

**PERSONAL**

# Computer

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for your computer

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## RACING GAME ROUND-UP



**WIN A RACING START TO 1985**

**ENTER THE COMPETITION  
ON PAGE 19 AND YOU COULD  
BE RACING JAMES HUNT**

**ON TURBO 64**



The price tag. It's something rather special. When you take a look at the new Goldstar MSX you'll find an asking price of around £240. Quite a bit less than most of the others. And since you're choosing a micro that's designed and built to one standard, that'll leave you a whole lot more for the super new MSX games or business software.

What is standard, of course, is the superb MSX specification.

# There's one thing about this MSX that isn't quite standard.



State-of-the-art features like 64K of 'user' RAM and 32K of ROM and 16K Video RAM place the Goldstar right at the top of the MSX league.

Sixteen vivid colours and eight octaves of sound make it a great games player's micro.

And there's a powerful Z-80A processor to take on a world of home office tasks.

Goldstar MSX. The brightest new star among micros that's unbeatable value for money.

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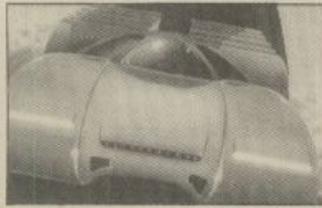
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Your letters wanted on any subject related to computing, with £15 to the best of the week.

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Gotta problem? We can probably tell you the answer. Hundreds of satisfied readers.

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Hints, tips, routines and utilities here. It could be the solution you've been looking for.

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Dozens of bargain buys — and you could sell your unwanted equipment. It's all free.

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Where PCN is dragged away for another week, yelling idiocies, confessing errors, and hurling insults.

## A shortage of Plusses

A Christmas shortage of Spectrum Plusses looms as Sinclair struggles to get on top of a keyboard production problem.

The Spectrum Plus, launched just over a month ago (issue 83), has a keyboard produced in Sweden. The factory there has reportedly had trouble tooling up for production of the new keyboard and Sinclair's quality control uncovered some problems in the early production runs.

Meanwhile, Sinclair's advertising has generated great demand for the new machine and distributor Terry Blood (TBD) said last week: 'We could sell 100,000 between now and Christmas if we could get them'.

TBD had to close its order book as a backlog built up.

Other distributors and smaller outlets have been unable to get nearly as many machines as they wanted. Lightning's Dave Woods commented: 'We do have limited supplies, but not as many as we'd like. We're in Sinclair's hands — it's impossible to say whether there will be enough for Christmas.'

Ironically, a Spectrum Plus shortage could boost sales of the Spectrum, which TBD's spokesman said was holding its own against its big brother. Good news for Spectrum owners is that Sinclair is almost ready with plans to enable owners to move to the Spectrum Plus keyboard and case.

It would not talk about this upgrade in any detail last week, but look out in January for the terms of the trade-in.



## Lap-held battle moves into second phase

Tandy and NEC are steering towards another lap-held battle as both plan new machines for the new year.

Code named the Model 200, Tandy's light-weight computer is a souped-up version of the popular Model 100. It is likely to have improved specifications — the obvious being more memory and perhaps a bigger screen. But at the moment, Tandy's lips are sealed about the innards and the price of the machine.

On the NEC front the new baby will be on the same lines as the Epson PX-8 (issue 61). In terms of price it won't be far from the PX-8's £917 mark and will have more memory and a better screen to work on.

A spokesman from NEC said:

'The PC 8400 was launched in the US recently — but we don't know exactly when it will be available in the UK.'

'As far as we are concerned it's a follow-up to the PC 8201A — and it's certainly not replacing it.'

Olivetti, the other big name in lap-helds, says it has no immediate plans to produce a follow-up to the M10 and looks as though it'll keep out of the price war between Tandy and NEC with its M10 selling at a hefty £458.

At the moment the PC 8201A is being sold at a knockdown price of £299 compared to the Model 100's £449 price-tag. But with the new machines, a head-on price war looks inevitable.

## IN BRIEF

**The party spirit** has infected Ocean, which has released a Spectrum soccer game for up to eight players. Not all at once, of course — the game is a knock-out tournament with 3D action and animated players. It costs £7.95.

**Commodore and the Spectrum Group** are offering a holiday in Florida to the four people who manage to list seven features of the Plus/4 in the right order. The competition, the most extravagant Plus/4 promotion so far, closes on December 31.

**MSX is advancing** on two fronts, with the appearance of the Sanyo MPC100 in the catalogue of distributor Lightning and the build-up of software from Kuma. Kuma, with about 40 MSX titles at the moment, has launched Superchess for the range at the price of £8.95.

**Panasonic is expected** to have a shipment of its MSX entry in the UK by Christmas, but like several of the other suppliers it won't have any great volumes here until next year — the first shipment is thought to be of 1,000 machines.

**Piracy prevention** has taken another step as the Federation Against Software Theft increases its pressure. Thanks to its lobbying the Conservative MP William Powell has introduced a Private Member's Bill on software copyright.

**Century City Software** has jumped on the budget bandwagon with four titles for the Spectrum. Olympic Challenge, Accelerator, House on Damned Hill and Attack on Atlantis cost £1.99. The last game could be a prelude to Attack on Mastertonic but Atlantis is still going strong at this end of the market.

**Wrapping its existing products** in new clothes, A and F Software is selling packs of four BBC and Electron games for £14.95 — this still doesn't put it in the pocket-money category but it's only half of what you'd pay for them separately. The titles are Cylon Attack and Chuckie Egg in each of two packs, with Haunted Abbey, 180 Darts, Kamikaze and Pharaohs Tomb making up the numbers.

**IBM compatibility** spreads beyond systems suppliers to third-party peripheral specialists. Alloy Computer Products' latest back-up cartridge tape, called the PC-Qictape, will run under PCDOS, MSDOS, and Concurrent CP/M.

## Spectrum disk interfaces coming

There should be Spectrum disk systems aplenty within the next few months. Following on the Timex system (reviewed in issue 89) Watford Electronics (0923-40588/37774) has begun marketing a disk interface produced by Abbeydale Designers.

The interface is actually a development of the Morex interface previewed in PCN earlier this year, Abbeydale being run by Dimitri Koveos and Dave Farnborough, who are both ex-Morex.

The interface should run with practically any drives, and is to be marketed in the US for the Timex 2068. It has full sequential handling, is double density and, depending on the drives you use, has a capacity of up to 800K per drive formatted.

For £99 plus VAT you get the interface with bundled disk versions of Tasword 2, Omnicalc 2 and Masterfile — we assume you'll have to specify the disk format you're using here. As far as software support goes, Hisoft has adopted it as its official disk system, and should be offering a disk compatible version of Devpack shortly. OCP should also be looking at porting its software across to disk, and Abbeydale is looking at tape to disk transfer systems.

Dimitri Koveos is as yet unsure about the transfer system that will be used, as he doesn't want Abbeydale to be accused of supporting pirates, but he's currently looking at some kind of once-only transfer system.

## Amstrad delays anger retailers

Hunt the Amstrad may be the game this Christmas as shops report steady sales but limited supplies.

The best places to go seem to be high street multiples like Boots, Comet, Dixons and Rumbelows.

But independent retailers have been finding it difficult to get enough machines and some are expressing concern that they might not be able to meet the expected sales rush.

One south coast retailer said: 'We have just received the machines we ordered in July for delivery at the beginning of November.'

A north London shop said that it had great difficulty in getting any machines at all out of Amstrad's distribution subsidiary, Europa.

'We had to continually write, telephone and keep on pressing the company to get some machines to sell,' it said.

## QL gets mail-order communications

The QL has been given the ability to communicate — with other computers, that is.

OEL (0768 66748), the Cumbrian modem specialist has got together with software house Scicon to produce a family of add-ons with supporting software.

They all went on sale by mail order at the end of last week.

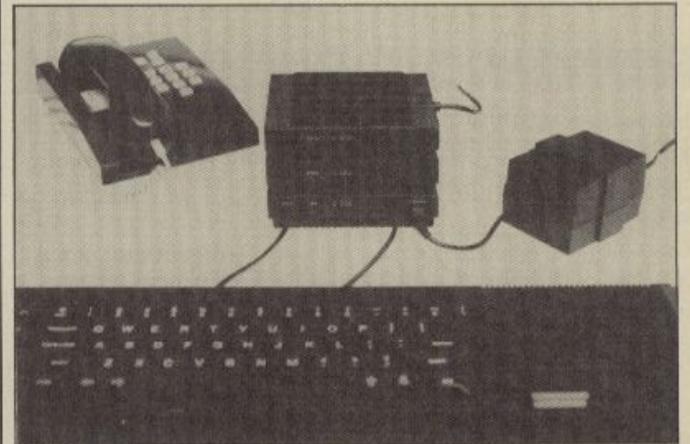
To overcome the hardware limitations of the QL, the basic product is QCOM, an asynchronous communications interface

that provides a full RS232 serial interface and speeds from 74 to 9600 baud.

'The QL serial port is really intended to operate as a printer port. It doesn't have full handshaking, data flow controls or ability to work at split speeds,' said Martin Ansell, of OEL.

The QMOD is a V23 modem to provide access to Prestel and viewdata services at 1200/75 baud and user to user communication.

The final module, the QCALL, adds auto-dialling and auto-answer facilities to the modem.



OEL: lining up comms for the QL.

Its impression was that Europa was playing around by spreading out a small number of machines very thinly.

Amstrad admitted that there may have been some distribution problems initially but these have now been ironed out.

'Europa has had stock for the whole of November. Providing a credit rating has been agreed, a retailer should be able to get supplies by phoning up,' said Amstrad sales director, Richard Mould.

The main delay in retailers getting their initial supplies is caused by the need to obtain the credit rating, he added.

Mr Mould accepted that retailers may have experienced delays because of administrative problems. However, since the beginning of November a new computer system had been installed at Europa and the company had changed its carrier.

## Oric enters Stratos in French market

Oric's three-point plan to dominate the European micro market in 1985 gets under way in January in France.

Its Stratos, cunningly disguised for the UK as something called the IQ164, is due to appear in French shops close to the first anniversary of the Atmos. The Atmos, launched at

last year's Which Computer? Show, was part of last year's three-point plan . . .

Asked why Oric is launching the Stratos in France first Bruce Everiss, managing director of Tansoft said: 'This machine is what the French want. We shall meet the demand there first, then deal with the UK later on. As yet, we don't know when the machine will be available in the UK.'

A different tag had to be found for the machine in the UK, and Oric has hit on IQ164.

Provisionally, it is expected to cost between £250 and £300. It has 64K of RAM, a 6502, two ROM slots (for 64K and 48K) and two joystick ports.

The ROM slots will serve for languages or applications — Logo is one of the languages planned to be implemented on the IQ164.

'It will have more modes than the BBC,' said Everiss, 'and it will be compatible with existing Oric and Atmos software. In addition, the new Basic will give better graphics and 3D capabilities.'

The other parts of the plan, an IBM-compatible and a lap-held, will take Oric into new areas. The lap-held machine will be produced by an American OEM dealer with exclusive European rights going to Oric. In terms of features and price it will be on the same lines as the Data General One.

## Acorn comes home for spring launch

Glad tidings for the New Year are on the way from Acorn as the company steps into the home control era.

Earlier this year in an exclusive interview with PCN Chris Curry, Acorn's managing director, gave a hint of the things to come (issue 71). Now it seems that the company is about to make good his prophecies.

Next spring Acorn will launch a series of home control products which will enable an Acorn computer to control electrical devices and receive signals via the mains circuit.

The scope of what could be controlled in the home is so vast that this could be a turning point in the usefulness of computers.

Chris Curry said: 'Stories about computers being a passing craze must be proved wrong. It is time now to start showing where they can perform tasks... they will only become an essential part of the home if they do practical things.'

It is expected that when Acorn's control device is plugged into the telephone line and connected to the mains, it will put home systems and domestic appliances under local or remote control and keep home status reports on screen.

Later on Acorn hopes that manufacturers of such things as washing machines and televisions will build these control devices into their products.

Acorn is also set to go into battle with ICL's One Per Desk computer when it unveils its 'C series' of terminals to be used for obtaining information from databases.

The C series is expected to undercut the ICL computer and will cost between £500 and £800 based on a 16-bit 8086 processor. Acorn is coy about revealing any of the machine's other features, but we should get the first glimpse in early 1985.

## Red faces as the sun sets on Prestel mole

With faces as red as pillar boxes, Prestel chiefs are hunting a mole whose leaks led last week to the second embarrassing break-in of the month.

The victim this time was Timefame, a large supplier of information to groups like Harrods, the Army & Navy Stores, and Bejam. Timefame is convinced that somebody at Prestel is leaking security codes, but Prestel has not so far confirmed this.

After the last major breach of Prestel's security earlier in November, a source close to Prestel confirmed that somebody within the organisation was freely handing out access codes.

In neither breach has any great damage been done, but pressure will grow on Prestel to find the source of the leaks.

## PCN throws down the gauntlet to hackers

Calling all hackers!

If you fancy yourself as a code-cracker, we want to hear from you. Just leave a message in our Prestel mailbox — it needn't be anything fancy, just a name or an alias and some means for us to contact you.

That shouldn't be too much trouble, should it?



## IBM's latest weapon — the 'Fear Factor'

As 1984 draws to a close, US microcomputerdom has been taking stock and pondering the future. This has been the year that the optimists' projections proved to be a bust; what will 1985 bring?

For a start, the era of venture capitalists in microcomputer products is probably over. At the recent Comdex show in Las Vegas there was little of the manic enthusiasm of previous years, when dozens of hopeful start-ups burning venture capital brought new machines and/or new software to the show. Instead there were a few innovative lap-held machines such as the Data General One and the Texas Instruments Pro-Lite, and all were conspicuously IBM-compatible. The only big software announcement was of Lotus's Jazz (1-2-3-4) for the Macintosh, which wasn't even announced at the show since Lotus refused to spend \$500,000 on a booth and instead took reporters off to a converted hangar.

Nor was Las Vegas as welcoming as in previous years. The word is out on computer conventioners — they don't drink much, they don't stay up late, and they sure don't gamble in hotel casinos. No wonder some hotels this year refused to take any of the poor unhappy things.

Why unhappy? Why such concern for the future? Well, regular readers of this column will recall IBM's cherished dream of a Blue World in which all computing is done on IBM machines. That world continues to draw closer. Indeed, as IBM continues to lower prices, the remaining IBM clones may be driven out of business. Nor does the other US giant, AT&T, seem to really understand the micro business or be prepared to compete effectively. Now IBM is angling hard for the software market and the big fear is on.

Ben Rosen, New York venture capitalist, chairman of Compaq, and the key investor in Lotus 1-2-3, says venture capitalists evinced 'extreme reticence now to get into anything that could be in IBM's play-pen. IBM is having a chilling effect

on new ventures, a fear factor'. (Note: micros still account for only 14 per cent of IBM's \$45 billion revenue.)

Even Kaypro, sturdy defender of 8-bit CP/M, gave in and announced the Kaypro 16, an IBM compatible with 256K of RAM and both hard and floppy disks. This for \$3,295. 'It's what our dealers asked for,' said a Kaypro spokesman.

Not all the blame can be laid at the door of IBM, however. On Wall Street the big institutional investors such as Morgan Guaranty and Bankers Trust (with portfolios worth \$18.7 billion each) are not interested in dangerous hi-tech stocks that nose-dive shortly after introduction (for example Eagle Computer, which made a \$12 a share issue that now lurks in the 80 cent range).

Even IBM's stock, despite consistently excellent earnings, has swung between \$99 and \$128 this year.

This is a huge range for such a solid blue chip and evidence of the volatility in a stock market where money managers, working for the institutions, are desperately churning stocks around in search of fractional profits to make their monthly targets.

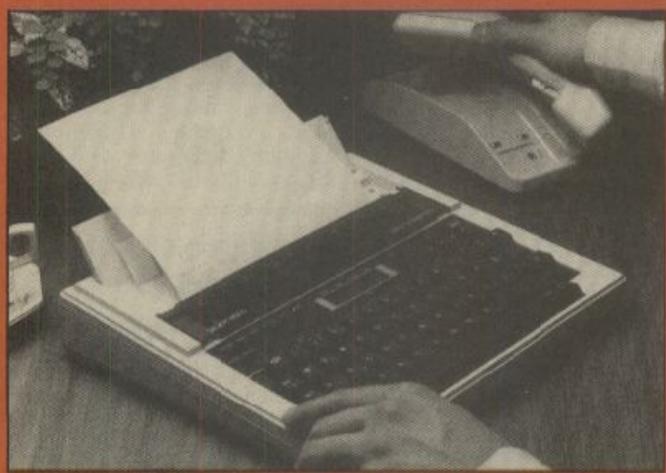
Since the small investors have largely fled the stock market in recent years as a result of such volatility, the big institutions are the whole ball game. It is to them that the venture capitalists must go for the money to fuel little start-ups like Apple and Lotus. The venture capitalists can no longer expect to find funds for further IBM clones.

One interesting pointer on next year's business was provided by Software Access, a Californian market research firm. Its study showed that only 13 per cent of people without computers have any plans to buy one in the next 12 months. In contrast 37 per cent of home micro users and 52 per cent of work users expect to buy another computer in the same time period.

Which means an experienced marketplace with very choosy consumers who will be looking for extra points of value and usefulness in shaping their decisions.

Enter a familiar figure in the micro market. Jack Tramiel says US manufacturers have become 'greedy' and 'too dull'. His new Atari Corporation is preparing two 8-bit machines, two 16-bit, and a 32-bit for releases beginning in January. Tramiel, of course, has shaken up US microcomputerdom before — and with any luck he'll do it again in 1985.

Chris Rowley

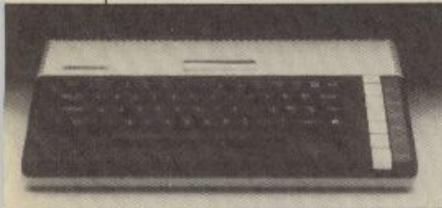


**FOUR COLOUR SILVER** — The rivalry between Japanese hard-copy specialists Brother and Silver Reed has spawned this £180 typewriter/printer/plotter from Silver Reed (0923-45976). Called the Colour Pengraph, it has a built-in Centronics-compatible interface for connections to personal computers, but it also operates off-line as a particularly colourful typewriter. Instead of daisy-wheels or golf balls it uses ball point pens. There are also erasing pens and correction memory to operate them. It weighs 2.5Kg and is battery-operated.

## Atari 800XL price tumbles — again

The new-look lean and hungry Atari UK has cut the 800XL to £129 to stay in step with its US parent company (issue 89).

'Old products at old prices,' is how marketing manager Rob Harding views the systems in Britain's stores this Christmas. Atari will offer old products at new prices, or as new boss Jack Tramiel puts it: 'The price the man next door can afford.'



Atari 800XL: price on the slide as Tramiel bares teeth.

Atari isn't revealing the annual income of Tramiel's neighbours but you can bet that the old price of £169 wouldn't have been out of their reach. Meanwhile, its announcement of the price-cut is shot through with the style that the rejuvenated Atari is trying to project.

There is a quote from Tramiel himself, beginning 'Listen sonny', another from his European marketing manager ('Massimo Rosi says in broken English:'), and a host of comments that show Atari as the kind of company that isn't going to let anything stand in its way. There is nothing on its current financial position, or its standing among the money men of Wall Street.

Anybody who bought an Atari in June should note that in the interval the cost of the system has been almost halved. £129 might be rock-bottom, but with Tramiel determined to sell Atari to the world and its wife you shouldn't bank on it.

## Victor bounces back with Vickie in tow

Just to prove that there is life after death, Victor Technologies announced last week that its Vickie transportable will be available in the UK in January.

The Vickie has been on sale for some time in France and Germany but has not been seen on this side of the English Channel.

It weighs in at 25lbs putting it firmly in the luggage category and will go on sale for £2,495 plus VAT. Essentially it is a 256K Sirius in a carryable box that houses a 9in green screen and twin 5.25in floppies.

Other new products available at the same time are MSDOS 2.1 and an upgrade

card to let you run IBM software.

Called the Victor PlusPC, the card is priced at £1,125 and allows the Sirius to read and write to disks in both the IBM format and the Victor format.

Announcing the product, Robert Webb, managing director of Victor's new UK subsidiary, said that all of 90 leading IBM software packages tried ran without glitches.

As expected, Victor said that the exclusive distribution agreement with ACT will expire at the end of this year. Victor plans to set up its own distribution network of 300 dealers to handle the new products along with new machines that will be released during the course of next year.

## Brother to join MSX family in Japan

Brother is to get in on the MSX act but it's by no means certain that the machine will appear in this country.

It's possible that it will be another MSX clone, but it may also shape up to be an enhanced version of the EP-44 electronic typewriter.

Brother has had a micro on the stocks for some time now, but the question of what operating system it should have has held matters up. Logically there's no reason why Brother should not be able to produce a micro, as all that need be added to its current range of machines is a Basic ROM and a little extra memory. If the MSX machine does turn out to follow the

EP-44 format it should generate considerable interest.

Besides the MSX machine the company will also be producing a PC-compatible next year. This will be sold in Japan, but again it's highly unlikely we'll see one here, the reasoning being that the market's too crowded.

## GEM threat to Apple Mac looms larger

Apple's Macintosh looks like turning into a whole coat-rack if speculation in the US turns out to be accurate.

There are rumours of a Unix Mac, a colour Mac, a flat-screen Mac, and a Mac with a full-page 8.5in by 11in screen. This spate of speculation may not be disconnected to the emergence of Digital Research's GEM, which could turn every PC under the sun into a Mac-killer.

At least in part the flood of rumours is a tribute to the impact the Mac has made, and evidence of the extent to which it is taken seriously as a credible alternative to the standards set by IBM.

But one significant straw in the wind is that none other than Jack Tramiel, head of Atari, is ready to implement GEM on one of Atari's forthcoming machines. Reliable sources in the US say that Tramiel has committed himself heavily to Concurrent DOS and GEM. Couple that with the intention of Atari to have a 68000-based machine by next summer, and you have a strong competitor for the Mac.

## Tandy tries again in PC clone stakes

Tandy has joined the IBM compatibility league with a computer to undercut the PC. The Tandy 1000 Personal Computer, due to make its appearance early in 1985 has similar features to a number of IBM clones.

The machine will have 128K memory, detachable keyboard, a 12in monitor and an 8088 16-bit processor. With one floppy disk drive as standard, the machine will run MSDOS, Basic and come with Deskmate, an integrated software package.

Deskmate consists of six applications: text, worksheet, filter, calendar, communications and mail — all of which are function-key driven. Popular IBM software such as Lotus 1-2-3, dBase III and Multimate will all run on the Tandy 1000 and you can plug in up to three IBM PC expansion cards to boost the machine's capabilities even further.

This is Tandy's second attempt to whittle away at IBM's sales, but the earlier Model 2000 (issue 61) offered only MSDOS compatibility.

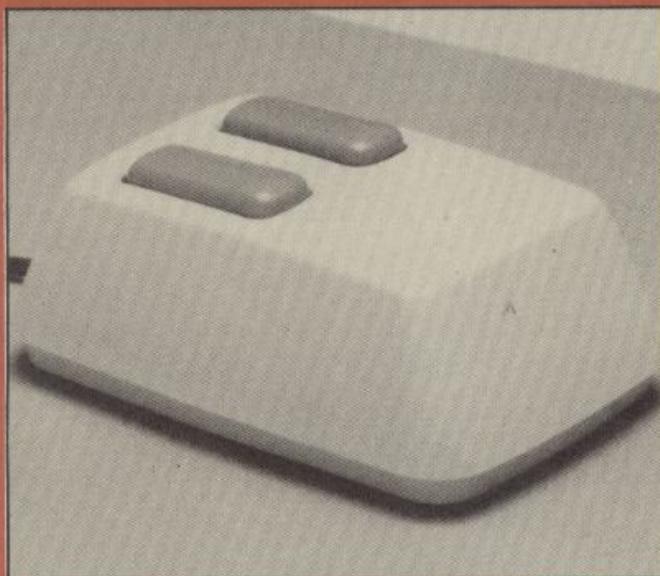
## MSX is the wonder of Woolworth stores

Woolworth has taken the most cheap and cheerful of the MSX computer family under its wing.

You can now buy the Goldstar for £239.95 from one of 11 Woolco stores around the country and a couple of large Woolworth stores.

At the moment the Japanese machine has been taken on a trial basis. But if the micro with a Z80A processor, 64K of RAM and 32K ROM, sells well it will be distributed more widely.

Woolworth says it has five games available for the Goldstar — namely Hunchback, Bagger, Humphrey, Q Bit and Crazy Golf at £7.95 each.

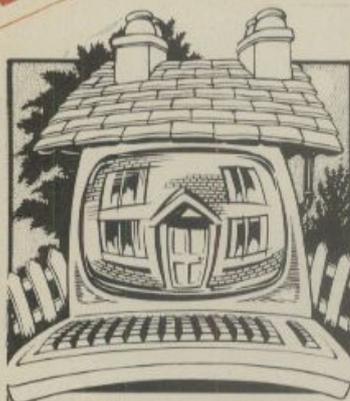


**MOUSE DANCE** — Disk maker Shugart has branched out into the rodent business by producing a mouse with no moving parts. This makes it an optical mouse, according to the jargon that is growing up around such devices. The main advantage is that it doesn't need the regular check-ups that punctuate the working lives of other mice, and Shugart says it's lighter and quieter into the bargain. Other fascinating details — you can move the device at 25ins a second and buy it in two- or three-button versions.

## Net Nurse cures the Econet fever

Networking schools that find the limitations of their Econet file-servers tiresome could find a solution in a new plug-in ROM.

At £29.95, the Net Nurse ROM includes a commands package which frees user memory for operational tasks. A spokesman from Mushroom Computers (0234-58303) which designed the ROM said: 'Net-Nurse doesn't tie up RAM or disk drive space'.



## Why the British may lose to the Japanese

What we need is a Campaign for Real Micros. Micros that live up to the image created in the advertising. That you can literally plug in and go. Micros that don't require you to wade through a thick manual before you can use them. And above all else, micros that will work.

Come Christmas morning there will be a lot of disappointed and frustrated children.

Parents, eager that their offspring should not miss out on the micro revolution, will have gone out in their tens of thousands and bought home computers as Christmas presents.

Unfortunately there is a high probability that, once unwrapped, the micro will refuse to perform as it should or as it was expected to.

Individual horror stories abound — people who bought a home computer only to find it faulty. The machine is returned to the shop and is replaced by another machine which sometimes also fails to work.

In some cases, half a dozen or more visits to the shop are required before a working machine is supplied.

Until now the facts and figures on the level of these returns has been a matter of speculation — or they've come via manufacturers and deserve to be taken with a large pinch of salt.

All that changed with the survey carried out by Business Decisions (Monitor, issue 89).

Even taking into account that it was commissioned by Acorn's advertising agency and may be subject to bias, it paints a horrifying picture of the reliability and quality of the leading home computers.

To suggest, as the survey results do, that a quarter of all Spectrums sold are returned to shops because they are faulty or the customers were dissatisfied with them is staggering.

Elsewhere in the consumer electronics field, British com-

panies have been squeezed out by the Japanese onslaught which has traded on reliability more than anything else.

So why should home computers be any different? In the longer term, the answer is probably that it is no different. In the short term, the unattractive specification and high prices of the MSX micros will ensure that Japanese micros will not figure too strongly in the sales charts.

But the nagging gut feeling remains that this Christmas is just a dry run for the Japanese. Rumours abound that next year will see MSX II — a new standard specification that will incorporate all the lessons learned from the current MSX prototype.

To be fair to Sinclair, it does say that the survey's results do not tally with its own figures of returns from shops. It also says that 40 per cent of those returns turn out not to have any faults in them.

All the advertising on the TV and in the press conveys the impression that micros can do all sorts of wonderful things at the press of a button. It is just a question of plug in and go.

It is not surprising then that new users find themselves completely baffled/disappointed as they unpack their newly purchased home computer only to find it is not so easy to get going after all.

What is surprising is that we have put up with this situation for so long. The newcomer to home computing doesn't want to know that having bought the micro they then have to buy a cassette player or disk drive before they can do anything — it is like selling a car without wheels.

Nor do they want to suffer the indignity of switching it on to find that all that appears on the screen is a copyright notice and a cursor winking at them.

