
Tel: *0403-50854/58153*

Computer fair

The Association of London Computer Clubs, formed in 1980, hopes that the London Computer Fair to be held at Central Hall, Westminster, London in April will lead to the formation of other regional computer clubs.

The North London Hobby Computer Club (a member of ALCC) is offering a part-time course in recreational computing which incorporates a PET and VIC users group. The club holds meetings which are open to both members and non-members. The club is based at The Polytechnic of North London, Holloway, London N7 8DB (telephone 01-607 2789).

Another micro show

Microscene, organisers of last September's micro show in Birmingham, are planning a similar show after Easter. This time it will be held in Sheffield and the organisers hope to cover products for micros under £500. The exhibition, called Microscene Hallam '83 (using the pre-Norman name for Sheffield) will be held on April 16 in the Top Rank Suite. Exhibitors are already booking show space. Anybody wishing to attend should send 50 pence for one ticket plus a stamped addressed envelope.

Area: *Exhibitions*
Company: *Microscene.*
Address: *6 Battenhall Road, Harborne, Birmingham B17 9UD*
Tel: *021-426 6762*

Merging routines and programs

You are halfway through a program and you realise that the routine you now require is already on your disk. With Merge, produced by Leader Systems, the routine and the program can be combined simply by loading the Merge program. It is available for Basic 3 and 4 PETs using 4040 disks and uses RAM but no basic memory. And the cost? Just £7.95.

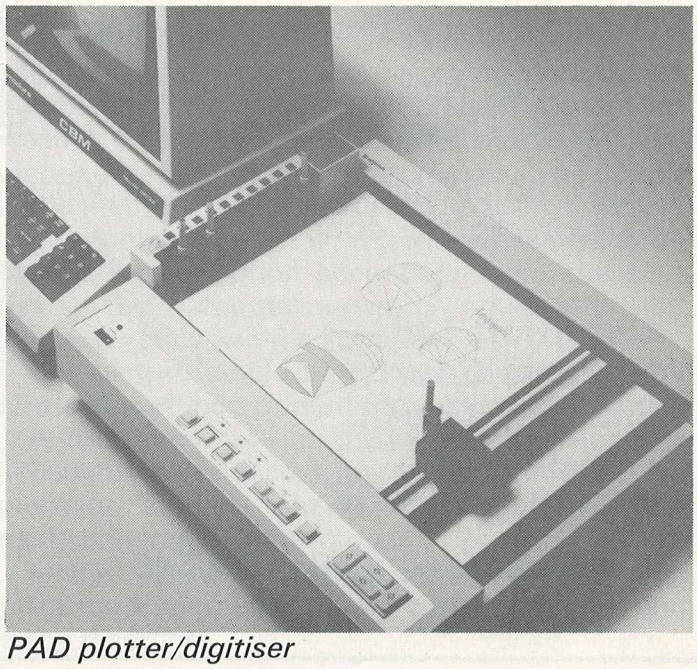
Area: *Combination programs*
Company: *Leader Systems,*
Address: *85 High Street, Hampton-in-Arden, Solihull, West Midlands B92 OAE*
Tel: *021-236 9768*

Aid for draughtsmen

For architects, draughtsmen and anyone else who likes drawing, Autographics have produced a system called PAD (Power Assisted Draughting). Its make-up consists of a 32k micro with plotter/digitiser and a 1 megabyte disk system. It retails at £7,000 and its potential market is small engineering and architects' offices. It has storage facilities for drawings which are stored on disk. Drawings on a scale of 1/8 can be combined with the details of 1/100.

The software, which includes a graphics matrix ROM, will add another £2,000 to the bill.

Area: *Architectural design*
Company: *Autographics.*
Address: *120 Clay Road, Toye, Downpatrick, County Down, Northern Ireland*
Tel: *039682-8138*



PAD plotter/digitiser

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I have a model Commodore business machine.

The young ones

Teenagers delight judges with some original ideas

Microcomputers can be applied to most activities — business, medicine, entertainment and many others — and are so easily accepted and well-documented that practically anyone can use them. Anyone, that is who does not suffer from a mental or physical disability. But that could soon change, thanks to the winning design in the 1982 Young Computer Brain of the Year competition sponsored by The Sunday Times and Commodore Business Machines.

Aim of the competition was to produce ideas for computers to help society in a practical way. There were 328 entries in the three age group categories. Of these, 19 were chosen to share computer prizes worth £12,000, and from these the judges, who included Peter Hall of the British Computer Society, Gail Wellington, Software Products Manager of CBM (UK) Ltd and Tony Osman, Science Editor of The Sunday Times Magazine, chose an overall winner, the Young Computer Brain of the Year.

That coveted award went to a 14-year-old from Newcastle-upon-Tyne, Derek Reynolds, for his proposal to enable mentally and physically handicapped people to educate themselves. In the beginning, two ideas were inspired by a school trip to a school for the handicapped. He noticed that when some children were presented with a mixture of shapes or letters, not all of them could recognise the odd one out. So he combined the ideal of producing an educational program with devising a keyboard for easy use by the handicapped.

Derek is familiar with PET Basic and the keyboard he designed is built around the 3032. It is a strange looking machine attached to an adaptor which has a large square shape situated above the 'enter' key and a circular shape above the 'choice' key. The program he wrote is called 'Odd Man Out' and its aim is to help the disabled to recognise the odd character in a word or a series of symbols.

The computer accepts a maximum of 500 words or a series of small sentences up to 255 characters long which are fed in manually or loaded by cassette. Breaking these limits causes an error signal to appear, and the same happens if a wrong key is pressed.

All input requirements having been satisfied, a loop is set from 1 to n and a word is displayed on the screen along with a dummy letter which the pupil has to indicate by pressing the round key to move the indicator along. Pressing the square key informs the computer that a choice has been made. A weeping face denotes a wrong choice and a smiling face a correct one.

But did the children rebel against this educational 'game' and become bored? "No," says Derek. "The longer the children played, the more they wished to play."

Many of the entries dealt with medicine or crime. Rachael Gooberman's winning entry in the under-13 group described a more efficient Identikit system using computer-aided design. She pictures her system as having two VDUs, 3D images and colour for the more accurate portrayal of a criminal. She criticises the present system for wasting time and space and says that if her system were adopted, recorded features could be stored in the memory banks and called up using a special code number. If none of the memorised features fitted the description accurately then, she suggests, the computer operator could alter the characteristics using a light pen.

Derek Reynolds receives his trophy from Mr Peter Hall.

The picture would be rotated to show off the features and then printed for publication.

Analysing her project, the judges concluded that although the technical aspects would pose severe problems, the idea was so well thought out that it merited first prize in her group.

In the 16-18 age group, Lionel Tun won first prize for a computer to help cure depression and sleep disorders.

Games for all abilities

Boss plays chess

Writing a chess program is never the easiest of software problems to tackle, and writing a good one is even worse.

Probably the best program produced for the PET was one of the first that appeared, namely Microchess by Peter Jennings (who reputedly made his fortune from the product). This managed to play chess to a reasonable "club player" standard and was never bettered, at least as far as the PET was concerned, until fairly recently.

Now that the VIC has been with us for a while the challenge was to come up with a decent version of that, bearing in mind that you only had 22 columns and 3.5K of memory to play with.

User defined graphics

Ignoring both those factors, Kavan Software have written Boss, a totally machine code program for the VIC, which requires at least 8K of memory expansion. The 22 column problem was solved by extensive use of user defined graphics, so you'd never really know you were playing on such a limited screen.

The graphics are very good indeed, and all the pieces look as they should do, although I would have preferred to see a black and white board rather than the easier blue and white that they've opted for. Movement of these pieces is rapid, to say the least : no sooner have you entered a move than it is performed.

The speed with which the VIC moves is up to you. There are 10 levels of play ranging from 0 (average response time of 1 second) to 9 (average response time of 4 hours!) but all these times can vary depending on what stage the game has reached.

Worthwhile opponent

And so on to the game itself. The test of any chess program will be the quality of the game it plays. Kavan are to be congratulated on producing a most worthwhile opponent.

Even at the lower levels it manages to put up a good fight, and at the higher ones it is unbeatable, at least in our office. No doubt grand masters would not find too much trouble defeating it, but I should think the average player in the street would be well satisfied.

Castling and en passant are recognised, but one fault is that a pawn is automatically promoted to a queen, when there are many instances where this is not desired. For example, a knight might produce checkmate where a queen would not.

One other fault is that it does not always recognise a stalemate position but these are minor complaints against an otherwise very competent package.

Area: *Chess for the Vic*
Distributors: *Audiogenic Ltd.*
Address: *PO Box 88, Reading, Berks*
Telephone: *0734-586334*

Pythonesque

This is a game suited to the experienced Adventure player, with an added bonus for those who are Monty Python addicts. The lack of instructions at the beginning will make life hard for the newcomer. The main scenario consists of a long tree-lined road with offshoots to a hospital room, a padded cell and a bus.

To progress in this game the essential step is to mug an old lady, who is programmed to turn into a nasty old lady. Once you issue instructions to mug her you are offered nine ways of beating her up to obtain any money which she may have on her.

New phase

Remembering my first adventure program, I became so infuriated at this seemingly inferior take-off of the original that I ordered the computer to mug the old lady out of spite. Lo and behold! A new phase in the game opened up. My lapsed interest revived at this hopeful sign and I took great pleasure in devising her end. But this old lady is of a new breed, she offers stiff resistance and if one becomes fed-up, frantic or just plain bored the out button happens to be number nine. Depressing this earns you the title of "Wimp".

This feature of the game confirmed my impression that it was rather anti-social and one that I would not play for pleasure. But if young people are tempted away from the streets and back into their homes to commit such acts of mugging, perhaps society will benefit.

Pythonesque is available from Supersoft, Winchester House, Canning Road, Wealdstone, Harrow, Middlesex HA3 7SJ (telephone 01-861 1166). Price £16 plus VAT.

The player will need a PET capable of 32K with a 40 or 80 column screen.

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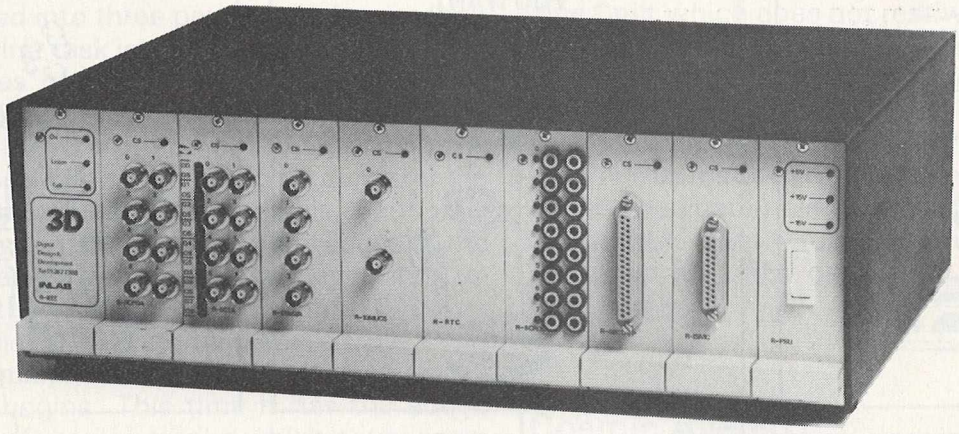

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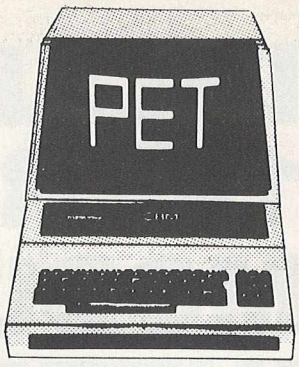

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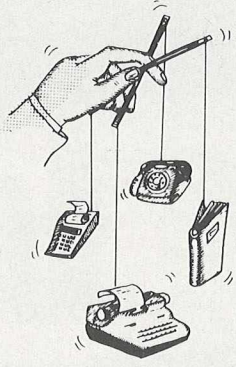

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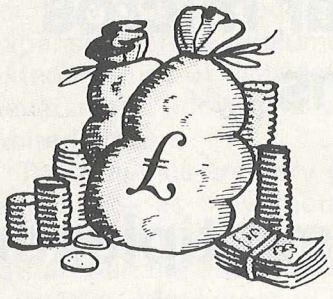
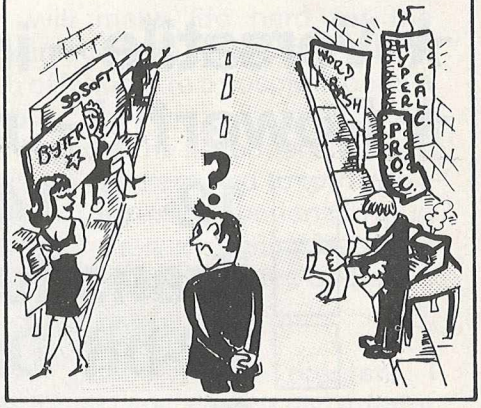


WITHOUT BEING A COMPUTER EXPERT

IN WHAT CAN ONLY BE DESCRIBED AS A CONFUSING MARKET



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Crazy Kong

It was inevitable. After those nostalgic repeats of the classic film on cinema and TV, there was bound to be a computer game called Crazy Kong. The object is to rescue the maiden from Kong. The game is divided into three parts, each harder than the last. The first task is relatively simple — climbing up a series of ladders while trying to avoid seven cannonballs which are descending.

The player has the option of moving along the points compass, but you have to be quick on the jump button to avoid the cannonballs. Caution is also advisable when retreating to the edges of the field — with an unwary move the player ends up dropping off the edge and dying. Aagh!

Once the player has stormed the citadel Kong snatches the maiden out of reach and a new phase in the game begins. This time it has the added complication of moving tracks which never seem to go in the right direction. The jumping option is important here and it is possible to make it to the top only to find the maiden snatched yet again.

Watch those fireballs

In the third and final phase the key features are the ladders and the fireballs which until now have been easy to avoid. A variation of the old cartoon device — stepping out into the wide blue yonder and finding by good fortune a girder swinging into place — is used here. The ladders are elongated, but you have to wait for a lift to rise and time the jumps with skill. And watch out for the fireballs.

It is a little frustrating to find that at the end of this Herculean effort Kong retains custody of the maiden. But it's still a thoroughly enjoyable game for players of all standards.

Crazy Kong from Supersoft costs £8 plus VAT. You will need a PET capable of 16K with a 40 column screen.

Cosmic Lemmings

I am assured that this program has nothing to do with lemmings and that the operative word in the title is cosmic. The object of the game is to prevent the lemmings and the space ship from dropping to the ground, all the while avoiding the bombs dropped by the lemmings.

You also have to watch out for the explosion fall-outs from the spaceship and the lemmings hitting the ground. In the case of the spaceship there is no escape. Unless you destroy it before it hits the ground you will most certainly be blown up by the force of its self-destructing landing. The lemmings are only a little less dangerous; their fall-out does not spread quite so far and the bombs, if they don't get you on the way down, only release three XXX of explosion matter.

One soon learns that the machine will win not eventually, not later, but sooner than you think. One fault which does not rest with the program is the slowness of the machine to respond to your instructions. All too often the brain has reacted as it should to find that the machine did not respond — it doesn't help to find yourself floating around the machine as minute particles of electrical impulses. For the dedicated player I think.

Available from Supersoft for £8 plus VAT. Designed for a PET capable of 8K with a 40 column screen.

Cosmic Aliens

Based on a similar arcade game, Cosmic Aliens will appeal to all players, being easy to learn. The player is fixed to a horizontal plane which allows him to go left to right but not up and down. Helping the player are a series of 'houses' which enable him to hide from the bombs which rain down on him from the different spaceships stacked above them.

Floating at spaced intervals along the top of the screen are high-value spaceships; to knock these out one must first clear a path through the stacked ships. When firing your laser you have to be careful not to demolish your houses from beneath and be left without cover.

Available from Supersoft for £8 plus VAT. Designed for a PET capable of 8K with a 40 or 80 column screen.

Scramble

Taken from the arcade game, this version of Scramble is specially written for the Commodore machine. The game progresses through varying degrees of difficulty, although I have only managed to reach the cavern in the second stage.

This is an ideal game for all players of all standards. The basic idea is to guide your space rocket across the skyline, bombing all comers and refuelling on the way by bombing the fuel dumps. The rocket is programmed to blow up if it touches the ground. Having penetrated the first obstacle course, the player has to guide his ship through a cavernous type skyway, where the hazards of touching land are doubled.

Scramble costs £8 plus VAT from Supersoft. The player will need a PET capable of 8K with a 40 column screen.

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To arrive not later than 21st March 1983.

The entries will be judged on 7th April 1983 by a team of experts at Commodore Computing International. The prize is a Commodore 64 and the name of the winner and runners-up will be published in a future issue.

Here comes the new generation

The winter of 1982/1983 sees the launch of the new family of computers from Commodore. These machines are intended as replacements for the existing 4000 and 8000 series.

The new range consists of three machines, the Commodore 64 — already available in the shops — the 500 or P series and the 700 or B series. The different series names apply to different parts of the world, the logic for this being rather obscure.

There is also a fourth machine in the new family, the MAX, a very low-cost unit designed principally as a video games machine, which will not be launched until later in the year. The new range of machines, in conjunction with the popular VIC-20, make Commodore one of the few manufacturers in the microcomputer industry to offer a complete range of machines, from the simple home computer to the powerful 16-bit business system.

To date only the Commodore 64 is on the market in commercial quantities. Despite current advertising the 700 is not expected to become generally available until the spring of 1983 and the 500 soon after. The 700 series is eagerly awaited since this is Commodore's answer to the Apple III and the IBM PC. We have been able to glean some insight into these machines by looking at their US versions, the P and B series, which are now available in limited quantities. The following is an analysis of some of the features of these new machines.

Case in three parts

Probably the most striking feature of the 500 and 700 series machines on first seeing them is the design. The 700 series is about the same size as the existing 8000 series machines, but the new case is totally different. Unlike previous machines the case is in three parts; the keyboard is detachable and the screen can be both rotated and tilted.

This new design makes the machine more convenient and comfortable for the operator to use. By detaching the keyboard it is not only easier to use but allows space for two integral disk drives on the front of the main processor unit. The keyboard is similar to that of existing PET machines but with the addition of a set of 10 programmable function keys, which can be used to enhance applications programs.

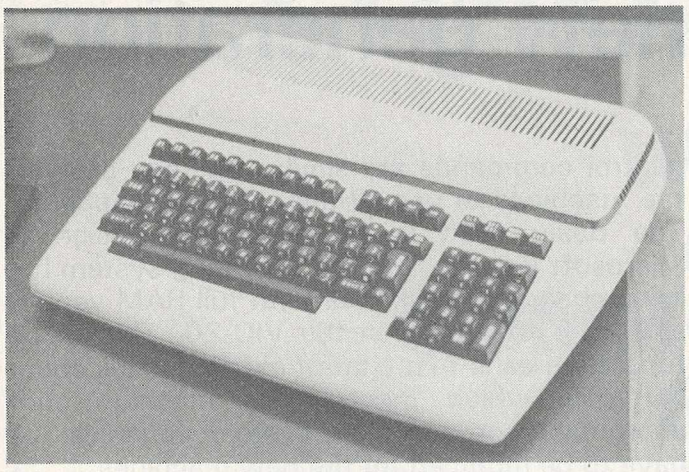
The new computers have many features in common with each other and the existing range. Thus the IEEE-488 bus is the same and the peripheral control commands are similar, thereby allowing the machines to use all the existing peripherals. The Basic used is an enhanced version of Microsoft Basic 4, but the operating system has been changed to a kernal with full RAM vectors similar to that used in the VIC-20. This unfortunately means that a lot of existing applications software which incorporates machine code subroutines or accesses system variables will have to be modified for the new machines.

Additional commands have been added, the most useful of which is an IF ... THEN ... ELSE command plus the necessary bank commands required to deal with the large amount of RAM memory available in these machines. The computers also have a cartridge slot similar to that on the VIC, which can be used to power up the computer directly into a machine code routine; the routine could be a game or extend the commands

The Commodore 700 or B series is a software compatible range of professional computers starting with 128K of user memory (RAM). This series features an attached display and integral disk units.

Like the 500 or P series, the B machines are also compatible with the full line of CBM peripherals, allowing them to be easily expanded as needs grow.

The 720 or BX series is an enhanced version of the B series, with 256K of user memory standard, and with a second processor — a 16-bit 8088 — also included as standard. The BX series is software compatible with the B series. In addition, the 8088 processor allows users to access the existing library of CP/M-86 programs.



The Commodore 500 or P series is a software compatible range of colour computers starting with 128K of user memory (RAM). These systems are designed for use with a separate colour monitor or TV via the built-in RF modulator. P series computers are compatible with the full range of existing Commodore disk and printer peripherals (CBM IEEE-488 series).

In addition to the standard text display of 40 columns by 25 lines, there is a high resolution display of 320 by 200 dots (pixels). 16 colours are available for text display or graphics, together with special sprite graphics for outstanding visual effects. Two control ports are included which may be used for joysticks or other peripherals.

in Basic. In the games environment both the 500 and 700 machines have a built-in three-voice music synthesiser.

New features have been added which enhance the versatility of the machines. These include an integral RS-232 communication port, of great value to users of non-Commodore printers, modems etc. Apart from the RS-232 port used with a modem, Commodore have designed the machines to be simply connected into a low-cost three-wire local area network.

The internal RAM memory is also expanded to allow up to 256K internally and in the 700 series up to 640K externally. The memory is organised in banks of 64K and special programming techniques are required to access the expanded memory; this is done in Basic using special commands.

The machines also have the option of adding an extra processor board. Initially there is a Z80 processor board which allows CP/M to be run and a 16-bit 8088 board allowing CP/M86 compatability with the IBM PC and Victor 9000 software. The extra processor board and expanded RAM memory allow the machine to be enhanced by soft-loading other languages in addition to Com-

Commodore series comparison chart

	500 or P SERIES	700 or B SERIES	720 or BX SERIES
USER MEMORY (RAM)			
Standard	128K	128K	256K
Maximum	896K 256K internally plus 640K external	896K 256K internally plus 640K external	896K 256K internally plus 640K external
PERMAMENT MEMORY (ROM)	40K	40K	40K
DISPLAY	40 Col. x 25 Line Color TV or Monitor 16 colors 320 x 200 dot Hi-Res Mode	80 Col. x 25 Line Integral Display Easy Read Green Phosphor	80 Col. x 25 Line Integral Display Easy Read Green Phosphor
KEYBOARD	Integral 94-key —10 function keys —Numeric keypad —Editing & Cursor —Control keys	Detachable 94-key —10 function keys —Numeric keypad —Editing & Cursor —Control keys	Detachable 94-key —10 function keys —Numeric keypad —Editing & Cursor —Control keys
PROCESSOR (standard) Optional	6509 Z-80 8088	6509 Z-80 8088	6509 & 8088 Z-80 8088
INTERFACES	IEEE-488 RS 232 CBM Cassette 8-Bit User Port Direct Audio/Video Output Cartridge Slot Control Ports	IEEE-488 RS 232 CBM Cassette 8-Bit User Port Direct Audio Output Cartridge Slot	IEEE-48 RS 232 CBM Cassette 8-Bit User Port Direct Audio Output Cartridge Slot
INTEGRAL DISKS		YES	YES
Standard language	BASIC 4.0+	BASIC 4.0+	BASIC 4.0+
Optional languages	CP/M, CP/M-86 U.C.S.D. Pascal	CP/M, CP/M-86 U.C.S.D. Pascal	CP/M, CP/M-86 U.C.S.D. Pascal
Real time clock	YES	YES	YES
SOUND SYNTHESIZER	YES	YES	YES

modore Basic. These include U.C.S.D., Pascal and, with the extra processor board running CP/M, the traditional languages like FORTRAN, COBOL and APL.

Comparison with other makes

	Commodore 700/720	IBM PC	APPLE III
MEMORY			
Standard	128/256K	16K	128K
Maximum	896K	256K	256K
Maximum capacity per 5¼ inch disk	1050K	160K	140K
OUTPUT			
RS 232	Yes	Yes	Yes
IEEE-488	Yes	No	No
Parallel	Yes	No	Extra
LANGUAGES			
Basic	Yes	Extra	Extra
HUMAN FACTORS			
Detachable Keyboard	Yes	Yes	No
Adjustable Screen	Yes	Swivel only	No
Monitor	Yes	Extra	Extra

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5	Eprom Burner	£40.00
6	Disk on/error Indicator	£17.50
7	Reset Button	£ 7.50
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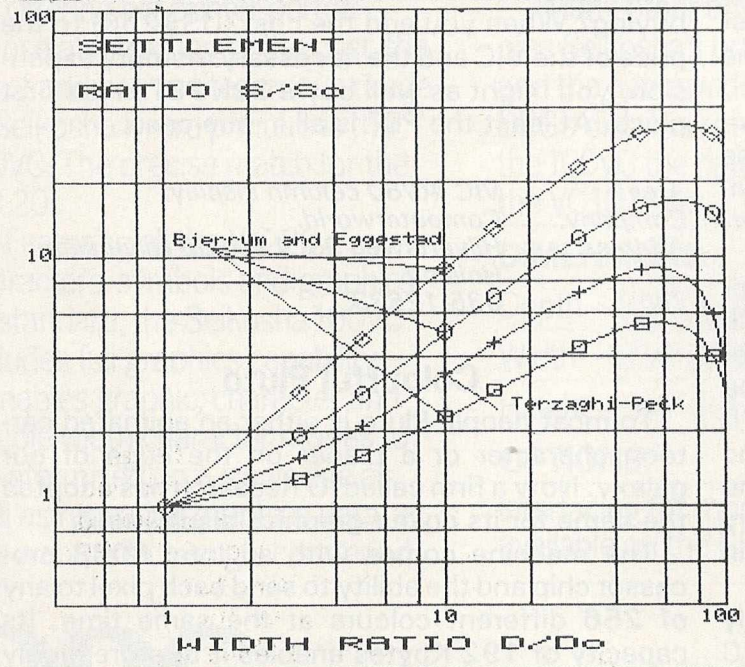

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40/80 character expansion

One of the major problems when using the VIC-20 is the limiting 22 column screen. Although this can be partially overcome by employing user defined graphics, you still have the disadvantage of not being able to use existing PET software.

A number of companies have tried to overcome this problem by producing 40 or 80 column expansion boards, but none of these has really achieved the job they were designed for.

The reason for this was that they were merely emulating a 40 or 80 column screen, rather than giving you that amount of space to work with. In other words, while you could display images on an 80 column screen area, you couldn't do anything with them.

Some boards went so far as to remove the existing graphic set from you altogether. This is obviously not desirable.

A possible solution has appeared with the introduction of a video-cartridge from a company called Computerworld in Holland. Is this the answer?

The cartridge

The cartridge slots neatly in the back of the VIC or, if you're using extra memory, in any of the spare slots of whatever memory expansion board you happen to have fitted. Given a 3K, an 8K and a 16K memory expansion cartridge you at least have 32K of Basic to play with, rather than the usual limiting 27.5K.

You can use the cartridge with either a television set or a monitor, although it is desirable to use a monitor for the 80 column mode, as the television display does tend to wobble. It is, however, fine for the 40 character display.

Once connected up you emerge on power-up into 40 column mode. The information sheet which accompanied our cartridge suggested a rather long-winded way of selecting the mode you wanted to be in: POKE this, SYS that and so on. It didn't take too long to discover that shift and restore gave you 80 columns, and run/stop and restore got you back to 40 again. All this occurs without losing any program that might be in memory at the time.

The display with 40 characters is extremely good. True descenders, all the PET and VIC graphics that we've come to know and love, remain with us in perfect form, allowing the running of most 40 column PET software, providing you haven't descended into machine code and aren't POKEing to the screen.

Screen memory remains a mystery, at least for this reviewer. You can certainly print to it, but POKEing to it does not appear to work. Presumably it's just using the screen as a monitor rather than RAM.

If you want to revert to 22 column mode, you end up using only half the screen width, which looks a little disconcerting. Rather like using windows on the 8032!

Another failing is in the screen editing. Although you retain the usual VIC editing features, you are still limited to a little over 80 columns in the length of the program lines you can enter.

The problem is that the screen displays all the intentions of accepting lines up to *any* length. You can type away to your heart's content, but you'll never get it to accept more than 85 characters in a program line.

Finally, but most significantly, you lose one of the VIC's most appealing characteristics, that of colour. Colour doesn't exist in Computerworld's repertoire, at least not in their 40/80 column display cartridge. Both colour and screen end up as normal Basic storage areas, which is a great shame.

Conclusions

It's an attractive beast to review, but is it worth buying? When you add the cost (US$250) to the price of the VIC and the necessary memory expansion, you might as well buy a 32K PET in the first place. At least the PET is all in one case.

Area:	*VIC 40/80 column display*
Company:	*Computerworld.*
Address:	*Hilvertsweg 99, 1214 JB Hilversum, Holland.*
Tel:	*035-12633*

Colourful Pluto

To most people Pluto is either an animated cartoon character or a planet on the edge of our galaxy. Now a firm called IO Research has adopted the name for its colour graphics display unit.

The machine comes with an Intel 8088 processor chip and the ability to send each pixel to any of 256 different colours at the same time. Its capacity of 192 Kbytes enables it to store highly detailed graphics in a multi-coloured video image. IO Research has interfaced Pluto to run with many micros, including Commodores, while Robocom's Bit-Stik system is being adapted to use it. The display is priced at £600.

VIC-20 USERS

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A user's experience with KeyChip

Alfred Rose

Many PET usrs are deterred from buying one of the ROMs which add extra facilities to the PET by the bewildering variety and high price of the products currently available.

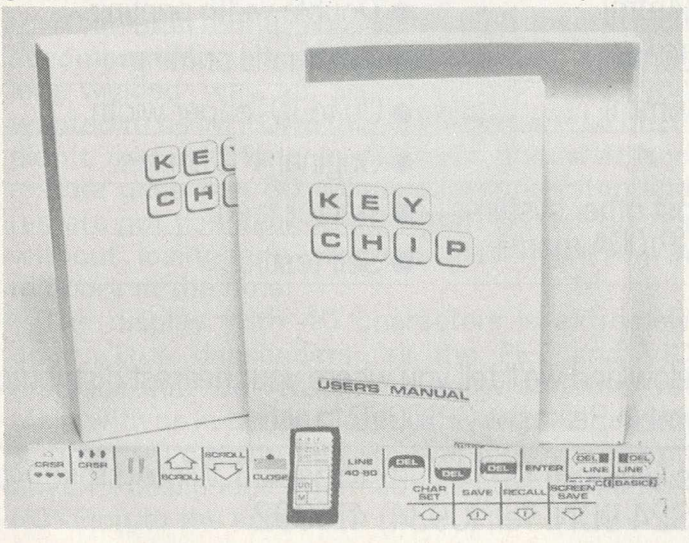
I fall into this category. Having bought "Toolkit" and "Visicalc", I hesitated in filling the last free ROM socket. I must admit that I was attracted to KeyChip by the lower price rather than any expectation of at last having found the ultimate PET chip.

KeyChip is a 4K chip which provides a large number of facilities for writing and debugging programs. All these functions are activated by pressing the left shift and one other key. None of them may be used from a Basic program. It is available for Commodore PET 9in screen models (3000, 4000 and 2000-Basic 3.0 series).

Price barrier

At a price of £15 including VAT and postage, it seemed too good to be true. Had the suppliers, Wirt Microsystems, really broken the price barrier, or just produced a shoddy piece of software? I was pleasantly surprised to find that KeyChip was very well packaged.

The 30 page manual was typeset and excellently produced. There were two strips of labels which had to be stuck above the top row of keys to identify their new functions. The labels and the functions on the back cover of the manual were laminated with clear plastic, a welcome innovation to stop the onset of premature greyness. The general standard of presentation in this product puts the producers of exorbitantly priced hardware and software to shame.



KeyChip is compatible with Toolkit and I used both chips simultaneously during all my tests. The manual gives the SYS commands to activate KeyChip in the preferred UD3 socket, although it can be supplied for any free ROM socket.

The most interesting KeyChip function is the ability to scroll a Basic program in both directions, either at high speed or one line at a time. Simply pressing "left shift L" will activate the List function, causing the cursor to disappear and the program to be listed from the beginning. Once in the List mode, the screen is a window on the program which will fill all 25 lines of the screen.

The program is still, however, quite difficult to read, which is where the List format functions come in. At the press of a key the line numbers can be reversed, or the second Basic line is indented clear of the line number, or a space is created between Basic 1 lines, or any combination of these functions.

Cursor control symbols

One of the features of PET program listings are the strange cursor control symbols. Reverse Q, for example, means cursor down. KeyChip can change these to more recognisable symbols. It can also fill spaces within inverted commas with reverse dollar symbols. This makes it possible to count spaces, eg when producing column headings.

After scrolling the program, pressing left shift will bring back the cursor and the program can be edited. Then 'left shift R' will re-enter the list mode at exactly the same place and the program can be scrolled again. How the KeyChip manages to scroll the program in both directions while keeping track of all the List formats I cannot imagine. It even scrolls Basic lines which are longer than 80 characters and labels these "illegal" third lines with a reverse arrow symbol!

In everyday use I found it helpful to load the disk directories by using the DOS/$. Then, with KeyChip, I was able to scroll both directories from the one loading.

As soon as KeyChip is activated all keys will repeat apart from RETURN and RVS/OFF. All "repeat" parameters can be changed by POKEs, ie limiting repeat to the cursor control keys or

changing the delay before repeat, or the repeat rate.

Pressing left shift and one of the labelled keys at the top of the keyboard accesses a large number of screen editing functions.

If the repeat key is too slow, then two dedicated keys make it possible for the cursor to move in half-screen jumps. This is useful for moving the cursor to the bottom of the screen or to the centre of a line.

There is a function to instantly regain control of the cursor when inverted commas have been entered. Similarly, pressing left shift will release the cursor when the INSERT key has been used. The screen can be scrolled in either direction or closed/opened up at any point. The latter is useful when inserting a line in a program.

The screen can be erased below or above the cursor or from one line to any other. Lines can also be erased either left or right of the cursor. There is a similar function for Basic lines which leaves the line numbers intact so that edited lines can be re-entered immediately.

Screensave is a unique function to store up to 10 complete screens in memory. There are many features, such as swapping a stored screen with a current screen, storing any rectangular part of the screen, or recalling a stored screen in reverse video. There are so many features that the manual takes six pages to list them all.

Screensave is of special interest to users who do not have a printer and have to resort to pen and paper to note down program output. Parts of a program can also be altered while saving the original version in case proposed "improvements" make it worse.

Further details from Wirt Microsystems, 12 Alleyn Cres, London SE21 8BN.

```
10 S=826:N=0:REM S=STSRT OF SUBR,N=NUMBER OF KEY(0-9)
20 S=S-1:H=INT(S/256):L=S-H*256:N=N*2+904:POKEN,H:POKEN+1,L
30 FORA=S+1TOS+99:READ B:POKEA,B:IF B=0THEN50
40 NEXT
50 R=S+9:H=INT(R/256):POKE S+4,H
60 DATA169,1,160,1,32,28,202,96
70 REM BELOW MESSAGE IN ASCII-TERMINATNTE WITH 0
80 DATA29,250,184,204,157,157,157,17,213,46,32,46,201,157,157,157,157,157,17
90 DATA202,32,221,32,203,157,157,157,17,205,45,206,145,145,145,29,29,0
206 REM FOR BASIC4 LINE 60 REPLACE 28 WITH 29 AND 202 WITH 187.
READY.
```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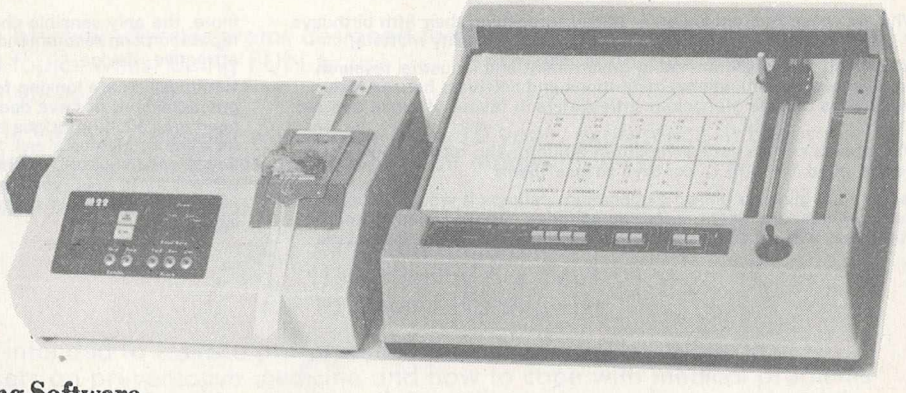

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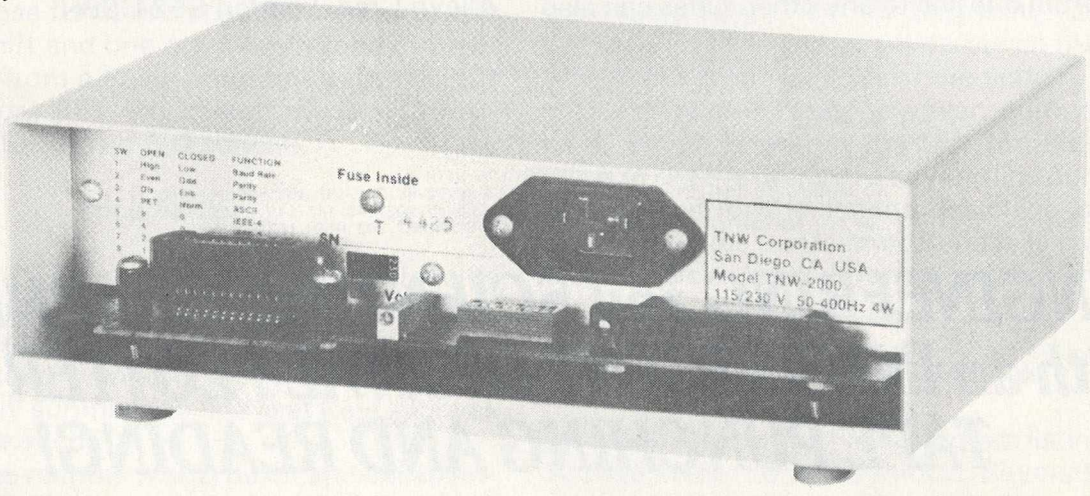

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Formatting listings

To clarify a program listing it is useful to be able to insert blank lines and indent lines in order to show the logical structure. The indentation of lines is primarily used to identify the levels of FOR..NEXT loop nesting. Unfortunately the PET left justifies all program lines, which means that normally it is impossible to insert blank lines or spaces at the start of a line.

However, we can insert spaces if at the beginning of a line of PET Basic we insert a colon (:) following the line number. The colon can then be followed with as many blank spaces as required, or by pressing return will enter a blank line.

```
10: INPUT A
20: FOR Q = 1 TO A
30: INPUT B
40: FOR X = 1 TO B
50: PRINTA*B
60: NEXT X
70: NEXT Q
```

This will work with all program statements except DATA statements, which require the insertion of two colons, thus:

```
100: : DATA 10,52,33
```

The use of a statement delimiting colon also allows the insertion of non-numeric remarks into lines following a GOTO, GOSUB, or THEN statement without the use of a REM command.

```
100: GOTO 200 INPUT DATA
```

This will only work with these three statements but it does provide the programmer with a useful way of labelling the destination of the jump.

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Region F — Berkshire Group — Brian Jones, Dept. of Maths and Computing, Slough College of Higher Education, Wellington St., Slough. Tel. Slough 34585 ext. 81. Their first meeting was held on 29th March, please contact Brian for future dates.
Region G — Essex Area — Please contact Walter Green, 151, The Hatherley, Basildon, Essex for further details.

Using micros as word processors

Paul Handover

Most professional people are familiar with the phrase "word processing". In any office equipment magazine, a large percentage of space, both editorial and advertising, is given over to the subject.

But being familiar with the phrase is not always the same as understanding it. An interesting exercise is to ask two or three people to write down what they think word processing is. The diversity of replies will be interesting.

One of the reasons why word processing is so poorly understood is that the problems word processing has to solve are themselves so poorly understood. I will refer to this later.

When we consider word processing on a micro-computer, the potential for misunderstanding is increased. Until recently the purchase of a word processing system was a significant capital item which was beyond the means of many small businesses. The purchase of a computer represented an even bigger outlay, also beyond the horizon of the small businessman.

The purchase of expensive capital items by larger organisations would involve purchasing disciplines, to ensure that the machinery being bought was likely to achieve proscribed business objectives.

Powerful

Even though the micro-computer is as powerful as the computer or word processor of a short time ago, micros do not appear to be subject to strict purchasing disciplines by potential users. My experience suggests it is rare indeed for a businessman to be aware of purchasing criteria, desired productivity increases and the financial pay-back objectives.

When a micro-computer is to be used for an application like payroll or stock control, the chances of misunderstanding and confusion after installation are high. Not surprisingly, many businessmen find it difficult to approach the purchase of a micro-computer based word processor objectively.

It is possible to be objective. We can, for example, consider what processes are involved when applying a micro-computer to increasing typing productivity.

Typing is full of productivity pitfalls. Most authors are aware of the loss of output that a keying error on a typewriter will cause — the break of typing rhythm as a typist realises she has made an error, reaches for the whiting fluid and corrects the mistake. But how many authors are aware that there are many other pressures which make typing difficult?

As a typist reaches the end of every line on a page, she has to decide where to end the line and whether there is a large word near the right hand margin that will need to be hyphenated, wondering what the hyphenation rules are in each instance. However much they have typed, most girls will start the job again if they make, on average, three typing errors per page.

They also have to plan the layout of a document when there may be little indication about the length of the dictation. And ask any typist what is involved in centering a heading or typing a column of figures where the decimal points must all be in line vertically.

Aggravation

Another consideration. How often do authors look at a letter and think, "Well, it's all right but it does not convey what I wanted to say in exactly the right way. But it will cause too much aggravation to change it." An enormous amount of business is done via letters. Measuring the effect of sending out correspondence that is not word perfect is extremely difficult, but most businessmen will agree that the effort of trying to send out word perfect business correspondence is considerable.

Typing inefficiency can also be a result of lack of organisation. The management of typists and secretaries is a specialised skill not always seen in businesses. Many word processor salesmen would be amazed to learn what productivity gains can be made through sensible allocation of tasks, and proper organisation. Improvements in office routines seem to come about only when new technology is considered; the purchase of a machine acts as a catalyst and generates a rethink of typing and secretarial organisation.

Justifying the purchase of a word processor is another tricky area. Research work by the Stamford Research Institute in America has shown that investment in the office is running at well under 10 per cent of investment in the shop floor. Yet office costs are the most rapidly rising cost element in a business today. Whereas in 1975 it was

Paul Handover is the Managing Director of Dataview, the Colchester-based manufacturer of business computer systems.

estimated that the cost of the office was 40 per cent of the cost of running a company, today the figure is more than 50 per cent.

The main reason why investment in the office has been so low is that it is an extremely difficult area to measure and control. The mathematics of investing in manufacturing capital equipment are much easier than the mathematics of investing in the office. After all, we are not going to try and double the number of letters we produce every day.

Complexity

So what is the work content of an office? The biggest generator of business communications is the professional man, involved in research, personnel, pricing, corporate financing, marketing and so on. Even small companies realise that the complexity of running a business requires the employment of specialists in key areas.

Several surveys of European managers have

Wordcraft is one of many word processing programs on the market, suitable for use on microcomputers.

shown that they spend about a quarter of their time writing and dictating and another quarter reading and telephoning. In other words, 25 per cent of a manager's time is involved in word processing and 50 per cent in "remote" communications.