It is about then that the problems really start. The cassette won't load (because it is a sub-standard tape or the micro is fussy over which cassette players it is prepared to talk to). The program won't run (because there is a bug in it or something wrong in the micro). The program/micro won't do what the advertising promises (because they failed to mention in the advert that you need an extra piece of kit like a joystick/modem).

The British microcomputer industry has had it too easy.

The companies have perhaps a year in which to get their house in order or they could find themselves going the same way as the UK motorcycle, hi-fi, television, and video industries.

Ralph Bancroft

# CHARTS

As featured on Radio 1's Saturday morning Chip Shop.

# GAMES

TW	LW	TITLE	PUBLISHER	MACHINE	PRICE
1	4	Ghostbusters	Activision	C64	£9.99
2	1	Knight Lore	Ultimate	SP	£9.95
3	2	Underworld	Ultimate	SP	£9.95
4	11	Raid Over Moscow	US Gold	C64, AT	£9.95
5	3	Elite	Acornsoft	AC	£15.00
6	7	Daley's Decathlon	Ocean	SP, C64,	£7.90
7	10	Bruce Lee	US Gold	C64, AT	£9.95
8	12	Tir Na Nog	Gargoyle	SP	£9.99
9	—	Doomdark's Rev.	Beyond	SP	£9.95
10	6	Pyjamerama	Mikrogen	SP, C64	£6.95
11	13	Suicide Express	Gremlin	C64	£7.95
12	5	Eureka	Domark	SP, C64	£14.95
13	—	Cyclone	Vortex	SP	£6.95
14	15	Skooldaze	Microprose	SP	£6.95
15	—	Monty Mole	gremlin	SP, C64	£7.90
16	—	Select 1	Comp. Records	SP, C64	£12.49
17	17	Jet Set Willy	Soft Projects	SP, C64	£5.95
18	—	Manic Miner	Soft Projects	SP, C64, AM	£5.95
19	18	Backpackers Guide	Fantasy	SP	£5.95
20	8	Beach-Head	US Gold	SP, C64	£9.95

## SPECTRUM

TW	TITLE	PRICE
1	Knight Lore	£9.95
2	Underworld	£9.95
3	Tir Na Nog	£9.99
4	Doomdark's Revenge	£9.99
5	Pyjamerama	£6.95
6	Eureka	£15.00
7	Cyclone	£6.95
8	Monty Mole	£7.90
9	Skooldaze	£6.95
10	Daley's Decathlon	£6.90

## COMMODORE

TW	TITLE	PRICE
1	Ghostbusters	£9.99
2	Raid Over Moscow	£9.95
3	Bruce Lee	£9.95
4	Suicide Express	£7.95
5	Jet Set Willy	£5.95
6	Daley's Decathlon	£7.90
7	Summer Games	£14.95
8	Fighter Pilot	£6.95
9	Pyjamerama	£6.95
10	Eureka	£14.95

# MICROS

## BELOW £1,000

TW	MACHINE	PRICE
1	Commodore 64	£199
2	Spectrum	£125
3	Amstrad	£349
4	Electron	£199
5	Commodore 16	£140
6	BBC B	£399
7	Memotech	£199
8	Einstein	£499
9	Spectrum Plus	£175
10	Sanyo MCP 100	£300

## ABOVE £1,000

TW	MACHINE	PRICE
1	IBM PC/XT	£2,390
2	ACT Apricot	£1,760
3	Compaq	£1,795
4	Olivetti M24	£1,595
5	Televideo TS1603	£2,640
6	DEC Rainbow	£2,359
7	NCR Dec Mate V	£1,984
8	Apple III	£2,755
9	ACT Sirius	£2,525
10	Macintosh	£1,795

These charts are compiled from both independent and multiple sources across the nation. They reflect what's happening in high streets during the week up to November 28. The games chart is updated every week. The prices quoted are for the no-frills model and include VAT. Information for the top-selling micros is culled from retailers and dealers throughout the country and is updated every month. PCN Charts are compiled exclusively for us by RAM/C, who can be contacted on 01-892 6596.

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# RANDOM ACCESS



Share your words of praise or send us a rocket about PCN. We want to hear your views and feelings on the articles we print — and those you feel we ought to. Write to *Random Access, Personal Computer News, Evelyn House, 62 Oxford Street, London W1A 2HG*. You could win £15 for the best letter of the week.

## Fulfilling idea for those empty screens



I'm sure I'm not alone in being fed up with seeing shop windows and shelves well

stocked with computers; most of which are powered-up; most of which are connected to monitors; most of whose screens remain obstinately blank, apart from the unchanging proclamation that they are 'Ready'.

What's the point? Where's the appeal?

Why don't shops — at a local, regional or national level — sponsor monthly competitions? Computer owners could be challenged to write programs which could auto-run to provide attractive, eye-catching demonstrations.

The outlay to shops would appear to be minimal and need extend only to a few in-shop displays and the cost of each month's prize (say £10 worth of software). The benefits would seem to be obvious to all concerned — no matter which side of the counter or shop window they stand.

How about it you managers and shopkeepers? Are you Ready... Ready... Ready...?  
*Alan Sturgess  
Keighley, Yorks*

## First class service from Quen-Data

Having read much in the computer press about the poor after-sales service given to purchasers of computers and peripherals, you can imagine how I felt when my Quen-Data DWP 1120 daisy wheel printer developed a fault.

To add to my problems I then discovered that the firm that had sold it to me was already in the hands of the receiver!

With fear in my heart I approached the printer's importers in Milton Keynes.

Far from being made to feel somehow obscurely in the wrong, however, I received such excellent customer service from Quen-Data (who had a replacement printer on its way to me within 24 hours, and free of charge at that) that I felt honour-bound to set the record straight.

It may be that there are a few sharks in this business, but I have nothing but praise for the few firms with whom I have had direct dealings.

*J Brown  
Cirencester, Glos.*

## No Brotherly love with my QL...

I was delighted in August to receive my Sinclair QL and was looking forward to using my Brother EP 44 as a printer for it. Unfortunately the QL software only had a printer/driver for the FX80, but I could get the printer to work after a fashion using the default.

Having paid up to be a member of QCLUB I wrote for assistance, requesting the printer driver for the EP 44. I received a prompt answer giving me some details for linking a Brother HR-5. Needless to say, that was useless.

I wonder if any of your readers can help me with the correct parameters for linking the Brother to the QL.

*J Stephenson, c/o Saudia  
CC: 772, PO Box 167,  
Jeddah 21231.*

## ... and no help from either source

I see (issue 87) that a director of a software house objects to the tepid assessment given by your review of Kokotoni Wilf. Sad. But then I imagine the review was not written particularly for his enlightenment. He already knows it's a wow. He tells us so.

I, on the other hand as an endlessly paying consumer, offer you fulsome praise for your review of the book *Sinclair QL User Guide* by one Lionel

Fleetwood in issue 86. Here a Daniel, or rather your JL, comes to judgment.

The book claims that once furnished with a QL, a printer, the Quill cartridge and no doubt a copy of LF's book, one need only 'hit' keys F3 and P to be a-printing. Your reviewer puts it succinctly: 'With RS232 — pull the other one, Lionel!'

My experience is that anyone looking for a printer to work with the QL should proceed with the utmost caution. Quill provides for suitable printers to be programmed, and as Brother has brought out the M-1009 dot matrix at the £200 mark fitted with both RS232 and parallel interfaces, this seemed to offer a reasonable compromise in price and facilities. I bought one from Boots who, while unable to make it run with its display QL, admitted limited knowledge of both machines.

That was over four weeks ago. I wrote to Brother and to QCLUB for help. The Brother clearly belongs to some Trappist order and made no answer.

QCLUB was very different. Within 48 hours I had the answer — a three-page reply advising me on the re-wiring required of my Sinclair RS232 lead to fit Brother printer wiring, citing the HR 5 printer.

Sadly — not even with my re-wired lead could I scratch out a word from Quill or QL.

The way forward is not clear. What do I do with a £200 printer limited to a self-test print-up? Might the answer be lurking in the last screen of Kokotoni Wilf?

One thing's for sure. It will not be found in LF's book or a flush of others like it. The more reviewers like your splendid JL

who can put the finger on idiot comments like that quoted on QL printing, the better for the payers and the industry.

*G C Watson  
Croydon, Surrey*

*We know what you mean about Brother's vow of silence — we tried to ring them. If any reader has a solution, perhaps you'd let us know — Ed.*

## Why I'm feeling Vic-timised

I've been a Vic 20 owner for about a year, and as the months go by I regret I even got the Vic. Now I hear the Commodore 16 is going to take over the Vic 20. What are all the Vic 20 owners supposed to do with their machines?

*Paul Rebello  
Thornton Heath, Surrey*

*If you've never been happy with it you simply make a mistake. If you were happy with it stop grouching and use it! — Ed.*

## Chess column is a winning move

With reference to your new monthly chess column I would like to say that chess enthusiasts in this country have always had great difficulty in obtaining information about developments in the field of computer chess. The obvious reason is a lack of regular articles. So, your decision to include a monthly chess column comes as a welcome addition.

Could I make three points about this new feature of your magazine.

Thanks for employing a journalist who actually does know something about the subject, namely Tony Harrington.

If anyone would like a copy of the games from the recent Microcomputer World Chess Championship, write to: Chess Supplies (Scotland), 15 Hope Street, Glasgow G2.

Can you improve the chess diagrams as they were truly awful.

*B Whitby  
Vice president, British Postal Chess Federation  
Warrington, Cheshire  
We're striving to improve the diagrams — look for improvements shortly — Ed.*

Looks like Scottie got beamed up!





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# ROUTINE ENQUIRIES



Got your digits in a twist over a problem? Can't decide what micro to buy? Need some sensible advice? Why not try writing to the experts? Remember we cannot reply personally, so no stamped self addressed envelopes, please. Address your questions to *Routine Enquiries, PCN, Evelyn House, 62 Oxford Street, London W1A 2HG.*

## Electron modem dilemma

**Q**I have an Acorn Electron and wish to buy a modem. I am considering a Protek interface and Unicom modem and I wonder if the Electron will run this modem with Prestel etc.

*James McCallum, Glasgow.*

**A**If you can get your hands on either of these devices then you will be very lucky. At the moment neither Unicom nor Protek have those products on the market. Protek informed PCN that it is still considering whether to produce an interface and is waiting to see how well the Electron sells over Christmas.

If Protek does bring one out, it will be early next year. It will not be entirely RS232 compatible, nor will it work with the Unicom modem. It will, however, work with the Protek modem which is available now for the BBC, Spectrum, and Commodore 64.

Unicom is still, as far as we know, having problems with its software and if it is ever finished, the modem should run with any standard RS232.

At the moment, there doesn't appear to be any RS232 interface for the Electron. Acorn is reputed to be producing one in cartridge form, but this won't work unless you buy the Plus 1 interface as well.

Most manufacturers are waiting to see how well the Electron does in the Christmas-mega buy. If it does well then there will probably be a wealth of interfaces available. If not, they will be few and far between. All you can do is wait until next year and see what happens then.

## Amstrad and Microdrive?

**Q**Do you know where I can find out how to fix a ZX Microdrive to my Amstrad? It can't be impossible (can it?).

*P Goddard, Ipswich, Suffolk.*

**A**Yes it can be impossible. While you might, with some difficulty, be able to get the Microdrive physically attached to the Amstrad, getting them to communicate will be far more difficult.

The problem is that the commands required to drive the tape unit will not be understood by your computer, which will reject them as syntax errors.

You could write your own machine code routines to send the necessary signals to the drive, but to do so would require detailed information on both the software drivers and the technical details of the Microdrive. The only source of this would be Sinclair Research and we suspect they will be reluctant to divulge such information.

If the Amstrad's tape system is inadequate for your needs, you'll have to wait for the appearance of Amstrad's disk system which is promised 'real soon now'.

## Pink-eyed Apricot user

**Q**My firm has just bought an Apricot PC. Our suppliers tell us we have to have a green and black screen, but the operators have found that if they work on the screen for more than two or three hours at a time they get headaches. In one extreme case the lady concerned was dizzy and everything she looked at was coloured pink!

Have any of your readers had similar experiences, and is it possible to buy a compatible black and white 12in screen?  
*D Shemming, Maidstone, Kent.*

**A**Your pink lady is fairly conclusive evidence of where your problems lie. If you look hard at a naked light bulb, then look away, you'll still see its image even if you close your eyes. The image will persist for some time, and with your eyes closed you'll 'see' it change colour gradually until it disappears.

There's a simple reason for this. Your eye's retina has a considerable number of receptors in it, and these deal with shape, movement, colour etc. It's the colour ones that concern us here. By staring hard at a bright light source you're 'bleaching' those receptors, and as they bleach they go out of service. The different colour receptors recover at different rates, so what you see will be an odd colour until they return to normal.

You should be able to see the relevance to your own case —

your light source is just too bright. Try to position your monitor so that it's not too close to the operator, then adjust the contrast and the brightness until the operator can read it comfortably. This should improve matters.

If it doesn't, then you might like to try an amber on brown monitor. These are usually easier on the eye, and if you find they help (whip one of your operators round to a dealer to make sure) then tell your supplier to stop messing about and fix you up with one. This may involve their making up a cable, but if they're any use they'll be able to do this.

You can get black and white screens, but these usually come with dedicated word processors, and we imagine they'd be fearfully expensive bought separately. They also probably wouldn't help you much.

## Coverage of TRS-80 is not likely

**Q**I am about to collect a TRS-80 64K computer and want to know whether it is likely that you will provide material in your columns for this computer? Can you also advise me if Dragon tapes are compatible with my machine.

*P Borthwick, Gourock, Renfrewshire.*

**A**Since Tandy dubs all of its machines TRS-80 it is difficult to know exactly which one you have bought. However, if it's the Tandy Colour Computer some Dragon programs will work, but by no means all of them.

Apart from your local Tandy store your best source of software will be the US where the Coco is quite popular. Several American magazines regularly carry features and reviews. Try *Compute!* especially — a good newsagent ought to be able to order it for you.

As for PCN contribution, it will be rather limited, unfortunately. We have never received a single piece of Coco software for review, nor have we had any programs submitted by readers.

## A printer problem on the Amstrad

**Q**I am considering buying a printer for use with my Amstrad computer. My first thought was to get Amstrad's own, but my local

Boots branch tells me that it is not going to stock it because tests have shown that its reliability is suspect.

I have singled out the Shinwa CP80 as a reasonable alternative but I believe there may be problems with printing graphics on printers other than Amstrad's.

I am also considering the Amstrad disk drive. How much memory, if any, is taken up by the disk interface?

*CB Nowell, Beaconsfield, Bucks.*

**A**First of all, just because Boots is not stocking the Amstrad printer does not mean it should be ruled out.

The Shinwa is a good printer but as you suspect, there are problems with high-resolution graphic dumps. This is because of the way the bit-map is handled but the problem is not insuperable. You could write a routine to solve it.

The disk drives are not available yet but when they are released the operating system will take up 1280 bytes of memory. Amstrad warns that some cassette-based games will not run with the disk drive installed — you'd have to unplug it for some software.

## Calling it quits on the QL

**Q**Psion's Quill on the QL has just swallowed 1,000 carefully selected words of mine and lost them, again! I have eight Microdrive cartridges of carefully honed text and the machine and program refuse to recognise 50 per cent of the files.

It seems I'm going to have to look for a more professional machine. The shortlist consists of the Osborne 1 at £500 or sending out for a Sanyo at £1,000 and a Barclaycard.

*J Smith, Islington.*

**A**You could do a lot worse than the Sanyo, provided you accept that the software you get with it is probably all you'll get for it. We'd suggest the Sanyo beats the Osborne...

You might also like to consider Kaypro, which at one point was offering a reasonable machine around the £1,200 mark, and do you remember something called the Pied Piper? It's a CP/M machine with one high capacity drive at around £1,000. If anyone out there's still distributing it please let us know.

Finally, how about the Wren, also £1,000?

# MICROWAVES



Have you any good answers for Amstrad owners or brainwaves for the Beeb? Share them with fellow computer users by sending them to us. Not only will you get £10 for every tip published, but you could find a bonus of £50 comes your way if you are chosen as the Microwave of the month. Send them to *Microwaves, PCN, Evelyn House, 62 Oxford Street, London W1A 2HG.*

## Joystick control on the Atari

Here is a short routine to demonstrate a use of joystick control over cursor movements on the Atari.

It could be useful for cutting down input errors in programs

with menus.

There is room for 20 items on the screen, but I've included only four examples. If the number of items is increased the value of Y will have to be changed.

*Peter Williams, Edinburgh.*

```
100 GRAPHICS 0: POKE 710,224 : POKE 712,224 :
    POKE 82,8:POKE 752,0
110 POKE 559,0 : POSITION 4,0: ?*I REV ONJ MOVE
    STICK TO PICK PROGRAM: POSITION 4,1: ?* THEN
    PRESS TRIGGER TO RUN*:?:?
120 POSITION 8,3: ?*01 LIST PROGRAM"
130 POSITION 8,4: ?*02 MAKE SOUND"
140 POSITION 8,5: ?*03 STOP SOUND"
150 POSITION 8,6: ?*04 EXIT PROGRAM"
160 FOR I=7 TO 22 : POSITION : 8,I : IF I<12 THEN
    ?*0*:I-2: "-----":GOTO 180
170 ? I-2: "-----"
180 NEXT I
190 X=B:Y=23:POKE 559,34
200 S=STICK(0)
210 IF S=7 AND X<39 THEN X=X+1: ? CHR$(31): : GOTO 250
220 IF S=11 AND X>8 THEN X=X-1: ? CHR$(30): : GOTO 250
230 IF S=14 AND Y>3 THEN Y=Y-1: ? CHR$(28): : GOTO 250
240 IF S=13 AND Y<23 THEN Y=Y+1: ? CHR$(29):
250 R=PEEK(B4) : R=R-2 : IF R<1 OR R>4 THEN 200
260 IF STRIG(0)=0 THEN GOSUB 200*R+100: GOTO 280
270 GOTO 200
280 X=B:Y=23:GOTO 110
300 ?*I CLEAR*: POKE 82,0 : LIST : FOR W = 1 TO 500
    : NEXT W : POKE 82,8: ?*I CLEAR*:RETURN
500 SOUND 0,255,10,15 : RETURN
700 SOUND 0,0,0,0 : RETURN
900 GRAPHICS 0:POKE 82,0: END
```

## It's a rainbow-hued Amstrad

A multi-coloured character can be created on the Amstrad CPC464 using the transparent mode PRINT CHR\$(22);CHR\$(0).

By setting the computer in this mode and printing different coloured characters on top of each other, it is possible to create colourful characters.

*B J Moore, Reading, Berks.*

```
5 MODE 1
6 SYMBOL AFTER 190
10 SYMBOL 200,16,56,16,0,0,16,24
20 SYMBOL 201,0,0,0,40,108,0,0,0
30 SYMBOL 202,0,0,0,16,16,40,16,0
40 FOR X=1 TO 40
50 PRINT CHR$(22);CHR$(1)
60 CLS
70 PEN 1
80 LOCATE X,10
90 PRINT CHR$(200)
100 PEN 2
110 LOCATE X,10
120 PRINT CHR$(201)
130 PEN 3
140 LOCATE X,10
150 PRINT CHR$(202)
160 PRINT CHR$(22);CHR$(0)
170 NEXT X
```

## Serve up a triple function Atmos

Use the following machine code listing to produce a three-function Atmos.

The routine enables the FUNCT and 1 keys to reset the Atmos from the keyboard, FUNCT and 2 dumps the current text screen display onto a printer and FUNCT and 3 OLDS a recently NEWED program.

It works by intercepting the keyboard scanning routine at #23C and #23D. These addresses normally contain address #EB78, the keyscan routine, but by DOKEing your routine's start address there

you'll find you are able to reroute control.

However, your own routine must end with a jump to #EB78, or the Atmos develops a headache.

Initially it PEEKs #209 to see if it contains #A5. This address returns a different value if either of the shift keys or the function key is pressed, and #A5 represents the function key.

If it does, the routine calls the keyscan routine until a key is pressed and checks for 1, 2 or 3 branching to the appropriate routine and then back to the keyscan routine.

*Peter Cooper, Broseley, Shropshire.*

```
1 REM THREE FUNCTION ATMOS
10 A=£9540
20 FOR N=0 TO 125: READ D#
30 POKE A+N,VAL("£"+D#):NEXT
40 DOKE £23C,£9540
50 CLOAD""
60 DATA 09,02,C0,A5,F0,03,4C,78,EB,
    20,78,EB,10,FB,C9,31,F0,0B,C9,32,F0,0D,
    C9
70 DATA 33,F0,43,4C,78,EB,20,E2,F8,4C,
    78,EB,48,98,48,8A,48,A9,AA,85,06,A9,BB,
    85
80 DATA 07,A2,1A,A0,00,B1,06,20,C1,F5,
    C8,C0,25,D0,F6,A9,0A,20,C1,F5,18,A5,06,
    69
90 DATA 28,85,06,A5,07,69,00,85,07,CA,
    D0,DF,68,AA,68,A8,68,A9,EA,4C,78,EB,48,
    98
100 DATA 48,8A,48,A2,04,EB,BD,00,05,D0,
    FA,EB,8E,01,05,A9,05,8D,02,05,68,AA,68,
    A8
110 DATA 68,A9,EA,4C,78,EB
```

## Amstrad print formatting

Mr Barratt wrote regarding the Amstrad's print formatting (issue 77) and pointed out that if an item is to be printed away from the edge of the screen a carriage return is generated if the item would otherwise overlap the right-hand edge eg

```
10 MODE 1
20 A$=STRING$(22,"X")
30 PRINT A$;A$
```

This gives A\$ on two separate lines. This is in fact an intentional feature of the Basic. To avoid this happening instead of PRINT USE PRINT USING "&"; ie change line 30 to PRINT USING "&";A\$;A\$; and the printout will be continuous.

The same applies to using LOCATE eg

```
30 LOCATE 30,1 : PRINT A$ puts A$ on the next line.
```

```
30 LOCATE 30,1 : PRINT USING "&";A$ gives the intended result.
```

The following is a way of using ASCII codes of less than 32 direct from the keyboard as control characters. Type in PRINT CTRL character ENTER and try the following examples: PRINT CTRL G — this gives a beep PRINT CTRL DO — gives mode 0 PRINT CTRL 03 — gives red (if in mode 0)

You can try putting this into a program as follows:

```
10 MODE 0
20 PRINT CTRL 01aaaaCTRL 02bbbbCTRL 03cccc etc
```

This gives a multicoloured line of yellow, cyan and red.

*N McKernan, Whitstable, Kent.*

# FLYER FOX™

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# FACE UP TO THE TIME

Here's a formula to help you integrate a real-life timepiece into your program, thanks to BA Willcocks.



A. Forrest

Most micros have one or more interrupt inputs. When an interrupt input goes active, it causes the processor to suspend the current program, and branch to a designated interrupt service routine. The interrupt mechanism is particularly suited to periodic tasks, or tasks requiring rapid response from the program. The main program does not know it has been interrupted.

Some computers use the interrupt technique to drive a printer. When the printer is ready for a new character, it interrupts the processor, causing an 'output character to printer' routine to be executed.

Upon interruption, the processor performs the following sequence of operations:

- 1 The current instruction is completed (remember that the interrupt input is run separately from the program).
- 2 Further interrupts are disabled.
- 3 The return address (ie the program counter contents) is stacked (as for CALL).
- 4 The interrupt service routine is then branched to (ie the program counter is loaded with its start address).

A RET instruction at the end of the interrupt service routine causes the original program to be resumed. RETI and RETN may also be used, but they have additional functions outside the scope of this article. You must ensure that interrupts are re-enabled at the end of the interrupt service routine, by

means of the handy EI instruction.

The machine code program given here implements a real time clock, which displays the time in the messages area of the screen. Being interrupt driver, it is transparent to the user, and has no effect on the normal operation of the computer (other than a negligible reduction in program execution speed). When Basic requires the clock's screen territory, this is sensed and the time display is temporarily inhibited.

## Program 2

```

10 INPUT "Start address?" : a
20 PRINT "Enter code one byte at a time"
30 PRINT "in upper case"
40 PRINT "ADDRESS = "
70 INPUT a$
80 IF a$="XX" THEN STOP
90 IF LEN a$ <> 2 THEN PRINT "err or - retype": GO TO 70
100 LET b=CODE a$(1)-48
110 IF b>9 THEN LET b=b-7
120 LET d=b*16
130 LET c=CODE a$(2)-48
140 IF c>9 THEN LET c=c-7
150 LET d=d+c
160 PRINT a$
170 POKE a,d
100 GO TO 40
    
```

The clock could simply be used as a convenient enhancement of the Spectrum's facilities — however, it has the shortcoming that LOAD, SAVE, VERIFY, BEEP and any routine that disables interrupts will cause it to lose time. For this reason, it will be most useful in

conjunction with other programs, where it will allow easy implementation of timing functions.

The Spectrum's Z80 has two interrupt inputs: NMI — non-maskable interrupt; and INT — maskable interrupt.

Interrupt masking is controlled by the use of the instructions DI (Disable Interrupt) and EI (Enable Interrupt). As the names imply, maskable interrupts are only obeyed if enabled, whereas non-maskable interrupts are obeyed regardless of the enabled/disabled status.

For various reasons, non-maskable interrupts are of no use to the Spectrum programmer, so I will deal with the maskable variety.

## Interrupt modes

Interrupts would be very simple if it was only necessary to provide for one interrupt service routine. In practice, there may be many items of hardware which need to interrupt the processor, each requiring its own unique service routine. The process of selecting the required routine is known as interrupt vectoring. The Z80 provides three interrupt modes, which implement different vectoring schemes and are selected by using IM 0, IM 1, and IM 2.

**Mode 0:** After interruption, the processor expects the hardware to place an instruction on the data bus. Typically, this would be an RST instruction which requires only one byte. The instruction is then executed by the processor.

**Mode 1:** This mode implements branching to one specific address (#0038), and is a neat and simple solution when only one interrupt service routine is required.

**Mode 2:** This is the most complex, but also the most versatile mode. The Z80 contains a special I register, which must first be loaded with the appropriate data. Upon interrupt, the following occurs:

- 1 The processor requires the interrupting hardware to place one byte of vectoring data on the data bus.
- 2 A 16-bit address is formed, the most significant byte being the contents of the I register, and the least significant byte being the data on the data bus.
- 3 The data at the address is formed, and that immediately following it is read and taken to be the start address of the required interrupt service routine, which is branched to. (This data is stored in the conventional least-significant-byte-first format.)

Think of the I register as containing the most significant byte of the address of the vectoring table. The data provided by the interrupting hardware is then the pointer to a particular entry within that table.

Since each entry is a two-byte one, this gives a maximum of 128 selectable routines).

### In use

The Spectrum hardware activates the INT (Maskable Interrupt) line every 1/50th of a second. The Basic operating system uses Mode 1, so the interrupt service routine starts at #0038 (in the ROM). This routine performs two functions: the scanning of the keyboard, and the incrementation of the system variable Frames (see Spectrum manual, chapter 18).

Clearly, the only way to achieve your own interrupt-driven routines is to

change the interrupt mode. Mode 0 is not suitable, because external hardware would be required. It might appear that Mode 2 has the same limitation, since it also requires vectoring data, but this is not the case.

Assume that the contents of the data bus are random at the time of interrupt (since we have not connected any hardware to specify a value). The processor may therefore read the address of the interrupt routine from any one of 256 locations within the vectoring table.

We could use Mode 2 by choosing a start address for the interrupt service routine in which the two bytes are the same (eg #A0A0), or filling the whole table with this value.

This approach would obviously waste a good deal of memory space. In practice, things are easier because, if left to its own devices, the data bus will assume the value #FF (ie all the bits will be logic 1). We therefore know which entry in the vectoring table will be read.

Let us assume that you have a machine code routine, which will be referred to as FRED which you want to run every 1/50th of a second, without affecting the normal operation of the computer. You might think that all we need do is locate FRED somewhere in memory, and arrange Mode 2 vectoring to execute FRED upon interrupt. There are, however, three other requirements:

- When the vectoring has been altered, the keyboard scanning routine in the ROM at #0038 will no longer be executed — we need to tack on a CALL #0038 or RST #38 before or after FRED to maintain normal Basic operation.
- Remember that upon interrupt, the processor automatically stacks the return address, but nothing else. It is likely that FRED will modify the contents of the registers, so these must be pushed beforehand, and popped afterwards. If FRED uses the alternate register set, these should also be saved.
- Interrupts must be re-enabled before returning.