There are two conclusions one can draw. Firstly, that if a manager can be made more efficient in the area of communications and word processing, the productivity increases will be enormous. Secondly, it explains why technology companies are pouring so much money into business communications. They realise the rewards are tremendous if the businessman accepts that the time has come to attack office costs.

The easiest way to make a business professional more productive is to improve his business communications. Most business communications pass from the manager via the secretary. If we can make the secretary more efficient through the use of word processing equipment and other machines and if we can use the spare time generated to remove routine tasks from the shoulders of the business manager, the return can be handsome.

Regrettably in the last few years, many companies have cut back on secretaries and typists, thus reducing support to the manager. But the professional is there to be a *creative* manager. Every time he performs a secretarial duty such as going to the photocopier or making his own telephone calls his creative ability is impaired.

How often we come across businessmen who leave their real work to the hours before 9 am or after 6 pm. Yet the brain is at its most creative at mid-morning.

The importance of word processing is that it is the easiest way to make both the secretary and the manager more productive. The importance of the micro-computer is that it offers computing power at a price which any business can afford. The importance of word processing on a micro-computer is that it enables the smaller business to control office costs and makes the manager more productive.

Defining word processing as anything narrower than business communications is to overlook the technological trends that are taking place today. The word processor will in time become a general telecommunications terminal as well as the "gateway" to integrated electronic systems. Such facilities will be available within the life-time of equipment bought today. In the long term an understanding of word processing equipment can help educate the businessman in advanced office technology.

Not all micro-computers are suitable for word processing and not all word processing programs are suitable for the secretarial office. A micro-computer forming the basis of a word processor will have the following minimum specification:

A screen capable of showing at any one time a minimum of 80 columns width of text and 15 lines of the page.

A keyboard fundamentally similar to a typewriter. There should be a shift key, preferably one either side of the space bar. There should be a key which can be accessed by the little finger of the right hand to delete the last character typed in.

The computer should have enough memory to give at least 10,000 text characters after the word processing program is loaded; 20,000 characters is even more desirable.

There should be at least two floppy disk drives.

The computer should be able to drive a modern daisywheel printer.

A large number of word processing programs is available on micro-computers. We have Wordstar, Magic Wand, Spellbinder, Wordpro, Wordcraft, Scripsit, Memowrite, Format, Superscript, Lexicom, and many others.

For a word processing program to be used by a secretary, a number of purchasing criteria have to be considered. The typist is used to dealing with paper. She will think of a document in terms of the words on each page, and number of pages. For a typist to use a word processor in a satisfactory manner, it should appear to be similar to a typewriter.

We have talked about the importance of the keyboard but we should also consider other aspects. Can the typist start typing on the word processor without going through any complicated setting-up procedures? As text is keyed in it must take up a position on the screen that closely matches what the typist would expect to see on paper. Without this facility the typist cannot gain a 'feel' for the document and she loses her ability to control the quality of the layout.

Alterations to the document involving margins, tabs and indentations must be simple and visual. The typist should be able to see at all times what has been set at the point she has reached. It's no good asking her to take her fingers off the keyboard to verify what tabs have been set; that would be like asking a driver to take his hands off the wheel to check his speed.

Some security

Regarding amendments and deletions, here the program must offer some security against accidental loss of text. If text is entered but not stored on the disk how easy it is for that text to be lost. Does the system remind the operator that she has text in the computer memory that is not saved on disk?

The number of key strokes required to delete text should become slightly more complex as the amount of text that can be potentially lost increases. Deleting a character or a word should be a simple and swift operation. Deleting two pages of text should not be so swift and simple an operation or there is the danger that it will happen accidentally.

When the operator is editing a document she is working from an amended version of the docu-

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ment which the author has returned to her. The productivity of the re-type will depend on how easily the operator can identify the points of change on the screen. The process will involve her looking at the draft document, identifying the beginning of the line that contains the amendment, then transferring her gaze to the screen and looking for the same relationship between the words beginning the line and the point within the line where the change is to be made.

The document on the computer screen must closely resemble the printed document. As the typist makes changes to the text, particularly when adding words, does the screen indicate exactly how the document will appear on paper? Several systems do not provide the operator with a 'printed look' until the document is ready to be sent to the printer. Clearly, this is unsatisfactory.

The special codes that need to be contained within the text to indicate to the computer such things as automatic centering, indentations and paragraph spacing are another consideration. If the control codes are visible on the screen they will distract the typist and she will have to keep reminding herself that these funny characters are only there on the screen and will not appear on the paper. Yet if the control codes are invisible she will be unable to determine exactly how the layout of the document was achieved. This is especially important if one girl is editing text typed in by another girl.

Essential requirements

This may seem like an unnecessarily strict set of criteria to apply to a word processing system that may cost as little as £3,000. However, if the microcomputer is to be regarded as a serious word processing machine then these requirements are essential.

Of course, it is all too easy to think that this type of machine can handle all typing work. This is not the case; there are still certain categories of typing work that need to be handled with care if they are to be done on a microcomputer.

Typing can be broken down into the following categories:

1. Letters and memos of less than 15 lines.
2. Letters and memos longer thn 15 lines.
3. Multi-page documents subject to revision.
4. Documents containing partial standard text.
5. Standard documents or documents made up of standard paragraphs.
6. Standard letters.
7. The merging of standard paragraphs with lists.
8. The merging of standard letters with lists.
9. Forms.

It is difficult to increase the productivity of documents which are under 15 lines in length. The typewriter, especially the correcting typewriter, is an efficient machine at producing short documents. Generally, a short document is one with which the typist is familar and the layout is minimal. The word processor gives the author the opportunity to make minor changes and shorter letters often have repetitions which might allow some standardisation.

As letters and documents become longer they are usually the product of more careful thought and the benefits of capturing a draft of the document on a word processor and allowing the author to amend it are enormous. A word processor allows the author to increase the speed of dictation. The author does not need to take care over syntax, grammar and logical order of dictation when he knows how quickly he can have a draft copy back to read and amend for subsequent final print-out.

Standard paragraphs

Two areas that need to be looked at carefully are categories 7 and 9. In certain business areas such as insurance there is a heavy requirement for the assembly of documents from standard paragraphs and the automatic merging with name and address lists. This would be extremely difficult to manage on microcomputers as they are at the moment although the facility is being developed.

Forms can be effectively handled on a standard word processor, but the microcomputer-based word processor can be bought with a variety of printers and paper handling devices. The dedicated word processor tends to be sold with one type of printer and therefore the knowledge of what that printer will do when handling forms is usually more detailed than that obtained from your local micro dealer. If you wish to process forms you should see the machine doing the job, using your form layout and your data, before you agree to buy the machine.

Finally, do not overlook the changes in organisation that can be made in the office. Secretaries suffer many interruptions. They are asked to perform important tasks but are also required to carry out a range of duties, including the trivial. Bringing together two or more staff members in a support group can provide some interesting benefits. The group can develop skills and allocate jobs.

If an important document needs to be typed, others within the group can protect the typist from interruptions. The members become familar with each other's work, thus coping with holiday and sickness absences more effectively.

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A Commodore enthusiast wanted a word processor that was simple, fast and easy to use. He wanted to handle up to 20,000 characters of text, to use a wide screen format of up to 240 characters, with full window scrolling in all directions, and be able to use the screen while printing. He wanted a word processor at a reasonable price. The enthusiast, Simon Tranmer, couldn't find one... so he wrote

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a 30,000 word disk-dictionary with automatic spelling checker, that will verify the largest SuperScript (or Wordpro) document in under two minutes... and you can easily modify the dictionary, or add your own words.

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- Needs very little mathematics
- Uses structured BASIC throughout
- Divided into Studies and Problems – each Study presents a short program with an explanation of how it works, and each Problem entails modifying that program to make it do something slightly different
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What is a system?

Robert Moscrop

Any business enterprise exists in order to provide goods or services. This necessarily involves physical activity, making or acquiring the goods, rendering the service, eg a nurse visiting and treating a patient at home. This will involve an orderly pattern or sequence of events known as a 'physical system'.

How easily this is accomplished will depend not only on the skills of those performing it, but to a large extent on the support they get from the administrative procedures on which they must rely. This is known as an 'information system'.

An information system, like the physical system, is made up of three elements:

1. The ingredients — the raw materials of production
   — the skills of the nurse
   — data to be processed
2. The sequence — in which the operations are performed
3. The mechanism — by which the processes are to be performed, eg manually or by computer.

When administrative procedures or information systems are on a manual basis, a number of advantages accrue.

1. They can be designed and implemented easily and speedily.
2. Changes in the business pattern can as speedily be incorporated in the systems.
3. They can operate in a non-sophisticated environment.

Such systems are all too often used without really thinking too much, if at all, about some fundamentals which lie behind the performance of a system. The purpose of this article is to consider some of the factors which lie behind the workings of systems.

The term 'system' is often misused by manufacturers to identify a particular range of computer equipment. For the purpose of this article, this meaning will be ignored. Rather we shall consider a system as being 'an administrative procedure to meet a business objective'.

Robert Moscrop, director of Computotech Ltd, is a widely experienced systems analyst and designer. Since 1978 he has been developing training systems for the Manpower Services Commission and working as a consultant.

We can easily identify a number of objectives within the smallest organisation:

1. To determine trading profit.
2. To control income/expenditure.
3. To pay employees.
4. To control stock etc.

This leads one to wonder: ''What are the boundaries of a system?'' There are two levels:

1. The whole business procedure — a total system.
2. Sub-systems or applications within a total system.

The information which circulates in a company is the life support of any system or application whether it is originated within the organisation (eg. a payment to an employee, which in turn affects the control of expenditure) or outside the organisation (eg. an order from a customer affects both the control of stock and income).

The organisation can therefore be considered as a total information system which can be broken up into a number of application areas.

In larger business enterprises, the activities may be bound by artificial groupings, eg. departments or the functional superstructure.

Application boundaries

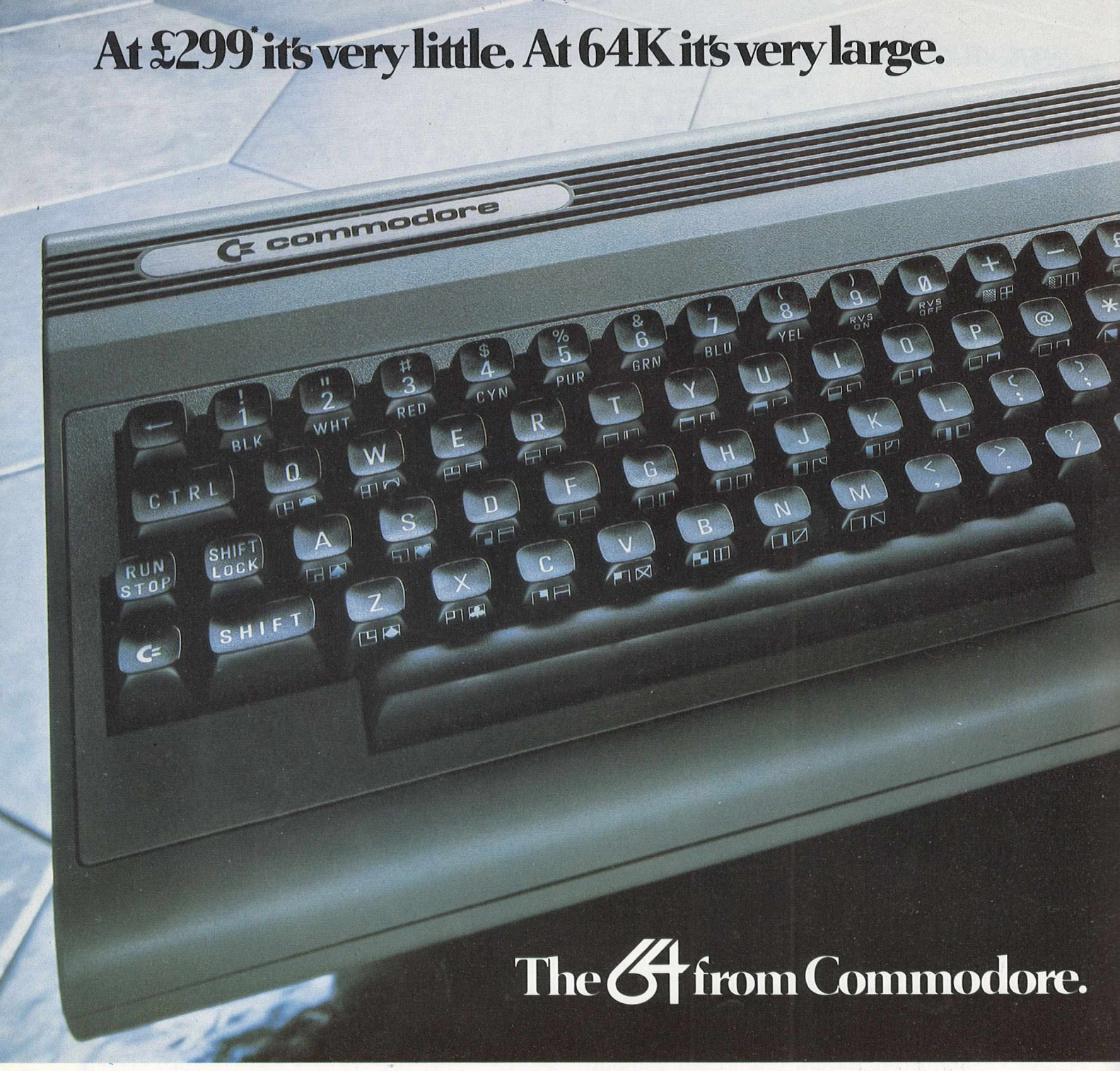
In organising any systems thinking, the first step must be to define the application boundaries. This may appear a simple matter, but in fact it is not — no two businesses operate in exactly the same market, in the same way or to the same management objectives. This should certainly be borne in mind when you are considering matching software packages to the needs of the business. The '90 percent fit' syndrome is all too often at the root of dashed hopes.

In commercial business, not only are the risks too great to leave to chance, but the complexity demands that a number of levels of system be considered, each offering more sophistication. These are structured in a hierarchy.

Recording systems (low order) Those which simply receive a given volume of data, process it and output a similar volume. Examples are order processing, billing, payroll routines.

While higher order systems must have their input from lower systems, this level simply enables an operation to function. If applied to a computer it will show an increase in operating cost with little compensating benefit, although this is less so with personal micros.

At £299* it's very little. At 64K it's very large.



This is the new Commodore 64 Personal Computer.

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And as one of the world's leading high-performance micro-computer companies, we're not exactly unknown when it comes to outstanding achievements.

The Commodore 64's nearest rival – if that's the word – costs over half as much again.

Here is the specification, a comparison with the Apple II, and a coupon.

The rest is up to you.

---

1. A total memory capacity of 64K; 38K directly available to BASIC. When not using BASIC a full 54K is available for machine code programs.

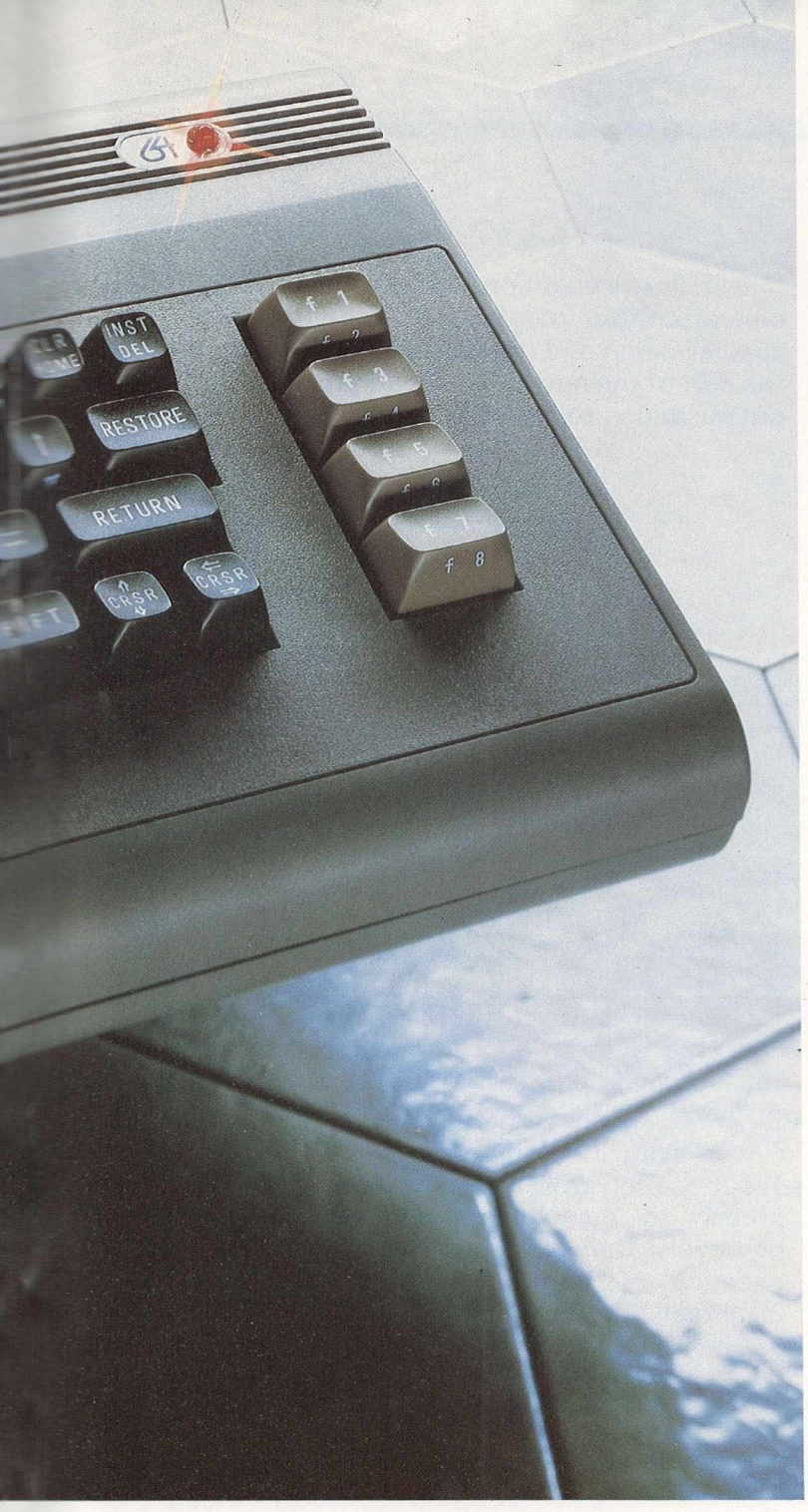
2. Interface adaptors will allow the use of a complete range of hardware peripherals including disk units, plotter, dot matrix and daisy wheel printers, Prestel communications, networking and much, much more.

3. A complete range of business software including word processing, information handling, financial modelling, accounting and many more specific application packages will be available.

4. Other computer languages such as LOGO, UCSD PASCAL, COMAL and ASSEMBLER are being developed. Existing VIC and 40 column PET BASIC programs can be easily converted.

5. The powerful sound chip gives 3 totally independent voices each with a range of 9 octaves. User control over music envelope, pitch and pulse shapes provides the ability to make your Commodore 64 sound like a variety of musical instruments, solo or in harmony.

6. 62 predefined graphic characters plus



full alpha numerics with upper and lower case letters, all available directly from the keyboard and displayable in normal or reverse video in any of 16 colours.

7. 40 column by 25 lines colour display. In high resolution graphics mode, a bit mapped screen gives 320 x 200 individually addressable pixels.

8. The dedicated video chip allows the use of high resolution multi-coloured "Sprites" (moveable object blocks). Sprites can be moved pixel by pixel, independently of anything else on the screen.

9. Sprites can also be set up in 8 "layers" giving full 3 dimensional effects with, if required, automatic collision detection between sprites and any other screen object.

10. Machine bus port will accept ROM cartridges for many applications, including business, educational, home and leisure software.

11. A second processor option using the Z80 gives the Commodore 64 the ability to support CP/M®.

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FEATURES	COMMODORE	APPLE II+
Base Price	£299*	£499*
ADVANCED FEATURES		
Built-in user memory	64K	48K
Programmable	YES	YES
Real typewriter keyboard	YES (66 keys)	YES (52 keys)
Graphics characters (from keyboard)	YES	NO
Upper & lower case letters	YES	NO**
Function keys	YES	NO
Maximum 5¼" floppy disk capacity per drive	170 K.B. to 1 M.B.	143 K.B.
AUDIO FEATURES		
Sound Generator	YES	YES
Music Synthesizer	YES	NO
Hi-Fi Output	YES	NO
VIDEO OUTPUT		
Monitor Output	YES	YES
T.V. Output	YES	EXTRA
INPUT/OUTPUT FEATURES		
Cassette Port	YES	YES
Intelligent Peripherals	YES	YES
Serial Peripheral Bus	YES	NO
ADDITIONAL SOFTWARE FEATURES		
CP/M® Option (over 1000 packages)	YES	YES
External ROM cartridge slot	YES	NO

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Reporting systems (middle order) These have the facility to produce, to an outside environment, points or events on which decision or action must be taken. These can be compared to management by exception techniques.

They can produce tangible and quantifiable benefits, in that they upgrade the decision level even at the lowest point. An instance of such a system would be the distribution of stock in a warehouse on the basis of a moving demand pattern, or a reduction in stockholding.

In considering the automation of systems, this is probably the highest point at which a first-time user should aim.

Control systems (high order) These introduce more sophistication and produce information to show the alternative paths which can be taken and the probable results.

Their basis is more likely to be expressed in mathematical terms. Applications are likely to be based on the use of packages such as simulation and forecasting and could well incorporate management techniques, DCF and capital evaluation.

Learning systems (artificial intelligence) Current transaction data is not only reflected by the control data held within the system, but also directs operations automatically according to changes, eg the alteration of minimum/maximum stock holdings and the automatic generation of orders on supplier.

These demand data which is not necessarily large in volume, but must have been derived over a long period of time.