We now have a program block consisting of register pushes, an RST #38, FRED, register pops, an EI, and RET. We must decide where to place this in memory — for example, at a start address of #C017. Next, we must decide where to locate the vector table. Remember that the least significant byte of the table address will be #FF. The two byte long table will inevitably straddle a page boundary. In view of our present choice of FRED's location, it would be tidy in this example to load the I register with #BF, so that the table resides in addresses #BFFF and #C000. The table holds the start address in least-significant-byte-first form, so to vector the interrupt to #C017, we would load (#BFFF) with #17, and (#C000) with #C0.

There are two things left to be done; the I register must be loaded with the value we have decided on, and the

## Spectrum Real-Time Clock

#ADD	CODE	LABEL	MNEMONIC	COMMENTS
FE4C		FFTH		SYSTEM VARIABLE 1/50ths
FE4D		SECS		SYSTEM VARIABLE SECS
FE4E		MINS		SYSTEM VARIABLE MINS
FE4F		HOUR		SYSTEM VARIABLE HOURS
FE50		DAYS		SYSTEM VARIABLE DAYS 0 to 6
FE51		WEEK		SYSTEM VARIABLE WEEKS COUNTER
FE52	31	DATA	DEFB #31	DEC 49=LAST 1/50th IN SEC
FE53	3B		DEFB #3B	DEC 59=LAST SEC IN MIN
FE54	3B		DEFB #3B	DEC 59=LAST MIN IN HOUR
FE55	17		DEFB #17	DEC 23=LAST HOUR IN DAY
FE56	06		DEFB #06	DEC 06=LAST DAY IN WEEK
FE57	00		DEFB #00	
FE58	E5	STRT	PUSH HL	SAVE REGISTERS
FE59	D5		PUSH DE	
FE5A	C5		PUSH BC	
FE5B	F5		PUSH AF	
FE5C	FF		RST #38	CALL ROM ROUTINES AS USUAL
FE5D	F3		DI	ROM ROUTINE ENABLES INT'S
FE5E	CD 6D FE		CALL INCR	
FE61	CD D0 FE		CALL TEST	
FE64	CC 84 FE		CALL Z,PRIN	PRINT ONLY IF SPACE ON SCREEN
FE67	F1		POP AF	RESTORE REGISTERS
FE68	C1		POP BC	
FE69	D1		POP DE	
FE6A	E1		POP HL	
FE6B	FB		EI	
FE6C	C9		RET	RETURN TO MAIN PROG.(BASIC)
FE6D	21 4C FE	INCR	LD HL,FFTH	HL POINTS TO SYS. VARS.
FE70	11 52 FE		LD DE,DATA	DE POINTS TO SYS. CONSTS.
FE73	06 05		LD B,#05	B=LOOP COUNTER
FE75	34		INC (HL)	INCREMENT 1/50ths
FE76	1A	INCRA	LD A,(DE)	IF VAR. IS NOT GREATER THAN
FE77	BE		CP (HL)	CORRESPONDING CONST. THEN
FE78	30 05		JR NC,INCRB	JUMP AHEAD.
FE7A	36 00		LD (HL),#00	ELSE ZERO CONSTANT
FE7C	23		INC HL	
FE7D	34		INC (HL)	& INCREMENT THE NEXT ONE
FE7E	2B		DEC HL	
FE7F	13	INCRB	INC DE	
FE80	23		INC HL	INCREMENT POINTERS
FE81	10 F3		DJNZ INCRA	REPEAT LOOP
FE83	C9		RET	
FE84	11 F8 50	PRIN	LD DE,#50F8	FIRST SCREEN POSITION
FE87	21 4F FE		LD HL,HOUR	
FE8A	7E		LD A,(HL)	A CONTAINS HOUR
FE8B	CD A3 FE		CALL DECP	PRINT HOUR
FE8E	3E 3A		LD A,#3A	ASCII CODE FOR ":"
FE90	CD B6 FE		CALL CHRA	PRINT COLON
FE93	2B		DEC HL	POINT TO MINS
FE94	7E		LD A,(HL)	A CONTAINS MINS
FE95	CD A3 FE		CALL DECP	PRINT MINS
FE98	3E 20		LD A,#20	ASCII CODE FOR SPACE
FE9A	CD B6 FE		CALL CHRA	PRINT SPACE

# FIRST AID



## for your 64

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interrupt mode must be changed. This is best done by means of a short "initialising" routine (Figure 2).

When you are sure that your programming is correct, run this routine and FRED should be interrupt-driven there-

after. Note that providing you have CLEARED properly, the Basic command NEW will not remove your machine code, but it will reinstate Mode 1 interrupts. You will then need to run the initialising routine again to cause FRED to be interrupt-driven again.

## Program notes

**STR1 (#FE58)** Saves registers. Performs RST #38 to execute keyboard scanning routine in the ROM. Calls INCR. Calls TEST. Calls PRIN if the screen territory is clear. Restores the values of the registers. Re-enables interrupts. Returns to the main program (normally Basic).

**INCR (#FE6D)** Increments the system variables. The method used may appear to be unnecessarily complicated, but it has the advantage of removing any illegal values that may have been POKED in when the clock was set.

**PRIN (#FE84)** Uses the subroutines DECP and CHRA to print out the time. In each case, the accumulator carries the decimal value/ASCII code.

**DECP (#FEA3)** Uses the subroutine CHRA to print out the number in the accumulator in two-digit decimal format with leading zero, if appropriate.

**CHRA (#FEB6)** Prints the ASCII character in the accumulator at the screen position pointed to by the DE register pair. Sets DE ready for the next print operation.

**TEST (#FED0)** Tests the two character cells immediately to the left of the hours. If no pixels are set, the zero flag is set on return.

## Entering the program

If you have an assembler, you probably will prefer to enter the program using the mnemonics.

If you decide to locate it in a different area of the memory, remember to change the I register value, and the vector table accordingly. Note that some assemblers have interrupt-driven routines themselves. Any attempt to run the real-time clock from such an assembler is likely to result in a crash. So play safe and save the source code on tape before you try it.

If you do not have access to an assembler, then you can use the program on page 12 to POKE it in.

The apparently weird addresses used were chosen because they were easy to remember in decimal, and thus easily used from Basic.

## Figure 1

FFTH	Fiftieths of a second	65100 dec.
SECS	Seconds	65101 dec.
MINS	Minutes	65102 dec.
HOUR	Hours	65103 dec.
DAYS	Day of the week 0 to 6	65104 dec.
WEEK	Weeks counter 0 to 255	65105 dec.
INIT	Start of initialising routine	65300 dec.

## Figure 2

Initialising routine. Run this once and the interrupt routine will be serviced on interrupt.

```

DI
LD A,#BF
LD I,A
IM 2
EI
RET

```

### Vector table

```

#BFFF  DEFB #17
#C000  DEFB #C0

```

### Interrupt routine start

```

#C017  PUSH HL

```

```

PUSH DE
PUSH BC
PUSH AF
RST #38
DI

```

### FRED

### Return to normal program

```

POP AF
POP BC
POP DE
POP HL
EI
RET

```

## Real-Time clock continued

#ADD	CODE	LABEL	MNEMONIC	COMMENTS
FE9D	2B		DEC HL	POINT TO SECS
FE9E	7E		LD A,(HL)	A CONTAINS SECS
FE9F	CD A3 FE		CALL DECP	PRINT SECS
FEA2	C9		RET	
FEA3	06 2F	DECP	LD B,#2F	B="TENS" IN ASCII.SET START
FEA5	04	DECPA	INC B	INC TENS
FEA6	D6 0A		SUB #0A	SUB 10dec FROM NO. LOOP IF
FEA8	30 FB		JR NC,DECPA	GREATER THAN ZERO
FEAA	C6 3A		ADD A,#3A	CONVERT UNITS TO ASCII
FEAC	F5		PUSH AF	SAVE UNITS
FEAD	78		LD A,B	PUT TENS IN A
FEAE	CD B6 FE		CALL CHRA	PRINT TENS
FEB1	F1		POP AF	RESTORE UNITS IN A
FEB2	CD B6 FE		CALL CHRA	PRINT UNITS
FEB5	C9		RET	
FEB6	D6 20	CHRA	SUB #20	1st CHAR IN ROM IS ASCII #20
FEB8	06 0F		LD B,#0F	
FEBA	87		ADD A,A	
FEBB	87		ADD A,A	POINTS BC TO CHAR IN ROM BY
FEBD	CB 10		RL B	MULTIPLYING (ASCII-#20) BY 8
FEBE	87		ADD A,A	AND ADDING OFFSET.
FEBF	CB 10		RL B	
FEC1	04		INC B	
FEC2	4F		LD C,A	
FEC3	0A	CHRAA	LD A,(BC)	TAKE CHAR. BYTE FROM ROM
FEC4	12		LD (DE),A	PUT IT ON SCREEN
FEC5	14		INC D	POINT TO NEXT SCREEN BYTE
FEC6	0C		INC C	POINT TO NEXT ROM BYTE
FEC7	79		LD A,C	
FEC8	E6 07		AND #07	TEST FOR LAST OF 8 BYTES
FECA	20 F7		JR NZ,CHRAA	IF NOT LAST LOOP BACK
FECC	16 50		LD D,#50	
FECE	1C		INC E	SET DE FOR NEXT POSN.
FECF	C9		RET	
FED0	21 F6 50	TEST	LD HL,#50F6	1st SCREEN BYTE TO TEST
FED3	97		SUB A	ZERO ACCUMULATOR
FED4	B6	TESTA	OR (HL)	
FED5	24		INC H	
FED6	CB 5C		BIT 3,H	
FED8	28 FA		JR Z,TESTA	TEST ALL LOCATIONS IN CHAR CELL
FEDA	26 50		LD H,#50	
FEDC	2C		INC L	SET UP FOR 2nd CHAR CELL
FEDD	CB 45		BIT 0,L	
FEDF	20 F3		JR NZ,TESTA	IF 1st PASS, JUMP BACK
FEE1	3D		DEC A	
FEE2	3C		INC A	SET Z FLAG IF A IS ZERO
FEE3	C9		RET	
FEFF	58		DEFB #58	
FF00	FE		DEFB #FE	VECTURING TABLE
FF14	F3	INIT	DI	INITIALISATION ROUTINE START
FF15	3E FE		LD A,#FE	
FF17	ED 47		LD I,A	SET UP I REGISTER
FF19	ED 5E		IM 2	SET INTERRUPT MODE
FF1B	FB		EI	
FF1C	C9		RET	



# KNIGHT SHIFT

**Chess addicts look no further. The Chess Master can turn the novice into an expert, says Tony Harrington, while David Levy proves even computers lose sometimes.**

**W**ould-be chess players could do worse than learn with a British Grandmaster at their elbow. The tutorial program for the Commodore 64, *Chess Master*, comes with a commentary from Tony Miles, and even if the style is reminiscent of late night Open University programmes, having a Grandmaster of his calibre on call is a major plus.

There are three tapes — one for the program and two for Tony Miles. Because the commentary tapes provide all the instructions you need, the manual confines itself to loading instructions and a brief index to the tapes.

Having crossed that particular bridge you start your education. The program is designed as a series of 'boards', each consisting of a sequence of pre-arranged animated moves. There are quizzes at intervals as you go along, ranging from simple ('what square is the Queen on at the start of the game?') to more complex problems like 'find a good move for White in this position'.

The difficulty with many chess tutors is that a beginner needs to learn quite a lot before attempting a decent game. If you try to explain all this at once you

simply fog up the novice's mind, but without the information they wind up groping around in the fog.

*Chess Master* gets round the problem by anticipating blunders, allowing them to happen and then letting you work out why a particular move, or sequence of moves, was wrong. The Tony Miles style is to take you firmly by the neck, walk you up one blind alley after another, then bang your head smartly on the brick wall at the end. It may hurt sometimes, but it certainly teaches you to recognise a dead end.

A good example of this comes in 'how to play the openings', which appears in boards 67-69, and deals with White bringing the Queen out to h5 on the second move. On the first board Miles considers a sequence that would give his fellow Grandmasters severe heartburn: **1 e2-e4 e7-e5**

**2 Qd1-h5? g7-g6??**

This particular blunder is calculated to alert you to a particularly obvious mug-trap. Remembering that pawns capture diagonally the novice rushes to attack the white Queen. 'Find a good move for White', says Miles, prodding you in the direction of Qh5xe5, forking King and Rook with check. So far, so

good — the pupil should at this point learn not to make a similar blunder as black.

With board 68 the sequence alters slightly. Instead of attacking the Queen immediately, Black defends the e-pawn with

**2 Nb8-c6.**

White plays the Bishop to c4. Then, he e-pawn protected, blind to the threat of mate, Black rushes once more to attack the Queen and the commentary says 'having lost faith in attacking the Queen with his g-pawn, Black moves his Knight from g8 to f6, where it attacks the Queen'.

The point here is that Miles knows full well that in the second position on board 68 there is no problem in Black playing **3 g7-g6,**

since White then cannot take the e-pawn with the Queen.

This program is long, just as a chess tutor should be. There are two sides to the computer tape (covering boards 1 to 66 and 67 to 121 respectively) and the commentary tapes are extensive. It should keep beginners occupied for hours and if they don't emerge with some feel for the game, it won't be Miles' or Serin Software's fault.

## Sicilian Defence Annotated by David Levy

**White: Cray Blitz**  
**Black: Fidelity "X"**

A prominent chess player once remarked that although there has been over a century of research into chess openings, Masters and Grandmasters can still wade into hot water in their first dozen moves. One might expect that a computer program endowed with a large openings 'book' could avoid falling into the quagmire so early in a game.

The following game is an excellent illustration of this. It was played in the 1984 North American Computer Championship in San Francisco. The Fidelity program was operating in the wooden auto response board which is marketed as *Prestige*. Cray Blitz is the current World Computer Champion.

**1 e2-e4 c7-c5**

**2 d2-d4**

More usual is **2 Ng1-f3**, though the text move can transpose.

**2 ... c5xd4**

**3 Ng1-f3**

Inviting a transposition to regular variations, by **3 ... d7-d6**, **3 ... e7-e6**, **3 ... Nb8-c6**, or various other moves.

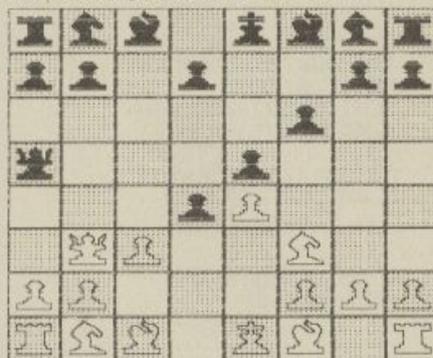
**3 ... e7-e5?**

Invitation refused. Fidelity X tries to hold on to the pawn, failing to under-

stand that it will fall badly behind in development and simultaneously weaken itself along the a2-g8 diagonal.

**4 c2-c3!?**

Also possible is **4 Bf1-c4**, putting immediate pressure on f7, but not **4**



**White to move, move 6.**

**Nf3xe5?? Qd8-a5+**, winning a piece.

**4 ... Qd8-a5?!**

Black is only thinking of material. The Queen move compounds its earlier error by getting further behind in the development of its Knights and Bishops. Black should have played either **4 ... d4xc3**, followed by **5 ... Nb8-c6**, or **4 ... Nb3-c6** **5 c3xd4 e5xd4** **6 Nf3xd4 Bf8-c5.**

**5 Qd1-b3 f7-f6?**

A horrible move, which turns a bad position into a hopeless one.

Black might have tried **5 ... Ng8-f6**, followed by **6 ... d7-d5**, attempting to create some play for its minor pieces.

**6 Bf1-c4 Ng8-h6**

**7 Bc1xh6 g7xh6**

**8 Bc4-g8**

Threatening **9 Qb3-f7+ Ke8-d8** **10 Qf7xf6+**, picking up the corner Rook.

**8 Ke8-d8**

**9 Qb3-f7**

There are too many threats: **Qf7xf6+**, **Qf7xf6+**, and if **9 ... Bf8-e7**, **10 Qf7-g7.**

**9 Rh8xg8**

**10 Qf7xg8 Kd8-e8**

The rest is a rout.

**11 Qg8xh7 Qa5-b5**

**12 b2-b3 Qb5-c6**

**13 0-0 d4xc3**

**14 Nb1xc3 b7-b6**

If **14 ... Qc6xc3** **15 R(either)-c1** and **16 Rclxc8+**

**15 Nc3-d5 Qc6-d6**

**16 Nf3-h4 Bc8-a6**

**17 Nh4-f5 Qa6-a3**

**18 Qh7-g6+ Ke8-d8**

**19 Qg6xf6+ Kd8-c8**

**20 Rf1-c1+ Ba6-c4**

All Black can do is give up material.

**21 Rc1xc4+ Qa3-c5**

**22 Qf6xf8+ Kc8-b7**

**23 Rc4xc5 b6xc5**

**24 Qf8xc5 Nb8-c6**

**25 Nf5-d6+ Kb7-b8**

**26 Qc5-b5 mate**

# Spectrum Speech Synthesizer!

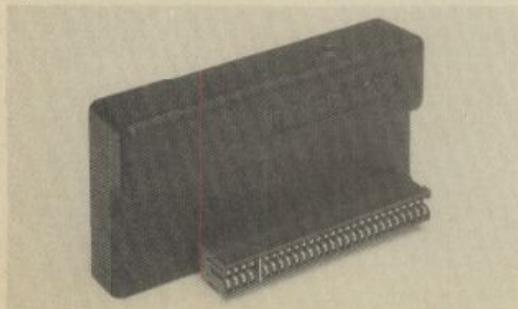


The dk'tronics synthesizer, like all their other peripherals is both Spectrum & Spectrum plus compatible, it uses the popular SLO/256 speech chip and has an almost infinite vocabulary. It is supplied with a text to speech converter for ease of speech output creation. Everything you wish to be spoken is entered in normal English, without special control codes or characters, it is therefore extremely easy to use. The voicing of the words is completely user transparent and the computer can carry on its normal running of a program while the speech chip is talking.

Although there are only 26 letters in the alphabet, letters have a totally different sound when used in different words. For example, The "a" in Hay is much longer and softer than in Hat. When you speak you automatically make adjustments because you know just how a word should sound. Not quite so easy with a computer. After looking at other speech synthesizers we decided that it was essential that the dk'tronics Spectrum Speech would offer a simple system that would enable the user to produce realistic speech that was instantly recognisable.

The solution to the problem was extremely complicated, it required hours of programming to enable the computer to look at the individual letters that make up each word and compare their relative position to each other before deciding on the appropriate sound.

I am delighted that we have now perfected what I consider to be the best Spectrum Speech Synthesizer on the market, one which has achieved my aim, within the limitations of the allophones, of producing realistic speech.



At only £24.95 the dk'tronics speech synthesizer represents remarkable value for money. Naturally it is compatible with their other peripherals which can be used via the rear through connector.

Available from department stores and good computer shops everywhere or direct from

**dk'tronics, Saffron Walden, Essex CB11 3AQ. 12PCN  
Tel. (0799) 26350 add £1.25 post and packing.**

# JINGLES ON YOUR

# 64

Play a three-part musical composition or jazz up your megagame via interrupts. Nick Higham's program shows you how it's done.

Many games for the Commodore 64 take advantage of its excellent sound chip (SID) by featuring a musical soundtrack, often full two- or three-part arrangements. Home users who want to add musical accompaniment to their own programs encounter difficulties, since concurrent music and screen activity can only be obtained with machine code.

With this listing you can key in a machine code program for playing three-part music on the 64 which allows the computer to carry on with other tasks while the music is playing. This is achieved by playing the music via the interrupts.

The program can easily be incorporated into your own software, to add music to a game written in Basic, or perhaps to play three-part musical compositions. In the latter case, interesting effects can be obtained by changing the SID chip registers from Basic while the music is playing — in fact, experimenting in this fashion is probably the easiest way to learn about the SID chip if you don't have one of the excellent commercial music programs available for the 64.

## The interrupts

In order to understand how the musical-interrupt technique works, it is necessary to know some basic facts about the Commodore 64's interrupts. Fifty times a second the 64's 6510 processor suspends its current activity and executes code at the location specified by the interrupt vector, which is stored in RAM at locations \$0314 and \$0315 (788 and 789).

Normally the interrupt vector points to address \$EA31, the beginning of a routine in the KERNAL ROM that performs the 64's housekeeping operations, such as the real-time clock and scanning the keyboard.

However, you can alter the interrupt vector to make it point to one of your own machine code routines, in this case to send instructions to the SID chip. As long as we jump to \$EA31 at the end of our routine, the 64 will carry on processing, oblivious to the extra work that it is performing.

The assembler program in Listing 1 contains the necessary machine code routines for playing three-part music. The object code occupies about 280 bytes

and is stored in the spare 4K of RAM at \$C000.

There are four parts to the program: a routine to install a new interrupt vector that points to the music routine (WEDGEON at line 815) and one to restore the old interrupt vector, for use when the music is no longer required (WEDGEOFF at line 890); a routine to turn the music on (MUSICON at line 2010); and the main section of code (WEDGE at line 1000) which plays the music.

## How it works

The WEDGE routine first examines location \$C000 (49152). A zero here indicates that music is off, in which case control is returned immediately to the standard interrupt routine. Thus music can be turned on and off by poking 49152 with 1 and 0 respectively.

Similarly \$C001-\$C003 (49152-49155) indicate which of the SID chip's three voices is to be played. You can use any combination of the three voices,

## Listing 1

```

100 REM BASIC LOADER FOR INTERRUPT DRIVEN 3-PART MUSIC ON THE C64
110 REM BY NICK HIGHAM
120 :
500 T=0:FORI=49152 TO 49431:READZ:T=T+Z:POKEI,Z:NEXT
510 IF T<>32881 THEN PRINT"CHECKSUM ERROR: CHECK DATA STATEMENTS":END
550 :
1000 REM DATA FOR MACHINE CODE
1005 :
1010 DATA 0,1,1,1,10,0,160,0,160,0,160,32,32,32,0,0
1020 DATA 0,0,7,14,0,0,49,234,173,20,3,201,79,208,0,173
1030 DATA 21,3,201,192,208,1,96,120,173,20,3,141,22,192,173,21
1040 DATA 3,141,23,192,169,79,141,20,3,169,192,141,21,3,88,96
1050 DATA 120,173,22,192,141,20,3,173,23,192,141,21,3,88,96,173
1060 DATA 0,192,200,3,108,22,192,206,21,192,240,3,108,22,192,173
1070 DATA 4,192,141,21,192,169,2,141,20,192,174,20,192,189,1,192
1080 DATA 240,57,222,14,192,208,52,189,11,192,41,254,188,17,192,153
1090 DATA 4,212,138,10,170,32,223,192,240,41,172,20,192,153,14,192
1100 DATA 185,17,192,168,32,223,192,153,0,212,32,223,192,153,1,212
1110 DATA 174,20,192,189,11,192,9,1,153,4,212,206,20,192,16,186
1120 DATA 108,22,192,189,5,192,149,247,189,6,192,149,248,161,247,208
1130 DATA 201,181,247,208,2,214,248,214,247,169,255,172,20,192,153,14
1140 DATA 192,185,17,192,168,169,0,153,0,212,153,1,212,240,204,246
1150 DATA 247,208,2,246,248,161,247,96,169,0,141,0,192,162,2,138
1160 DATA 10,168,56,185,5,192,233,1,153,247,0,185,6,192,233,0
1170 DATA 153,248,0,202,16,233,169,1,141,14,192,141,15,192,141,16
1180 DATA 192,141,21,192,141,0,192,96
1190 :
1195 :
40000 REM -- DEMONSTRATION --
40005 REM 3-PART ARRANGEMENT OF PASSION CHORAL
40010 LOC=49152
40012 :
40014 REM ALL THREE VOICES ON
40015 FORI=LOC+1TOLOC+3:POKEI,1:NEXT
40016 :
40017 REM START OF CHANNEL POINTERS
40020 FORI=LOC+5 TO LOC+10:READX:POKEI,X:NEXT
40030 DATA 0,200,169,200,118,201
40035 :
40037 REM ALL VOICES TRIANGLE WAVEFORM
40040 FOR I=LOC+11 TO LOC+13:POKEI,16:NEXT
40045 :
40048 REM TEMPO
40050 POKE LOC+4,18
40055 :
40060 REM ADSR=0/12/0/0, VOLUME=8
40070 SID=54272:FORI=0TO14STEP7:POKE SID+5+I,11:POKE SID+6+I,0:NEXT
40080 POKE SID+24,8
40090 :
40095 REM POKE IN THE MUSIC DATA
40100 FORI=51200 TO 51778:READX:POKEI,X:NEXT
40120 :
40130 REM PARAMETERS AND DATA INSTALLED - NOW PLAY THE MUSIC
40140 SYS 49176: REM WEDGEON
40150 SYS 49384: REM MUSICON
40160 :
40170 END: REM CARRY ON PROGRAMMING!
40180 :
50000 REM DATA FOR PASSION CHORAL
50005 :
50010 DATA 2,238,21,2,70,29,2,220,26,2,60,23,2,238,21,4
50020 DATA 138,19,2,238,21,2,220,32,2,208,34,2,208,34,1,220
50030 DATA 32,1,70,29,2,220,32,6,70,29,2,238,21,2,70,29
50040 DATA 2,20,26,2,60,23,2,238,21,4,138,19,2,238,21,2
50050 DATA 220,32,2,208,34,2,208,34,1,220,32,1,70,29,2,220
50060 DATA 32,6,70,29,2,208,34,1,220,32,1,70,29,2,70,29
50070 DATA 2,70,29,2,220,32,4,208,34,2,208,34,2,20,26,2
50080 DATA 70,29,2,20,26,2,60,23,2,60,23,6,238,21,2,208
50090 DATA 34,1,220,32,1,208,34,2,19,39,2,208,34,2,220,32
50100 DATA 4,70,29,2,220,32,2,238,21,2,60,23,2,238,21,2
50110 DATA 138,19,2,20,26,6,238,21,0,2,104,17,2,104,17,2
50120 DATA 104,17,1,104,17,1,137,19,1,137,19,1,104,17,2,104
50130 DATA 17,2,110,16,2,104,17,2,137,19,1,104,17,1,137,19
50140 DATA 2,238,21,2,238,21,1,238,21,1,137,19,6,104,17,2
50150 DATA 104,17,2,104,17,2,104,17,1,104,17,1,137,19,1,137
50160 DATA 19,1,104,17,2,104,17,2,110,16,2,104,17,2,137,19
50170 DATA 1,104,17,1,137,19,2,238,21,2,238,21,1,238,21,1
50180 DATA 137,19,6,104,17,1,70,29,1,20,26,2,60,23,1,238
50190 DATA 21,1,137,19,2,104,17,2,60,23,2,60,23,1,238,21
50200 DATA 1,137,19,2,238,21,2,238,21,2,60,23,2,238,21,2
50210 DATA 238,21,2,137,19,6,113,18,2,137,19,2,137,19,2,137
50220 DATA 19,2,238,21,2,137,19,2,238,21,2,137,19,2,137,19
50230 DATA 2,104,17,1,104,17,1,110,16,2,104,17,2,104,17,2
50240 DATA 110,16,6,104,17,0,2,10,13,2,158,11,2,10,13,1
50250 DATA 163,14,1,10,13,2,10,15,2,163,14,2,10,13,2,10
50260 DATA 13,2,208,13,2,247,10,2,163,14,2,163,14,2,208,13
50270 DATA 6,163,14,2,10,13,2,158,11,2,10,13,1,163,14,1
50280 DATA 10,13,2,10,13,2,163,14,2,10,13,2,10,13,2,208
50290 DATA 13,2,247,10,2,163,14,2,163,14,2,208,13,6,163,14
50300 DATA 2,238,21,1,137,19,1,104,17,2,110,16,1,163,14,1
50310 DATA 10,13,1,158,11,1,10,13,2,163,14,1,10,13,1,158
50320 DATA 11,2,10,13,2,104,17,2,104,17,1,104,17,1,10,16
50330 DATA 2,163,14,2,163,14,6,163,14,2,163,14,2,10,13,1
50340 DATA 10,13,1,79,12,1,10,13,1,163,14,1,110,16,1,10
50350 DATA 13,1,247,10,1,163,14,2,79,12,2,10,13,2,10,13
50360 DATA 2,158,11,2,10,13,2,163,14,1,197,9,1,10,13,6
50370 DATA 10,13,0

```



The accompanying programs can be amended to allow the use of a musical keyboard.