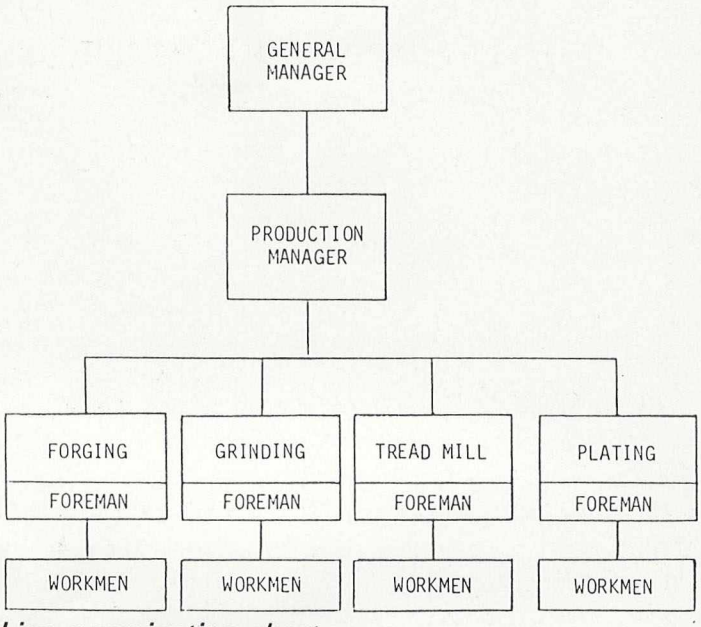
The implementation of an information system at any level should revise the appropriate decision level in the physical system. At the same time a plan should be made to train personnel in their new responsibilities.

One characteristic of an information system is that the greater the degree of automation, the greater the lead time and work involved in making changes.

It is always necessary to understand the structure of a business before studying the systems requirements. The structure can be broken down into three types:

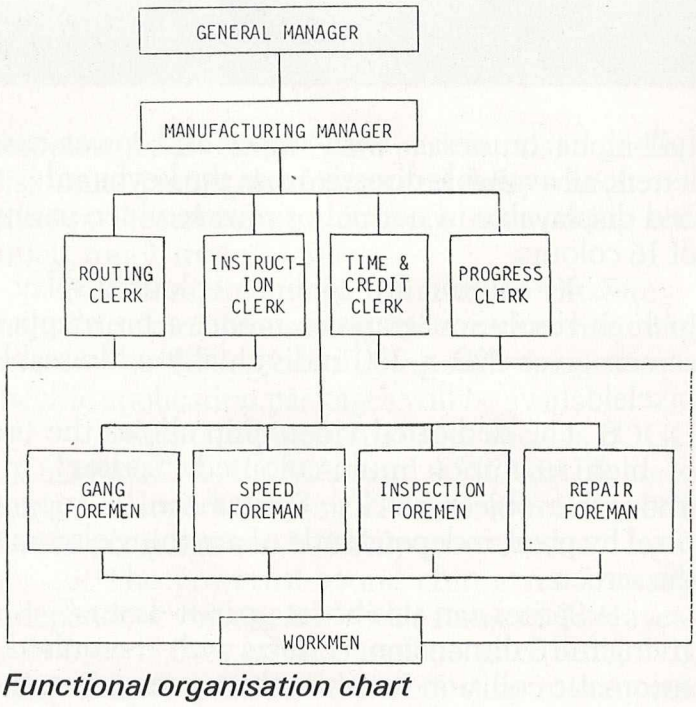
1. *Line organisation*. In this case, authority is passed down directly from manager to worker. Each section is an independent and self-contained unit, within which each manager is responsible for all the activities under his control, eg planning, finance, personnel, in addition to his prime function.

This is the traditional structure but it has the disadvantage of ignoring the benefits of specialisation and usually leads to overloading on the part of the manager. It is surprising how many organisations today have this basic structure.



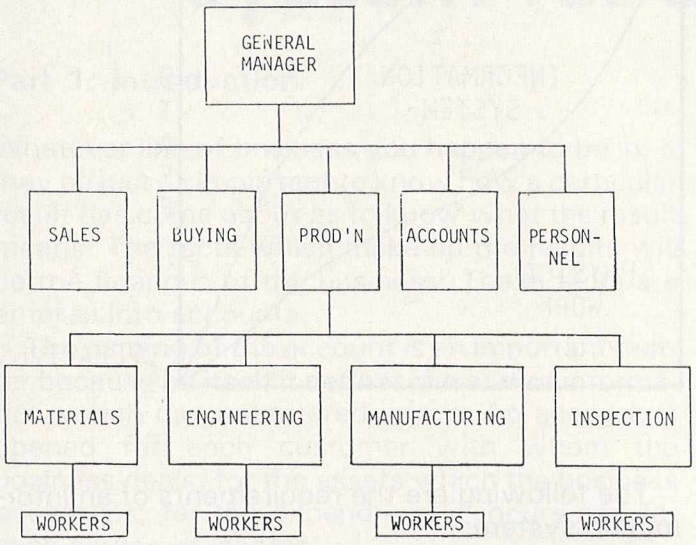
Line organisation chart

2. *Functional organisation*. First developed by F.W. Taylor in the late 19th century to induce specialisation and encourage a more scientific approach to management. Experience showed, however, that workers were often confused because of lack of co-ordination and split loyalties. The structure also made it difficult to assign responsibility.



Functional organisation chart

3. *Line and staff organisation*. This structure is the one most commonly found today and combines the intentions of the first two.



Line and staff organisation chart

Depending on the size of the organisation, these structures can become complex.

The foregoing are all formal structures. There may also be informal structures, resulting from personal relationships or customs. In this case, communication lines may not be recorded. While it is the responsibility of managers to allow such conditions, anyone thinking about the system should note them.

Decision making

Every business needs to control its operations. Before this can be accomplished, the activity being controlled must be expressed in terms of an activity objective, which must have four elements:

1. A statement of a quantitative or qualitative goal — to control stock.
2. A unit by which the quantity or quality can be measured × percentage of turnover.
3. A target in terms of the unit of measurement ± 5 per cent.
4. Time limit for meeting the objective — 12 month review.

Business systems provide the information for control and thus enable future objectives to be set. Using this information managers can take action, measure and compare results and revise their objectives.

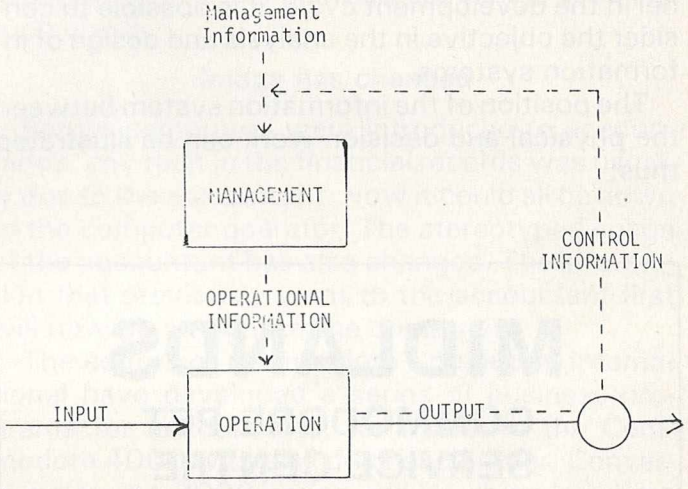
System structure

It is convenient to consider the operation of an information system, at whatever level, in the areas of planning, control and operations. In analysing or designing any system, consideration should be given to all three aspects. Input/output can come at any level, but should in volume be relative to that of other levels.

The environment of the physical system will provide the constraints or volume of the information system. Anomalies in the structure will give rise to new and/or more sophisticated applications, eg automatic calculation of control levels.

At the lowest level are the application areas within the organisation. At the second level are the control elements and at the highest level the planning operations which define the objectives. Information flowing upwards may cause modifications to the objectives which will flow downwards.

Within each total, sub or application system, the cybermatics loop can now be placed on the decision making function discussed earlier:



The physical system is illustrated by solid lines, and the information system by the dotted lines. The chain reaction of a transaction in the above structure shows clearly the need to abandon functional, departmental, even application boundaries in considering applications for the future.

Characteristics of information

Information is the raw material on which administrative systems are based. It is therefore of interest to consider the characteristics and behaviour pattern in order to provide adequate yet economic systems.

The volume of data generated for a given size of organisation moves in a geometric progression. And since information is related to the results of work, Parkinson's Law equally applies. One constraint is the amount of data that can be absorbed by one person over a given period of time.

During investigations, the amount of information asked for will often be excessive. It may be above the absorption level, in which case alternative solutions must be sought.

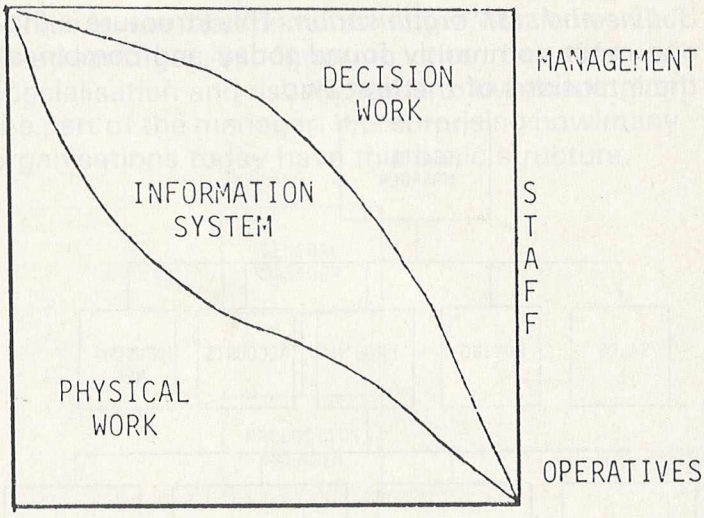
A distinction should be made at this point between 'information' and 'data', the interpretation put on it. A marketing organisation used to responding to trends will treat a 24 hour sales report more seriously than one geared to a six month production cycle.

Accuracy will cost money, the correct amount being determined by the raw condition of data and its processing, and the use to which it is put. Care should be taken at the early stages to think only in terms of information and not to try and break it into elements.

The aim of a management information system

Appreciating the inter-action of techniques, methods and standards, and understanding the duties and responsibilities of the various personnel in the development cycle, it is possible to consider the objective in the analysis and design of information systems.

The position of the information system between the physical and decision work can be illustrated thus:



The following are the requirements of an information system:

1. It must reflect the *modus operandi* of the organisation. Management objectives and policies must be considered.

The following check-list is invaluable in planning the study:

Evolution
a) company
b) industry
Constraints
a) Industry conversions
b) legislation
Resources
Organisation
a) Structure
b) Operations
The market
a) Products and/or services
b) Competition
Systems achievements
a) In house
b) Generally
Problem areas

2. The structure should ensure that the amount of information is compatible with the job for which it is intended and with the method of processing it.
3. The computer should be employed in those areas where its potential can be fully realised, using other mechanical aids or manual procedures where these are warranted.
4. The system should be within the abilities of those who must operate it.

Next month

Where to start. The techniques involved in setting up an information system.

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A complete nominal ledger system for accountants

Part 1: Introduction

Whatever line of business you happen to be in, it may be just as important to know how a particular result has come about as to know what the result means. The facts which make up the results will be the finances of the business. These facts are entered into accounts.

The naming of the account is an important matter because by itself it defines the sort of information which can be entered into it. An account is opened for each customer with whom the business deals, for the assets which the business possesses, for the expenditure it incurs and for each source of income.

The principal book or file of account is known as the general ledger. Such a ledger may be divided alphabetically, numerically, geographically or by some other form of classification. Ledger accounts come in two main classes, these being personal and impersonal accounts.

Impersonal account

Whereas a personal account records all the transactions between the business and the customer, be it a person, firm or company, the impersonal account, under which heading comes the nominal ledger, concerns itself with the income and expenses, profits and losses which have to be accounted for when calculating the profitability or otherwise of the business.

And so it can be seen that purchases, sales, wages, rent, rates and interest all come under the nominal ledger, which may also include the real account dealing with the purchase of plant and machinery, sale or part sale and devaluation of the firm's assets. VAT and export and import tariffs can also be recorded.

When making a record of a transaction, there are several important facts which must appear. For instance, any change in taxes, the name of the consumer, what was bought, when it was bought and whether it was paid for are of prime concern to any business. But imagine the problems that arise when the manager finds that five of his customers are called Smith and an entry into the wrong account has been made, making it appear that a debt has been paid when in fact the opposite is true. In any system of data flow an accounting code is an important element in avoiding such errors.

Image has changed

Before computers were introduced to accountancy, any fault in the financial records was usually due to the accountant. Now it could all be down to the computer operator. The stereotyped image of the accountant has also changed. The information that previously went to the accountant first will now go straight to the computer.

The editors of Commodore Computing International have developed a series of business programs for accountants, for use with the Commodore 4000 with disk drive and printer. Conversions to the 8000 series will be given in a later article.

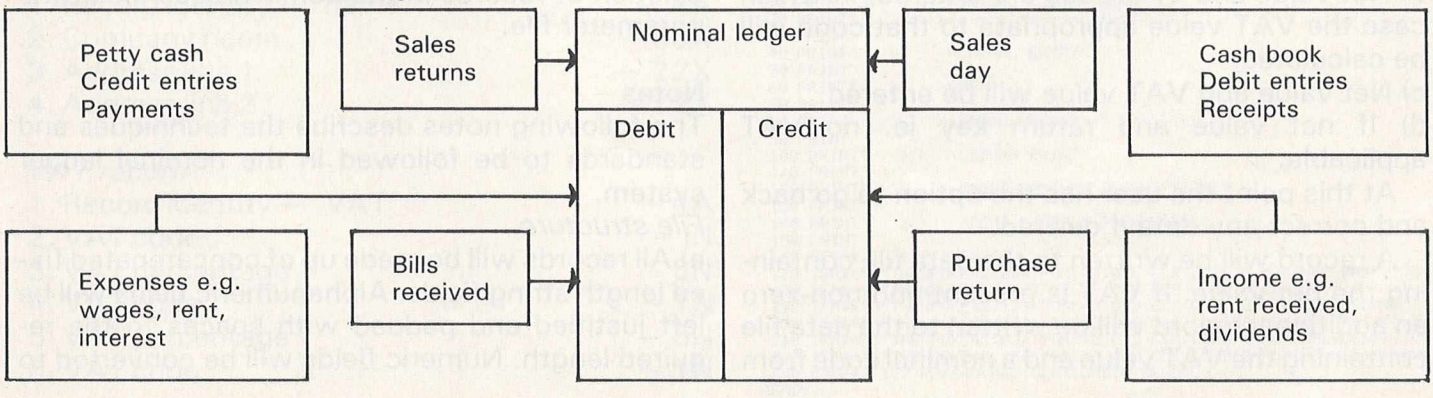
The following is a description of the various programs that make up the nominal ledger package. The first of these, the entry program, is reproduced on pages 44-48.

The other programs will appear in subsequent issues.

Nominal ledger

This system will run on a standard 32K PET with floppy disk system and printer.

Entries in the nominal ledger



Menu programs
A variety of menu programs will be available, so that the user is presented with a variety of options, which he can select by entering the appropriate code.

The menu program will then load the appropriate program from disc and enter it. When the program is terminated the menu will be loaded and re-entered. The main menu for the system will be initially loaded by the user as program ''menu''. This will allow access to the application menus — in this case 'nominal menu'.

When nominal processing is finished, return to the main 'menu'. The menus will also have options for file copy, back-up etc.

Entry program
The program will allow a user to enter data for input to the nominal ledger program.

The program will open the 'nominal unsorted' as output. If this file already exists the program will abandon with the message 'run nominal ledger update', since the previous data has not been input to the nominal ledger.

The parameter file will be accessed and the company name record, VAT record and transaction reference table will be stored in tables.

The nominal descriptions file is opened as input and the descriptions read into an array.

The user will be prompted for:
1) Nominal account no — looked up in table and description shown.
2) Date of transaction — normal checks, convert to internal form.
3) Transaction reference — must be in transaction reference table.
4) Reference number — default is program generated and unique.
5) Narrative.
6) Value — there are various options, viz:
a) Gross value is entered, followed by VAT code. The program will calculate the VAT value based on the percentage rate for that code held in the table. This will be subtracted from the gross value to give net value.
b) Net value and VAT code are entered, in which case the VAT value appropriate to that code will be calculated.
c) Net value and VAT value will be entered.
d) If net value and return key ie. no VAT applicable.

At this point the user has the option to go back and correct any data if desired.

A record will be written to the data file containing the net value. If VAT is present and non-zero an additional record will be written to the data file containing the VAT value and a nominal code from the VAT parameter record as follows:
Input code — P/L???
Output code — S/L???

As each record is written to the file it will be printed in the format in appendix 1. At the end of run the number of records and total value will be printed.

Sort
This will make use of the standard sort utility: The sort will display and print the input and output file names together with the narrative, as well as a display indicating the current state of the sort.

When finished the number of records sorted will be displayed and printed. The parameters for this sort will be held on the parameter file as follows:
a) Input file name — Nominal unsorted
b) Output file name — Nominal sorted
c) Start key position — 1
d) Narrative — 30

Update program
The transaction records will be merged with the B/F records on the nominal ledger file to create an updated file. At the end of the run the following controls will be printed on the brought forward file, transaction file and carried forward file:
— Total number of records.
— Total value.

Print program
This program will print reports from the nominal ledger file. The operator is given the option of selecting which transaction references are to be printed or 'ALL' to print the entire file. The nominal ledger will be read and records selected as above. For each new nominal code, the description will be obtained from the nominal desc file and printed.

Each selected record will be printed and totals of debits and credits accumulated for printing at the end of the nominal account as well as a grand total at the end of run.

Parameter and nominal desc file maintenance
This routine will allow insertion, amendment and deletion of records in the nominal desc file or the parameter file.

Notes
The following notes describe the techniques and standards to be followed in the nominal ledger system.
File structure
a) All records will be made up of concatenated fixed length string fields. Alphanumeric fields will be left justified and padded with spaces to the required length. Numeric fields will be converted to

string fields, right justified and padded with zeros to the required length.

Where values are negative, the negative sign must precede, not follow, the preceding zeros.

The above structure reduces sort requirements to simple alphanumeric keys.

b) In all cases the key by which the record is identified and in which order the records are stored, is the first field in the record.

c) This is followed by a record identifier, which allows two or more records with differing structures under the same key. This is made necessary by the 80 byte record length restriction.

d) All files will be terminated by a record whose key contains all ZZZZ. This obviates any incompatibility problem with the status word.

Data input/output

a) All programs will commence by prompting for operator name and today's date. This information will appear on all prints and control summaries.

b) All variables will be input as strings, so that validation is carried out by program rather than basic run time messages. The program will then convert to numeric when required.

c) All prompts for new input will have an * positioned over the cursor position, so that if return is pressed with no data entered by the operator, control is not returned to basic but retained within the program and appropriate action taken.

d) Any validation errors or amendment of entered data will cause the reprompting to take place on the same line as the data is displayed, so that it can be sent unchanged merely be pressing the return key, or changed by the use of the edit keys.

File layouts

The files used in this system are structured as follows:

Parameter file

This file is the mechanism by which the package can be adapted to each user's requirement. It contains a variety of records.

Company name record

1. Record identity — 'name'	— 4A
2. Company name	— 30X
3. Address line 1	— 22X
4. Address line 2	— 22X

VAT record

1. Record identity — 'VAT'	— 4A
2. VAT code	— IN
3. VAT percentage	— 5N
4. VAT code	— 1N
5. VAT percentage	— 5N
6. VAT code	— 1N
7. VAT percentage	— 5N
8. VAT output nominal a/c no	— 3N
9. VAT input nominal a/c no	— 3N

Sort control records

1. Record identity 'sort'	— 4A
2. Sort name	— 4A
3. Input file name	— 20X
4. Output file name	— 20X
5. Sort key start position	— 2N
6. Sort key length	— 2N

Special symbol records

1. Record identity 'spec'	— 4A
2. Special symbol identity	— 10X
3. Parameters 6 each of 2 chars	— 6 × 2N

Transaction reference table

1. Record identity — 'TRRF' references:- each 2N	— 4A
2. 'BST' — bank statement	— 3X
3. 'CSH' — cash	— 3X
4. 'NJL' — journal	— 3X
5. 'S/L' — sales ledger	— 3X
6. 'P/L' — purchase ledger	— 3X

Nominal ledger and nominal data file

Key chars 1 — 16

1. Nominal a/c no	— 3N
2. Record identity — 'NL01'	— 4X
3. Transaction reference	— 3X
4. Reference number	— 6N

N.B. This will either be a sales or purchase ledger a/c no or if not entered will be generated by program.

5. Date — internal format	— 4N
6. Net value 999999.99	— 10N
7. Narrative	40X

Nominal descriptions file

Key chars 1 — 7

1. Nominal a/c no	— 3N
2. Record identity 'ND01'	— 4X
3. Nominal a/c description	— 40X

```
 10 PRINT"□       NOMINAL LEDGER MENU"
 20 PRINT"       ------- ------ ----"
 30 PRINT
 40 PRINT"   1     NOMINAL ENTRY"
 50 PRINT
 60 PRINT"   2     SORT"
 70 PRINT
 80 PRINT"   3     LEDGER UPDATE"
 90 PRINT
 100 PRINT"   4     LEDGER PRINT"
 110 PRINT
 120 PRINT"   5     AMEND NOMINAL DESCRIPTIONS"
 130 PRINT
 140 PRINT"   6     AMEND COMPANY PARAMETERS"
 150 PRINT
 160 GETA$:IFA$=""THEN160
 170 IFA$="1"THENPOKE42,064:POKE43,036:CLR:LOAD"0:NOMINAL ENTRY",8
 180 IFA$="2"THENPOKE42,206:POKE43,030:CLR:LOAD"0:GENSORT",8
 190 IFA$="3"THENPOKE42,159:POKE43,019:CLR:LOAD"0:NOMINAL UPDATE",8
 200 IFA$="4"THENPOKE42,131:POKE43,019:CLR:LOAD"0:NOMINAL PRINT",8
 210 IFA$="5"THENPOKE42,032:POKE43,012:CLR:LOAD"0:NOMINALAMENDDESC",8
 220 IFA$="6"THENPOKE42,156:POKE43,032:CLR:LOAD"0:NOMINALAMENDPARS",8
 230 POKE42,177:POKE43,047:CLR:LOAD"0:MENU",8
READY.
```

```
5 REM **********************************
10 REM *** C O M P U T A B I T S ***
20 REM *** NOMINAL LEDGER SYSTEM ***
25 REM **********************************
30 REM
40 REM THIS PROGRAM VALIDATES
50 REM NEW DATA FOR INPUT
60 REM TO THE NOMINAL LEDGER
70 REM
115 REM
120 REM ***   OPEN OUTPUT  FILE   ***
122 REM
130 OPEN 2,8,2,"@1:NOMINALUNSORTED,SEQ,WRITE"
132 IFST>0THEN15000
135 REM
140 REM *** OPEN PARAMETER FILE ***
144 REM
150 OPEN 3,8,3,"1:PARAMETERS,SEQ,READ"
151 IFST>0THEN15000
152 DIMVREF$(15)
154 DIMVCODE$(4),VPERCENT(4)
160 INPUT#3,A$
165 ID$=LEFT$(A$,4)
170 IFID$="ZZZZ"THEN360
180 IFID$<>"NAME"THEN200
182 REM
185 REM *** STORE COMPANY NAME ***
187 REM
190 CNAME$=MID$(A$,5,30)
195 GOTO160
200 IFID$<>"VAT "THEN290
202 REM
205 REM *** STORE V.A.T. CODES ***
207 REM
210 J=0
220 FORI=5TO17STEP6
230 J=J+1
240 VCODE$(J)=MID$(A$,I,1)
250 VPERCENT(J)=VAL(MID$(A$,I+1,5))
260 NEXTI
270 VOACC$=MID$(A$,23,3)
280 VIACC$=MID$(A$,26,3)
285 GOTO160
290 IFID$<>"TRRF"THEN160
295 REM
300 REM *** TRANSACTION REFERENCES ***
302 REM
305 J=0
310 FORI=5TO41STEP3
320 IFI>LEN(A$)THEN160
330 J=J+1
340 VREF$(J)=MID$(A$,I,3)
350 NEXTI
355 GOTO160
360 REM
```

```
370 REM *** CHECK ALL DATA PRESENT ***
372 REM
380 IFCNAME$=""THENMESS$="NO COMPANY NAME ON PARAMETER FILE":GOTO13000
390 IFVCODE$(1)=""THENMESS$="NO V.A.T. DATA ON PARAMETER FILE":GOTO13000
400 IFVREF$(1)=""THENMESS$="NO REFERENCE  DETAILS ON PARAMETER FILE":GOTO13000
405 REM CLOSE3
407 REM
410 REM *** OPEN NOM DESCRIPTIONS ***
415 REM
420 OPEN10,8,10,"1:NOMINALDESC,SEQ,READ"
422 I=0
426 VNMB=250
427 DIM VACC(VNMB),VDESC$(VNMB)
429 REM
430 REM *** STORE NOM ACC DESC  ***
432 REM
440 IFST=64THEN510
442 INPUT#10,A$
450 IFLEFT$(A$,3)="ZZZ"THEN510
460 I=I+1
470 IFI>=VNMBTHENMESS$="TOO MANY NOMINAL ACCOUNTS ON SYSTEM":GOTO13000
480 VACC(I)=VAL(LEFT$(A$,3))
490 VDESC$(I)=MID$(A$,8,40)
500 GOTO440
510 CLOSE10
515 REM
520 REM *** INITIALISE CONTROL TOTS ***
530 REM
540 CNET=0:CMB=0
550 REM
560 REM *** PROMPT FOR TRANS NO PREFIX ***
570 REM
580 INPUT"□□ENTER TRANSACTION NO PREFIX  *■■■■";PREF$
590 IFLEN(PREF$)>3THENMESS$="ONLY 3 CHARACTERS ALLOWED":GOSUB14000:GOTO580
595 IFPREF$="*"THENMESS$="PLEASE ENTER TRANS NO PREFIX":GOSUB14000:GOTO580
600 REM
610 REM *** SET START DEFAULT TRANS NO ***
620 REM
630 PSTRT=0
640 REM
650 REM *** PROMPT FOR OPERATOR IDENT ***
655 REM ***   AND RUN DATE  ***
660 REM
670 INPUT"□□ENTER OPERATOR IDENTITY  *■■■■";OPER$
680 IFOPER$="*"THENMESS$="PLEASE ENTER OPERATOR IDENT":GOSUB14000:GOTO670
682 INPUT"□□ENTER TODAYS DATE DDMMYY  *■■■■";ODATE$
684 IFODATE$="*"THEN682
690 REM
692 REM *** SET PRINT FORMAT ***
693 REM
694 OPEN5,4,2:PRINT#5,"":OPEN4,4:PRINT#4,""
695 F1$="  AAA   AAAAAA  AAA AAAAAA  "
696 F2$="AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA 999999.99-"
697 F$=F1$+F2$:PRINT#5,F$
698 OPEN6,4,1
699 REM
700 REM *** OPEN PRINT FILE ***
710 REM
730 REM
740 REM *** SET UP HEADINGS ***
750 REM
751 PRINT#4,CHR$(147)
752 PRINT#4,"OPERATOR "+OPER$+"    "+CNAME$+" NOMINAL LEDGER INPUT"
754 PRINT#4,"DATE ";ODATE$
756 PRINT#4,""
758 G$="ACCOUNT  DATE   REF  TRANS              NARRATIVE"
760 G$=G$+"                          VAL"
762 PRINT#4,G$
765 LL=4
780 REM
790 REM *** INPUT DATA FROM SCREEN ***
800 REM
810 PRINT"□□NOMINAL LEDGER INPUT■  ";CNAME$
815 PRINT"OPERATOR ";OPER$;"      DATE ";ODATE$
822 REM
824 REM *** NOMINAL ACCOUNT NO ***
826 REM
828 COL=1:LNE=5:GOSUB10000
830 INPUT"NOMINAL ACCOUNT  *■■■■";IACC$
835 IFIACC$="END"THEN1872
```

```
840 IFIACC$="*"THENMESS$="NOMINAL A/C MANDATORY":GOSUB14000:GOTO828
841 IFLEN(IACC$)<>3THENMESS$="NOMINAL A/C MUST BE 3 CHARS":GOSUB14000:GOTO828
842 IACC=VAL(IACC$)
844 IFIACC=0THENMESS$="NOMINAL A/C MUST BE NUMERIC":GOSUB14000:GOTO828
850 FORI=1TOVNUMB
860 IFIACC=VACC(I)THEN890
870 NEXTI
880 MESS$="NOMINAL A/C NOT ALLOCATED":GOSUB14000:GOTO828
890 COL=3:LNE=6:GOSUB10000
900 PRINTVDESC$(I)
910 REM
920 REM *** TRANSACTION DATE ***
930 REM
940 COL=1:LNE=8:GOSUB10000
950 INPUT"TRANSACTION DATE  *####";IDATE$
960 IFIDATE$="*"THENMESS$="DATE MANDATORY":GOSUB14000:GOTO890
970 DD=VAL(LEFT$(IDATE$,2))
980 IFDD<1ORDD>31THEN1020
985 MM=VAL(MID$(IDATE$,3,2))
990 IFMM<1ORMM>12THEN1020
1000 YY=VAL(MID$(IDATE$,5,2))
1010 IFYY>60ANDYY<90THEN1030
1020 MESS$="INVALID TRANSACTION DATE":GOSUB14000:GOTO890
1030 GOSUB12000:REM CONVERT DATE TO INTERNL FORMAT
1040 REM
1050 REM *** TRANSACTION REFERENCE ***
1060 REM
1070 COL=1:LNE=10:GOSUB10000
1080 INPUT"TRANSACTION REFERENCE  *####";IREF$
1090 IFIREF$="*"THENMESS$="TRANS REFERENCE MANDATORY":GOSUB14000:GOTO1070
1095 IFLEN(IREF$)<>3THENMESS$="TRANS REF MUST BE 3 CHARS":GOSUB14000:GOTO1070
1100 FORI=1TO12
1110 IFIREF$=VREF$(I)THEN1140
1120 NEXTI
1130 MESS$="INVALID REFERENCE":GOSUB14000:GOTO1070
1140 REM
1150 REM *** REFERENCE NUMBER ***
1160 REM
1170 COL=1:LNE=12:GOSUB10000
1180 INPUT"REFERENCE NUMBER  *####";ITRANS$
1190 IFLEN(ITRANS$)>6THENMESS$="TRANS NUMBR TOO LONG":GOSUB14000:GOTO1170
1200 IFITRANS$<>"*"THEN1250
1210 PSTRT=PSTRT+1
1220 ITRANS$=PREF$+STR$(PSTRT)
1230 COL=19:LNE=12:GOSUB10000
1240 PRINTITRANS$
1250 REM
1260 REM *** GROSS VALUE ***
1270 REM
1275 INET=0:IGROSS=0:IVAT=0
1280 COL=1:LNE=14:GOSUB10000
1290 INPUT"GROSS VALUE  *####";IGROSS$
1300 IFIGROSS$="*"THEN1340
1310 IGROSS=VAL(IGROSS$)
1320 IFIGROSS=0THENMESS$="GROSS VALUE NON NUMERIC OR ZERO":GOSUB14000:GOTO1280
1330 GOTO1410
1340 REM
1350 REM *** NET VALUE ***
1360 REM
1370 COL=1:LNE=14:GOSUB10000
1380 INPUT"NET VALUE  *####";INET$
1390 INET=VAL(INET$)
1400 IFINET=0THENMESS$="NET VALUE NON NUMERIC OR ZERO":GOSUB14000:GOTO1370
1410 REM
1420 REM *** V.A.T. VALUE OR CODE ***
1430 REM
1440 COL=1:LNE=16:GOSUB10000
1450 INPUT"V.A.T. CODE OR VALUE  *####";IVAT$
1460 IFIVAT$="*"THEN1580
1470 IFLEN(IVAT$)>1THEN1550
1480 REM *** V.A.T. CODE ***
1490 FORI=1TO3
1500 IFIVAT$=VCODE$(I)THEN1530
1510 NEXTI
1520 MESS$="V.A.T. CODE NOT IN TABLE":GOSUB14000:GOTO1440
1530 IFIGROSS<>0THENINET=IGROSS/(1+VPERCENT(I)/100):IVAT=IGROSS-INET:GOTO1590
1540 IFINET<>0THENIVAT=INET*(VPERCENT(I)/100):GOTO1590
1550 REM *** V.A.T. VALUE ***
1560 IVAT=VAL(IVAT$)
1570 IFIVAT=0THENMESS$="V.A.T VALUE NON NUMERIC OR ZERO":GOSUB14000:GOTO1440
```

```
1580 IFIGROSS<>0THENINET=IGROSS-IVAT
1590 IVAT=SGN(IVAT)*INT(ABS(IVAT*100)+.5)/100
1591 INET=SGN(INET)*INT(ABS(INET*100)+.5)/100
1592 REM
1598 REM
1600 REM *** NARRATIVE ***
1605 REM
1610 COL=1:LNE=18:GOSUB10000
1620 INPUT"NARRATIVE  *■■■■";IXTEXT$
1630 IFIXTEXT$="*"THENGOTO1610
1640 IFLEN(IXTEXT$)>40THENMESS$="NARRATIVE TOO LONG":GOSUB14000:GOTO1610
1650 COL=1:LNE=20:GOSUB10000
1660 INPUT"ENTER RETN TO CONTINUE, R TO REENTER   *■■■■";A$
1670 IFA$="R"THEN780
1680 REM
1690 REM *** PACK TO FIXED LENGTH ***
1700 REM
1710 DUMMY$=ITRANS$:FTYP$="L":FLN=6:GOSUB11000
1712 ITRANS$=DUMMY$
1715 DUMMY$=IIDATE$:FTYP$="R":FLN=4:GOSUB11000
1717 IIDATE$=DUMMY$
1720 DUMMY$=STR$(INET):FTYP$="R":FLN=10:GOSUB11000
1725 INET$=DUMMY$
1730 DUMMY$=IXTEXT$:FTYP$="L":FLN=40:GOSUB11000
1735 IXTEXT$=DUMMY$
1740 CMB=CMB+1
1750 CNET=CNET+INET
1755 REM
1760 REM *** PRINT TRANSACTION LINE ***
1765 REM
1770 PRINT#6,IACC$,CHR$(29),IDATE$,CHR$(29),IREF$,CHR$(29),ITRANS$,CHR$(29);
1780 PRINT#6,IXTEXT$,CHR$(29),INET;CHR$(13);
1782 LL=LL+1
1785 REM
1790 REM *** WRITE TO DISC ***
1795 REM
1800 PRINT#2,IACC$;"NL01";IREF$;ITRANS$;IIDATE$;INET$;IXTEXT$;CHR$(13);
1810 IFST>0THEN15000
1815 REM
1830 REM *** WRITE V.A.T. REC IF THERE ***
1835 REM
1840 IFIVAT=0THEN1870
1850 INET=IVAT:IVAT=0
1852 IFMID$(IREF$,3,1)="P"THENIACC$=VIACC$
1853 IFMID$(IREF$,3,1)="R"THENIACC$=VOACC$
1854 DUMMY$=STR$(INET):FTYP$="R":FLN=10:GOSUB11000
1856 INET$=DUMMY$
1860 GOTO1740
1870 IFLL>60THENPRINT#4,CHR$(19):GOTO750
1871 GOTO780
1872 REM
1880 REM *** CLOSE FILES ***
1890 REM
1900 PRINT#2,"ZZZZZZZZZZZZZ";CHR$(13);
1905 CLOSE2
1910 PRINT#4,"       T O T A L  R E C O R D S  ";CMB;
1920 PRINT#4,"     T O T A L  V A L U E  ";INT(CNET*100)/100
1925 CLOSE4
1930 CLOSE5
1940 CLOSE6
9999 POKE42,010:POKE43,036:CLR:LOAD"0:NOMINAL MENU",8
10000 REM
```

```
10005 REM *** CURSOR CONTROL S/R ***
10007 REM
10010 ACROSS$="■■■
```

How to progress from Basic

Getting More From Your PET/CBM originated in the program of external short courses on microcomputers offered by the University of Salford. The course lecturers, Edward Flinn, Arthur Hill and Robert Tomlinson, have written the book for hobbyists as well as businessmen with a good knowledge of Basic and a desire to proceed further than simple programming.

Most of the contents apply to all CBM micros, although some sections are specific to the 2000, 3000 and 4000 series PETs. The authors supplement their thoroughly researched text with 80 sample programs.

For readers using their micros to create graphics, there are chapters on cursor controlled and PEEK and POKE graphics, including a section on the relationship between PET ASCII and PEEK/POKE codes.

In the business area, the authors discuss logical files, printers, data storage on cassette and data files on disk. They also describe, in detail, the use of PET/CBMs in control applications, eg monitoring production and supervising testing. Three appendices list Basic commands and statements, arithmetic functions and extension ROMs for the PET (Toolkit, Petmaster, Pic-Chip).

Although the volume is sub-titled *Advanced Microcomputer Applications,* the authors make allowance for the fact that not all their readers will have an advanced knowledge of PET/CBM hard and software.

● *Getting More From Your PET/CBM* by E. Flinn, A. Hill and R. Tomlinson (Sigma Technical Press, 5 Alton Road, Wilmslow, Cheshire, telephone 0625-531035). Price £7.50.
ISBN 0 905104 234.

From borders to 3D

VIC Graphics is a sequel to the author's *Vic Revealed* and *Spectrum Graphics.* It demonstrates the versatility of the VIC as an instrument for creating graphic displays.

A rather limited area of computer technology, you might say, but Mr Hampshire notes many applications. In the classroom, for example, science teachers can use three-dimensional graphics to show molecular structures and bonding. The computer can also simulate the reactions that occur during a chemical process.

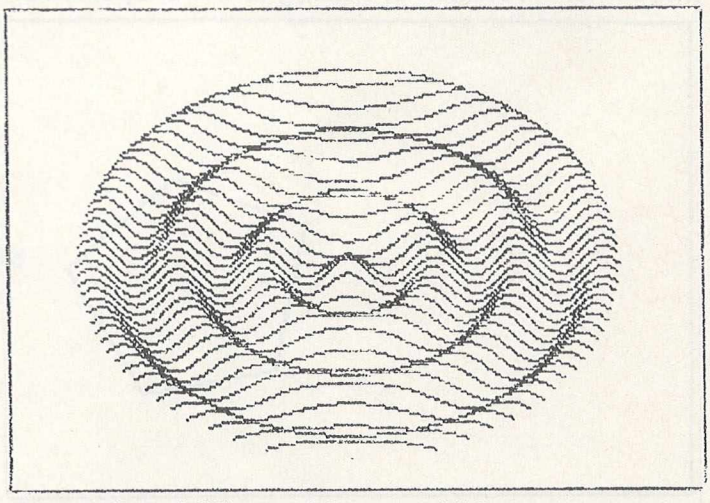
"The provision of low-cost high resolution colour graphics is probably one of the most exciting and challenging features of home computers," says the introduction. "With these features a whole new range of exciting applications are opened up for the adventurous programmer."

The range, of course, includes special effects in films like *Tron.* For those who are not quite up to that standard but would like to be, *VIC Graphics* makes a useful starting point.

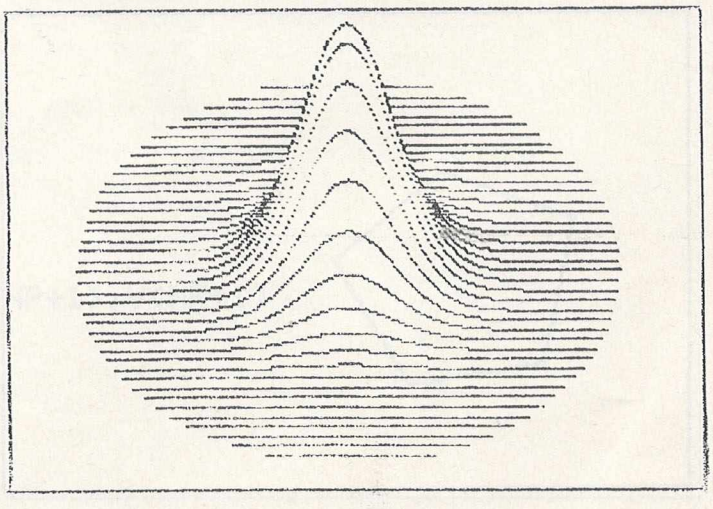
The material is presented in six sections — high resolution graphics, graph plotting, using the video memory, scaling and stretching, rotating and 3D displays. Dozens of programs and illustrations of the patterns that are possible on the VIC are supplemented with concise text. For each graphic the author supplies a description, program running details and the program structure.

The graphics range from the simple, the one that appears most often in the book, ie the border, to more advanced three-dimensional shapes, while the text includes hints on defining characters with the use of the character editor.

● *VIC Graphics* by Nick Hampshire (Duckworth, The Old Piano Factory, 43 Gloucester Crescent, London NW1, telephone 01-485 3483). Price £6.95.



Examples of 3D graphics on a VIC



Manipulating displays on a VIC

The primary purpose of this program is to show how a shape can be moved about the screen, but it also contains techniques for scaling and rotation.

The transformation matrix consists of six quotations. These equations are stored in lines 3000 to 3100. Notice that equations 1 to 4 consist of the rotational transform equation multiplied by a scaling factor, while equations 5 and 6 do the movement by adding an offset to the shape position.

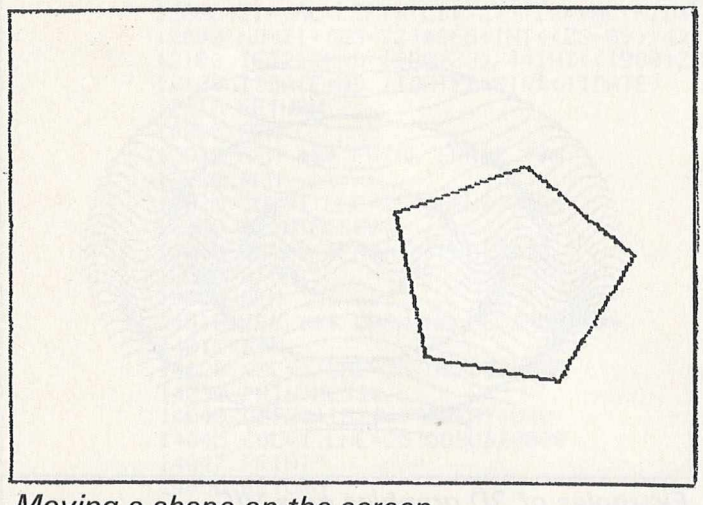
360 degrees

The program can display any two-dimensional shape. This shape can be moved to any part of the screen, rotated through 360 degrees and stretched in either X or Y axis or both.

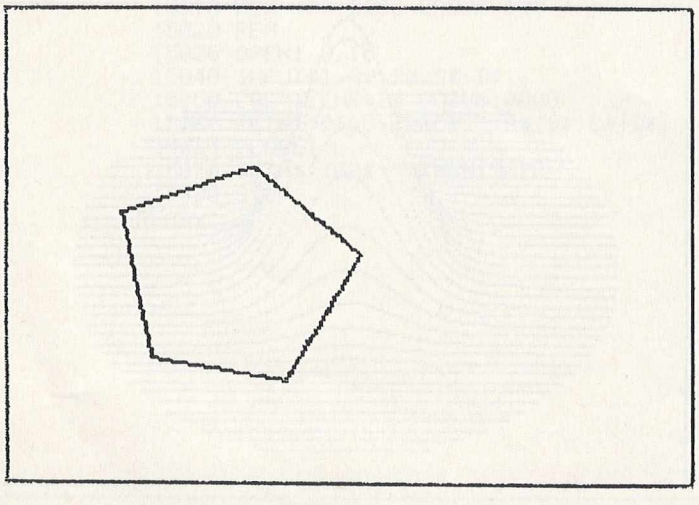
There are no input parameter values since they are all within the program as LET statements. There are six parameter values which control the movement, rotation or scaling of the shape, these are set in lines 120 to 160. Lines 120 and 130 contain the X and Y scaling factors — full size = 1, half size = 5 etc.