20►

## Listing 2

```

10 033C      ! INTERRUPT DRIVEN 3-PART MUSIC FOR THE COM 64
15 033C
20 033C      ! BY NICK HIGHAM
30 033C
50 033C      ! MIKRO ASSEMBLER (SUPERSOFT) SOURCE CODE
100 033C
110 C000     **=C000
160 C000
170 C000     ! TO USE:
172 C000
175 C000     ! CALL <WEDGEON> TO ACTIVATE THE INTERRUPT WEDGE
180 C000     ! CALL <MUSICON> TO START (OR RESTART) THE MUSIC
185 C000     ! POKE FLAG,0 TO HALT MUSIC
190 C000     ! POKE FLAG,1 TO CONTINUE MUSIC
195 C000     ! CALL <WEDGEOFF> TO REMOVE THE WEDGE FROM THE INTERRUPT
200 C000
290 C000
292 C000
295 C000
300 C000
310 C000 00  FLAG      BYT 0          ! MUSIC OFF=0, ON=1
320 C001 01  FLAG1     BYT 1          ! DEFAULT:ALL VOICES ON
330 C002 01  FLAG2     BYT 1
340 C003 01  FLAG3     BYT 1
342 C004
344 C004 0A  TEMPO     BYT 10         ! 0<=TEMPO<=255
346 C005
347 C005     ! POINTERS TO START OF NOTES FOR EACH CHANNEL
348 C005
350 C005 00  LOW1      BYT #00        ! DEFAULT:PLAY
351 C006 A0  HIGH1     BYT #A0        ! BASIC ROMS
352 C007 00  LOW2      BYT #00
353 C008 A0  HIGH2     BYT #A0
354 C009 00  LOW3      BYT #00
355 C00A A0  HIGH3     BYT #A0
356 C00B
357 C00B     ! MUSIC DATA MUST BE STORED IN MEMORY AT ADDRESSES
358 C00B     ! (LOW1), (LOW2), (LOW3).
360 C00B     ! EASIEST TO USE MUSIC MASTER (SUPERSOFT)
361 C00B     ! OR MUSICALC TO GENERATE THE DATA.
364 C00B
365 C00B 20  CREGVAL1   BYT 32         ! SAWTOOTH
370 C00C 20  CREGVAL2   BYT 32
380 C00D 20  CREGVAL3   BYT 32
390 C00E
395 C00E
397 C00E
400 C00E 00  ELAPSE1   BYT 0
410 C00F 00  ELAPSE2   BYT 0
420 C010 00  ELAPSE3   BYT 0
440 C011
450 C011 00070E  OFFSET   BYT 0,7,14   ! FOR VOICE REGISTERS
530 C014
540 C014 00  VOICE     BYT 0
560 C015 00  COUNTDOWN BYT 0
570 C016
600 C016     SID      = 54272
610 C016     CTRLREG1 = SID+4
620 C016
630 C016     ! SAFE ZERO-PAGE LOCATIONS
635 C016
640 C016     LDWPTR1   = 247
650 C016     HIGHPTR1  = 248
660 C016     LDWPTR2   = 249
670 C016     HIGHPTR2  = 250
680 C016     LDWPTR3   = 251
690 C016     HIGHPTR3  = 252
790 C016
800 C016 31EA  OLDIRQ    WGR #EA31
805 C018     IRVECTOR   = #0314
810 C018
812 C018
814 C018
815 C018 AD1403 WEDGEON   LDA IRVECTOR   ! IS WEDGE SET ALREADY?
816 C01B     !#####
818 C01B C94F
819 C01D D00B     CMP #<WEDGE
820 C01F AD1503   BNE NEEDSDOING
821 C022 C9C0     LDA IRVECTOR+1
822 C024 D001     CMP #>WEDGE
823 C026 60      BNE NEEDSDOING
824 C027     RTS
825 C027 7B     !
826 C028 AD1403  NEEDSDOING  SETI
830 C02B BD16C0  LDA IRVECTOR   ! SAVE OLD VECTOR
835 C02E AD1503  STA OLDIRQ
840 C031 BD17C0  LDA IRVECTOR+1
845 C034         STA OLDIRQ+1
850 C034 A94F     !
855 C036 BD1403  LDA #<WEDGE    ! SET UP NEW VECTOR
860 C039 A9C0     STA IRVECTOR
865 C03B BD1503  LDA #>WEDGE
870 C03E 5B     STA IRVECTOR+1
875 C03F 60     CLI
RTS

```



# OUTPUT: COMMODORE 64

◀ 19

which is useful as you may want to reserve one sound channel for special effects, produced in the normal way from the host program.

The loop from lines 1150 to 1490 services each active voice. It determines whether the current note for each voice has finished, and if it has, fetches the next note and duration from the storage area, sets up the voice's frequency registers in the SID chip, and gates the oscillator.

The notes are stored in separate blocks, one for each voice, in groups of three bytes of the form duration, frequency low-byte, frequency high-byte. Thus a C note in octave 4 of duration four beats is represented by '4,37,17' (see the Commodore 64 User's Guide).

The notes can be stored anywhere in memory and there is no limit to the number allowed, but the starting addresses of the blocks must be stored at locations \$C005-\$C00A (49157-49162), in low/high-byte form.

Note that the three starting addresses three starting addresses can be the same, causing the voices to play in unison. Try starting addresses differing by 3,6,9 etc in order to play a canon. Once all the notes for a given voice have been played that voice starts again.

The tempo of the music is controlled by location \$C004 (49156). A ten in here, for example, causes each beat to last for ten interrupts, or one fifth of a second.

The final piece of information that the program needs to know is the contents of the control register for each voice — this determines the waveform, the selection of synchronisation and ring modulation effects (refer to the Programmer's Reference Guide for details). The values should be placed at addresses \$C00B-\$C00D (49163-49165).

For those who don't have an assembler, or who prefer not to enter the source code, Listing 2 gives a Basic loader which pokes in the machine code from data statements and then plays a

demonstration — a three-part arrangement of the *Passion Choral*. The program takes about six seconds to run; when it has finished you have full control over the computer for programming — with a soothing musical accompaniment.

The program given here can easily be incorporated into another piece of software, for example a game. The most difficult task will be the setting up of the music data, which is rather tedious and error-prone, unless you use a sophisticated program such as Supersoft's *Music Master*, whose music files can be read and converted into the required form.

For more impressive musical arrangements it is useful to be able to change the tempo, waveforms, envelopes and volume while the music is playing. This can be done by specifying blocks of data of the form (waveforms 1-3, envelopes 1-3, tempo, volume, number of beats). Add extra code to the WEDGE routine to count for the requisite number of beats and install the new parameters. ▀

## Listing 2 (cont)

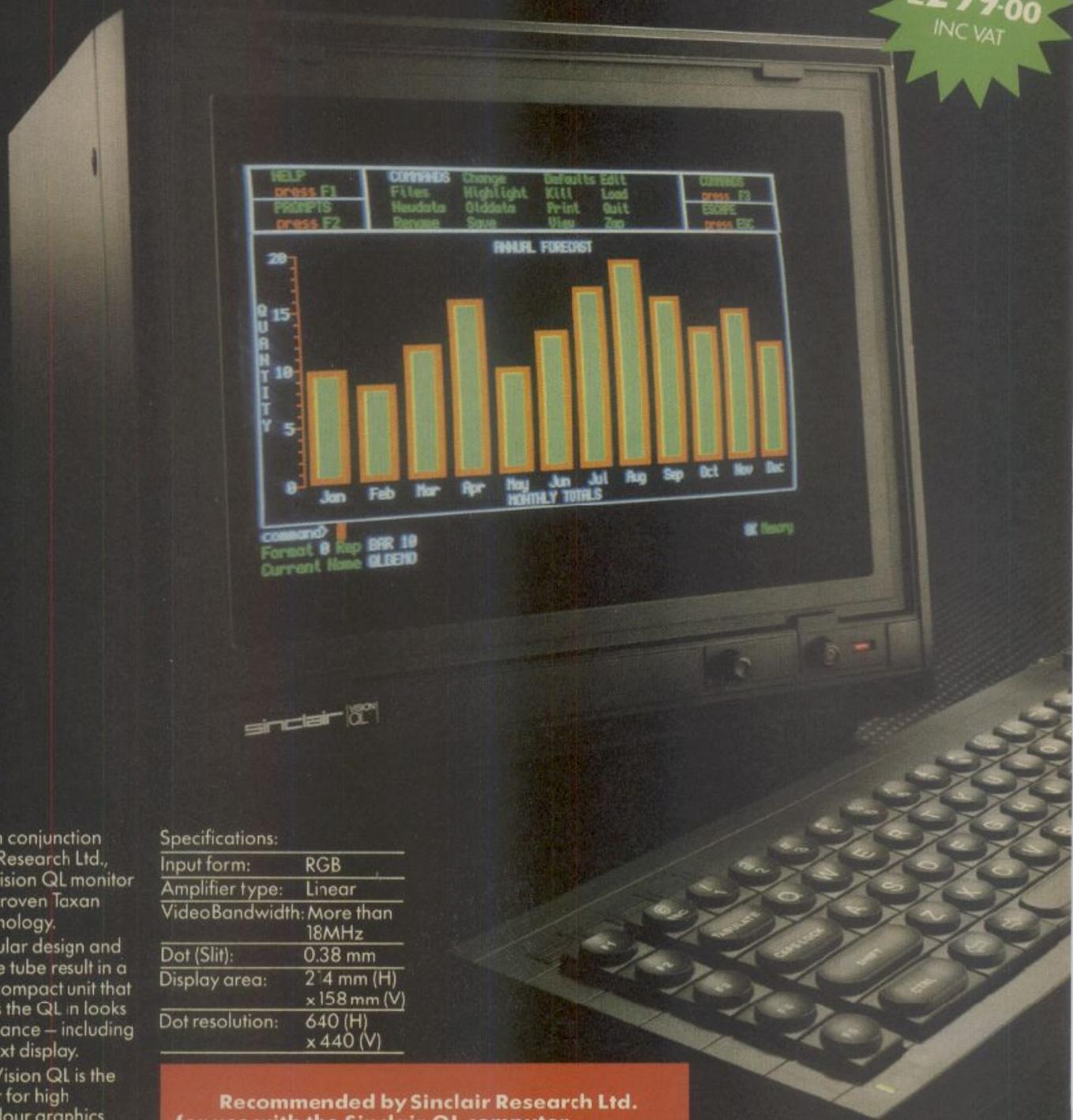
```

885 C040      !
890 C040 78  WEDGEOFF  SET
895 C041      !*****
900 C041 AD16C0      LDA OLDIRQ
905 C044 8D1403      STA IRQVECTOR
910 C047 AD17C0      LDA OLDIRQ+1
915 C04A 8D1503      STA IRQVECTOR+1
920 C04D 58          CLI
925 C04E 60          RTS
985 C04F      !
990 C04F      ! THE MAIN ROUTINE, CALLED ON EACH INTERRUPT
995 C04F      !
1000 C04F AD00C0 WEDGE  LDA FLAG
1010 C052      !****
1020 C052 D003      BNE ON
1030 C054 6C16C0      JMP (OLDIRQ)
1040 C057      !
1050 C057 CE15C0 ON    DEC COUNTDOWN
1060 C05A F003      BEQ NEXTBEAT
1070 C05C 6C16C0      JMP (OLDIRQ)
1080 C05F      !
1083 C05F      ! BEGINNING OF A NEW BEAT.
1085 C05F      ! RESET COUNTDOWN THEN DEAL WITH EACH VOICE IN TURN.
1086 C05F      !
1090 C05F AD04C0 NEXTBEAT LDA TEMPO
1100 C062 8D15C0      STA COUNTDOWN
1110 C065      !
1120 C065 A902      LDA #2
1130 C067 8D14C0      STA VOICE
1140 C06A      !
1150 C06A AE14C0 LOOPVOICE LDX VOICE      ! FOR VOICE = 3,2,1
1160 C06D B001C0      LDA FLAG1,X
1170 C070 F039      BEQ NEXTVOICE      ! VOICE OFF?
1180 C072 DE0EC0      DEC ELAPSE1,X
1190 C075 D034      BNE NEXTVOICE      ! END OF NOTE?
1200 C077      !
1210 C077 8D0BC0      LDA CREGVAL1,X
1215 C07A 29FE      AND #254      ! CLEAR GATE BIT
1220 C07C BC11C0      LDY OFFSET,X
1230 C07F 9904D4      STA CTRLREG1,Y      ! GATE OFF
1240 C082      !
1250 C082 BA          TXA
1260 C083 0A          ASL A
1270 C084 AA          TAX      ! X= 4,2 OR 0
1280 C085      !
1290 C085 20DFC0      JSR GETBYTE      ! GET DUR. OF NEW NOTE
1300 C088 F029      BEQ ENDOFNOTES
1310 C08A      !
1320 C08A AC14C0 RESETCOUNT LDY VOICE
1330 C08D 990EC0      STA ELAPSE1,Y      ! COUNT FOR NEW NOTE
1340 C090      !
1350 C090 8911C0      LDA OFFSET,Y
1360 C093 AB          TAY
1370 C094      !
1375 C094      ! FETCH AND INSTALL FREQUENCY
1377 C094      !
1380 C094 20DFC0      JSR GETBYTE
1390 C097 9900D4      STA SID,Y
1400 C09A 20DFC0      JSR GETBYTE
1410 C09D 9901D4      STA SID+1,Y
1420 C0A0      !
1430 C0A0 AE14C0      LDX VOICE
1440 C0A3 8D0BC0      LDA CREGVAL1,X
1450 C0A6 0901      ORA #1      ! SET GATE BIT
1460 C0AB 9904D4      STA CTRLREG1,Y      ! GATE ON
1470 C0AB      !
1480 C0AB CE14C0 NEXTVOICE DEC VOICE
1490 C0AE 10BA      BPL LOOPVOICE
1500 C0B0 6C16C0      JMP (OLDIRQ)
1510 C0B3      !
1520 C0B3 8D05C0 ENDOFNOTES LDA LOW1,X      ! RESET POINTERS TO
1530 C0B6 95F7      STA LOWPTR1,X      ! FIRST NOTE
1540 C0B8 8D05C0      LDA HIGH1,X
1550 C0BB 95FB      STA HIGHPTR1,X
1560 C0BD      !
1570 C0BD A1F7      LDA (LOWPTR1,X)
1580 C0BF D0C9      BNE RESETCOUNT      ! DURATION NONZERO?
1590 C0C1      !
1595 C0C1      ! DEAL WITH A VOICE WHICH IS TURNED ON
1597 C0C1      ! BUT HAS NO NOTES TO PLAY
1598 C0C1      !
1600 C0C1 B5F7      LDA LOWPTR1,X
1605 C0C3 D002      BNE L1
1610 C0C5 D6FB      DEC HIGHPTR1,X
1615 C0C7 D6F7      L1  DEC LOWPTR1,X
1640 C0C9      !
1650 C0C9 A9FF      LDA #255
1660 C0CB AC14C0      LDY VOICE
1670 C0CE 990EC0      STA ELAPSE1,Y      ! REST FOR 255 BEATS
1680 C0D1 8911C0      LDA OFFSET,Y
1690 C0D4 AB          TAY
1700 C0D5 A900      LDA #0
1710 C0D7 9900D4      STA SID,Y
1720 C0DA 9901D4      STA SID+1,Y
1730 C0DD F0CC      BEQ NEXTVOICE      ! ALWAYS
1740 C0DF      !
1750 C0DF      ! INCREMENT POINTER BY ONE AND GET THE BYTE POINTED TO
1935 C0DF      !
1940 C0DF F6F7      GETBYTE  INC LOWPTR1,X
1950 C0E1      !*****
1960 C0E1 D002      BNE NOCARRY
1970 C0E3 F6FB      INC HIGHPTR1,X
1980 C0E5 A1F7      LDA (LOWPTR1,X)
1990 C0E7 60          RTS
2000 C0E8      !
2005 C0E8      ! PREPARE TO PLAY THE MUSIC - SET UP
2007 C0E8      ! POINTERS AND COUNTERS
2008 C0E8      !
2010 C0E8 A900      MUSICON  LDA #0
2020 C0EA      !*****
2030 C0EA 8D00C0      STA FLAG      ! MUSIC OFF
2040 C0ED A202      LDX #2
2042 C0EF      !
2045 C0EF BA          LOOPCOPY TXA
2050 C0F0 0A          ASL A
2055 C0F1 AB          TAY
2060 C0F2      !
2065 C0F2 3B          SEC
2070 C0F3 B905C0      LDA LOW1,Y
2075 C0F6 E901      SBC #1
2077 C0FB 99F700      STA LOWPTR1,Y
2080 C0FB B905C0      LDA HIGH1,Y
2085 C0FE E900      SBC #0
2090 C100 99F300      STA HIGHPTR1,Y
2095 C103 CA          DEX
2100 C104 10E9      BPL LOOPCOPY
2105 C106      !
2106 C106      ! NEW BEAT, AND NEW NOTE FOR EACH VOICE,
2107 C106      ! ON THE 'FIRST' INTERRUPT.
2108 C106      !
2110 C106 A901      LDA #1
2120 C108 B00EC0      STA ELAPSE1
2130 C10B B00FC0      STA ELAPSE2
2140 C10E 8D18C0      STA ELAPSE3
2150 C111 8D15C0      STA COUNTDOWN
2160 C114 8D00C0      STA FLAG      ! TURN MUSIC ON
2170 C117 60          RTS

```

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## OUTPUT: RACING SIMULATORS

# AND THEY'RE OFF

There's something about the thrill of racing around a track at high speeds that catches the excitement of most games players. Peter Worlock dons his racing helmet and evaluates some of the 3D racing simulations competing on the market.

### Turbo 64

*Turbo 64* is the latest contender on the starting grid, coming from Oxford Computer Systems by way of its subsidiary Limbic Systems.

With *Turbo*, the emphasis is really on the 'simulator' and the screen display presents some exceptional graphics. The lower half is a detailed representation of a dashboard complete with a steering wheel that turns, rev counter, speedometer and H-type gear shift, in addition to the lap counter and score display.

The greatest hazard with *Turbo* is the loading sequence. Limbic has gone to ludicrous lengths to prevent piracy, forcing you to enter four colour codes from an almost unreadable chart before you can start.

Once that is accomplished, however, the program is straightforward. Control is either by keyboard using a diamond



cluster for speed and steering, and the sensible use of the function keys for gear change, or by joystick. The joystick is better for driving but gear changes involve awkward diagonal movements.

You can choose between two circuits, and a number of laps, and there is the option of multi-player tournaments. The two tracks differ not only in layout but in scenery, the first being a rather mundane desert trip, the other a more regular racetrack with superb scenery.

As in *Chequered Flag* you're not actually racing. The challenge is in mastering the car and setting record times. You gain points for correct use of gears and approach to bends, as well as staying on the track.

*Turbo* is a much more demanding game than *Pole Position* and initially is almost discouragingly difficult but, with the exception of road signs which judder noticeably, the graphics are unbeatable.

If Limbic could rectify the abysmal security system and recode the control sequence it might have a winner.

**Game Turbo 64 System Commodore 64 Price £7.95 Publisher Limbic Systems, 0993-812700.**



### Pole Position

Still the daddy of them all, *Pole Position* is now available for a range of machines.

This one features exceptionally smooth graphics and it's a true race — often to the death. The perspective is not 'through the windshield', but rather as though you were seeing your car from a helicopter above and behind.

You have a multitude of choices from simple practice laps up to eight-lap races, and on one of three racetracks. The circuits are a compromise with the layout changing but the scenery remains the same. One other aspect of *Pole Position* prevents it from being a true simulator. If you accelerate to a moderate speed and stay there, the car will almost drive itself around the track.

However, although this will prevent a blazing death, you won't win.

In the race sequence you start by qualifying for the race and your lap time governs your place on the starting grid.

*Pole Position* is a great game with a mean combination of fast graphics and excellent sound.

**Game Pole Position System Atari, Commodore 64, Price £9.95 Publisher Atarisoft.**

### Chequered Flag

*Chequered Flag* — another Spectrum racing simulation — puts you behind the wheel of a Grand Prix racing car. The view is almost 3D with minimal scenery to give a sense of perspective, but the scrolling road is well done.

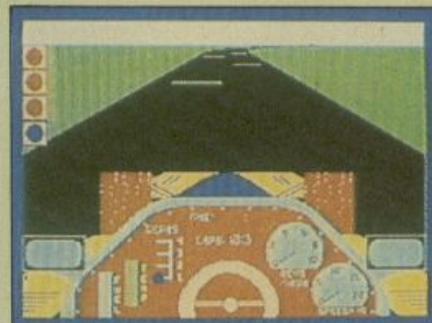
Again you have a choice of tracks with six real ones and four created by the programmers, but a new twist is the choice of three different cars.

Each car is built differently and has different handling characteristics, while a range of on-track hazards like oil slicks and broken glass will keep you on edge.

*Chequered Flag* is a slightly misleading title in that you're not actually racing other vehicles. You're on a time trial aiming to beat the track record for each circuit.

Control of the car is accurate with a very responsive brake and accelerator but steering takes some getting used to. Until you master it, you'll have to get used to the screeching as you skid round corners.

Once your driving skills develop, however, *Chequered Flag* is addictive and the choice of tracks and cars provides plenty of variation.

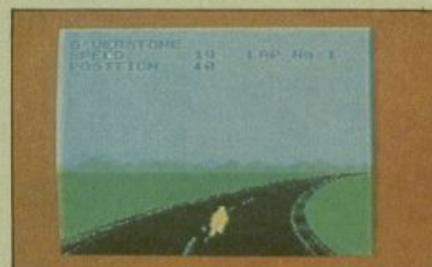


**Game Chequered Flag System Spectrum Price £6.95 Publisher Psion.**

### Full Throttle

Death on two wheels this time in *Full Throttle* from Micromega. Mount your 500cc motorbike and compete with 40 riders on your choice of ten tracks.

*Full Throttle* is one of the few true racing simulations in that your primary objective is to win — covering set distances or setting lap records are secondary considerations.



The track layouts are based on real racing venues from Silverstone to the Nurburgring and having selected one you can opt for a practice lap (good idea) or go straight into the race.

There are only four controls for acceleration and braking, and left and right steering but control is good and your approaches to the bends are critical. But the best feature is that controlled skidding is catered for with suitable graphics and sound effects.

On the whole, the sound is adequate and the display is reasonable. This is one of the best simulations.

**Game Full Throttle System Spectrum Price £6.95 Publisher Micromega 01-223 7672.**

# Win a racing start to 1985



## Fifty prizes

In our latest competition *PCN* has got together with Limbic Systems to offer a collection of superb prizes to motor racing enthusiasts — whether you're a fan of the real thing, or prefer to indulge your passion from the comfort of your living room.

Fifty winners will win a trip to a top London venue to meet James Hunt and the overall winner will take him on at a computer racing simulator. Hunt, now better known as a television motor racing commentator, was the only Briton to win the Formula 1 championship in the last ten years.

All you have to do to enter is answer the questions below, complete the entry form and send it to reach *PCN* by the closing date of Friday, December 21. The prize ceremony will take place in the new year at a date and venue to be announced.



Send to: Racing Competition, Personal Computer News, 62 Oxford Street, London W1A 2HG. The Judges' decision is final. No correspondence will be entered into. The competition is not open to employees of VNU, Quickset, Chase Web Offset or Limbic Systems.



## Entry Form

- 1 In which year was James Hunt world champion? .....
- 2 Name the winner of this year's championship.....
- 3 In which countries are the following Grand Prix circuits?  
 a) Zandvoort..... b) Zolder..... c) Kyalami .....
- 4 Name two other British drivers to win the world championship  
 a)..... b).....

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All versions contain a programme an audio tape and glossary.

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# GAMER

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# GREAT SCOTT!

The thirteenth Scott Adams
adventure confirms his
status as super-star among
adventure writers. Bob
Chappell hails the master.

Scott Adams has just had a huge success with *The Incredible Hulk*, the first of the Questprobe series featuring famous characters from Marvel Comics. Meanwhile, Adams has returned to his more traditional stamping ground. If you exclude the Questprobe series, his newest adventure, *The Sorcerer of Claymorgue Castle* (published by Adventure International), is his thirteenth. I don't believe in superstitions, touch wood, and they clearly don't bother Adams for adventure 13 is a smasher.

Like *Hulk*, *Claymorgue* offers pithy textual descriptions coupled with impressive and instantaneous high-resolution graphics. The simple verb-noun command structure is still there (*Spiderman* promises a sophisticated full-sentence analyser) but the main ingredient for an Adams success is the humour and, above all, the puzzles. You don't get lavish or atmospheric text and you don't get an enormous vocabulary to juggle with. What you most definitely do get are some of the most stimulating and testing puzzles in the business — the solid gold hallmark of a Scott Adams adventure.

Judging by my lack of progress so far, this one's got some humdingers.

## Lost property

And so to the plot — it's the favoured 'he lost 'em, you find 'em' theme. Long ago, Solon the Master Wizard (and careless buffoon in my book) lost the 13 Stars of Power to one Vileroth. Unfortunately for Vileroth, he didn't manage to get his paws on the Secret Cloak without which the Stars were useless. Just before Vileroth handed in his wand and dinner pail, he hid the Stars around Claymorgue Castle. Solon now wants you, Beanwick (a wally wizardling), to recover them. As a mere apprentice to the magical arts, you have only a sprinkling of spells to hand.

Possessing or finding spells is one thing; predicting their outcome is quite a different kettle of frogs.

Claymorgue Castle, its drawbridge raised, loomed before



me. Not being a Dungeon Master just on account of my wizened features, I took a quick inventory before exploring further. I had the following spells: Fire, Seed, Light Squared, Yoho, Wicked Queen's and Lycanthrope. Hmmm.

## Spellbound

I decided to let loose with some of the spells to see what they could do. The Fire spell was obvious and, being familiar with Scott Adams' earlier *Pirate Adventure*, I had a pretty good idea what the Yoho spell would do — so I left these two alone. With one exception, the experiment was a resounding failure, since each spell pro-

duced no obvious result. This clearly meant that I'd just have to wait until the right moment came along before casting a particular spell — always assuming that I recognised the moment when it arrived and that I hadn't already wasted the spell in foolish experiments (whoops).

The one exception had lowered the drawbridge for me (I'm not saying which spell did it but beware — a dreadful Adams pun lurks nearby). Before entering the castle, I took a quick dip in the moat and met a sleeping moat monster. I drowned in my first attempt to escape. Next time round I emerged groaning but unscathed.

The groans were the result of a direct hit from yet another Adams pun.

## Tempting providence

The lever inside the castle just shouted to be pulled but I resisted. However, the magic fountain in the courtyard was just too tempting so in I went. Aha! The first Star! My glee was short lived and I came over all peculiar and expired a few moves later.

Back again, I popped into the castle kitchen and took a quick look at the drains — not too appetising. The plain room was strange as it appeared to be made of Gruyere. In the ballroom, the rope stretched between the chandelier and the wall begged to be untied — exit one Dungeon Master with crushed borce.

My few minor triumphs have me well and truly hooked. This is without question another excellent adventure from the master and it's available for a wide range of micros. Hang on, world, Beanwick is on the way home.

## Have map, will travel

Do your adventure maps look tatty and tangled? Print 'n' Plotter Products (01-403 3622) have the perfect remedy. It's called *Adventure Planner* and consists of a 50-page pad of A3 maps, each map having 150 preprinted, interconnecting boxes. The paper is high-quality and there's space set aside for the title, date started and finished, and any other information.

Costing £3.95 a pad from your local stockist (or £4.50 mail order from 19 Borough High St, London SE1), *Adventure Planner* is a map-making must for dedicated adventurers, players or planners.

## Dungeonade

Rachel Young of Maidenhead has a problem with the sphinx in *Time Machine* and entering Hades in *Zork 1*. For those in similar difficulty, read on (backwards): Sphinx: REVE LEHTMAJ, Hades: first KOOB KCAL BDAE R:SE LDNA CTHG IL:LLEBG NIR; second, ECNE SSEE HTFO SIEM IT:R EDRO TAHT NI. ■

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High-resolution graphics  
without touching the keyboard:  
Francis Jago gets to the  
art of the matter.

## A TOUCH OF ART

The ability to draw anything in high-resolution without touching the keyboard could be a programmer's dream. This touch tablet, with its accompanying *Multipaint* software, brings this dream nearer reality.

### First impressions

Both Commodore 64 and Spectrum Touchmaster come attractively packaged in a large box — the tablet is noticeably larger than any other I've used. The tablet, and the ports at the back, are identical on both versions, so it's only the interface which differs for the two.

The *Multipaint* software provided with the Touchmaster is designed to be a basic Computer Aided Design program for budding armchair artists and possibly for more serious applications.

### In use

I'd already used the *Koala* touch tablet with the Commodore, so I tried the Touchmaster with my 64 first. The interface plugged into the user port with no difficulty and, for a nice change, the software loaded straightaway. Touchmaster has most of the graphic commands you would expect, such as two types of circles, a polygon facility and many more basic ones. The Commodore *Multipaint* gave good high-resolution graphics although only sixteen colours are provided by the computer. There was no effort in programming extra shades of colour, a facility I had come to expect from programs provided with a peripheral with this price-tag. The same facility was much more expected from the Spectrum *Multipaint*, but I did not expect commands as important as, for example, Zoom to be missing from the Spectrum software.

### Documentation

The manual, although neat enough, did not give sufficient detail on each command; experimentation was the only way to properly understand some of them.

The cover material used to indicate where to press on the pad to get a certain function was made from a flexible plastic, one side smooth and the other slightly rough. Unfortunately, to get the screen to register any depression on the



Two Sanyo TVs showing the Touchmaster Graphics.

tablet you must press the stylus hard marking both the overlay and the black sensor material underneath. I enquired whether the *Multipaint* overlays are available separately. The answer is that they are not available now, but Touchmaster is considering producing them separately at extra cost.

The *Multipaint* screen layout is straightforward, and the program is remarkably easy to use. For anything but the simplest doodles, however, a program would need to be written which registers the pen's movement more accurately. Thoughtfully, Touchmaster provides the basis for writing programs at the back of its user guide. With this information, I managed to write a program more suited to my specific requirements.

Another problem common to both the Spectrum, and surprisingly, the Commodore, was encountered when two separate lines crossed. The resolution of the second line decreased so much that it completely obscured the first. Although not grave, this is the kind of small programming error that restricts the serious application value of the Touchmaster.

One of the nicest features of the Commodore version is the large, clear text, perfectly suited to the titling of drawings. Unfortunately, the Sinclair version uses normal Sinclair characters and is therefore much less attractive.

Although neatly put together, the Touchmaster, especially the Commodore version, lacks commands which it shouldn't. This came home to me when I tried to draw a circuit diagram. I drew one diode and wanted to place the same diode another point on the screen. Only then I realised there was no repeat function and I had to draw the same diode, the same size, in a different place.

One of the nicest facilities on both versions was the FREE DOTS command

which makes creating 3D drawings possible. All pictures created on the Touchmaster can be saved but, unfortunately, they can only be loaded back into the Touchmaster program which means it would be a complicated procedure to incorporate a Touchmaster picture into your own program; all budding graphic adventure writers take note.

One reason for buying the Touchmaster is probably that unlike most other touch tablets, I have used, there is a large range of software. The catalogue which comes with the Touchmaster has many titles, several designed to exploit the Touchmaster's best points, eg making computers easier to use as teaching aids for young children or physically or mentally handicapped people unable to use a computer normally.

### Verdict

For the home user or hobbyist who wants to make the most of artistic flair, there are cheaper and better programs using joysticks or, at half the price of the Touchmaster, the *Koala Pad* by Audiogenic.

The same applies with professional uses since the Touchmaster is just not accurate enough.

To anyone who has children or pupils who have learning difficulties, not necessarily to do with computing, the Touchmaster and the extra software you can purchase (especially for the Commodore 64) could prove invaluable. ▀

### REPORT CARD: 1 TO 5

Features	●●●●
Documentation	●●●●●
Performance	●●●●
Overall value	●●●●

Price £149.95 Availability Touchmaster, Kenfig Ind Estate, Margam, West Glamorgan SA13 2PE, 0656-744770



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Acornsoft have a range of education programs that encourage children to think logically and creatively. And at the same time, they make learning bags of fun.

**SPOOKY MANOR:** An adventure game for up to four players. Where exploring the creepy old house and solving mysteries involves co-operation and planning. It is suitable for children aged seven and upwards but many adults will enjoy the challenge it provides.

**WORKSHOP:** An easy to use and completely captivating program. Full of unusual machinery. By experiment children discover what each of the machines can do with simple geometric shapes. For ages three or over, Workshop encourages highly creative thinking and experimentation.

**ABC:** A writing tool designed for young writers aged seven and upwards. It is easily operated and quickly understood and before they realise it children will be creating and reshaping their words and ideas.

**TALKBACK:** Both entertaining and demanding. It allows children to create their own computer 'characters' capable of holding simple conversations on the screen and provides valuable lessons in both English

and computer literacy. For ages ten and over.

All four programs are available for the BBC Micro computer on either cassette (£9.95) or disc (£11.50). Talkback and Workshop are also available for the Electron on cassette (£9.20).

For your local Acornsoft stockist or to order by credit card simply ring 0933 79300 during office hours. Alternatively you can order the programs by writing to Acornsoft, c/o Vector Marketing, London Road, Wellingborough, Northants. NN8 2RL, enclosing a cheque or postal order. Please allow 21 days for delivery.



## ACORNSOFT

**PERSONA**

# PLUG IN PARAPHERNALIA

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**Our eight-page guide to Christmas peripherals**





# PERIPHERALS: BUYERS GUIDE

## DECIPHERING

## THE

## PERIPHERALS

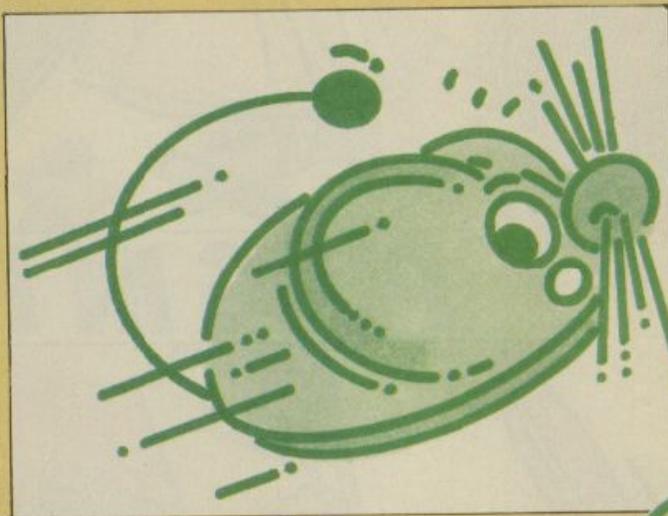
## PUZZLE

Once you've had a computer for a little while, you may be wondering what else you can do with it, aside from playing games and writing the odd program.

Buying one of the wealth of peripherals currently on the market can open up a whole new realm of possibilities, by presenting new programming challenges, new types of software, and providing more capabilities for your computer. The problem is, what to buy, for how much, and where from?

Probably the most uninteresting peripherals are printers, which are only of real use for word processing, screen dumps, and program listings. These come in many different types, sizes, prices and capabilities, from dot matrix to daisywheel.

Of much more interest these days are modems. Unfortunately, they can give you that dreaded disease known as Hackery, which includes symptoms such as high telephone bills, sleepless nights and no



interest in anything else.

Other add-ons include light pens and touch pads for budding computer artists. These generally come with some software, but make sure when you buy that there are some details on how to program it yourself. The same applies to joysticks and tracker balls. On some machines handling these is easy but on others, such as the Spectrum and Electron, things are a little more difficult.

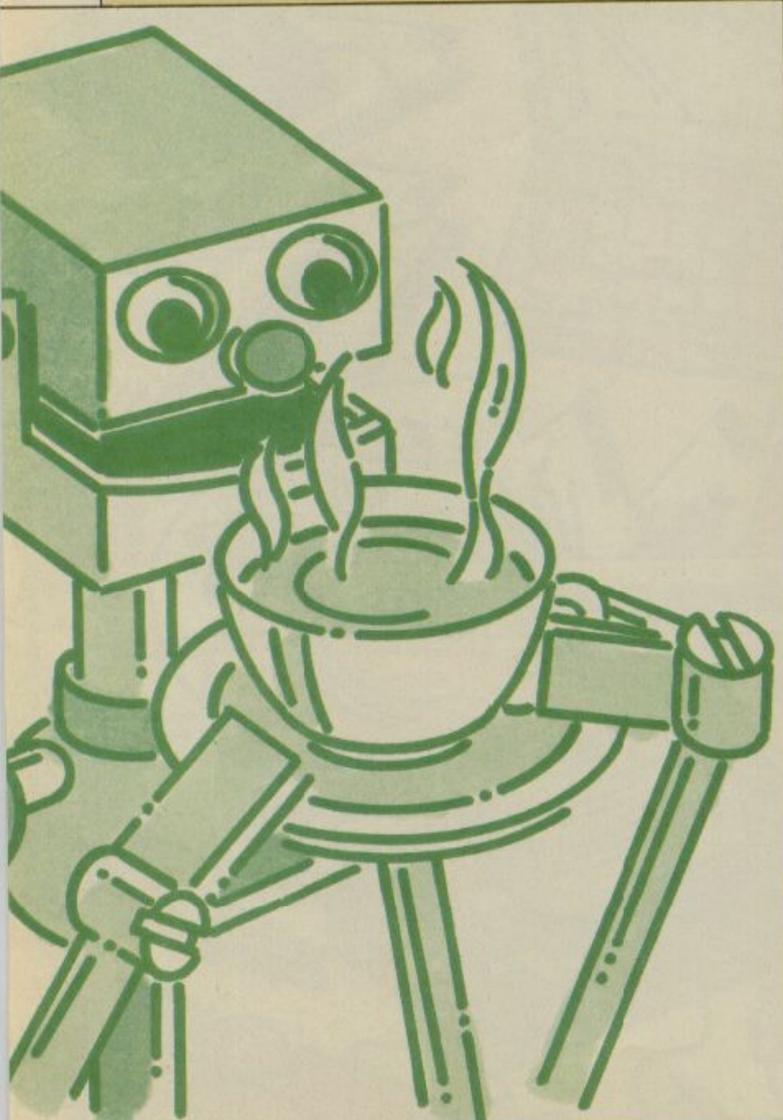
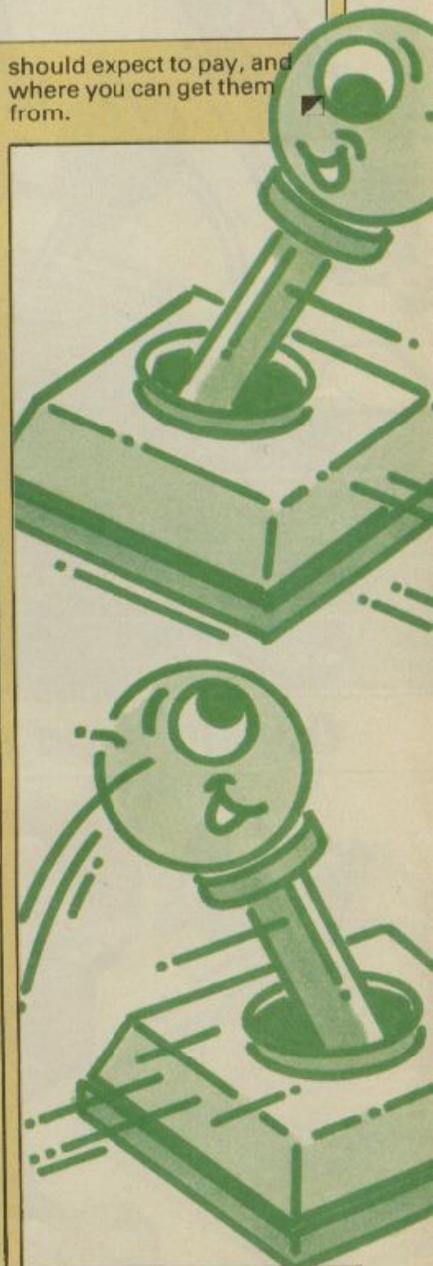
There are so many gadgets available that it would be impossible to name them all. Out of these, perhaps the most exciting are second processors, some of which can turn your humble home micro into something approaching the power of a minicomputer.

Others are just add-ons to allow a sought after CP/M system. These are much more common, being available for the BBC, Commodore 64, Amstrad CPC464, and Sinclair QL, to name but a few.

One point to bear in mind when you buy something extra for your micro is what you are going to do with it when you become fed up with the applications that come with it. If you make sure that there are details on how to access and control it, you will be able to write your own routines to run it, thereby giving it a whole new lease of life.

PCN's six page peripherals guide should give you some idea of what is available, how much you

should expect to pay, and where you can get them from.



# PRINTERS

Many people think they can live without printers, probably due to their high prices, but eventually you'll probably want one for your micro-computer.

There are a number of types around, from the more expensive daisy wheels to

the cheaper thermal or ball-point pen printers. Not to be forgotten, too, are the ubiquitous dot matrix and the ink jet types. The former are generally judged by their Epson compatibility and features.

Once the type of printer

has been decided upon, there are then a number of additional features to choose from, print buffers, RS232 or Centronics, graphics capabilities, redefinable character sets, and speed being just a few.

A printer with all of these—

the Smith Corona D200 for example—can cost up to £500.

Alternatively, a ballpoint pen plotter such as a MCP-40 will cost around £150, but this only takes narrow paper and doesn't give you half the facilities.

## THERMAL

### ● Brother EP-22

The EP-22 is quite cheap and will take either thermal paper or a carbon ribbon. It has a keyboard, which makes it a word processor too.



**Price** £169.95  
**Interfaces** RS232  
**Review** issue 35  
**Feed mech** Pinch  
**Print mech** Thermal paper or thermal carbon ribbon  
**Paper size** A4 width  
**Speed (approx)** 16 cps  
**Power supply** 4U2 batteries  
**Availability** Jones & Brother 061-3306531

### ● Brother HR5

The HR5 thermal printer from Brother basically uses the same mechanism as the EP-22 and the EP-44.



**Price** £180.55  
**Interfaces** RS232  
**Review** issue 47  
**Feed mech** Pinch  
**Print mech** Thermal paper or thermal carbon ribbon  
**Paper size** A4 width  
**Speed (approx)** 16 cps  
**Power supply** 4U2 batteries  
**Availability** Jones & Brother 061-3306531

## DOT MATRIX

### ● Smith Corona D200

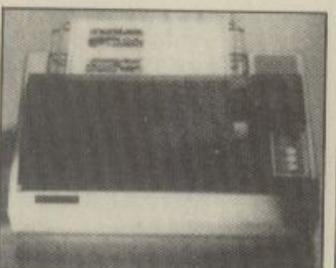
If you want a dot matrix that does nearly everything for your needs then the Smith Corona D200, at £483, is a good buy.



**Price** £483  
**Interfaces** RS232 and Centronics, both fitted  
**Review** issue 87  
**Feed mech** Pinch and tractor  
**Paper size** A4 width  
**Speed** 160 cps  
**Features** 2K internal buffer, NLQ capability  
**Availability** Smith Corona dealers

### ● Walters WM80

If you just want a workhorse with no fancy bits, then choose a bottom-end machine such as this.

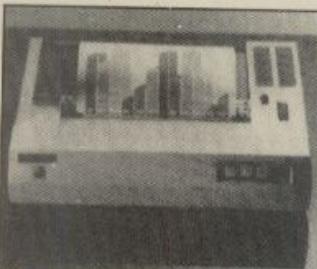


**Price** £189.75  
**Interfaces** RS232 or Centronics  
**Review** issue 43  
**Feed mech** Pinch and tractor  
**Paper size** A4 width  
**Speed** 80 cps  
**Availability** Walters Microsystems International, 0494-32751

## COLOUR

### ● Integrex Colorjet

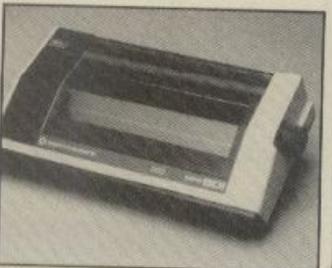
The Integrex Colorjet is mainly for BBC and Apple owners. A BBC screen dump program comes with this very versatile printer.



**Price** £632.50  
**Interfaces** RS232 and Centronics  
**Review** issues 51 and 44  
**Feed mech** Pinch  
**Paper size** A4 width  
**Speed** 37 cps  
**Availability** Integrex 0283-215432

### ● Commodore MPS 801

There are no frills on this and you will have difficulty attaching it to anything except a Commodore.

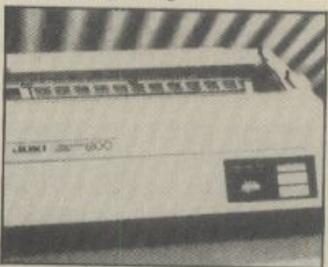


**Price** £395.95  
**Interfaces** I triple Commodore  
**Review** issue 79  
**Feed mech** Pinch and tractor  
**Paper size** A4 width  
**Speed** 38 cps  
**Availability** Commodore 01-7574111

## DAISIES

### ● Juki 6100

The Juki 6100 has above average speed at 17cps and is a nice cheap daisy wheel printer although it does have a few roughedges.



**Price** £385.25  
**Interfaces** RS232 and Centronics  
**Review** issue 17  
**Feed mech** Pinch  
**Wheel types** Triumph Adler  
**Paper size** Up to 13in  
**Speed** 17 cps  
**Availability** Most dealers

### ● Smith Corona L1000

The L1000 from Smith Corona is a good quality printer if a little noisy and slow. £50 extra for a parallel interface.



**Price** £368  
**Interfaces** RS232 and Centronics  
**Review** issue 78  
**Feed mech** Pinch and optional tractor feed  
**Wheel types** Smith Corona  
**Paper size** Up to 13in  
**Speed** 12 cps  
**Availability** Smith Corona dealers



# PERIPHERALS: BUYERS GUIDE

## MODEMS

Modems could well be classed as the up and coming peripheral of 1985. With the rapid growth of bulletin boards and the increase in Prestel-type systems, the number of cheap modems available has doubled since last year.

One of the problems that beset their introduction was BABT/BSI approval. The modems had to be sent to the BABT or BSI for testing for compatibility with BT's telephone network. By the middle of 1984, there were so many modems awaiting the green sticker that people started selling them without.

Things have settled down

a bit now and there are a number of good modems on the market.

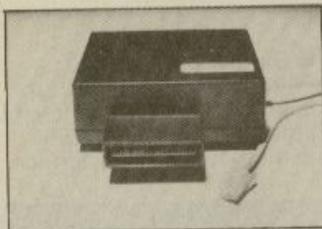
These can be split up into different types — direct connection, acoustic coupler, single speed, or multi speed.

The standard transmission speeds are 300/300 and 1200/75. The first is generally used for bulletin boards, although both Prestel and Telecom Gold are available on this speed.

Whatever modem you buy, make sure you get one that fits your needs as far as baud rates go, otherwise you may feel a bit left out.

### COMMODORE COMMUNICATIONS

Those with a Commodore 64 needn't feel left out. The Commodore Communications modem gives you access to Compunet, of course, and also Prestel. In the near future, Commodore is going to produce some software to allow user to user communication. If you want to use the various bulletin boards, you will have to acquire an RS232 port and a standard 300 modem.



**Price** £99.95  
**BABT?** Yes  
**Baud rates** Full duplex 1200/75  
**Interface** Commodore cartridge port and direct connection to BT  
**Contact** Commodore dealers

### PRISM VTX 5000

One of the most popular modems for the Spectrum is the Prism VTX 5000. If you only want access to Micronet and Prestel it is ideal, although it can have a

few problems with Interface 1. The way around this is to connect the whole system up without the modem and let it warm up (go and make a cup of coffee). Once warm, the VTX5000 can be connected (after powering down again) and it will work.



**Price** £99.95  
**BABT?** Yes  
**Baud rates** Full duplex 1200/75  
**Interface** Spectrum system bus and direct connection to BT  
**Contact** Micronet 800, 01-278 3143

### PACE NIGHTINGALE

The Pace Nightingale is another multi speed modem with both Bell and CCITT frequencies. It is a hard wire modem ie it connects directly into the telephone socket. Built mainly to be used with the BBC, for which the Commstar ROM is available, the complete package costs about £136. It is also available for any other RS232 compatible communications package.



**Price** £136.85  
**BABT?** Yes  
**Baud rates** Full duplex 300/300, 1200/75  
**Interface** RS423/232  
**Contact** Pace Software 0274-729306

### MINOR MIRICLES WS2000

The Minor Miricles WS2000 is great for bulletin board hackers and Prestel users alike. It lacks auto dial and auto answer facilities, which are a little expensive at £30 each but at least you're given the option.



**Price** £149.44 Auto dial and answer boards extra at £30 each  
**BABT?** Yes  
**Baud rates** Full duplex 300, 1200/75, half duplex 600, 1200

**Interface** RS232 with DTR, RTS, CTS, DCD  
**Extras** Also has the Bell 103/113, 108, 202 and CCITT, V21, V23 tones standards fitted.  
**Contact** Minor Miricles 0473-50304

### SENDATA 700B

For the ultimate in portability, it is hard to beat the Sendata 700B acoustic modem, distributed by Tandy. This modem will fit onto any standard telephone via its flexible connector so you can use it in a phone box if you don't mind the pips corrupting your data.



**Price** £235  
**BABT?** Yes  
**Baud rates** Full duplex 300/300  
**Interface** RS232 to the computer, and acoustic modem to BT  
**Contact** Sendata 01-387 7792

## MONITORS

The major excuse for not buying a monitor is that it's not strictly necessary if you have a TV.

The counter arguments are that with a monitor you can see your superb high-resolution graphics with less eyestrain. The clincher is that someone else might want to watch TV.

You mostly measure a monitor's quality by its bandwidth. This defines how fast the individual dots are scanned on the screen so obviously the faster it does this, the better the picture will be. 10MHz is at

the low end of the range with the better colour monitors having over 20MHz.

Another consideration is whether to buy colour or monochrome. The latter comes in various different coloured phosphors, usually green on green. Other options are orange on orange or grey on grey.

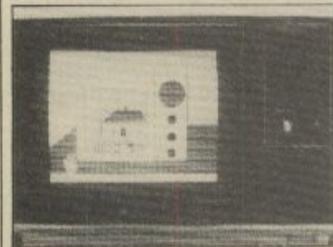
If you want full colour, you must pay quite a lot more for high quality. If you are not too bothered about that there are a number of converted TV tube monitors available for much less.

### CHEAP COLOUR

At the very cheap end come the JVC and Fidelity converted TV tube-type monitors. The JVCs come in two different versions, medium- and high-resolution.

The 1302-2 is the high-resolution version but has a rather dirty white. This is generally caused by the quality of the phosphors used. However, it's not at all bad for £229.95.

The lower priced version, the 1302-1, costs less at £149.95 but the bandwidth is not as good.



<b>Monitor</b>	JVC 1302-1/ 1302-2
<b>Price</b>	£253
<b>Resolution</b>	370 x 470 pixels/580 x 470
<b>CRT size</b>	14in/14in
<b>Bandwidth</b>	6MHz/10MHz
<b>Characters</b>	80 x 25/ 80 x 25
<b>Connection</b>	RGB analogue/TTL
<b>Sync</b>	Pos or neg
<b>Availability</b>	Opus Supplies, 01-708 8668

The Fidelity CM14 resembles the JVCs *ie* it's a converted TV tube. Its advantage is that it can be interfaced to a number of different machines, and has a built-in speaker and amplifier to allow access to,

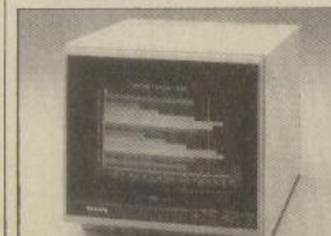
for instance, the Commodore 64's sound output. Cables for a number of machines are available from Tape Recorder Spares. One drawback to the CM14 is that it gives a better picture with some computers such as the Oric, but a bad one with others, notably the Dragon.



<b>Monitor</b>	Fidelity CM14
<b>Price</b>	£228
<b>Resolution</b>	370 x 470 pixels
<b>CRT size</b>	14in
<b>Bandwidth</b>	12MHz
<b>Characters</b>	80 x 25
<b>Connection</b>	RGB TTL, Audio input (1Kohm imp)
<b>Sync</b>	Pos or neg
<b>Availability</b>	Micro Peripherals 0256-473232

### BETTER QUALITY

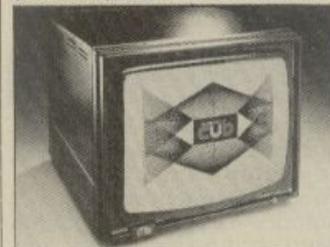
Near the top of the range of colour monitors are Kaga, Microvitec, and one from Prism. The latter looks suspiciously like the Fidelity



although it is better quality. The Kaga monitors come in a range, at the top of which is the Vision III. This has a black anti-glare tube and good colours.

<b>Monitor</b>	Kaga Vision III
<b>Price</b>	£370
<b>Resolution</b>	640 x 440
<b>CRT size</b>	12in
<b>Bandwidth</b>	18MHz
<b>Characters</b>	80 x 25
<b>Connection</b>	RGB
<b>Availability</b>	MBS Data Efficiency, 0442-60155

The Cub is popular and usually found attached to BBCs. The range is wide but the standard version is probably the most common.



<b>Monitor</b>	Microvitec Cub 1431
<b>Price</b>	£225
<b>Resolution</b>	452 x 585
<b>CRT size</b>	12in
<b>Bandwidth</b>	18MHz
<b>Characters</b>	80 x 25
<b>Connection</b>	RGB TTL
<b>Availability</b>	Dealers

### MONOCHROME

There are several monochromes around, and again, you pay for quality.

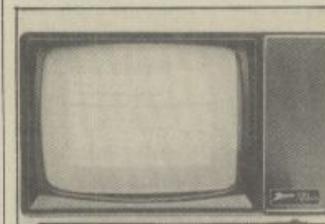
A very average green-on-green monitor is Zenith's. This produces a fairly good picture on its 12in tube. It does have a switched option to allow the screen size to be

altered between 40 or 80 columns.



<b>Monitor</b>	Zenith 123E
<b>Price</b>	£90.85
<b>Resolution</b>	640 x 300
<b>CRT size</b>	12in
<b>Bandwidth</b>	18MHz
<b>Characters</b>	80 x 25 or 40 x 25
<b>Connection</b>	Composite video
<b>Availability</b>	Most dealers

Since most home micros now have an RF output socket as standard, many people want to use them with TVs. The quality of picture varies but the Sony Trinitron range is generally the best.



<b>Monitor</b>	Sony Trinitron KV1430
<b>Price</b>	£249
<b>Resolution</b>	320 x 250
<b>CRT size</b>	14in
<b>Characters</b>	60 x 25
<b>Connection</b>	UHF switchable.
<b>Availability:</b>	Electrical stores



# PERIPHERALS: BUYERS GUIDE

## STORAGE

Most home micros can only store data and programs on cassette, which can be a major hassle. The first big upgrade step that most micro owners take is some kind of fast access, mass storage system. For most machines this means a disk drive although for the Spectrum, Microdrives or Wafa drives are usually cheaper.

As well as the disk/wafer drive, most machines need an interface to allow them to control the system. The odd one out is the Commodore 64 which has all the necessary bits and pieces built in. The problem here is that it can only be used with Commodore disk units (a typical Commodore gambit).

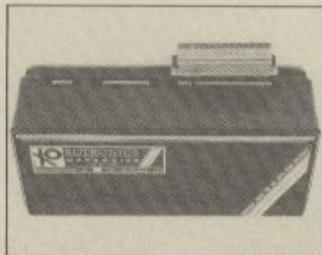
### SPECTRUM

The main Spectrum storage system is the Sinclair Microdrive. This needs the Interface 1 to be fitted but once in, up to eight drives can be used, each giving access to 85K or so of storage. Unfortunately, this is not too reliable and is still rather slow, and there's no fancy filing system. The additional commands are those printed on the top row of the keyboard in red, so there are no random access files and no way of telling what type the file is until you try to load it.