The rotational angle of the shape is stored as the variable rz in line 140. Note that since this angle must be in radians it is multiplied by 3.14159/180. The movement of the shape in the X and Y axis is stored in lines 150 and 160, and is the number of pixels in either direction from the original coordinates stored in the shape table.

The object shape is stored in a shape table. This table consists simply of the X and Y coordinates of the end of each line comprising the shape. It should be noted that there is one more pair of coordinates than there are lines in the shape. The number of lines in the shape is stored as the variable np as the first value in the data table. The data table is stored as data statements in lines 1110 to 1130. Try designing your own shapes using graph paper and then entering the new values into the data statements.



Moving a shape on the screen

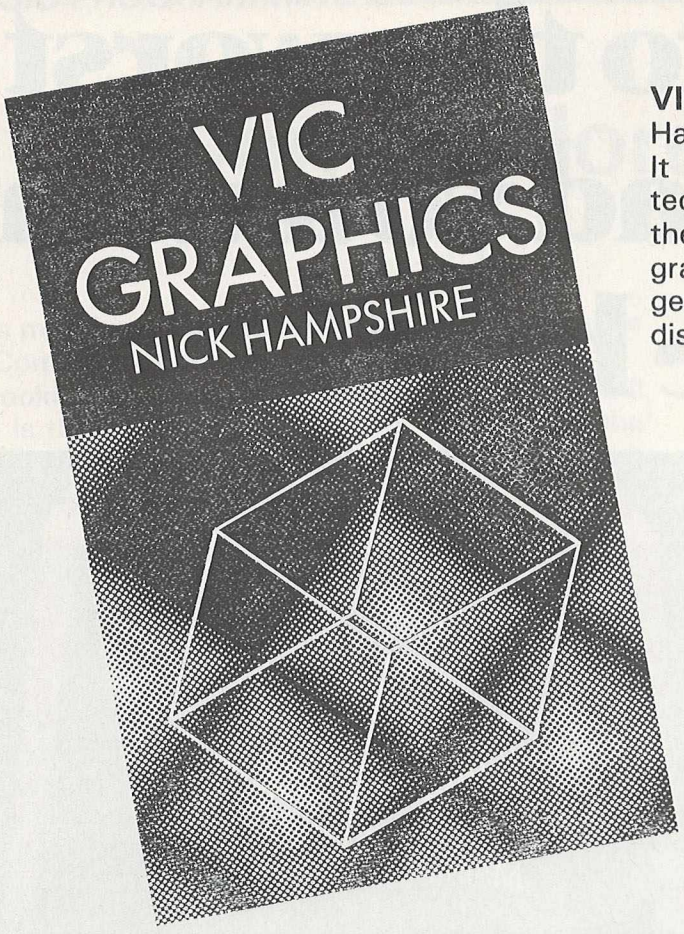


90	draw border around screen using subroutine at 400
110	set up transform matrix array
120-130	X and Y scaling factors
140	angle of shape rotation in radians
150-160	X and Y axis movement of shape from initial position
210-260	main program execution loop
400-460	border drawing subroutine
1000-1050	load shape data into arrays — arrays X and Y contain the original shape data — arrays U and V contain the transformed shape data
1110-1130	data statements containing shape data — line 110 contains the number of lines in the shape
2000-2080	find the centre of the shape
3000-3100	perform transformation matrix calculations
4000-4070	performs the transformation on each coordinate point within the shape table
5000-5220	draws the shape using the transformed data in the arrays U and V, note lines 5120 and 5130, check that the shape does not fall outside the screen area

```
1 REM MOVE
2 REM ************************
3 REM
10 REM THIS PROGRAM USES MATRIX TRANSFORMATION TO
20 REM MOVE,ROTATE, OR SCALE A TWO DIMENSIONAL SHAPE
30 REM
40 REM
50 REM SET COLOURS
60 GRAPHIC 2
70 COLOR 3,3,0,10
75 REM
80 REM DRAW BORDER
90 GOSUB 400
95 REM
100 REM SET UP CONSTANTS, VARIABLES, AND ARRAYS
105 REM
110 DIM A(3,3)
120 SX=1
130 SY=1
140 RX=80*π/180
150 TX=-50
160 TY=2
190 REM
200 REM MAIN PROGRAM LOOP
205 REM
210 GOSUB 1000
220 GOSUB 2000
230 GOSUB 3000
240 GOSUB 4000
250 GOSUB 5000
260 GET A$:IF A$="" THEN 260
270 COLOR 1,3,6,0
280 GRAPHIC 0
290 END
395 REM
400 REM DRAW BORDER
405 REM
410 POINT 3,0,0
420 DRAW 3 TO 0,1023
430 DRAW 3 TO 1023,1023
440 DRAW 3 TO 1023,0
450 DRAW 3 TO 0,0
460 RETURN
995 REM
1000 REM INITIALISE SHAPE
1005 REM
1010 READ NP
1020 DIM X(NP+1),Y(NP+1),U(NP+1),V(NP+1)
1030 FOR I=1 TO NP+1
1040 READ X(I),Y(I)
1050 NEXT I
```

```
1090 REM
1100 REM SHAPE DATA
1105 REM
1110 DATA 5
1120 DATA 100,100,150,120,175,75
1130 DATA 150,30,100,50,100,100
1200 RETURN
1995 REM
2000 REM FIND CENTRE OF SHAPE
2005 REM
2010 CX=0:CY=0
2020 FOR C=1 TO NP
2030 CX=CX+X(C)
2040 CY=CY+Y(C)
2050 NEXT C
2060 CX=CX/NP
2070 CY=CY/NP
2080 RETURN
2995 REM
3000 REM SET TRANSFORMATION MATRIX
3005 REM
3010 A(1,1)=SX*COS(RZ)
3020 A(1,2)=SX*SIN(RZ)
3030 REM
3040 A(2,1)=SY*(-SIN(RZ))
3050 A(2,2)=SY*COS(RZ)
3060 REM
3070 A(3,1)=TX
3080 A(3,2)=TY
3090 REM
3100 RETURN
3995 REM
4000 REM DO TRANSFORMATION
4005 REM
4010 FOR Q=1 TO NP+1
4020 XT=X(Q)-CX
4030 YT=Y(Q)-CY
4040 U(Q)=CX+(XT*A(1,1)+YT*A(2,1)+A(3,1))
4050 V(Q)=CY+(XT*A(1,2)+YT*A(2,2)+A(3,2))
4060 NEXT Q
4070 RETURN
4995 REM
5000 REM DRAW SHAPE
5005 REM
5010 FOR Q=1 TO NP
5020 XB=U(Q):YB=V(Q)
5030 XE=U(Q+1):YE=V(Q+1)
5040 P=XE-XB
5050 Q=YE-YB
5060 R=SQR(P*P+Q*Q)
5070 LX=P/R
5080 LY=Q/R
5090 FOR I=0 TO R STEP 1
5100 X=6*.7*(XB+I*LX)
5110 Y=1023-6*(YB+I*LY)
5120 IF X<0 OR Y<0 THEN 5200
5130 IF Y>1023 OR X>1023 THEN 5200
5190 POINT 3,X,Y
5200 NEXT I
5210 NEXT Q
5220 RETURN

READY.
```



VIC GRAPHICS. The latest book from Nick Hampshire.
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Commodore all sorts

This month we feature programs for a wide range of Commodore equipment.

Looking at the headings, the first thing you'll see is the name of the program, followed by the author's name (where known!). The third item relates to the machine on which it is intended to work.

Universal means that it will work on any of the PET range, and would thus work on a VIC or a 64 without any major alterations. Basic 4.0 implies a 40 or 80 column Basic 4.0 machine, 40 column implies any 40 column machine (other than the 64), and Basic 2.0 logically means a Basic 2.0 machine.

Files to Wordpro — Paul Higginbottom — Universal

This short Basic program will take another program stored on disk and convert it into a file suitable for use with Wordpro and its own unique editing facilities.

All the Basic keywords are contained in data statements in lines 900 to 960, but the line to look at is line 201. This determines the length of the lines as they will appear in Wordpro. Currently set at 55 (as in IF PEEK(198))55), this can obviously set to whatever value you like.

As you might have gathered, you'll need a disk drive for this one.

```
100 DIMA$(90):FORI=0TO90:READA$(I):NEXT
110 PRINT"PROGRAM FILENAME ";:GOSUB890:FI$=A$
112 PRINT"WORDPRO FILENAME ";:GOSUB890:WF$=A$
115 INPUT"DEVICE NUMBER        8";DV
120 OPEN2,DV,2,FI$+",P":GOSUB880:GET#2,A$,A$
121 OPEN3,DV,3,WF$+",P,W":GOSUB880:PRINT#3,CHR$(192)CHR$(91);
125 SL=0:GET#2,A$,A$:IFA$=""THEN600:REM SKIP LINK UNLESS END OF PROGRAM
126 PRINT"  "CHR$(14);:GET#2,A$,B$:REM GET LINE NUMBER
140 N=ASC(A$+CHR$(0))+ASC(B$+CHR$(0))*256:PRINTN;
150 GET#2,A$:P=ASC(A$+CHR$(0)):IFP=0THENPRINT"←":GOTO500
160 IF(PEEK(205)<>0)OR(P<128)THENPRINTCHR$(P);:GOTO200
170 PRINTA$(P-128);
200 IF(A$=":"ORA$=",")AND(PEEK(198)>45)THEN220
201 IFPEEK(198)>55THEN220
210 GOTO150
220 PRINT"←":PRINTN;CHR$(150);:SL=SL+1:GOTO150
500 FORL=0TOSL:O=22768+L*80
505 FORI=0TO79:P=PEEK(O+I):PRINT#3,CHR$(P);:NEXT
510 NEXT
520 GOTO125
600 CLOSE3:CLOSE2:END
880 IFDS<20THEN RETURN
885 PRINTDS$:END
890 POKE623,34:POKE624,27:POKE158,2:INPUTA$:RETURN
900 DATA END,FOR,NEXT,DATA,INPUT#,INPUT,DIM,READ,LET,GOTO,RUN,IF,RESTORE,GOSUB
910 DATA RETURN,REM,STOP,ON,WAIT,LOAD,SAVE,VERIFY,DEF,POKE,PRINT#,PRINT,CONT
920 DATALIST,CLR,CMD,SYS,OPEN,CLOSE,GET,NEW,TAB(,TO,FN,SPC(,THEN,NOT,STEP,+,-
930 DATA*,/,↑,AND,OR,>,=,<,SGN,INT,ABS,USR,FRE,POS,SQR,RND,LOG,EXP,COS,SIN
940 DATATAN,ATN,PEEK,LEN,STR$,VAL,ASC,CHR$,LEFT$,RIGHT$,MID$,GO,CONCAT
950 DATADOPEN,DCLOSE,RECORD,HEADER,COLLECT,BACKUP,COPY,APPEND,DSAVE,DLOAD
960 DATA CATALOG,RENAME,SCRATCH,DIRECTORY
READY.
```

Hex-Dex — Peter Gabor — Universal

This is included not so much as an example of a wonderful routine (after all, we've all seen programs that convert hexadecimal to decimal and vice versa) but as a rather elegant way of performing this particular function.

For any of you considering sending in your own programs, it might be worth studying this: if you find this easy to follow, won't others find your programs easy to follow if you lay them out this way?

As one interesting point, look at lines 240 to 270, which read the data statements in lines 60102 to 60150 and print them on the screen. It's one way of doing it, using our screen data routine from an earlier issue.

```
100 REM ******************************
110 REM * H E X - D E X   CONVERTER *
120 REM * P.GABOR          23/03/82 *
130 REM ******************************
140 :
150 MD=0: M$(0)="DEC -> HEX": M$(1)="HEX -> DEC"
160 P0$="■■■■■■■■"
170 P1$=P0$+"■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■"
180 P2$=P1$+"■■■■■■": P0$=P0$+"■■■■■■"
190 :
200 REM ******************************
210 REM *       DRAW SCREEN          *
220 REM ******************************
230 :
240 PRINT"■■";
250 FOR K=1 TO 23
260   READA$: PRINTA$
270 NEXT
280 :
290 REM ******************************
300 REM *       INPUT ROUTINE        *
310 REM ******************************
320 :
330 P$="":N=0
340 PRINTP1$;
350 PRINT"■■       ■■■■■■■■";
360 GET C$: IF C$="" THEN 360
370 C=ASC(C$)
380 IF C=13 THEN530
390 IF C=20 THEN330
400 IF C=19 THEN PRINT"■";:END
410 IF C=64 THEN MD=1-MD: PRINTP2$M$(MD):GOTO330
420 IF C<48 OR C>70 OR (MD=0 AND C>57) THEN360
430 IF LEN(P$)>6 THEN360
440 N=16*N+C-48+(C>57)*7
450 PRINTC$;
460 P$=P$+C$
470 GOTO360
480 :
490 REM ******************************
500 REM *         EVALUATE           *
510 REM ******************************
520 :
530 P$=RIGHT$("       "+P$,7)
540 IF MD THEN630
550 D$=P$: D=VAL(P$): H$="": A=D
560 FOR K=1TO6: A=A/16: IF A<1 THEN580
570 NEXT
580 FOR J=K TO 1 STEP -1
590 H%=D/16↑(J-1): D=D-16↑(J-1)*H%
600 H$=H$+CHR$(H%+48-(H%>9)*7): NEXTJ
610 H$=RIGHT$("       "+H$,7): GOTO660
620 :
630 D$=RIGHT$("     "+STR$(N),7)
640 H$=P$: IF N>9999999 THEN D$="*******"
650 :
660 PRINTP0$H$;"■■■■■■■■■■■■■■■■";D$
670 GOTO330
680 :
60102 DATA"          ┌──────────────────┐"
60104 DATA"          ■■ HEX-DEX CONVERTER *■■"
60106 DATA" "
60108 DATA" "
60110 DATA" "
60112 DATA"      H  E  X              DECIMAL"
60114 DATA"     ┌──────┐            ┌──────┐"
60116 DATA"     │      │            │      │"
60118 DATA"     └──────┘            └──────┘"
60120 DATA" "
60122 DATA" "
60124 DATA" "
60126 DATA"                   INPUT"
60128 DATA"                  ┌──────┐"
60130 DATA"                  │      │"
60132 DATA"                  └──────┘"
60134 DATA" "
60136 DATA" "
60138 DATA"                 ┌──────────┐"
60140 DATA" INPUT MODE:     │ DEC -> HEX │"
60142 DATA"                 └──────────┘"
60144 DATA"                 _          _"
60146 DATA"PRESS ■@■ TO CHANGE MODE, ■HME■ TO QUIT PGM"
60148 DATA" "
60150 DATA" "
READY.
```

Catalog (8050) — Peter Gabor — Universal

A disk routine now, which looks at an 8050 disk and tells you not only what's on the disk but puts it all into alphabetical order and indeed tells you where all the programs start and end in memory. It will work on any PET, but as the title might suggest you'll need to have an 8050 hooked up as well.

```
10 REM ******************************
20 REM *   C A T A L O G - 8 0 5 0   *
30 REM *                             *
40 REM *THE ORIGINAL PROGRAM, UPDATED*
50 REM *TO 8050, WITH LINE#385 ADDED *
60 REM *AND CHR$(34) PRTED IN LNE 750*
70 REM *     P.G.                    *
80 REM ******************************
90 :
100 DIMT$(4),S%(225),F$(225),K$(225),D$(225),I$(100),B$(100)
105 PRINT"□                                  "
110 PRINT"      ■DISK CATALOG SYSTEM (8050)"
115 PRINT"■                    BY JIM BUTTERFIELD■■"
120 DATA 169,0,162,4,149,95,202,16,251,169,160,133,94,162,2,32,198,255
130 DATA 230,98,208,10,230,97,208,6,230,96,208,2,230,95,32,228,255,165,150
140 DATA 240,235,32,204,255,198,94,6,98,38,97,38,96,38,95,16,244,96
150 FORJ=860TO914:READX:POKEJ,X:NEXTJ
160 DATA "XXX","SEQ","PRG","USR","REL"
170 FORJ=0TO4:READT$(J):NEXT
180 OPEN3,8,3,"1:INDEX"
190 INPUT#3,I%
200 FORJ=1TOI%
210 INPUT#3,I$(J),B$(J)
220 NEXTJ
230 CLOSE3
240 P=3:INPUT"PRINTER";Z$:IFASC(Z$)=89THENP=4
250 PRINT:OPEN4,P
260 G$="                    "
270 OPEN1,8,15,"I0":CLOSE1:OPEN1,8,3,"$0"
280 N%=0:FORJ=1TO4:GET#1,A$:NEXTJ
290 N$="":FORJ=1TO16:GET#1,A$:IFA$=CHR$(160)GOTO310
300 N$=N$+A$
310 NEXTJ:GET#1,A$:GET#1,A$
320 I$="":FORJ=1TO2:GET#1,A$:IFA$=CHR$(160)GOTO340
330 I$=I$+A$
340 NEXTJ:PRINT"ID='";I$;"'      ";N$
350 FORJ=1TOI%
360 IFI$(J)<>I$THENNEXTJ:GOTO390
370 PRINT"ID '";I$;"' ALREADY EXISTS."
380 INPUT"OVERWRITE";Z$:IFASC(Z$)<>89GOTO850
382 :
385 GOTO400:REM    OTHERWISE ID APPEARS TWICE IN THE INDEX FILE!! - GP
387 :
390 I%=I%+1:I$(I%)=I$:B$(I%)=N$
400 FORJ=1TO738:GET#1,A$:NEXTJ
410 M=M+1:GET#1,K$,T$,S$:IFS$=""THENS$=CHR$(0)
420 F$="":FORJ=1TO16:GET#1,A$:IFA$=CHR$(160)GOTO440
430 F$=F$+A$
440 NEXTJ
460 FORJ=1TO10:GET#1,A$:NEXTJ
470 L=0:IFA$<>""THENL=ASC(A$)
480 GET#1,A$:IFM<8THENGET#1,A$,A$:GOTO500
490 M=0
500 SW=ST:IFK$=""GOTO720
510 K=ASC(K$)-128:IFK<1ORK>4GOTO720
520 PRINTF$
530 T$=T$(K)
540 T$=T$+STR$(L)
550 IFK=0GOTO700
560 OPEN2,8,4,"0:"+F$+","+T$(K)+",R"
570 D$="":A=0:IFK<>2GOTO610
580 GET#2,A$,B$:A=LEN(A$):IFATHENA=ASC(A$)
590 B=LEN(B$):IFBTHENB=ASC(B$)
600 GOSUB860
610 POKE1,92:POKE2,3:A=A+USR(0)
620 IFK<>2THEND$=STR$(A)+"BYTES":GOTO650
630 A%=A/256:A=A-A%*256:B=B+A%
640 GOSUB860
650 CLOSE2
660 IFN%=0THENJ=0:GOTO700
670 FORJ=N%TO1STEP-1:K=S%(J)
680 IFF$(K)<F$GOTO700
690 S%(J+1)=S%(J):NEXTJ
700 N%=N%+1:S%(J+1)=N%
710 F$(N%)=F$:K$(N%)=T$:D$(N%)=D$
720 IFSW=0GOTO410
730 CLOSE1:OPEN7,8,7,"@1:"+I$+",S,W"
735 PRINT#4,"DISK: ";N$;"       ID: ";I$:PRINT#4
740 FORJ=1TON%:K=S%(J)
750 PRINT#7,CHR$(34);F$(K);CHR$(13);
760 PRINT#7,K$(K);CHR$(13);
770 PRINT#7,D$(K);CHR$(13);
780 PRINT#4,F$(K);LEFT$(G$,17-LEN(F$(K)));K$(K);LEFT$(G$,9-LEN(K$(K)));D$(K)
790 NEXTJ:CLOSE7:PRINT#4:PRINT#4:INPUT"ANOTHER DISK";Z$:IFASC(Z$)=89GOTO270
800 OPEN3,8,3,"@1:INDEX,S,W"
810 PRINT#3,I%,CHR$(13);
820 FORJ=1TOI%
830 PRINT#3,I$(J);CHR$(13);B$(J);CHR$(13);
840 NEXTJ:CLOSE3
850 CLOSE4:END
860 X=B/16:GOSUB870:X=A/16
870 FORJ=1TO2:X%=X:X=(X-X%)*16:IFX%>9THENX%=X%+7
880 D$=D$+CHR$(X%+48):NEXTJ:RETURN
READY.
```

Recipe — Jim Butterfield — Universal

A little novelty item, a recipe filing system, and as such requires a disk drive somewhere along the line. It will also, if required, print out everything as well. The volume and weight table at the start (lines 200 to 320) can obviously be changed to suit your own requirements. You'll notice that in line 1100 you are asked to input SAME, LESS OR MORE. This program calculates quantity servings as well!

```
100 DIM U(40),I$(40),Q(40)
200 REM VOLUME TABLE
210 DATA DROP,.00,60
220 DATA TSP,4.2,3
230 DATA TBLSP,1,2
240 DATA OUNCE,7.8
250 DATA CUP,23,16
260 DATA GALLON,1E7,0
300 REM WEIGHT TABLE
310 DATA OUNCE,15,16
320 DATA POUND,1E9
500 DIM V$(15),VL(15),VN(15)
520 V=0
530 V=V+1:READV$(V),VL(V)
540 IFVL(V)<1E8THENREADVN(V):GOTO530
600 I=0:PRINT"RECIPES..."
610 INPUT"INGREDIENT  *■■■■";I$
620 IF I$="*" GOTO 900
625 Q=0:U=0:IFASC(I$)=42GOTO770
630 INPUT"QUANTITY  0■■■■";Q
640 IF Q=0 GOTO610
650 INPUT"UNITS  #■■■■";U$
660 U=0:IF U$="#" GOTO 770
670 IFRIGHT$(U$,1)="S"THENU$=LEFT$(U$,LEN(U$)-1)
680 J1=1:IF U$<>"OUNCE"GOTO720
690 INPUT"WEIGHT OR VOLUME";Z$
700 Z=ASC(Z$):IFZ=86 GOTO 900
710 J1=5:IFZ<>87GOTO510
720 FORJ=J1TOV:IFU$=V$(J)GOTO760
730 NEXTJ:GOTO650
760 U=J
770 I=I+1:I$(I)=I$:Q(I)=Q:U(I)=U
780 GOTO610
900 IFI>0GOTO1000
910 INPUT"NAME OF FILE";N$
920 I=0:OPEN1,8,3,N$+",S,R"
925 INPUT#1,S9
930 I=I+1
940 INPUT#1,I$(I):INPUT#1,Q(I):INPUT#1,U(I)
950 IFST=0 GOTO930
960 CLOSE1:GOTO 1100
1000 INPUT"WRITE TO FILE";Z$
1010 IFASC(Z$)<>89GOTO1100
1020 INPUT"NAME";N$
1030 OPEN1,8,3,"0:"+N$+",S,W"
1035 PRINT#1,S9
1040 FORJ=1TOI
1050 PRINT#1,I$(J):PRINT#1,Q(J):PRINT#1,U(J)
1060 NEXTJ:CLOSE1
1100 INPUT"SAME, LESS, OR MORE  S■■■■";F$
1101 F=1:R=ASC(F$):IFR=83GOTO1110
1102 IFR<>77ANDR<>76GOTO1100
1103 INPUT"FACTOR";F
1104 IFR=76THENF=1/F
1110 P=3:INPUT"PRINTER  N■■■■";Z$:IFASC(Z$)=89THENP=4
1111 OPEN3,P
1115 PRINT#3,"   ";INT(S9*F+.5);" SERVINGS"
1118 FORJ=1TOI
1130 Q=Q(J)*F:U=U(J):I$=I$(J)
1135 IFQ=0THENPRINT#3,I$(J):GOTO1410
1140 REM TEST IF QUANTITY TOO GREAT
1145 IFU=0GOTO1300
1150 IFQ<=VL(U)GOTO1200
1160 Q=Q/VN(U):U=U+1:GOTO1300
1200 REM TEST IF QUANTITY SMALL
1210 V=U-1:IFVN(V)=0GOTO1300
1220 Q1=Q*VN(V)
1230 IFQ1>VL(V)GOTO1300
1240 Q=Q1:U=V:GOTO1210
1300 QX=Q+.065:Q1=Q-QX:Q$=STR$(QX)
1310 F$="":IFQ1=0GOTO1400
1320 E=1:D=2:GOSUB2000
1330 D=3:GOSUB2000
1340 D=4:GOSUB2000
1350 D=5:GOSUB2000
1360 D=8:GOSUB2000
1390 IFQ$=" 0"THENQ$="":F$=" "+MID$(F$,2)
1400 S$="S ":IFU=0OR(Q$=" 1"ANDF$="")THENS$=" "
1405 PRINT#3,Q$;F$;" ";V$(U);S$;I$
1410 NEXTJ
1420 CLOSE3
1430 GOTO1100
2000 FORK=1TOD-1
2010 E1=K/D:E=ABS(Q1-F1)
2020 IFE1>=EGOTO2090
2030 IFK=0THENF$="":GOTO2090
2040 E=E1-.01:F$="-"+CHR$(K+48)+"/"+CHR$(D+48)
2090 RETURN
READY.
```

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Automating a laser analyser

Dr K.T. Kibasi and Dr A. Mills

Control systems have played an important role in research and in production engineering. From the initial analog linear systems, we have seen in recent decades the emergence of hybrid and digital control systems. In the early systems feedback (or occasionally feed-forward) was some form of hardware-derived signal such as position, velocity, temperature etc. These signals were obtained using a variety of transducers, eg potentiometers, tachometers, thermocouples etc, and the control system was generally designed to perform a certain well-specified operation.

At their zenith these systems were designed to be adaptive in that their behaviour could be altered to suit changing circumstances or demands by placing hardware parameters under the influence of a further, higher order of control loop. Such adaptive control systems are found in radar trackers, missile guidance systems and some process control plant. But irrespective of the complexity of these systems and the number of control loops, they did not have any "intelligence" apart from that which the designers had built into them.

With the advent of digital systems the possibilities for sophisticated and flexible behaviour were soon realised, and throughout the sixties and early seventies expensive minicomputers were pressed into service in such applications.

In this article we aim to show how an inexpensive microcomputer, such as those in the Commodore range, may be interfaced to a wide range of existing control systems and semi-automatic instruments. In particular, we deal with linking into electro-mechanical servo-systems and automating manual control panels.

Objectives

The type of system we are considering is often to be found in a research environment involved in repetitive or continuous measurements, or in a process plant or factory production line. This can mean that the system can only be shut down for a short time in order to minimise the financial loss incurred during down-time, and consequently interface installation and testing must be relatively quick and straightforward.

Another aspect that may have to be considered is the need to maintain the option of manual control, so that an operator can if necessary override the automatic system should special circumstances arise. Sometimes it is useful to provide a combination of manual control plus computer monitoring and data logging, perhaps with alarm indication included.

All this means that the interface designer must have an in-depth understanding of the hardware components, including transducers, signal conditioners, actuators and associated instruments.

And of course, to achieve the objective of a successful working system, a software package must be written to handle the interface in such a way that it interacts with the target system to realise the desired automatic behaviour. This program is the link between the hardware interconnections and intentions of the designer, and so needs as much care and attention to detail as the hardware aspects.

Case study

In this section we describe a real-life project which had all the elements mentioned so far — electro-mechanical and electronic subsystems, monitoring and control. The system to be automated was a Laser Raman Microprobe Analyser manufactured by Jobin Yvon Co of France, an expensive and sophisticated scientific instrument which employs a powerful laser to bombard the sample of interest and then subjects the diffuse scattered light to spectral analysis at wavelengths close to the original laser light. Molecular Raman effects scatter light into slightly different wavelengths, and the energy shifted into each nearby peak characterises the molecular compounds involved.

The Microprobe may be considered to have the following main sub-systems:

(a) Raman digit control unit with keyboard and displays.
(b) Wavelength scanning motor and collimating slit drive motors plus motor position indicators and safety protection circuitry.
(c) Remote control console containing multi-turn potentiometers which effect the slit width motors controlling the shutters on the laser optical bench.
(d) DC amplifier provides the necessary gain for the signal from the photomultiplier detector. This unit has the facility for sensitivity and response time constant selection.
(e) Brookdeal photon counting system type 5C1.

Dr K.T. Kibasi and Dr A. Mills are senior researchers at 3D Digital Design & Development in London.

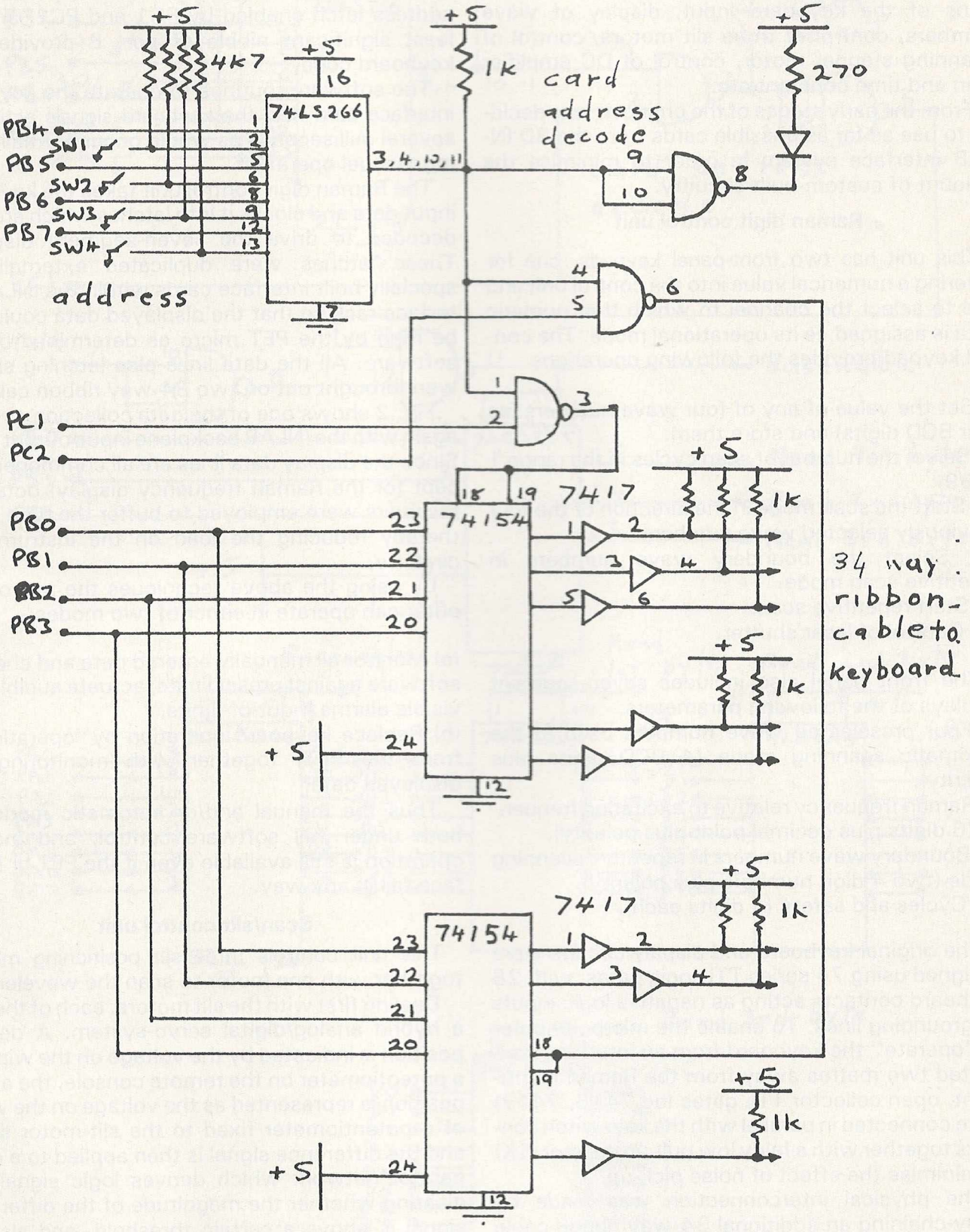

Figure 1: Keyboard control interface

It can be seen from the above that an interface system must be designed to perform all the functions of the keyboard input, display of wave numbers, control of three slit motors, control of scanning stepper motor, control of DC amplifier gain and time constant etc.

From the early stages of the project it was decided to use as far as possible cards from the 3D INLAB interface system in order to minimise the amount of custom-built circuitry.

Raman digit control unit

This unit has two front-panel keypads, one for entering a numerical value into the control unit and one to select the channel to which that numeric data is assigned, ie its operational mode. The control keypad provides the following operations:

(i) Set the value of any of four wave numbers (as four BCD digits) and store them.
(ii) Select the number of scan cycles in the range 1 to 99.
(iii) Start the scan mode in the direction of the four previously selected wave numbers.
(iv) Select the boundary wave numbers in repetitive scan mode.
(v) Start repetitive scan.
(vi) Control of laser shutter.

The front panel also includes seven-segment displays of the following parameters:
(i) Four preselected wave numbers used in the automatic scanning mode (4 BCD digits plus polarity).
(ii) Raman frequency relative to excitation frequency (6 digits plus decimal point plus polarity).
(iii) Boundary wave numbers in repetitive scanning mode (two 4 digit numbers plus polarity).
(iv) Cycles and safety (4 digits each).

The original keyboard and display circuits were designed using 74 series TTL logic gates, with 28 keyboard contacts acting as negative logic inputs by grounding lines. To enable the microcomputer to "operate" the keyboard from an interface connected two metres away from the Raman instrument, open collector TTL gates (eg 7416, 7417) were connected in parallel with the keyswitch contacts together with a fairly low pull-up resistor (1K) to minimise the effect of noise pick-up.

The physical interconnection was made by daisy-chaining an additional 34-way ribbon cable onto the existing cable connecting the keyboard to the electronic encoding circuit. The open-collector outputs were mapped in such a way as to match the keyboard connections. Fig 1 shows the circuit of the keyboard interface with its connection to the INLAB rack backplane bus.

The card identity within the INLAB rack is decoded from the most significant nibble of port B (with address latch enabled by PC1 and PC2) and the least significant nibble of port B provides the keyboard code.

The software routines to operate the keyboard interface card held the keyboard signals active for several milliseconds as would occur normally during manual operation.

The Raman digit control unit takes the keyboard input data and clocks it into latches which are then decoded to drive the seven-segment displays. These latches were duplicated externally on specially built interface cards within the INLAB interface rack so that the displayed data could also be read by the PET micro as determined by the software. All the data lines plus latching signals were brought out on two 34-way ribbon cables.

Fig. 2 shows one of the data collection circuits, again with the INLAB backplane input/output lines. Since the display data lines are all commoned (except for the Raman frequency display) octal line receivers were employed to buffer the data lines, thereby reducing the load on the instrument's circuitry.

By using the above techniques the microcomputer can operate in either of two modes:-

(a) Monitor all manually entered data and check in software against preset limits; actuate audible and visible alarms if out-of-limits.
(b) Replace keyboard operation by 'operating' it from the PET, together with monitoring the displayed data.

Thus the manual and/or automatic mode are both under full software control, and manual operation is still available even if the PET or interface fail in any way.

Scan/slit control unit

This unit controls three slit positioning motors together with one motor to scan the wavelength.

Dealing first with the slit motors, each of these is a hybrid analog/digital servo-system. A desired position is indicated by the voltage on the wiper of a potentiometer on the remote console, the actual position is represented as the voltage on the wiper of a potentiometer fixed to the slit-motor shaft, and the difference signal is then applied to a comparator network which derives logic signals indicating whether the magnitude of the difference signal is above a certain threshold, and also its sign. These signals control a stepper motor phase control circuit by gating a clock pulse to an up/down counter, a drive circuit in common use.

Again the interface design must permit both manual and automatic (ie PET) control of the slit motors.

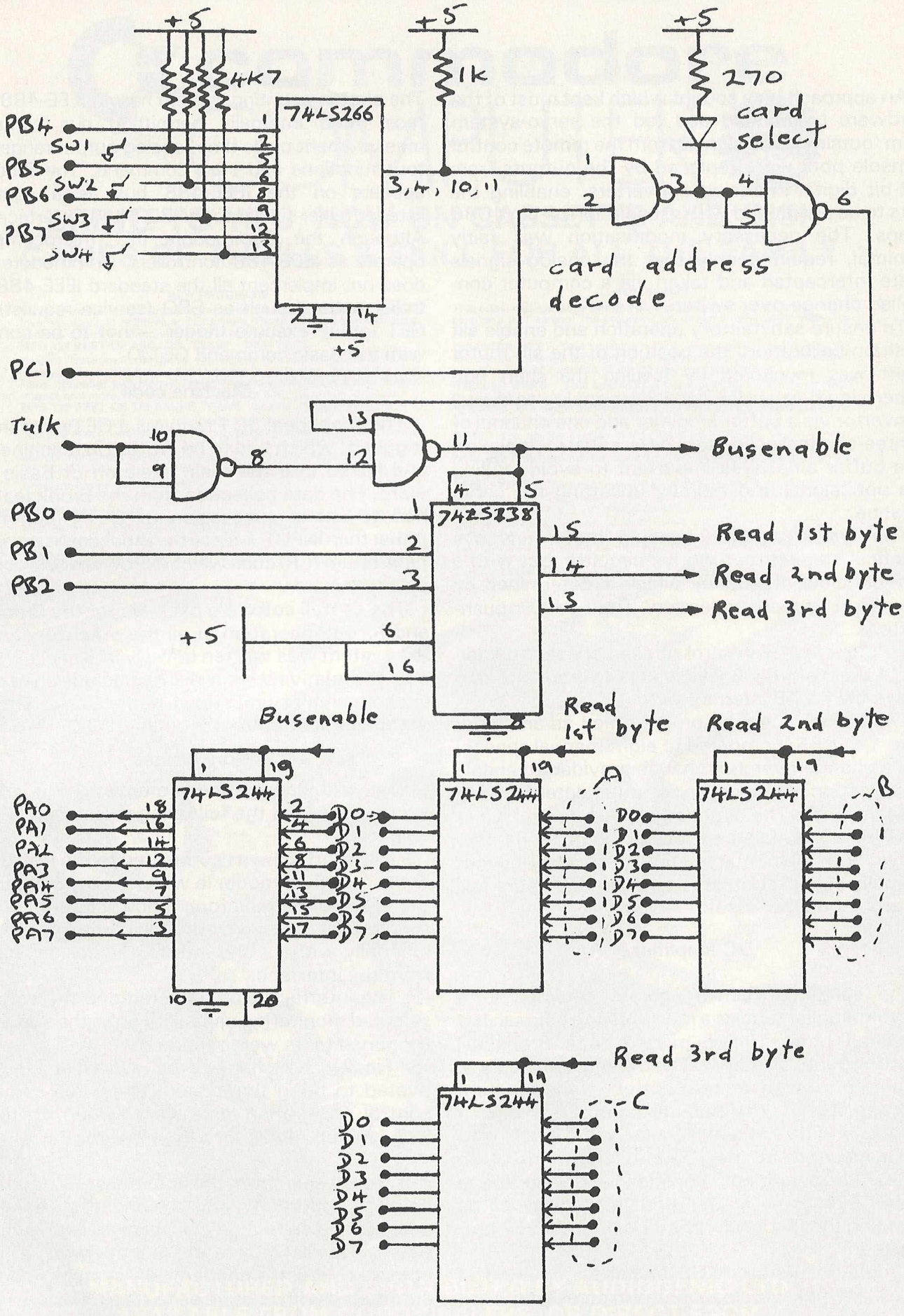

Figure 2: Data collection circuitry between Raman display and PET. A, B and C are data from keyboard on coding circuitry

An approach was sought which kept most of the hardware unchanged and fed the servo-system from 'outside'. The signals from the remote control console pots were replaced by the outputs from 12-bit digital-to-analog converters, enabling the slits to be positioned with a resolution of 1 in 4086 steps. The necessary modification was fairly minimal, requiring only that the analog signals were intercepted and taken via a computer controlled change-over switch.

To ensure satisfactory operation and enable slit position calibration, the position of the slit motor shaft was monitored by feeding the shaft pot. wiper signal to an INLAB 12-bit analog-to-digital convertor via a buffer amplifier and one channel of a three-channel solid-state differential multiplexer. The buffer amp. was important to avoid loading the pot. signal and thereby upsetting the servo balance.

The wave number scanning motor employs identical stepper motor drive circuitry, but with a variable clock frequency which is determined by the scan speed selection front-panel push-buttons.

To provide PET control of scan speed, an additional chain of frequency dividers was constructed within the INLAB interface rack.

The divisor could be programmed as aninteger from 1 to 255 (compared to eight manual speeds) and a change-over switch was provided to enable the selection of manual or computer determination of scan speed. The direction of scan, ie positive or negative scan, was controlled using change-over relays, with the contacts wired in such a way that normally closed contacts corresponded to manual control mode (fail-safe).

DC amplifier

The scattered Raman light is detected in a photomultiplier tube as a low level noisy signal. It is amplified before being passed to a Brookdeal photon counting system. The DC amplifier has two parameters which require control — time constant and sensitivity. The manual control is by front panel push-buttons which have the effect of inserting capacitors at the non-inverting input of an LM308A operational amplifier, and inserting a chain of resistors in the input stage as well as changing the feedback resistor of an LH0052 pre-amplifier.

Simple solid-state MOS switches mounted in the INLAB rack were connected in parallel with the push-buttons. Their OFF resistance is of the order of tens of megohms, and the ON resistance (~400 ohms) is negligible in comparison to the feedback resistors.

The photon counting system has an IEEE-488 interface fitted internally permitting bus control of measurement cycle time, analog output range, printout functions and start command. The Brookdeal appears on the IEEE-488 bus as a combined listener/talker similar to the 3D INLAB interface rack. Although the Commodore PET microcomputers operate as IEEE-488 controllers, Commodore Basic does not implement all the standard IEEE-488 controller options such as SRQ (service request) and GET (group execute trigger — not to be confused with the Basic command GET#).

Machine code

The Brookdeal 5C1 requires a GET exchange to trigger it, which had to be written in machine code and linked into the main skeleton of Basic software. The data collection from the Brookdeal then had to use a succession of GET# commands rather than INPUT # since the Brookdeal issues a carriage return (CR) code which INPUT # would consider as a terminator.

The overall software package for the Brookdeal and for the operation of all the other functions in the system was written entirely in Basic 4.0, with only the relatively short 6502 machine code group execute trigger embedded in the Basic. The program was written to run on an 8032.

Conclusions

The installation and commissioning of the system involved the following three steps:

(a) The interface was connected to the instrument in the 'passive' mode, ie with no power applied to the INLAB. Satisfactory manual operation was assured by carrying out full performance tests manually without any interference or impairment from the interface.
(b) The interface was powered and the software selected monitoring capability only: the above performance tests were repeated.
(c) Finally the change-over switches were activated to bring the system under full computer control. Calibration tests were carried out to provide look-up tables for the software.

It can be seen from the above that by adopting a holistic approach, and having the computer emulate the self-same control signals or switches that are available to a manual operator, a highly complex electromechanical system can be automated with relative ease. The objectives mentioned at the beginning of this article were clearly achieved and the complete execution time from feasibility study to installation and final commissioning was only 10 weeks.