A better system is the Rotronics Wafa drive. This gives access to more storage space and a few more details about file types and sizes.

The wafers, so far, have also been found to be much more reliable than the Sinclair Micro cartridges.

**Availability** High street stores



**System** Rotronics Wafa drive  
**Price** £129.95  
**Comments** Includes two drives, a word processor and a blank cartridge. Also includes an RS232 and a Centronics port.

**Availability** High street stores

### BBC

The BBC has one of the better filing systems found on home micros. From Basic you get proper random access files, loading and saving of programs and data with the big bonus that it is fast.

The drawbacks are that you must have your Beeb altered and a disk controller fitted, costing around £100. You are also limited to a maximum of 31 files per disk and only four drives. The Acorn system is the most common, so if you don't buy its disk drives (which are not the best) you won't get a format program or a disk manual. Most dealers have sussed this and will sell you some other drives with the format disk included, or just the format disk at a nominal cost. The manual or a facsimile can be obtained in most good computer stores.

There are a number of

alternative filing systems for the BBC. These include the AMCOM, Watford, plus many others. They are not standard and some AcornSoft programs may not run on them. They do, however, improve on the Acorn DFS by getting around the 31 file limit. Which one you get depends on its price, performance, and what you want to do.

Also for the BBC are a number of fast tape systems, including the Ikon Ultradrive and the Phloopy. The Ultradrive is better and costs about a quarter the price of a disk system.

**System** Acorn DFS Upgrade  
**Price** £115 Fitted

**Disk drives** Cumana 100K £171.35, 200K £222

**Availability** Acorn Dealers

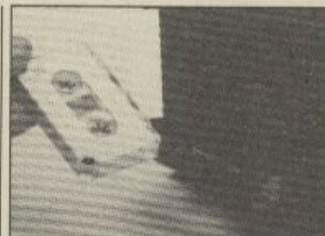
**System** Watford DFS  
**Price** In kit form £142.60 for single density, £97.75 for double density

**Comments** The single density (100K 40 track) is more expensive due to the 8271 disk controller costing £90.

**Availability** Watford Electronics 0923-40588

**System** Ikon Ultradrive  
**Price** £79.95

**Comments** Pack of 6 cassettes £20.13



**Availability** Ikon Computer Products 099-421 515

### AMSTRAD

The Amstrad has a disk system in the offering, from Amstrad itself. This is a Hitachi drive and can be accessed from Basic using the definable I command to give IA, IB to select which drive, ITAPE, IDISC, ICPM, IDIR, IERA, and IUSER. From Basic there are, unfortunately, no random access files. The facilities are minimal with no proper filing. However, it does come with a full CP/M system and DR Logo fitted. The CP/M is the same good old standard that has been around for a number of years, the assembler is for the 8080 but on the whole, it paves the way for the Amstrad to become a full business system.



**System** DDI-1  
**Price** £199.95  
**Comments** Includes interface CP/M and DR Logo  
**Availability** High street stores

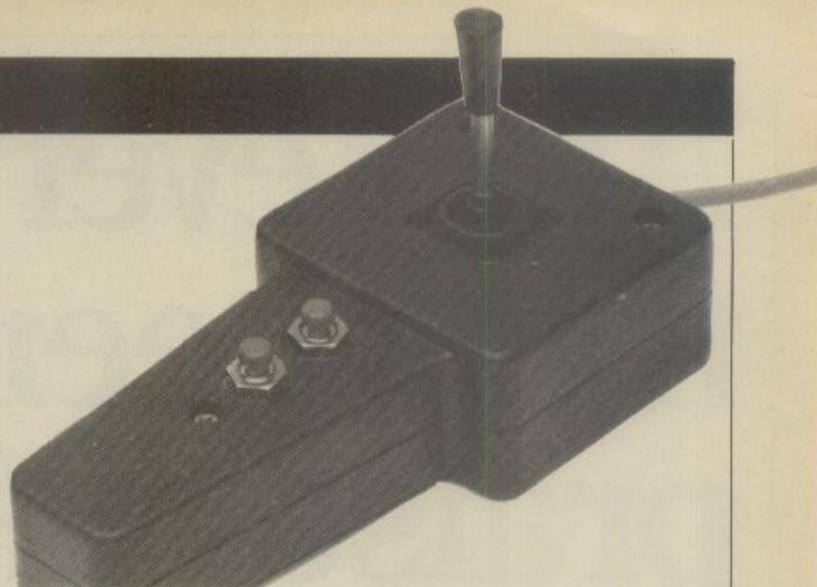


**System** ZX Microdrive expansion pack

**Price** £99.95

**Comments** Comes with Interface 1, a single Microdrive, four pieces of software, an introductory cartridge, and a blank. Extra drives at £49.95 each. Interface 1 has a pseudo RS232 and a network port.

# INPUTS



Input devices are things like joysticks, add-on keyboards, touchpads and light pens. Most of these can be simply plugged in and either come with their own software or can be used with existing games.



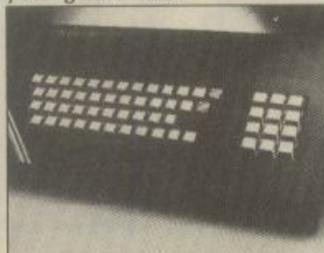
Most computers have a minimum of a keyboard for input but some, most notably the original Spectrum Minus, have a keyboard that is less than suitable for a great deal of typing, as in word processing. Due to this, there has been a ready supply of add-on keyboards offerings from, for instance, Fuller, Cheetah, Transform and lately Sinclair itself, with the launch of the Spectrum Plus.

Touchpads also seem to be booming with the release of the Touchmaster system for the Spectrum, Commodore 64, and Dragon. Also in the running is the KoalaPad but this is mainly for the Commodore 64 and the Apple.

Also in the range of peripherals to help you with your graphics are light pens. These are usually for the Commodore 64 and imported from the US.

A number of add-on Spectrum keyboards are available and most require fitting by the user. All you do is invalidate your guarantee by opening up the Spectrum's case, and pull out the keyboard connectors. These are then replugged into the add-on keyboard with the Spectrum circuit board and the add-on box re-assembled. A

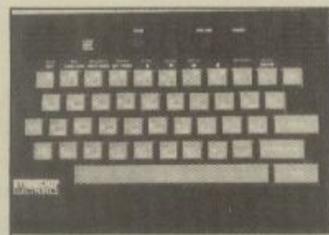
simpler way uses a buffer that plugs directly into the back of the Spectrum, so you don't have to invalidate your guarantee.



**Keyboard** Transform  
**Price** £69.95  
**Fitting** Invalidates guarantee  
**Availability** Transform 01-658 6350



**Keyboard** Fuller FDS  
**Price** £49.95  
**Fitting** Invalidates guarantee  
**Availability** Fuller 051-236 6109



**Keyboard** Stonechip  
**Price** £59.95  
**Fitting** Plugs straight in  
**Availability** Stonechip Electronics 0252-333361

The peripheral for games

players who want more speed and style is a joystick. The shape, size, and quality vary greatly but a rule of thumb is that quality costs more.

Joysticks also fall into two types, *ie* switched and analogue. The former is by far the most common with the usual connection being the standard Atari D plug with nine pins. Commodore, Atari, and Spectrum use this type and it is normally possible to obtain an interface for most other machines.

The BBC micro is left out when it comes to joysticks as it uses the analogue type. These tend to be more expensive but more flexible to use.

The major thing to watch out for is whether the stick might break just as you escape from the whirling hurling alien that is breathing down your back.

One of the best is the Quickshot MkII, which comes with suction cups on the base to stop it slipping at tight moments. It also has its fire button built into the handle — good value for £12.95.

Another good 'un is the Kempston Pro which doesn't have the fire button in the handle. It has two in tandem on the base allowing use by right or left handers. It is also very solid.

The BBC requires analogue sticks that plug into the analogue port at the back. The recommended version is marketed by Acorn but it seems to have been designed the wrong way round and is difficult to control. Other versions such as the Shado sticks from Spectrum at £16.95, come with an automatic centring mechanism that improves things no end.

Of the light pen systems available, most and by far the best, are for the Commodore 64. The

Flexidraw package from Inkwell Systems costs £140 but the accompanying software is flexible with full rubber banding, circles, fills, and a zoom.

For the BBC, the best graphics package available is the BitStick. The trouble is that this does require the 6502 second processor and disk drives plus a souped-up joystick. However, for your money you get a system that will allow very high quality graphics to be designed and stored. The cleverest part is where you can zoom into part of a picture and then into a smaller part and so on until



you run out of disk space. This means pictures can be designed with much more detail than is possible to see on screen. The major drawbacks are the price (£375 plus £199 for the second processor), and the lack of a suitable printer/plotter to obtain hard copy.

The Spectrum is way behind in the graphics stakes with Touchmaster, DK Tronics, and Stack being the few to produce something. The packages that come with these systems are primitive compared with other machines. The problem appears to be lack of interest from the US. The Touchmaster system costs £149.95 and is available from Touchmaster on 0656-744776. The DK Tronics light pen costs £19.95 and is available from DK Tronics 0977-26350.

# After everything that's been said in praise of Amstrad's CPC464, is there anything to add?

Plenty.

The CPC464 is an enthusiast's dream come true.

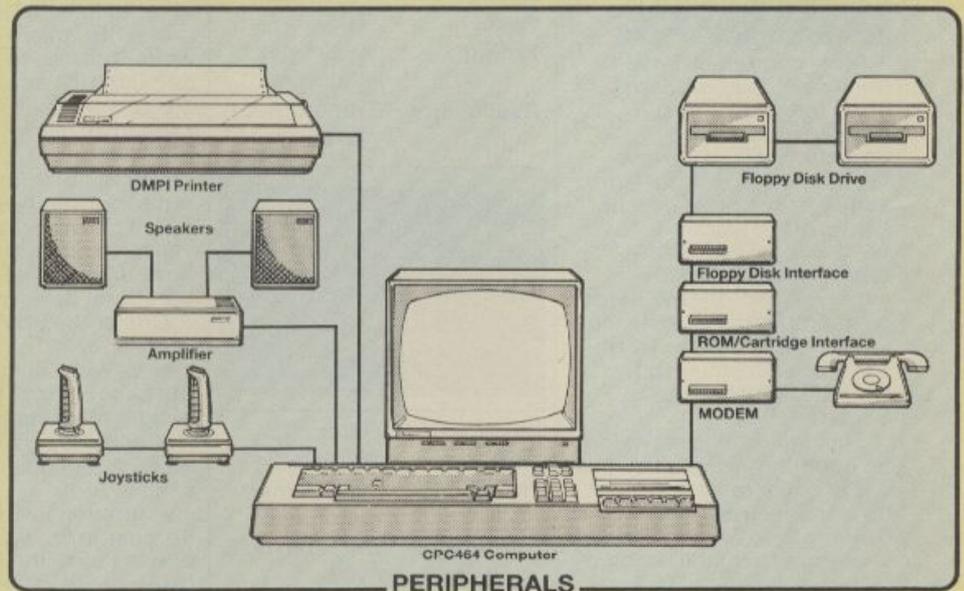
Few applications are beyond its capabilities, with its sophisticated features, complete expansion bus connector for sideways ROMs, serial interfaces, disk drives and modems.

No wonder the press is in raptures over it.

## The CPC464 system.

It comes complete and ready-to-go. Here's what you get for that incredibly low price.

64K of RAM (42K available), 32K of ROM, colour monitor or green screen VDU, typewriter style keyboard,



CPC464 green screen VDU (GT64)

integral cassette data recorder and a very fast extended BASIC.

The CPC464 offers you high resolution graphics, 80 column text display, up to 8 text windows plus a graphics window and a palette of 27 colours.

Not to mention a 3-voice, 7-octave stereo output you can feed through a hi-fi amplifier and speakers.

Now we think you'll agree, that's some system.

## Low cost disk drive.

An inexpensive floppy disk system is available which includes CP/M\* (giving you the option to access 3000 proven programs) and LOGO with its famous educational applications.



Optional disk drive DDI-1 including interface CP/M\* and LOGO £199.95

# £249

Computer complete with green screen VDU (GT64)

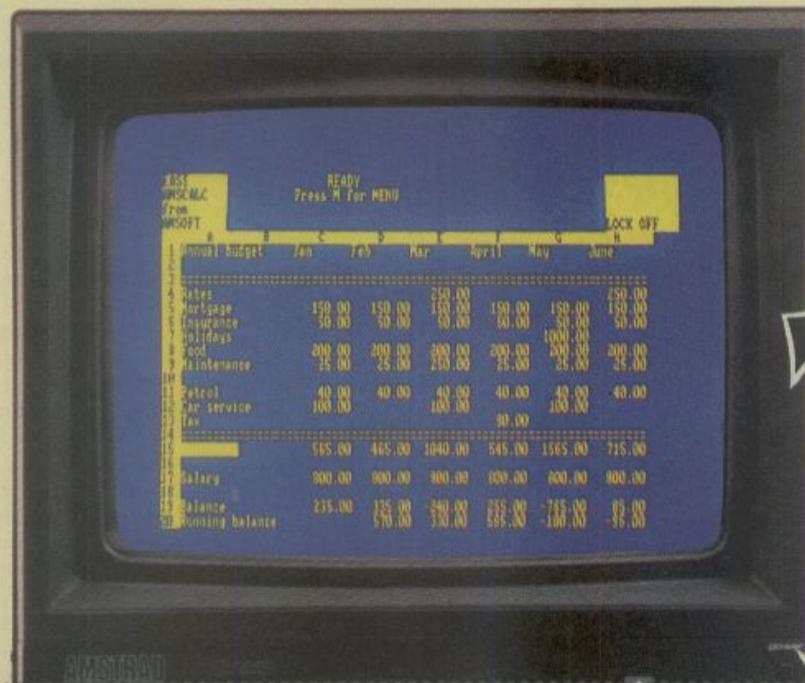
# £359

Computer complete with colour monitor (CTM640)

## CPC 464 complete with monitor and datacorder



The first low-cost personal computer to be approved by the British Electrotechnical Approvals Board.



### Printer port.

The CPC464 has a built-in standard parallel printer interface which offers you the facility to provide permanent reference of program listings, letters, invoices, anything that requires 'hard copy'.



Optional 80 column dot matrix printer DMP-1 operates at up to 50 characters per second. Combined with the CPC464, it offers a high performance text processing system for only £199.95.

### Joysticks.

### Power supply modulator.

You can bring those arcade games stunningly to life with the optional joystick controller which has a socket for a second stick.

The optional power supply and modulator enables the CPC464 to be connected to any home colour TV.

### Amsoft. Fast growing software.

The high quality software takes full advantage of the CPC464's high speci-

fication and speedloading capability. Which means even complex programs can be loaded quickly.

A range of software is already available. And it's growing rapidly.

Educational programs, business applications and arcade games are all designed to utilise the CPC464's impressive graphics, sound and processing abilities.



### Amstrad Club Membership.

Whether you're interested in commercial applications or you're a games fanatic, you'll want to join the Club.

Members enjoy immediate benefits like the privilege card, Club binder, regular magazine, competitions for valuable prizes and contact with other Amstrad users.

<b>AMSTRAD</b>	User club
<b>CPC 464</b>	
MEMBERSHIP NUMBER	
REGISTERED NAME	
EXPIRY DATE	
NOT TRANSFERABLE SEE MEMBERSHIP CONDITIONS FOR TERMS OF USE	

**BOOTS COMET Dixons**  
**Menzies RUMBELOWS** AND OTHER COMPUTER STORES

# AMSTRAD

ONE GREAT IDEA AFTER ANOTHER

\*Trade mark Digital Research

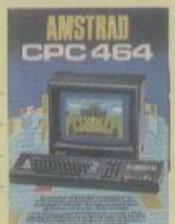
I'd like to know more about the exciting CPC464 complete computer system. Please send literature right away.

NAME

ADDRESS

POSTCODE

To: Amstrad Consumer Electronics plc, Brentwood House, 169 King's Road, Brentwood, Essex CM14 4EF. Tel: Brentwood (0277) 228888. P.C.N. 4





# A HANDY BOX OF TRICKS

**Philips has joined the IBM compatible bandwagon with its portable computer — the P2000C. Brendin Lewis puts the machine through its paces and reveals whether it has a fighting chance against high odds.**

**B**etter known for its household products, particularly televisions, Philips is launching itself on to small business computer market with the P2000C.

In addition to the tried and tested CP/M 80 operating system, two 640K floppy disks, 64K of RAM and an IEEE 488 interface board, our review model also included a prototype board, which comprises an 8088 and 256K of RAM. As well as allowing the system to run MSDOS, this allows a measure of IBM compatibility, which makes it interesting.

## First impressions

Philips has picked a striking shade of yellow for its packing case, manuals and

disk drives. The packaging itself is of a novel design. It's quite tall and slim and, by providing inset hand holds, it is remarkably easy to carry the 30lb box of tricks around.

Once out of its box, the machine holds a few more surprises. It has no carrying handle — instead it sports a shoulder strap similar to a camera's. This serves a dual purpose: it is used to move the machine around and holds the keyboard in place. Two spring loaded clips allow the strap to be removed but at the same time they release their hold on the keyboard.

It makes quite a nice change these days to see a keyboard that does not conform to the IBM standard. The keys are split into three main sections. To the

left are the normal alphanumeric keys. The layout shows few changes to the normal layout except that a Super Shift (similar to an Alt key) has been added. The only other change, which takes a bit of getting used to, is the position of the control key — instead of finding it in the third row, there is one on either side of the space bar.

The next group of keys is mainly used for word processing and other packages. There are also cursor keys and various keys with strange icons printed on them. The others are marked Search, Delete, and Insert. The final keypad has standard numeric keys plus two function keys and a key marked with a sideways 's' icon, which dumps the contents of the screen to the printer when used with the Super Shift key.

Overall, the 93 keys are of a high quality and are comfortable to use. The one problem I found concerns the keys with large keytops like Return, Shift, Back Space, Super Shift and the '+' on the numeric keypad. All are weak, as they are only supported centrally by the keyswitch. It is possible to put in dummy keyswitches under the keytops for support and Philips should look into this, as I am sure there will be problems with broken keytops.

## Storage

Once set up, the system is visually pleasing. The two 640K half-height disk drives are to the left. A small compartment just to the left of them holds the keyboard cable during transit, but is



Once set up, the system's two 640K half-height disk drives are to the left, flanked by the keyboard cable's compartment.



The keyboard layout has a Super shift key and two control keys, guarding the space bar.

quite handy for placing spare floppy disks while swapping them around. The green screen monitor sits in the centre of the unit and accommodates 24 lines by 80 columns of video text.

To the left of the unit are situated the on/off switch, the reset button and the monitor brightness control. The on/off switch is the push button type, which I frown on because of its susceptibility to being accidentally pressed, and this is especially true when the switch is front mounted. The reset button is nicely recessed into the cabinet also, again preventing accidental knocks.

At the rear of the machine are all but one of the connectors (the keyboard plugs into the side of the case). The mains socket is neatly fitted into a small recess. When in transit this has a plastic cover thus keeping the mains lead in check.

Two 25-way D-type connectors are used to connect the printer and modem while a seven-pin DIN socket is used to connect the external monitor. The two remaining connectors are both PCB edge connectors; both the hard disk and the external floppy disk unit are connected via these.

Internally, the machine is quite cluttered, making servicing quite difficult. The Z80 section of the machine takes up a lot of room, housing two large boards, one for the terminal section and one for the computer. One of these is mounted horizontally at the bottom of the cabinet and the other vertically along the back. The switch mode power supply is neatly positioned to one side of the unit, while the two disk drives counterbalance it on the other side.

The system is based on not one but two Z80s, both running at 4MHz (2MHz when accessing the ROMs). The first is the normal cpu and deals with the running of applications software. The other is an I/O processor, dealing with printers or the dedicated 32K of memory

mapped video RAM set aside for graphics.

The graphics capabilities available are 512x252 in high-resolution mode (single colour) and 256x252 medium-resolution with four grey scale (or green in this case).

The second board is the terminal board connected to the cpu board and running its own dedicated software from an 8K byte ROM. The cpu board can also be connected to other terminals if the internal terminal board is unavailable. There is space on the rear of the machine for a terminal connector, but it is sealed so obviously this facility is not yet available.

Interfaces contained within the system consist of two V24 data communications serial ports — one for a printer, the other for a modem, which can be run from 75 baud to 19,200 baud; an external video output connector designed for the Philips 12in stand-alone monitor; external floppy disk capabilities; and a SASI interface for an external hard disk unit. Internally, only one slot is available for expansion.

The connector is mounted on the bottom PCB and is quite difficult to get at. The options available for this slot include a 256K RAM board for use as a RAMdisk by the cpu board, an IEE488 interface allowing the control of up to 15 devices including most types of automated laboratory equipment.

The one limitation is that no device must be more than 20 metres away from the machine which shouldn't pose any difficulties. While operating the interface, the computer runs a modified version of Basic called IECBasic, designed especially for control purposes.

The other option is the 8088 Copower board, the latest development from Philips. The 256K of RAM on this board can also be used as a RAMdisk when the 8088 is not in use. This allows the system to run MSDOS. However, MSDOS is not

loaded in the normal manner. On this system, CP/M 80 must first load, then a utility called 'msboot' is run. This prompts for the MSDOS system disk, which then in turn loads the operating system.

## Documentation

Five manuals make up the documentation for this system; three for the Machine and one each for the *Wordstar* and *Calcstar* packages.

The operator guide falls well short of expectations. The whole manual could make up the first chapter in a normal user guide. It deals only with the very basic aspects of using the system, such as how to unpack it and switch it on. The CP/M user guide offers little more in the way of information and only scratches the surface of the subject.

The only saving grace in the documentation section is the 8088 Copower board user manual. This goes into some depth, covering MSDOS, IBM compatibility and sharing disk facilities. Though it is only a preliminary guide, both the contents and the layout are good.

The documents relating to *Wordstar* and *Calcstar* were the original Micro-Pro manuals. Both were self-assembly — if they were pre-assembled, no doubt someone would have noticed that *Wordstar* had grown 'too big for its boots'. The pages in the *Wordstar* guide wouldn't fit comfortably into the folder provided.

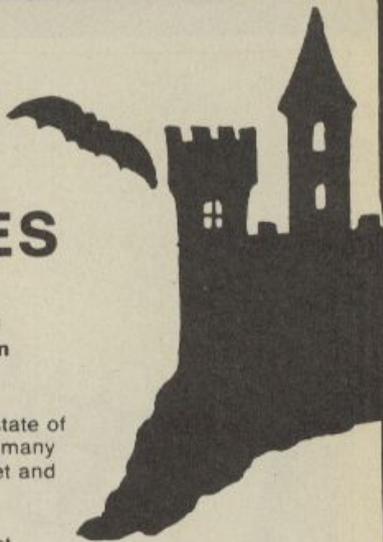
Overall, the Micro-Pro documentation was of a far higher standard than that produced by Philips. If, on the other hand, you wish to do more with the system than just run applications software, I thoroughly recommend the purchase of two other manuals produced by Philips. *The CP/M Reference Guide*, which takes a much more detailed look at the inner workings of CP/M on the P2000C, covers all the utilities like ED (the editor), ASM (the assembler) and



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# HARDWARE PRO-TEST: PHILIPS P2000C



Carrying around the 30lb box of tricks is easy.

as the TPA (Transient Program Area), or more simply, user memory.

Using MSDOS is quite messy because of the swapping around of disks. I found that the best results were obtained by putting the CP/M system disk in drive 2 and loading it, auto booting msboot and leaving the MSDOS disk in drive one. This is especially important when using IBM programs which hang.

All that was needed was to open drive one, reset, wait for CP/M to load and then close drive one.

The only software available to run

Packages are also available to run under CP/M 80 though how many will run under MSDOS, I don't know.

All the usual CP/M utility software is included on the system disk but the Config program allows more features than usual. It is possible to program all the keys on the keyboard and also the video attributes for the characters.

## Verdict

As far as CP/M on the system is concerned, the P2000C is a very well designed machine, it's well thought out



The Philips P2000C's shoulder strap also holds the keyboard in place.

DDT (the debugger) in some detail, as well as BIOS (Basic input/output system) and BDOS (Basic disk operating system).

The other, and far more important, manual is the *System Reference and Service Guide*. It covers in great detail such subjects as the I/O ports and the use of machine code for accessing the disk drives for test purposes. It also contains a full list of keyboard codes plus control and escape codes for the video driver.

## In use

When the system is first powered up, control is taken up by the PL (initial program loader) ROM. This tries to load CP/M first from drive 1 and then, if unsuccessful, from drive 2. If it still fails to find a system disk it prompts with 'System disk?'. By pressing escape, control can be passed over to the system monitor.

This allows the user the following features: compare memory blocks, dump memory, read disk track, write disk track, fill memory, execute from a specified address, move memory block, read or write to I/O ports, output all results to the printer, alter memory locations and find a string in memory.

All these are no doubt familiar to machine code users except possibly the disk read and write commands. The disk read facility simply reads a specified track and outputs any error encountered. The write function outputs data to disk two, side two, track nine for read test purposes. The escape key must not be pressed before the 'System disk?' prompt, as doing so causes a ROM error and the screen fills with the letter U. If this occurs, the only remedy I found was a reset.

If the IPL does find a system disk, it loads CP/M in double quick time. The operating system is well implemented on this machine to allow maximum free user memory. The BDOS takes up 4K and the BIOS only 1K. This leaves 59K

under MSDOS was *M Basic 86*, which worked well enough. I tried also to load some IBM Basic programs, but they didn't run, because Basic uses different tokens, I think.

## Software

Two well known software packages come as standard with the machine, *Wordstar* and *Calcstar*. Because not all the keys on the keyboard correspond with the *Wordstar* commands, the package includes command stickers to place on the keytops. Other software available includes *Mbasic*, a business graphics package, and the *Sage Accounting System*.

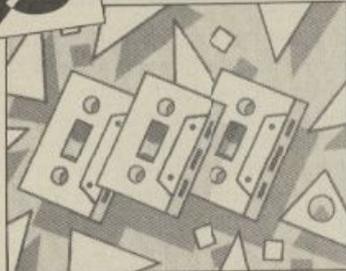
and reasonably priced. Good, reliable software is available immediately, which is always a good sign. The addition of MSDOS and IBM compatibility is not so nearly as good.

Philips appears to be under increasing pressure from other IBM compatibles and has responded by quickly putting together a board to meet this threat. It hasn't worked. The Copower board can only be recommended if you want another operating system and more memory, or you need to run a specific piece of IBM software. But as a machine that runs MSDOS and CP/M (and it is possible to run them concurrently sometimes), P2000C has a lot going for it. ■

## SPECIFICATIONS

System	Philips P2000C
Price	£995 to £1,990
Processor	Two Z80 4MHz, 8088 with Copower board
ROM	16K 8K-terminal, 4K-IPL, 4K-character generator
RAM	64K use, 32K graphics. Copower board adds 256K RAMdisk board adds 256K
Screen	80x25 or 512x252 high, 256x252 medium
Keyboard	93 keys, function, cursor, editing
Interfaces	Two serials, video out, external floppy and hard disks, various plug-in boards
Operating system	CP/M 80 or MSDOS with Copower board
Software	Wordstar and Calcstar and Basic86
Distributor	Kingsway Data Systems, 09328-68911

# SOFTWARE PRE-VIEW



We take a look at new appearances on the software scene and outline the shape of things to come. Note to publishers: If you wish your company's product to be included in this round-up, please send only the very latest releases to **Bryan Skinner, PCN, 62 Oxford Street, London W1A 2HG.** Don't forget to include prices and telephone numbers.

## COMMODORE 64



Addison Wesley's games are something of a surprise. Poor seems rather strong, but look at the price. For £15 you would expect to get quite a product.

The most exciting part *Dreadnought*, for example, is the packaging. The games themselves aren't as good as many magazine listing. You'd probably feel cheated if you'd paid the more usual £7. Something has gone very wrong somewhere, rather like it did with Century's new Spectrum games (PCN, issue 88).

Ever fancied being a barman? Well, *Tappper* draws on this theme in an original and entertaining game. It's a US import from Bally Midway in which you play the part of the bartender and have to keep clients' glasses filled.

Being toppers they knock the stuff back at a fair pace and sling their glasses about, which you also have to catch before they break.

Do you have nightmares about ink-worms? Arthur, the hero of *Quinx* has. You help him stamp out the inkworms which crawl across his exam paper. If they get to the other side they turn into paper-eating monsters which devour Arthur's A4 sheet.

There are bonus points for eating food, which appears at random. But then you'll have to take Arthur to the toothpaste or not even an apple will keep the death-dealing dentist at bay.

For younger players there's *Paddington's Garden Game*. It's a gentle introduction to arcade games as you guide Paddington around his garden. He has to catch butterflies (but don't worry, they're all released at the end), and avoid the snails and hedgehogs.

It's colourful, fairly tuneful and quite relaxed. Not much learning involved, but then

again, why should software aimed at a young audience always be educational?

Mirrorsoft is really going to town with its younger user software. Continuing the Caesar theme, *Caesar's Travels* comes with a 60 page instruction booklet which includes some half-dozen pictures to colour in.

The booklet has a story, but with 18 different endings and the package includes a useful keyboard overlay with commands like walk, go back, jump and hide.

One normally associates Longman with educational software, but according to the latest press release, the company's just released the arcade/strategy game, *Agent USA*. You must build up your defences while warding off the Fuzz (this is in the States, remember?). The aim is to defuse the Fuzzbomb which turns innocent citizens into Fuzzbodies.

We're told it uses 'top-flight graphics, smooth animation, and an instantly accessible but ultimately complex strategy framework'... we'll let you know what it's really like soon.

The trend of the game of the film continues with *Alien*. It's a sort of strategy/adventure in which you direct the actions and movements of the crew of the *Nostromo*.

The story is told in a booklet, just up to the point where the eighth passenger makes its stomach-turning debut. Although you're playing Commander, the characters won't necessarily obey your orders.

Their characters and experiences will influence their actions, so it's up to you to get familiar with them so you can predict what they're likely to do.

The film was good, but complex as the game may be I feel *Mindgames* has missed out on the chance to produce a really good product.

<b>Tappper</b>	£9.95	US Gold 021-359 3020
<b>Quinx</b>	£6.95	Supersoft 01-861 1166
<b>Alien</b>	£8.99	Mindgames 01-437 0626
<b>Caesar's Travels</b>	£7.95	Mirrorsoft 01-835 0246
<b>Combat Lynx</b>	£8.95	Durell 0823-54489/54029
<b>Paddington's Garden Game</b>	£6.95	Collins Soft 01-493 7070
<b>Agent USA</b>	£7.95	Longman 0279-26721

<b>Jet Power Jack</b>	£7.95	Micro Power 0532-434006
<b>Frenzy</b>	£7.95	Micro Power 0532-434006
<b>Military Coup</b>	£14.95	Addison Wesley 0734-794000
<b>Dreadnought</b>	£14.95	Addison Wesley 0734-794000
<b>Front Page</b>	£16.95	Addison Wesley 0734-794000
<b>Waterloo</b>	£16.95	Addison Wesley 0734-794000
<b>Mutant Monty</b>	£6.95	Artic 01-995 2151

## SPECTRUM



Bad news for those still struggling with *Lords of Midnight*. Beyond has just released the follow-up, *Doomdark's Revenge*. It is similar to *Lords*, but the plot, character independence, size, etc have been improved. We'll be carrying a review before Christmas.

*Mutant Monty* wants one thing from life — to get rich and famous. There are 40 rooms in which Monty can pick up piles of gold. Naturally there are various beasts, aliens and so on, intent on stopping him. And as for getting famous — just help Monty rescue the damsel.

For UXB freaks there's *Bomb Scare*. Essentially a platform game, you have to get to Cyril Saboteur's bomb before it explodes. There are some neat graphics touches, but it's one of those very fast, infuriatingly difficult games that are almost impossible to play, and which therefore is unlikely to do well.

Sinclair's association with ASK and MacMillan is producing a wide range of educational software.

If you want to get into meteorology, check out *Weather Master*. It's one of the latest in Sinclair's excellent Science Horizons series, some of which are as valid for adults as for

students. Written by Fiveways, *Weather Master* will help you learn about weather systems and how they produce our climate.

*Wordsetter* and its companion games are aimed squarely at the under-eights. *Wordsetter* gives you two games which are intended to introduce the concept of sets. *Estimator Racer* has you in the driving seat of a racing car which must be steered into the lane which corresponds most closely with the answer to a sum. If you're in the wrong lane at the half-kilometre mark, you'll be unable to avoid a large rock, not known to be beneficial to Formula One vehicles.

Do you ever get frustrated by your slow typing speed when you're hacking in PCN listings? *Touch-Type* might help, although it's intended as an aid to 'real' typing, with a proper keyboard (no, I don't include the Spectrum Plus in that category).

There are four levels of help and 15 lessons. There's a performance report at the end of a session, and the program probably beats evening classes on price at least.

*See-Kaa of Assia* was supposed to cost £7.50, (PCN, issue 84) but now Mastertronic has set up Master Adventurer, the price has tumbled to £2.99 and we're promised many more cheap adventures next year.

<b>Doomdark's Revenge</b>	£9.95	Beyond 01-837 2899
<b>Number Painter</b>	£4.95	Sinclair 01-499 2666
<b>Estimator Racer</b>	£4.95	Sinclair 01-499 2666
<b>Weather Master</b>	£7.95	Sinclair 01-499 2666
<b>Mutant Monty</b>	£6.95	Artic 01-995 2151
<b>Accelerator</b>	£1.99	Century City 0384-57077
<b>Olympic Challenge</b>	£1.99	Century City 0384-57077
<b>House on Damned Hill</b>	£1.99	Century City 0384-57077
<b>Attack on Atlantis</b>	£1.99	Century City 0384-57077
<b>See-Kaa of Assia</b>	£2.99	Master Adventurer 01-402 3316
<b>Touch-Type</b>	£8.95	JCS Software 0932-65354
<b>Bomb Scare</b>	£6.50	Dollarsoft 0742-363246
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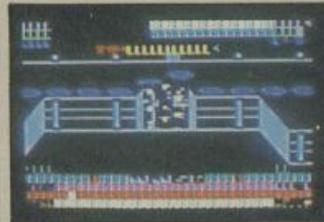
## COMMODORE 64

### PSI WARRIOR

Games are becoming so mega that you need a nuclear physics degree to understand the instructions.

The five chapters of introduction say you are a warrior in a gigantic silo, and you are trying to reach the Source at the foot of the silo to destroy it. The silo has guards, of course, and is vast, as you can see if you press the f3 key to take you into Remote View mode. This can be done if you are in a transportation chamber, such as when you start the game, and it allows

you to leave your body behind and scroll round the silo in peace using the keyboard or joystick. The size makes the Land of Midnight look like someone's back garden. Your



immediate vicinity is shown in the centre of the screen.

The silo is inhabited by Psis, Ids and Pupae — weird creatures attacking different parts

of your mind. They're ghostly shapes, represented by a group of tiny swirling squares of different colours, and you defend yourself and your sanity by firing your psi-nets at them. You start the game with 80, and they are activated by using the fire-button twice -once to jump). Netting a creature doesn't kill it, but restrains it for a while, allowing your escape.

The character you control is rather lacking in fine detail, and resembles an SAS man in jump-suit and white visor, but his movements are a delight. Turning the joystick in a full circle causes him to swivel through 360 degrees, while his head moves constantly from

side to side to check all the angles. He glides along, and with a neat switch you can be firing while retreating or advancing on one of the enemy.

There are almost as many controls on the screen as on the flight-deck of Concorde.

If it gets you hooked, it could keep you occupied for months, though it didn't hook me in the way the last few Beyond releases did. It was so complicated I switched it off with almost a psi of relief.

Mike Gerrard



Rating 7/10  
Price £9.95 Publisher  
Beyond Software  
01-837 3699

## DRAGON

### SNOW QUEEN

I've been reviewing Dragon software for almost two years now, more or less since the machine first came out, so it's obviously an outstanding piece of software that makes you say... this is about the worst thing that's ever been loaded into the beast. This is a shame because the intentions are obviously good, but good intentions don't make for good software, I'm afraid.

Based on Hans Christian Anderson's story, *Snow Queen*, this is a spelling and shape

recognition game from a software name new to me, Cambrian Computersolve.

At the start you're offered optional instructions and these are needed because the game itself is a mite confusing. You apparently have to help spell-out the words that are hidden in the ice on the Snow Queen's enchanted lake, using either keyboard or joystick to move a blue window about the screen to encircle the letters in the correct order.

What happens is that the screen is filled with what appears to be a jumble of various block graphics patterns and you are given a word

to spell out. Just as you can see patterns in the snow, so you can see that some of the letters stand out in the jumble, but others appear to be missing.



By moving the blue window around, though, it should be possible to find other letters because the window blocks out part of the apparent jumble to

sometimes leave a letter that you didn't know was there isolated inside it.

Boredom is just one of the major faults, another being that there is no indication as to what age-range this is aimed at. In fact, it isn't suitable for any age. It's a shame to be destructive over what is meant to be a helpful program, but there's no room on the educational software shelves for this.

Mike Gerrard



Rating 1/10  
Price £5.95  
Publisher Cambrian  
Computersolve  
07456-7121

## COMMODORE 64

### CLIFF HANGER

*Cliff Hanger* is so similar to the style of the *Roadrunner* cartoons that I wonder if it wasn't originally written with these in mind. Discretion being the better part of copyright problems, the characters here are two cowboys. Cliff Hanger is the hero (you may know his brother, Coat, and cousin, Aircraft).

There are 50 screens in all, each introduced by a clapperboard sequence which tells you which level you're on, which

screen you're on, and which 'take' it is for that screen — in other words, how many times you've goofed up so far and still not got it right.



Each screen has a slightly different desert setting, with rocks and cacti scattered about, you standing on one of the

foreground rocks, and a long road winding into the distance. Along this road runs Mr Bad-Guy, and you have to play the cunning coyote trying to stop the roadrunner using a series of ingenious devices.

The Faraday screen, for example, has you on a cliff on one side of the road with a giant magnet, while on the other side is an anvil. When you pick up the magnet it attracts the anvil to the middle of the road, where it plummets, hopefully just as the baddie is passing beneath.

Other screens include Getting Your Own Back, where you throw a boomerang, and va-

rious others involving trampolining, bomb-throwing and boulder-dropping.

Only falling off a cliff loses you a life, though in the 30 screens of the second level you have to be much more careful and get out of the way of the devices, which have a habit of backfiring on you.

The graphics aren't quite up to cartoon standard, but they're amusingly done.

Mike Gerrard



Price £7.95 Publisher  
New Generation  
Software 0275-  
884752

## SPECTRUM

### TRAVEL WITH TRASHMAN

Having won your Diploma of Trashmanship in *Trashman*, New Generation now makes you an offer you can't refuse (sorry) — the chance to be a bin-man all round the world.

You start with £250 in your pocket, which obviously won't get you far with the price of air fares these days, but it will take you to Paris, Munich or Madrid and still leave you some change.

In Paris the problem is frogs hopping about a pavement cafe. You have to move in and out of the tables to collect them,

avoiding the waitresses, who say something rude in French should you bump into them. Your cash decreases with time passing, especially if you're inefficient or clumsy. You can increase it by clearing the screen enough to allow you a little hop to another city.

Like Munich, perhaps, where you wind up in a beer hall and have to clear the tables of empties as the beer-swilling Germans go about the serious business of getting persistently drunk. Different tables raise their arms in unison, and some characters can put away more than others. It's up to you to nip round and collect the empty

glasses, trying to avoid the temptation of a quick tipple yourself.

If you're capable of standing and haven't lost the air fare you



can maybe then go to Madrid, keeping a bull-ring clean.

The only complaint is the long delay between games. You really want to get on rather

than watch messages scroll across the screen. There's a lot of rubbish about, after all.

You'll have to work hard and efficiently in the cheaper places to earn enough to reach exotic locations like Samoa and Hong Kong. Don't ask me what the trash trouble is in Samoa — I'm have enough trouble with the frogs. A fun game, and a good follow-up.

You shouldn't need to bin this one.

Mike Gerrard



Rating 8/10  
Price £5.95 Publisher  
New Generation  
Software 0225-  
316924)

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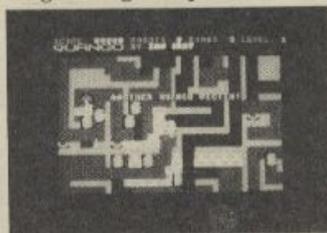
## COMMODORE 64

### QUANGO

It's taken me months to remember that a Quango is a Quasi-Autonomous Non-Governmental Organisation, and then along comes Interceptor to inform me that it is in fact a bird that has the power to fly through earth and rock and chase robots. The good news is that it takes ages to hatch out. The bad news is that you're a robot — Angus Fungus — and it's your job to gather the mushrooms in the eight caverns deep below the surface of the planet Sedron in this *Dig-Dug* variation.

In the first cavern there are passageways leading maze-like towards the ten mushrooms,

and as you move (joystick only) you remove patches of soil that fill some of the passages. There are also rocks hanging around, and if you remove the soil from beneath such a boulder it no longer hangs but plummets...



Make sure it doesn't land on you, but preferably on the Wrightoid robots that for some reason are chasing you round the passageways. Maybe they just like mushrooms, and while the instructions describe them as 'evil but stupid' they certainly

ly show no stupidity in the way they tail you and chase you.

Another hazard for Angus is the giant Quendorian wortweed. When the soil is removed from above one of these little plants it shoots upwards as far as it can, right up Angus's trouser-leg if he's not out of the way a bit sharpish. Even if he is, the plant still blocks the passage. Boulders, too, have a habit of blocking you in, and as well as being a test of joystick dexterity, *Quango* is also a strategy game as most of the mushrooms are in unreachable places. Fortunately you can pause the game to give you some hope of figuring out what to do, and I found a good tactic was to choose a different mushroom on each foray, spend a little time trying to figure out how to get at this particular

one, then hope later to string them all together in one mad dash. However, as I've not yet got out of the first cavern maybe this isn't the tactic to recommend.

Each cavern occupies several screens, and the scrolling movement is very smooth with lots of jaunty music. You're aided too by a supply of bombs, and you have just enough time to plant one of these (using the fire button) and escape. In the four deepest caves there are underground streams.

An excellent game, fast-moving and frustrating, addictive and amusing.

Mike Gerrard



Rating 9/10

Price £7.00 Publisher Interceptor Micro's 07356-71145

## AMSTRAD

### BRIDGE-IT

I wouldn't class this as one of the most exciting games I've seen — in fact it's dead boring.

*Bridge-it*, as its name suggests, is about bridges. You spend your time opening and closing bridges for your men to cross.

To control the four bridges you can use a joystick or the keyboard. If you prefer, you can redefine the keys for your own ease but I think that A for top, Z for bottom, > for right and < for left is quite a good selection.

There are nine levels of play and you can have from one to 50

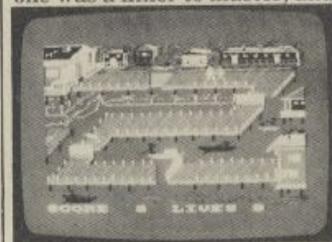
lives — sounds a lot but you'll need them if you are ever to finish the game. Other features of the game include H for hold, S for continue, N for music stop and M for music plays.

I started playing the game at level one with 50 lives — well, I'm a pessimist. The outcome was horrendous.

Getting the first man over the first two bridges wasn't difficult — it's when you have more than one man on the screen that things get a bit tricky.

Even with fast coordination on the keyboard, men kept dropping like flies into the water. And with 50 of them pouring onto the screen, things got out of hand

Next I opted for level one, but this time with one life. With one life you get three men. Well, would you credit it, even this one was a killer to master, and



as soon as one man falls into the water the game comes to an end.

The game then becomes tedious because you don't actually achieve anything. With 50 men I managed to get some

across the four bridges safely but I didn't win any prizes.

Another irritating thing about the game is that after you've lost a game you start the monotonous procedure of going through the general screens before you get back to the game.

The graphics are rather static, apart from the men crossing the bridges and the bridges opening and closing, and the sound is of a fairground type. At £8.95 it's not for me.

Sandra Grandison



Rating 5/10

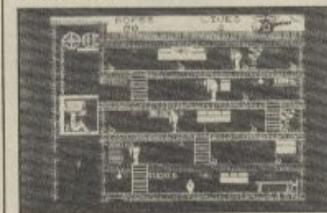
Price £8.95 Publisher Amsoft 0277-230222

## SPECTRUM

### PLUMMET

Ah, I do like a game that has a believable scenario. In *Plummet* you are present at the opening of New York's newest skyscraper when the Mayor gets stuck in the lift between floors. You have to take the 30 pieces of rope scattered about the building up to the lift, secure it to the steel beams before the chain breaks, while simultaneously avoiding the

falling concrete blocks, dust, mutant revolving doors and the ghoulish hunch-backed Zombie Doormen.



This nonsense might have made a nice enough game, but unfortunately it doesn't, being

badly let down by the poor graphics and even poorer sound.

Your hero is Mr and Mrs Cart's little boy, Orsen, and he starts at the foot of the building, which is made up of three vertical screens. Down the left of all the three is the lift shaft, where the Mayor does his plummet once you've lost your third life, and all three screens have the usual ladders and platforms and the flashing pieces of rope.

Apart from the fact that the game soon gets tedious, the main drawback is the poor

quality of the graphics. Not only that, but the falling dust is inaccurate: sometimes it kills you without actually touching you, and at other times it will pass right through you. The same might be said of the game... it passed along the conveyor belt of new Spectrum software with no discernible impact.

Mike Gerrard



Rating 4/10

Price £7.00 Publisher Interceptor Micro's, 07356-71145

## COMMODORE 64

### THE NOMAD OF TIME

The presentation of this 'illustrated text adventure' is impressive, with an excellent sci-fi cover to the large video-style wallet that houses the fast-loading tape and the 16-page booklet of instructions.

Sub-titled *The Adventures of Oswald Bastable*, it is based on a trilogy of books by Michael Moorcock, though you're told it's not essential to read the books before tackling the adventure.

The scenario takes a page to explain, but it boils down to the fact that the very logic of Time itself has been threatened and you, Captain Bastable, must explore the earth to find and bring together the Jewels of Time in order to avert disaster. You have enough food and water for 60 days — can you save the world in this time? Just to keep you on your toes there's a clock ticking away in the top-left corner of your screen.

There are two main parts of the program: a conventional adventure set in various places on Earth and a simplified flight-

simulator which shows the display panel of your airship, and by which you must land in the ten places where the adventure



takes place, ranging from Singapore to East Grinstead.

In the adventure itself you're given little help, other than

that you use the standard two-word format. Landing outside the public library in East Grinstead I wanted to explore but the commands I tried all resulted in 'Not possible, Bastable!'

There may be a good adventure in here struggling to get out, but if the world comes to an end in 60 days' time don't blame me, blame this program.

Mike Gerrard



Rating 4/10

Price £9.95 Publisher Mosaic Publishing 01-2284463



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## SPECTRUM

### SKOOLDAZE



I'm going to stick my neck out and say that *Skooldaze* is the most original, entertaining

game I've seen on the Spectrum this year, if not ever.

Eric's lot is not a happy one. The school reports are stashed in the staffroom safe and the young lad must remove his before the headmaster sees it. The safe works on a four-letter combination, each letter known to one master only, and the headmaster's comes first in the sequence.

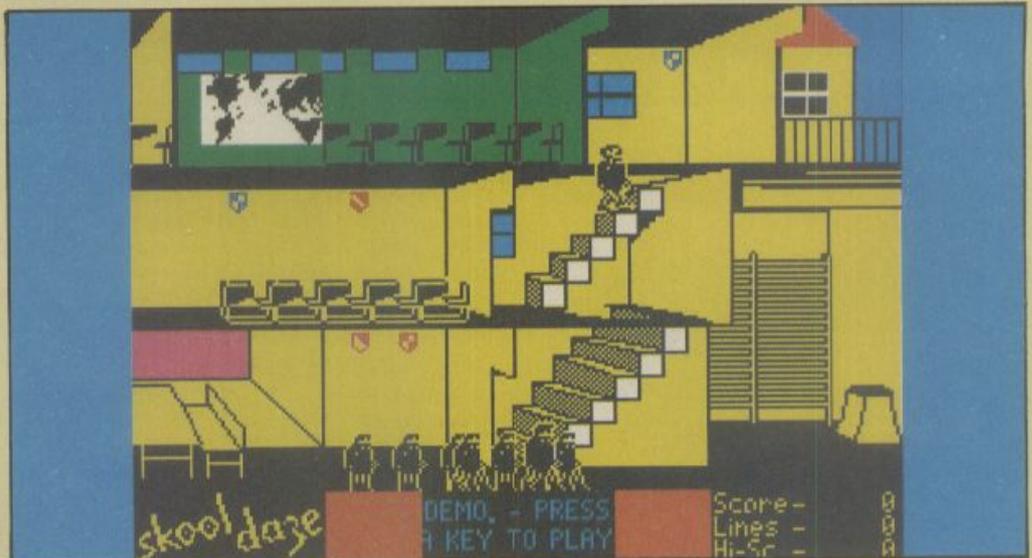
To get the letters Eric must hit all the shields hanging on the school walls. This starts them flashing which confuses the masters. Then you can knock them down and force them to reveal their letters.

There's so much going on in *Skooldaze* that it's difficult to know where to start. Imagine the screen as a window on the school. There are three floors and as Eric approaches the right or left of the screen, it scrolls to reveal a side of the school. There are staircases at the extreme left and right, and the graphic detail is fantastic.

The map room on the top floor comes complete with a tiny black and white map of the world on the wall. Many of the rooms have blackboards and you'll occasionally see some urchin chalking up graffiti like 'I hate fizzicks'.

The school is a hive of activity — masters and pupils wander about, bullies flatten classmates, catapult shots are rife and should Eric be struck he's out for the count for a few seconds.

And woe betide him if he's caught flat on his back, punching a fellow or using a catapult. The punishment is lines, lines and more lines. The worse his behaviour, the more lines he gets. If he accumulates more than 10,000 he's expelled and the game ends.



From time to time a bell sounds, marking a change in lessons and Eric must hurry to the room indicated at the foot of the screen. Some rooms are obvious, but before you can get very far in this game you have to master the geography of the school.

Arriving too early usually gets Eric involved in a scrap with his pals, but being late will earn him more lines. Even when he finds a seat and sits on it and not the floor, he can't look forward to a peaceful lesson. Pupils are in constant motion, may sneak round and unseat him, fire catapults at him from behind, rat on him to teacher for things he's not done and worse.

Speech is handled brilliantly. A tiny, cartoon bubble appears by the speaker's head and acts as a window through which the words scroll.

During a lesson, questions are posed by the teacher and pupils answer, generally beginning, 'Please Sir, I cannot tell a lie...'

And if Eric tries to escape the mayhem of the lesson, someone's bound to tell tales and it's more lines. It's unnerving to approach a group of schoolmates and be told that someone has hidden something implicating you in some misdemeanour, and that if one of the masters finds it you'll be in trouble — I

had visions of the counter soaring to the 9,000 mark.

A clever touch is that you can use names of your own choosing for the characters.

But what about the shields? Well, it'll take you some time before you get anywhere close to even thinking about that nasty report sitting in the safe. Merely existing for more than a few minutes is beyond the skill of the novice.

Most of the shields are too high to reach by jumping, but one method is to knock down a teacher with a catapult, then bounce another shot off his head while he's sitting dazed on the floor, hoping that the ricochet will strike the shield. Risky it may be, but it's not the only means at his disposal. He could knock down another pupil, then stand on him and jump or fire. Other methods I leave to your imagination.

But it's still not that simple. The History master cannot remember his letter. To find it out Eric must establish his year of birth (different for every game), get to a room with a clean blackboard before him and write it down, and when the master sees his birthdate he'll reveal his letter.

Letters won't be given in sequence — Eric may have to make several attempts at opening the safe by writing guesses

on clean blackboards, then rushing to the staffroom to try out the sequence. Once the safe's open all the shields have to be hit again to stop them flashing and conceal the evidence of Eric's errant ways. And then Eric moves on to the next class in school... I told you it wasn't easy.

The only criticisms I have are that it's so good that it distracts you from your aim, and it's too hard. But seriously, sometimes the keys repeat as if a keyboard buffer were being used. This means that if you hold the catapult key down too long, and get punished for the first shot, more, involuntary shots will be fired and more lines given. Also, it can be difficult to position Eric accurately at the foot of the stairs to make an ascent, and there are some attribute problems.

Minor niggles apart, *Skooldaze* is brilliant. It's got the most detailed and interesting display I've ever seen in a Spectrum game, the setting and idea are original, the execution a triumph of the programmer's art.

It could even create a cult following and if it's not number one by Christmas I'll be very surprised.

**Bryan Skinner**

**Price** £5.95

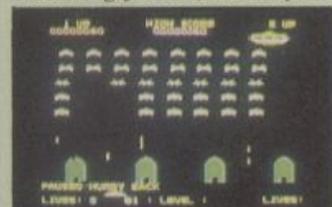
**Publisher** Microsphere, 01-883 9411

## COMMODORE 64

### INVADERS — 64

Just what eager Commodore 64 owners have been pining for ever since the machine's appearance... yes, a version of *Space Invaders*. What... it's been done before? I don't believe it! 'Re-live those exciting and frustrating moments on (sic) the arcades,' it says. But there seems to be something lacking in the translation of the game onto the micro... like speed,

for one thing. Even the hardest of the five skill levels begins exceedingly slow, as if your



laser base were gliding through treacle.

To be fair, Livewire has tried to incorporate just about every

facility known to the games player. Apart from the five levels and the one- or two-player option, you can pause the game, switch the sound off and on (sound is adequate), enter your name in the Hall of Fame, use joystick or keyboard (define your own keys) and finally have a demonstration. Perhaps the game is so old most people will have forgotten how to play it?

You can tell the company is pretty desperate to know what to say about the game from

reading the cassette insert. 'User definable operating key system', meaning you can choose which keys move you left and right, and 'Zap your way to the stars!'

Your reviewer is pretty desperate to know what to say about it too, other than put it at the bottom of your list.