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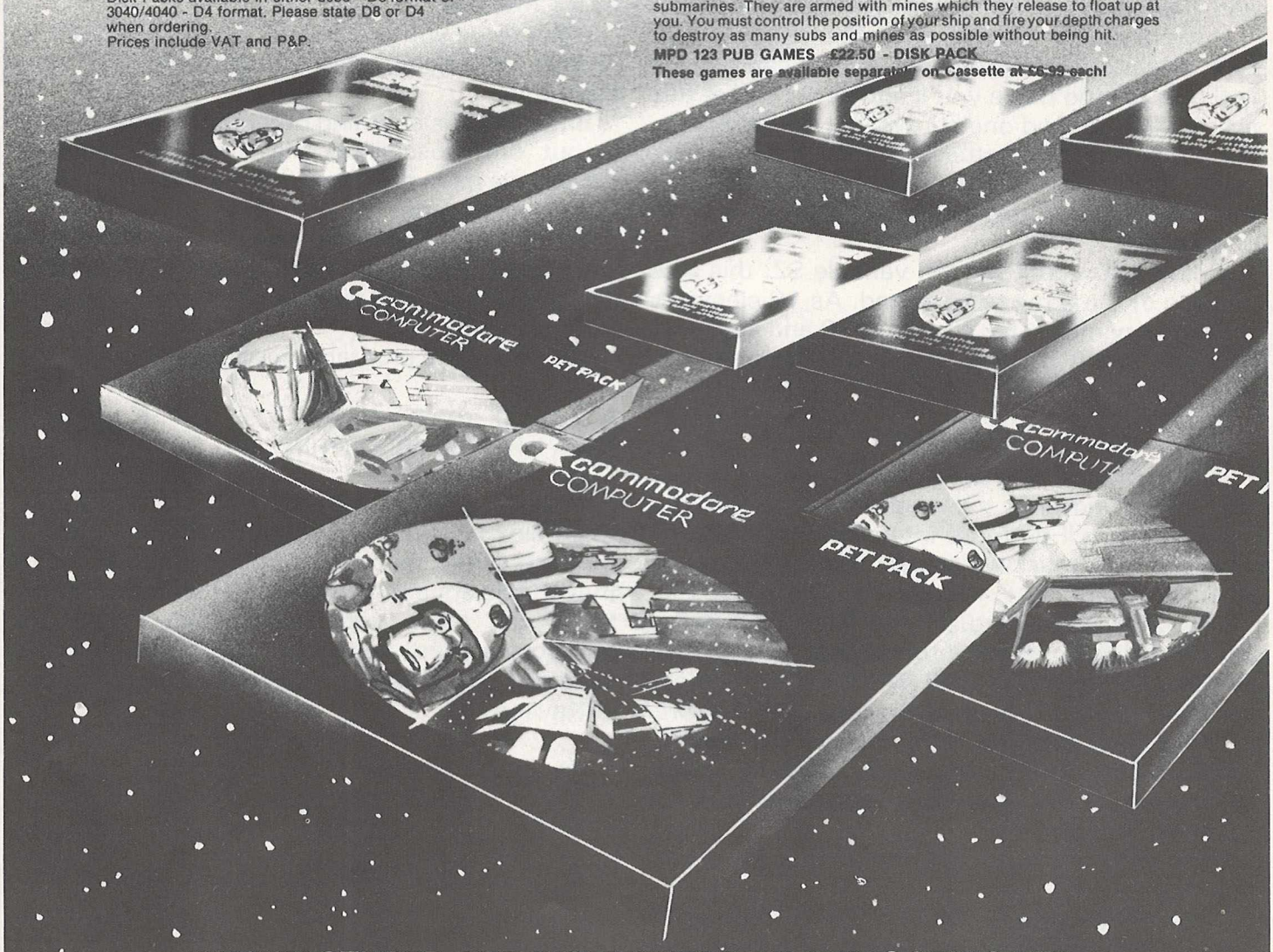

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Keysort techniques

In the past a number of routines have been published for sorting the elements of an array into ascending or descending alphabetical order, but we make no apologies for returning to this old subject, with one of the fastest sort routines we've ever seen.

This works on Basic 2 or 4 and consists of some machine code that lives at memory address 29780 ($7454) onwards. As it's only about 1K long, it can be used by those of you with less than 32K of memory, but you'll have to figure out where to place it in your own machine. From now on, we'll just consider 32K machines.

Don't worry if you know nothing about machine code at all, you don't need to for this program: just follow the instructions later *very carefully* and you'll soon be using this very fast program.

How fast, you may wonder. We've given you two demonstration programs so you can get the feel of it all, and these you'll find at the end of this article. The second one shows you on the screen how the program actually works (it's a cheat really, but the sort is definitely not cheating!), but the first, short program is simpler at first to understand.

In line 120 you'll see the variable SZ: this sets the size of the array to be sorted. As 19 elements are not very much, try it with 1000 and see what happens (we'll tell you, it takes a fraction over eight seconds!)

Random sets

Lines 150 and 200 simply set up random sets of characters and print them up on the screen, but obviously you'll be more interested in using this program with your own arrays: this is just serving as an example.

Line 230 is the actual sort. First we set the variable T1 to equal the internal time (TI) in jiffies, perform the sort with SYS 29780, and then set another variable T2 to equal the time after the sort.

The sorted array is then printed out on the screen, and finally line 320 does a quick calculation to tell you how long it all took in seconds. Fast, isn't it?

Now then, how to get the program up and running.

Enter the monitor with SYS 1024, type in M 7454 750B (RETURN), and then type in the values shown in the first block of numbers at the end of this article. When you've finished with that, type M 750C 75C3 (RETURN), and again type in the values in the second block of numbers.

This is bringing up one screenful at a time, to make it easier to enter all the machine code part. Continue typing M 'START ADDRESS' 'END ADDRESS' as shown in the first and last row of each block, until you get to the final one, which is M 77EC 77FF.

Save all this from the monitor under the name Keysort, using the syntax S ''0:KEYSORT'',08,7754,7800 if you happen to be using drive 0 of a disk drive numbered device 8, and remembering that you always have to save one byte more than the end of the code.

When this is completed, type in the following short piece of code in direct mode, and hit RETURN:

```
A=0:FORI=29780TO30719:A=A+PEEK(1):-
NEXT:PRINTA
```

If the value you see on your screen is 89441 all is well and good, and the program will work correctly.

If the value is anything other than 89441, there is but one possibility: the machine hangs up totally, we have problems and we'll have to check the machine code.

To make life easier for you, the machine code was earlier divided up into six blocks. We'll make use of this to try and pin down our error in typing it in.

Take our little program mentioned above:

```
A=0:FORI=XTOY:
A=A+PEEK(I):NEXT:PRINTA
```

where X and Y are the start and end addresses. The following table shows the values of X and Y for each of the six blocks, and also the value of A that should appear. If your total is different, we've found the block with the mistake. Enter the monitor, re-check your code, re-save the machine code part and we should now have a working copy of Keysort.

Block #	X	Y	A
1	29780	29963	18255
2	29964	30147	17875
3	30148	30331	16805
4	30332	30515	19397
5	30516	30699	16536
6	30700	30719	573

As with all routines of this kind, we think you'll find that the speed and usefulness of the program far outweighs the effort involved in typing it in. We hope that this sorts out a lot of your problems!

1

```
7454 A5 35 38 E9 74 90 10 D0
745C 06 A5 34 E9 2A 90 08 A9
7464 54 85 34 A9 74 85 35 20
746C 98 75 95 2C 85 15 A5 2D
7474 85 16 A5 02 C9 24 F0 06
747C A9 80 85 00 85 01 A0 00
7484 B1 15 C5 00 F0 06 A9 80
748C C5 00 D0 08 C8 B1 15 C5
7494 01 30 01 C8 98 AA A5 03
749C C9 25 F0 04 A9 09 85 04
74A4 A5 05 C9 23 F0 04 A9 00
74AC 85 06 A0 02 B1 15 18 65
74B4 15 85 18 C8 B1 15 65 16
74BC 85 19 A5 2F C5 19 F0 02
74C4 B0 0E A5 2E C5 18 F0 02
74CC B0 06 E0 02 B0 11 90 17
74D4 E0 02 B0 0B A5 18 85 15
74DC A5 19 85 16 18 90 9F A0
74E4 04 B1 15 C9 01 F0 08 20
74EC 98 75 A2 80 4C 57 C3 A0
74F4 06 B1 15 85 12 88 B1 15
74FC 85 13 18 6A 85 0E A5 12
7504 6A 18 69 01 85 0D A5 0E
```

2

```
750C 69 00 85 0E A5 15 18 69
7514 04 85 23 A5 16 69 00 85
751C 24 A5 12 85 0B A5 13 85
7524 0C A5 0E F0 03 4C AA 75
752C A5 0D C9 01 D0 F7 A5 0B
7534 85 1B A5 0C 85 1C 20 B3
753C 77 A0 00 B1 15 85 20 C8
7544 B1 15 85 21 C8 B1 15 85
754C 22 A5 23 18 69 03 85 18
7554 A5 24 69 00 85 19 B1 18
755C 91 15 00 B1 18 91 15 88
7564 B1 18 91 15 38 A5 0B E9
756C 01 85 0B A5 0C E9 00 85
7574 0C C9 00 D0 57 A5 0B D0
757C 53 A5 07 85 1B A5 08 85
7584 1C 20 B3 77 A5 20 A0 00
758C 91 15 C8 A5 21 91 15 C8
7594 A5 22 91 15 A2 24 BD DB
759C 77 48 B5 00 9D DB 77 68
75A4 95 00 CA 10 F1 60 38 A5
75AC 0D E9 01 85 0D A5 0E E9
75B4 00 85 0E 85 1C A5 0D 85
75BC 1B 20 B3 77 A0 00 B1 15
```

3

```
75C4 85 20 C8 B1 15 85 21 C8
75CC B1 15 85 22 A5 0D 85 09
75D4 A5 0E 85 0A A5 09 85 07
75DC A5 0A 85 08 18 26 09 26
75E4 0A A5 0A C5 0C F0 05 90
75EC 0D 4C 88 76 A5 09 C5 0B
75F4 90 04 F0 5E B0 F3 A5 09
75FC 85 1B A5 0A 85 1C 20 B3
7604 77 A0 00 B1 15 85 17 C8
760C B1 15 85 18 C8 B1 15 85
7614 19 18 A5 15 69 03 85 15
761C A5 16 69 00 85 16 A0 02
7624 B1 15 85 1C 88 B1 15 85
762C 1D 88 B1 15 85 1A A5 19
7634 85 1F A5 18 85 1E A5 17
763C 85 1D 20 D7 76 A5 14 C5
7644 17 90 0F F0 0D 18 A5 09
764C 69 01 85 09 A5 0A 69 00
7654 85 0A A5 09 85 1B A5 0A
765C 85 1C 20 B3 77 A0 02 B1
7664 15 85 1C 88 B1 15 85 1B
766C 88 B1 15 85 1A A5 22 85
7674 1F A5 21 85 1E A5 20 85
```

4

```
767C 1D 20 D7 76 A5 14 C5 17
7684 F0 02 B0 1E A5 07 85 1B
768C A5 08 85 1C 20 B3 77 A0
7694 00 A5 20 91 15 C8 A5 21
769C 91 15 C8 A5 22 91 15 4C
76A4 25 75 A5 07 85 1B A5 08
76AC 85 1C 20 B3 77 A5 15 85
76B4 18 A5 16 85 19 A5 09 85
76BC 1B A5 0A 85 1C 20 B3 77
76C4 A0 00 B1 15 91 18 C8 B1
76CC 15 91 18 C8 B1 15 91 18
76D4 4C D8 75 A0 00 84 0F A6
76DC 06 D0 0B A5 1D 85 10 A5
76E4 1A 85 11 18 90 70 A5 04
76EC D1 1E F0 08 C8 C4 1D 90
76F4 F7 4C EB 74 84 0F CA F0
76FC 02 B0 F1 C8 D1 1E F0 05
7704 C4 1D 90 F7 C8 88 98 38
770C E5 0F 85 10 E6 0F A5 0F
7714 18 65 1E 85 1E A5 1F 69
771C 00 85 1F A0 00 84 0F A6
7724 06 A5 04 D1 1B F0 08 C8
772C C4 1A 90 F7 4C EB 74 84
```

5.
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7734 0F CA F0 02 B0 F1 C8 D1
773C 1B F0 05 C4 1A 90 F7 C8
7744 88 98 38 E5 0F 85 11 E6
774C 0F A5 0F 18 65 1B 85 1B
7754 A5 1C 69 00 85 1C A5 10
775C C5 11 F0 08 B0 0C 85 0F
7764 A2 01 D0 0C 85 0F A2 00
776C F0 06 A5 11 85 0F A2 02
7774 C9 00 F0 33 A0 00 B1 1B
777C D1 1E D0 24 C8 C4 0F 90
7784 F5 E0 01 F0 09 10 10 A9
778C 00 85 14 85 17 60 B1 1E
7794 85 14 A9 00 85 17 60 A9
779C 00 85 14 B1 1B 85 17 60
77A4 85 14 B1 1E 85 17 60 E0
77AC 01 F0 EC 10 E1 30 D8 A5
77B4 1B 85 1E A5 1C 85 1F 18
77BC 26 1B 26 1C A5 1B 18 65
77C4 1E 85 1B A5 1C 65 1F 85
77CC 1C A5 1B 18 65 23 85 15
77D4 A5 1C 65 24 85 16 60 80
77DC 80 00 00 09 00 00 01 00
77E4 02 00 00 00 01 00 04 04

77EC 0A 14 00 43 24 78 41 CE
77F4 22 0A 03 00 04 01 00 04
77FC 73 73 2E 05 AA 53 44 00
```

Keysort Demo 1

```
110 PRINT"■■SAMPLE RUN FOR #1"
120 SZ=19:DIMA$(SZ)
150 FORI=0TOSZ:A$="":FORJ=1TO10*RND(1)+1:A$=A$+CHR$(65+26*RND(1)):NEXT
200 A$(I)=A$:PRINTI,A$:NEXT
230 T1=TI:SYS29780:T2=TI
260 PRINT"■■"TAB(20)"ORDER AFTER SORTING"
280 FORI=0TOSZ:PRINTTAB(24)A$(I):NEXT
320 PRINT"■TIME TO SORT="(T2-T1)/60"■■ SECONDS"
```

Keysort Demo 2

```
110 PRINT"■■SAMPLE RUN FOR #2"
120 SZ=19:REM ARRAY SIZE
130 F1=4:REM FIELD # TO SORT BY
140 D1=ASC(">"):REM FIELD DELIMITER
150 S$="A$":REM SORT ARRAY NAME
160 SY=29780:ZC=SY+903:REM START OF Z.P. COPY
170 NMFL=ZC+2:REM FLAGS GIVEN ARRAY
180 DFLG=ZC+3:REM FLAGS NEW DELIMITER
190 DLIM=ZC+4:REM STORES DELIMITER
200 FIFL=ZC+5:REM FLAGS KEY FIELD
210 FLDS=ZC+6:REM STORES KEY FIELD #
220 DIMB$(10,2),C%(10),D(10):REM GARBAGE
250 DIMA$(SZ):REM ACTUAL SORT ARRAY
270 FORI=0TOSZ:A$="":FORK=1TO5:REM # OF FIELDS
280 FORJ=1TO10*RND(1)+1:A$=A$+CHR$(65+26*RND(1)):NEXT
330 IFK<5THENA$=A$+CHR$(D1):REM FIELD DELIMITER
340 NEXT:A$(I)=A$:PRINTI;A$:NEXT
390 POKEFIFL,ASC("#"):REM TELL SORT FIELD # IS GIVEN
410 POKEFLDS,F1:REM TELL SORT WHICH FIELD TO USE
430 POKEDLIM,D1:REM GIVE NEW DELIMITER
450 POKEDFLG,ASC("%"):REM TELL SORT TO CHANGE DELIMITERS
470 POKENMFL,ASC("$"):REM TELL SORT SETTING NAME
480 REM CHANGE SORT ARRAY NAME TO BASIC
490 POKEZC,ASC(S$):REM CHAR #1
510 S2=ASC(MID$(S$,2)):REM CHAR #2
520 IF S2=ASC("$")THENS2=128
530 POKEZC+1,S2
540 T1=TI:SYSSY:T2=TI
570 FORI=ZCTOZC+6:POKEI,0:NEXT:REM CANCEL SPECIAL OPTIONS
610 PRINT"■SORTED ON FIELD #"F1
630 FORI=0TOSZ:PRINTI;A$(I):NEXT
640 PRINT"■TIME TO SORT="(T2-T1)/60"■■ SECONDS"
```

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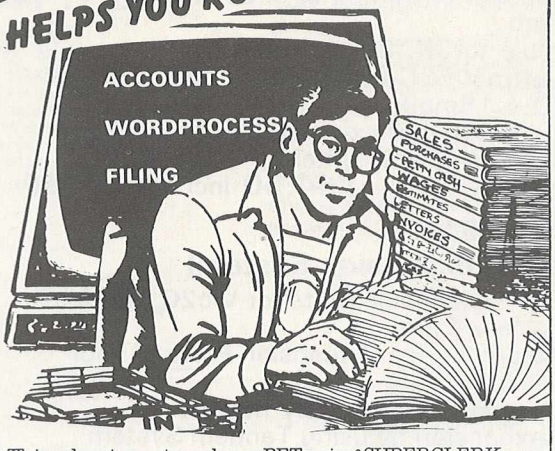

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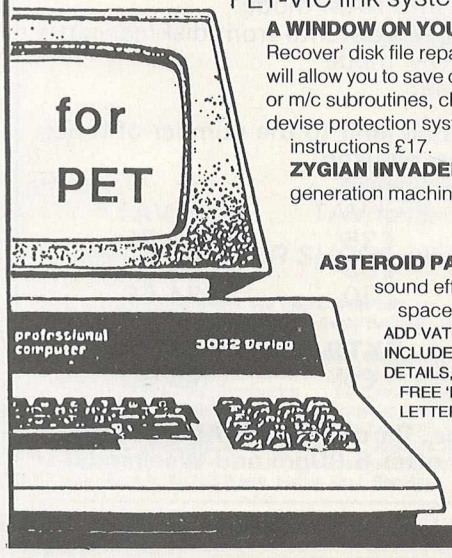

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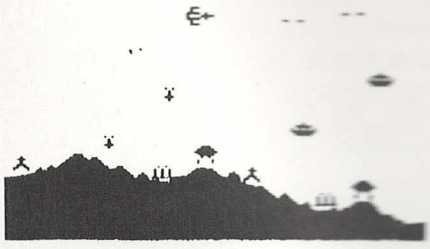

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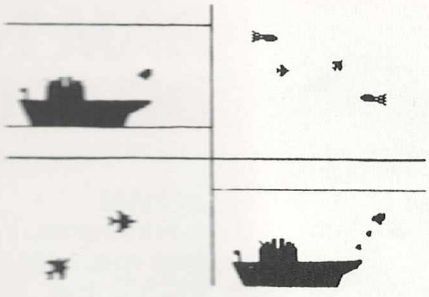

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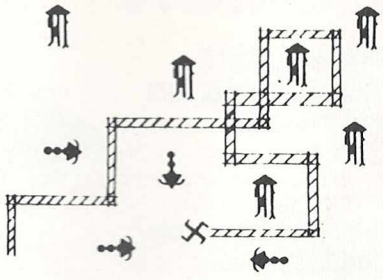

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Points. Ace 1 or 11. Jack, Queen, King 10.

Scoring 21 points with 2 cards — you automatically win.

Scoring 21 points or less with 5 cards — you automatically win.

Draw — the computer wins.

Your kitty is automatically adjusted win or lose. If you lose all your kitty — game over.

DECIPHER

You have to guess what combination of colours the computer has selected — to enter a colour just hit the colour button on the computer, when you have entered your five choices of colour, the computer will display (a) Nothing at all — none right; (b) Black or white squares or both — for every black square you will have a correct colour in the correction position, for every white square you will have a correct colour in the wrong position. If you cannot find the complete combination, it will be displayed when you have had twelve attempts.

FOUR THOUGHT

You have to make a line of four squares — horizontally, vertically or diagonally BEFORE the computer does, taking turns to take a square (squares can only be placed at the bottom of the grid or on top of another square). **Keys.** Hit the number key of the column you want your square dropped in, then hit the return key.

TEASER

The aim of the game is to score "15" BEFORE the computer does, using any combination of three boxes. If you cannot score "15" then you must try and stop the computer from doing so and force a draw. **Keys.** Hit the number key of the box that you want (you can only select an empty box).

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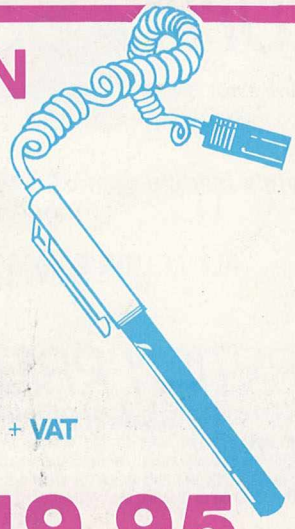

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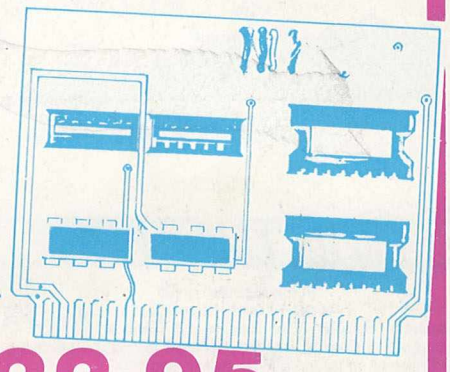

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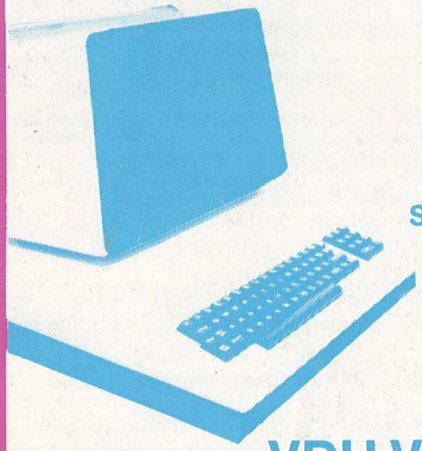

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