**Mike Gerrard**



**Rating** 3/10

**Price** £6.50

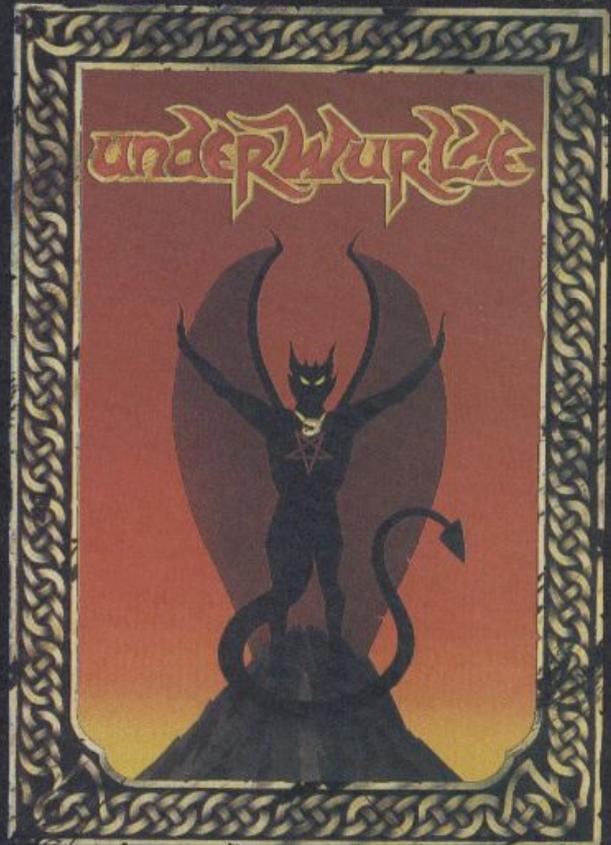
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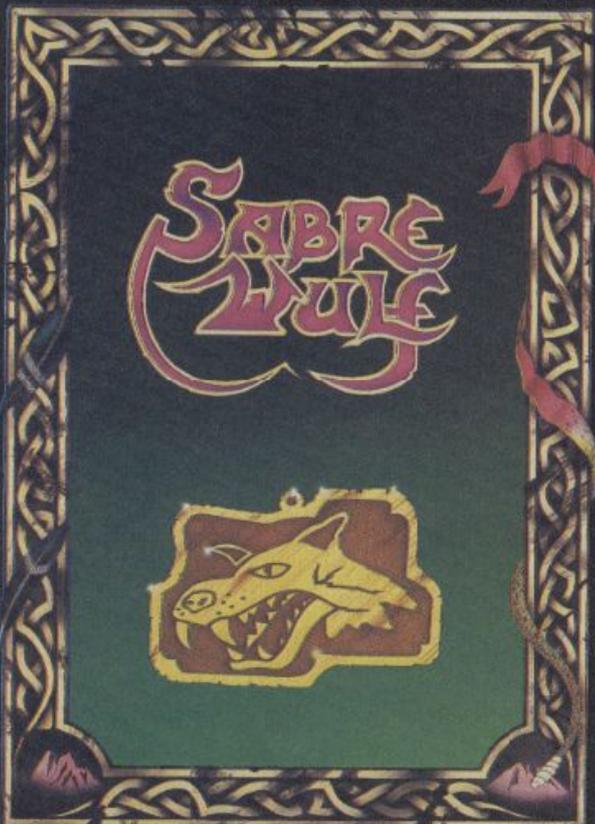


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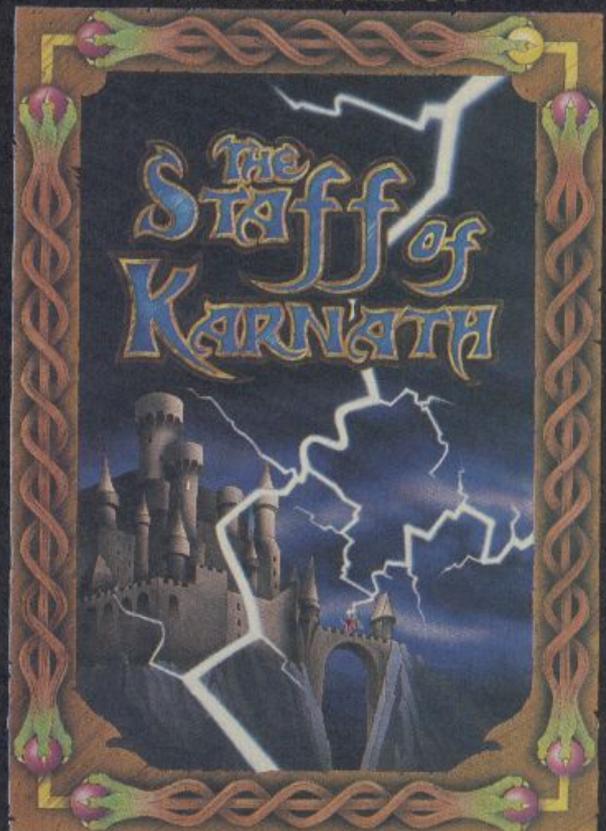
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COMMODORE 64



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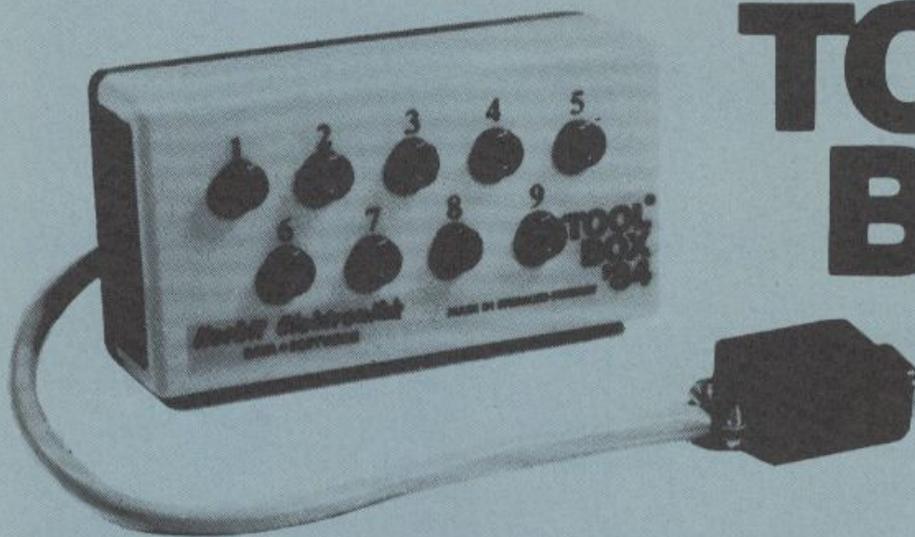
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As usual with a new machine, especially with a relatively new chip, the QL is short of software — apart from the excellent Psion programs.

Software developers have been waiting for machine code programming via an assembler. One of the first, and very good it is too, is Metacomco's QL Assembler Development Kit.

## Features

The package incorporates a powerful full-screen editor and a macro assembler. I feel the title is a bit of a misnomer as a full development kit should include some means of debugging and disassembling the resultant machine code as in Hisoft's *Devpac* for the Spectrum. The editor can be used to prepare any ASCII text file — not just assembly language source statements. The assembler supports the full Motorola instruction set and can produce absolute, position independent or relocatable code as required. A program to run via EXEC must be position independent, as the code is loaded anywhere in memory, and Metacomco's assembler automatically uses program counter relative addressing to assist in this process.

The two-pass assembler provides full macro expansion, conditional assembly, standard Motorola mnemonics and over 160 error messages in plain English.

## Presentation

The kit comes on a Microdrive cartridge containing the editor, as one file, and the assembler which is held in four files — the main module and three overlay segments. The cartridge also holds two sample assembly language source programs. One is a simple test and the other provides a clever demonstration of the QL's windowing and multi-tasking abilities. The review manual is in A5 format with 13 pages describing this lovely editor and 28 on the macro assembler.

## In use

Both programs are invoked using EXEC or EXEC\_w. EXEC allows you to switch back to SuperBasic while ED is running — then you are prompted for a file name to be supplied in standard QDOS form. ED goes on to ask for the workspace required — default is 12K bytes which is enough for small to medium text files. Specify this amount as a number (smallest 8000) or in units of 1024 bytes by putting number followed by K (largest 61K). I used ED to edit a SuperBasic program of some 494 lines (using 88 per cent of 20K space) changing all procedure names to upper case (once mentioned in Basic the normal editor will not allow change of case as it automatically converts to original) and generally tidying it up.

At the moment I am using the editor on two files concurrently, having EXECED

Tim Maddrell offers his views on a new QL assembler kit

# MACRO ASSEMBLER BOOST

one and EXEC\_wed the other, so I can flip between them using CTRL-C plus a quick F4 to redraw the screen. The main review is in this one and I am keeping casual notes of points-to-mention in the other, smaller window.

Multiple versions of ED can run at the same time but on my old ordinary 128K QL, multiple means two — even using smallest possible workspaces and windows.

I found I wanted to redefine windows after starting editing — too large windows take time to refresh, especially if a right margin is specified off the edge of the screen causing horizontal scrolling of the whole window when passing this edge, and too small is also a nuisance. Redefinition means exiting and starting again; I am using an 80-column main window now and each time I come back to it, I must guess at the window size — not always correctly. Perhaps I should set the window too large and then specify the right margin

## Table: extended commands

A/s/	Insert line(s) after current
B	Move to bottom of file
BE	Mark block end at cursor
BF	Backwards find
BS	Mark block start at cursor
D	Delete current line
DB	Delete block
E/s/	Exchange s into t
EQ/s/t/	Exchange but query first
F/s/	Find string s
IB	Insert copy of block
IF/s/	Insert file s
SH	Show editor information
T	Move to top of file
U	Undo changes on current line

at 80 ... yes, that seems to be the answer. Metacomco recommends 'snapshot' file saves at regular intervals especially if you are plagued by a spiky power supply — very simple with extended command SA. I have put an extension of \_exp on the file name and will import it into *Quill* to print it.

The bottom line of the window is reserved for error messages, and for entering extended commands; this single command line can hold many commands, separated by semicolons, and be up to 255 characters long.

The editor has most things well covered, including file merging and partial saving; I should like it to have tabs at any position, not just at fixed spacing, window redefinition and perhaps insertions or deletions changing whole paragraphs.

What is the next step once you have formed your assembly language source file? Unfortunately, there is not room to hold both the editor and the assembler together in memory, and use them, so there is a fair bit of swapping files in and out of memory via Microdrive during program development. The editor occupies about 20.4K on Microdrive and the assembler main module about 15.2K with the overlay segments taking roughly 6.6K, 30.5K and 2K each so these are large programs. I suppose this is the penalty paid for sophistication.

A session which loaded the editor, edited a small file — correcting one error, saved the source back, loaded the assembler, assembled the program without a listing and saved the final program in executable form took 3¼ minutes.

QDOS holds a wide selection of machine code routines available for use in your own programs — this should save having to write a lot of tedious code merely to handle character and file I/O, for example. These routines are called into action by putting various parameters into appropriate registers and then generating the requisite trap (all very well explained in *QL Advanced User Guide*, by Adrian Dickens).

## Verdict

A most professional product (reflected in its high price) which should enable the production of some really worthwhile software for this potentially powerful micro.

On a fairly trivial level, it is fun to see a clock ticking away in the corner of the command window, a trace of your SuperBasic program going on at the top of the screen, an alarm to remind you to feed the budgie and your Basic program all chugging along happily together — thanks to multi-tasking. It is a pity the programs are so large that they, plus source files, cannot be held in memory which would make simple changes much faster, and I think the Assembler Development Kit lacks a monitor/debugger. Otherwise I cannot fault it.

## REPORT CARD: 1 TO 5

Features	●●●●●
Documentation	●●●●●
Performance	●●●●●
Overall value	●●●●●

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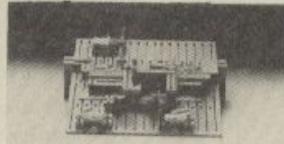
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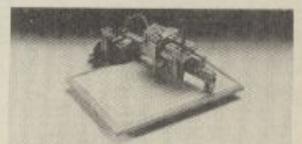
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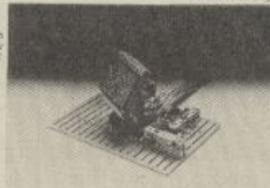


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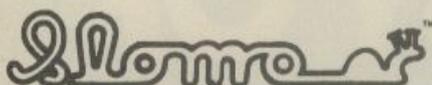
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The Logic 3 Spectrum Club was launched in July, 1984 and has been an outstanding success. Already more than half-way to its target of 10,000 members it has kept Logic 3's staff working seven days a week just to keep up with demand. Tony Toller, Logic 3's managing director and coordinator of the Club, explains its success as follows: "With other clubs once a person has joined there is no more reason for the club to try to support its members who each month have to purchase a certain number of products from a short list. Our Club is different. Members have no obligation to purchase any products from the club so the pressure is on us to choose only the best quality products and offer the best possible prices. We also take a lot of pride in publishing independent reviews on all the products we carry and if we do not like something about a product we are not afraid to say so."

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## LOGIC 3'S SOFTWARE PANEL

Neil Atkinson, pupil of Sir William Borlase School, spends his weekends in a shop selling home computer software, intends to work as a journalist.

Andrew Goitz, director of Logic 3, spent 6 years with Commodore's UK and International Division, instigated Commodore's 'Approved Product' scheme for third party software.

Bliss Healey, graduate of London School of Economics, has translated business software into French, currently working on the design of graphics for educational software.

Tony Toller, director of Logic 3 former journalist, specialist in business applications on Mic and co-ordinator of Logic 3's software club.

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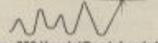
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**CBM 64**, C2N cassette, printer plotter, books, lots of software magazines. Swap for BBC-E with DFS or sell £350. Write: A M Simm, 67 Kings Avenue, Flint, Clwyd, CH6 5JS.

**C64 business software** Viza write/Vizaspell £59.95, Practicalcalc £29.95, Chartpak £19.95, Basicalc £12.50, all disk trippler graphics/text interface £39.95 1541 disk/drive £150. Tel: Petersfield 68597.

**Commodore 403232K** system, dual disk drive, printer, cassette unit, word processing program, dust covers, manuals. Sensible offers, may split. Tel: Marlow 06284 6768 daytime.

**VIC 20** + super expander + C2N + 3 tapes (Panic, Arcadia, Catcha Snatcher) + 5 blank tapes + 3 carts, £110 or swap for C16 Gary Bennett, 25 Broughton Road, Leicester LE2 6ND.

**CBM 64 Multiplan 64** spreadsheet program, as new in presentation case, with thick ring binder manual. Cost £99, sell for £50. Tel: Tony 01-690 3820.

**CBM 64 software** sale, superbase 64 £45, EasyScript £20, Makro-Assem. £10, RS232 I/F - cable £15, games less ½ price TI99/4A starter pack 1 & 2, Gamewriter 1 & 2 all £10. Tel: (Essex) 0865 54084.

**VIC 20 C2N** datasette 16K switchable RAM pack, joystick, carry case, £250+ of software + books and magazines worth over £400. Sell for £110. Tel: 0803 524448.

**CBM 64 software** to sell or swap: games like Kokotoni Wilf, Beach Head, Bruce Lee, Arabian Nights, Strip Poker and more. Tel: 07062 229875.

**Commodore 64** + cassette + £30 worth of games + Quickshot joystick + manual still under guarantee. £180 ono, v.g.c. Tel: 01-743 3619.

**Wanted Commodore 1541** disk drive for £100 or under. Extra software for 64 considered. Tel: 0223 247980, ask for Keith (not Tuesday or Sunday).

**VIC 20** cassette deck, new 16K RAM pack (switchable) Pastmaster Pro joystick, £60 worth of games, books, all original boxes, worth £250: £90 ono. Tel: Chipping Sodbury 312735.

**Centropods Galaxions**, Pakuda, Armageddon, Escape Lander, Blue Moon, Annihilator, Rollerball, Exterminator, Road Roller and lots more. Comm 64, £5 each. Darren Shack, 89 Cobbold Road, Leytonstone E11.

**Belgian CBM 64** user wishes to swap software. If interested contact de Schepper R, Rozenlaan 13, 9080 Moerbeke-Waas, Belgium, Speedsaver for £4.

**Commodore 64 swap**: I have about 400 titles, both American and English games. Contact Toakim Asplund Askebyvagen 32, S-59062, Lingshem, Sweden.

**Commodore PET** with games and software, also lots of literature £160. Hardly used. Contact Richard Wood, 10 Warren Gardens, Stockwood, Bristol. Tel: 0272 838606.

**Commodore 64** £145, C2N £30 Intro Basic Part 1 £8, reference manual £9. No offers please. Tel: Petersfield 68597.

## Sharp

**Sharp PC-1500** Pocket computer, brand new, cont. £179, sell for £100. 4K RAM, manual £ Tel: Worpleston 232967 between 6.30pm-10.00pm.

**Sharp MZ80K** computer with printer/twin disks and interface. Software including assembler, compiled, interpretive Basic, Forth, FDOS, £450. Tel: Brighton 34030.

**Sharp MZ700**, ten months old, excellent condition with, £120 software, magazines, manual, dusterover etc. £320 ono. tel: 0387 68682 evenings. Deal includes data recorder.

**Sharp PC-1500** pocket computer and CE-150 colour graphic printer/cassette interface, plus 8K RAM module, software and manuals, £200. Tel: John 051-420 4167 eves/weekend.

**Sharp MZ711** with cassette, approx £200 software. Also Lynx 96K, new unused, includes cables. Offers or swap both for BBC with DFS. Tel: Crayford 522380.

**Sharp MZ80K**, 48K RAM built in monitor, cassette, direct printer interface, Shinwa CT 80 printer, includes manuals, books — much software etc. £390 ono. Tel: Exeter 58479.

**Sharp MZ80A 48K** RAM computer with built in monitor and tape recorder, Basic and software tapes, still in box, £300. Tel: (0942) 216733 after 7pm.

**Sharp MZ700**, built in tape recorder database, Zen assembler, disassembler, Chess, extended Basic, 4 months old, £130. Manuals, books. Tel: 01-749 1165.

**Sharp MZ700 64K** memory, built in recorder with instruction manual, leads and information, as new in box. Also £50 of software. £200. Tel: Bolton 58579.

**Sharp MZ700** built-in recorder, books on machine. £100 ono, one year old, first-class condition. Tel: 05363-67711 eves only.

## Sinclair

**48K Spectrum** + data recorder, plus Holy Grail, hardly used, guaranteed, still boxed, unwanted gift, worth, £170, will sell, £95. Tel: Lea Valley 712830 buyer collects, Waltham Abbey.

**Will swap Spectrum 48K**, for CBM64 Spectrum, has much software and RAM Turbo. Tel: 021-777 9703 after 6pm, will collect, ask for Sean.

**Spectrum Software** for swap or sale. Send list to Brian O'Connor, 5 Almeida Tce Kilmainahan, Dublin 8. Also wanted cheap joystick interface (Kempston/DK Tronics).

**Wanted Spectrum** originals to buy or to swap. Tel: Stockport on 061-485 2883, between 4 to 6pm any day, ask for Steve, 48K only.

**48K Spectrum** software Hobbit £5, Kong £4, Hunchback £4, Hozat £4, Rommel's Revenge £4, Atic Atac £4, Lunar Jetman £4, £20 The lot. Tel: Mellis 350 eves.

**48K Spectrum**, Interface 1, 2 Microdrives, Fuller FDS keyboard, 5 Microdrive cartridges with storage box and RS232I cable. All manuals, leads etc, sell, £200 ono. Tel: 01-504 0565.

**ZX Spectrum 48K** + data recorder + £70 of software + Kempston joystick interface, still boxed, + Philips G7000 video game, worth £300, sell for, £160. Tel: 01-958 7390

**Spectrum 48K**, Currah Microspeech, plenty of software, 60 magazines, two books, hardly used, £150 or swap for Laserservision videodisk player. Tel: Sheffield 0742 884183.

**Spectrum 48K**, software, mags, joystick, interface (needs attention), tape deck, £200 ono. (System cost me over £450). Tel: Andy 051 4307608 or swap Atari 800XL + drives.

**Spectrum 48K** with full-size keyboard, joystick interface, joystick, lots of software, books and mags, £120 the lot. Tel: 021-748 3578.

**Sinclair QL**, latest JM operating system, faultless performance, £360. Tel: Gordon (0932) 63522 after 6.30pm eves and weekends.

**48K Spectrum** plus printer, tape recorder, voice box, £100 worth original software, books and other goodies. £240 boxed. Tel: Chris on Holywell 0352 711662.

**Will swap my 48K Spectrum**, printer, recorder, software, books + extra worth £350+ for BBC Teletext interface and 5¼in disk drive unit. Tel: Chris 0352 711662.

**Spectrum 48K Alphacom 32** printer Micronet modem data recorder, £175 software. All boxed, guaranteed sell, £250 ono. Tel: David 01-703 6625 after 5.30 all under four months old.

**QL complete** with software and manuals. Children require BBC B therefore dad has to sell. Offers or exchange young BBC B. Tel: 01-660 5857 evenings, Surrey.

**ZX81 16K** complete with HRG and plug-in keyboard. Books, over 25 games including Flight Simulation, Battleships, 3D Monster Maze, £50. Tel: Leeds 0532 852981.  
**Spectrum 48K** + tape deck + software + mags (over £200 worth) system valve £600+. Tel: Andy 051-430 7608. Offers? Will swap for Atari 800XL + Drives.

## Tandy

**Tandy CGP 115** printer/plotter, 9 months old, Centronics and RS 232C compatible interfaces, £90 ono. Tel: 02572 (Lancs) 71694 after 4pm.

**Tandy TRS-80 Model 1**, level II 16K plus green screen monitor and manual, £90. Tel: 0324 812470.

**Tandy TRS80 model 1**, level II, printer interface cable, joystick, manuals, books programs galore including Kansas Editor assembler, £150 ono. Tel: 01-894 1060.

**Bargain computer**, Tandy TRS-80 colour computer. Extended Basic, 16K, bought £400, sell for £250 ono. Games, manuals, leads included, boxed. Tel: 0241 75362 evenings.

**TRS-80 Mod 1 48K** + twin disks, assembler, disassembler, New DOS, plus blank disks. Enthusiast owner. Tel: 0922 35702 evenings after 7.00pm, £450 ono.

**Wanted Tandy TRS80 Model 1** business software and utilities on disk. Tel: Bristol (0272) 852620.

**Wanted Tandy monitor** with 12" green screen. Tel: Bristol 0272 562763.

**Tandy colour 16K-ext** including disk drive, assembler, ROM/cassette software, speech synthesizer, carrying case, books etc, originally £1000+, now £400. Tel: Steve 01-458 5415 after 6pm.

## Texas Instruments

**TI99/417 16K**, 11 months old, cassette recorder, speech synthesiser, 1 module, books/mags — £75 ono or sell separately. Tel: Nottingham 599604.

**TI99/4A** computer complete with cassette, joysticks, ex-Basic, 2 cartridges and cassette software, Speech synthesizer and all manuals, £100 ono. Ideal for beginner. Tel: Chelmsford 321514 evenings.

**TI99/4A**, with extended Basic, speech synthesizer, five modules, joysticks, cassettes, cassette lead, still in original box, perfect condition, £150 ono. Tel: Hull (0482) 811100.

**TI99/4A**. I am a 65 year old tapper in need of extended system. Can anyone help? Tel: 0329 221577, reasonably priced please.

**TI99/4A printer** (no expansion needed), as new, £110. Also TI cassette, £25. TI Writer (word processor) £60. Software and books. Tel: 0782 627561 eves.

**TI99/4A** with cassette lead, three cartridges and five cassettes all books included. Vgc, sell for £100. Tel: 01-904 3534 after 5pm.

**Wanted TI-99/A** expansion system, box, RS232, 32K disk, TI compatible printer, Minimemory, Parsec and other interesting modules. Tel: Peterborough (0733) 42642 evenings.

# PCN Billboard

## Others

**Colour Genie 32K** colour TV, tape recorder, books, printer interface, data stabiliser, software, assembler, leads, cost £650, accept £250 ono. Tel: (09662) 5641 after 6pm.

**Colour Genie's** haven't got single reaction from you. Where do you hide? Have about 120 programs. Write to: Fakkers A.F.A.V. Groot Rijshoofd, 14 3195 GB Pernis, RT Netherlands.

**Colour Genie 32K**, keypad, joysticks, Genie recorder, data stabiliser, £140 of software including assembler, technical manual, all for £220. Tel: 0782-516510 evenings.

**Video Genie 16K**, built in cassette, including loads of TRS80 manuals, books, games, adventures, mags. Incredible enthusiasts package, only £60. Tel: Birmingham (021) 382 3712.

**Video Genie**, 16K, EP1 ROM extension, integral recorder, sound box, £100 of software including compiler, Jumbo, all for £100. Tel: 0782 516510 evenings.

**Apple II+ 64K**, two disk drives, colour card, TV modulator, Apple Post mailing list system, manuals and software, £495. Tel: 0923 674472.

**Apple II+ 64K-RAM 2** disk drives, serial card, games paddles, many games, Basic, Pascal, manuals, £850 ono. Tel: 021 308-1439 evenings and weekends.

**Apple peripherals** for sale. Colour + 16K RAM, £40 each. ALFMC1 music system, £60. 80 COC, £30. Mountain AD/DA + clock, £90 each. Tel: Stuart 01-237 6803.

**Apple software** going cheap, cheap, cheap, Maquerade, Choplifter, Strip Poker, Bandits, Taxman, Locksmith, Ultimate III, Aztec, M Likierman, Grants House, 2 Little Oceans Yard, London SW1.

**Memotech MTX512**, as new, complete with over, £50 of software, only £230. Tel: Simon Ferrari on Moberley 3716 evenings and weekends.

**Memotech MTX512**, Data recorder, 14 games, tapes, books and joystick, £300 ono. Tel: Bradford 591856 evenings.

**Wanted second-hand MTX** gear, must be good condition, ROMs, RAM, printers, disk drives, anything will pay around half price, may collect. Tel: Northampton 890621.

**Memotech MTX 512**, recorder, high resolution monitor +swivel, 5 games, prof database, books and programs, will split, £325 ono. Tel: 01-476 4318 after 7pm.

**NEC 8201 A** portable, only a few weeks old, perfect condition, with application software and all manuals, £300. Tel: 01-625 8455 (evenings).

**Newbrain Model A** £90 cno. Tel: 01-858 1782 London SE3.

**Wordwise**, version 1.2 with manual, fitting instructions, as new, £30. Tel: 01-691 4005 evenings.

**Pision Organizer**, unwanted gift, still boxed, £90 ono. Atmos 48K, still under guarantee, £90 ono. Tel: M J Swanson on 0790 52120.

**Wanted MSX** computer for £200, Vic 20 for sale + software accessories, cost £390, sell for £199. Tel: 021-4540234 after 4.30pm. I'm desperate.

**Newbrain ad**, monitor, two tape decks, handbooks, technical manual, two books, 12 programs, 30 blank tapes, £150, the lot. Tel: 01-654 2735 (answer phone).

**Scisy's Mk6** (+Mk5 module) Chess computer, 1983 world champion, £130. Boxed + Executive Chess free, unused portable Casio PB700, 16K RAM, £180 ono. Tel: 01-527 5493.

**Sord M5** + cassette, games paddles, Basic-G and Basic-F, Tennis and Super Cobra cartrdges etc. All under warranty, as new, only £150. Tel: 0782 627561 eves.

**Bargain still available** PCW Oric handbook, PCN 60 programs book, Ultra, Hunchback, Multigames. Will send, £15 ono. Tel: Stephen Dundee (0382) 552473.

**Velnor's Lair and Rescue** (CRL), originals will swap for any good adventure, eg Level 9. Tel: Keith Giscombe on Hitchin (0462) 731239.

**Advance 860** + data recorder for sale or swap for QL or Amstrad with colour monitor. Offers to Zia. Tel: Nuneaton 329743.

**RML 380ZD 56K**, twin 5" disks, colour monitor, green monitor, 256 colours plus educational software, new £2,200, sell £1,300 ono. Tel: 01-764 3892 days 01-675 3139 evenings.

**Aquarius 16K** expansion, mini expander with paddles, cassette recorder, Burgertime and Nightstalker cartridges, program book etc, complete and unused, only, £100. Tel: 0782 627561.

**Floppy Disks**, 8" double density, unopened inc, library case, any offers or swaps. 58 Lakeside Place, London Colney, Herts. Tel: 0727-24189.

**Lynx 48K** home computer, virtually unused, good as new, includes introductory tape, manuals, leads and "user newsletters", price £100. tel: Aldershot (0252) 27366.

**Lynx 48K** two games (Colossal adventure, Sultans Maze), book Ian Sinclair's Lynx Computing, £80 ono. Also all PCN's £10. Tel: Ken Fagan, 051-494 0481.

**Lynx 48K**, good condition with manual, Lynx computing magazines, tapes, leads and games including Spannerman, Invaders, Sultans Maze and others, £115 ono. Tel: 0904 37690.

**Lynx 96K**, New unused, includes cables. Also Sharp MZ711 with cassette plus £200 software. Offers or swap both for BBC with DFS. Tel: Crayford 522380.

**48K Lynx**, in original condition, with leads, intro tape, manual and user mags — £85 ono. Tel: Hayes (Middx) 01-561 4653.

**Spectrum** wanted 48K working order, peripherals considered, £65 paid. Tel: Wally 051 424 5553 days.

**Colour Genie** (16K), perfect condition (still boxed), technical manual, Mastering C.G., manuals, sell for £150 ono. Write to J. Constable, 60 Prince Andrew Road, Broadstairs, Kent.

**Spectrum software**, Hobbit £8, OCP Finance Manager, Address Manager, VU-Calc, only £4.50 each. Also games from £2.50 including Arcadia, Timegate. All originals. Tel: 0291-424526.

**Spectrum, CBM-64**, Dragon original software for sale. These are originals. NOT copies. Tel: 061 881 3651 for list. Ask for Tony.

**Osborne Double Density**, Wordstar, Supergale, Dbase II, etc. £650. Tel: 01-740 6313 after 7.30.

**Casio PB700** portable computer, brand new. Supplied in case with all instruction manuals, and 16K high speed RAM, £180 for immediate sale. Tel: 01-527 5493.

**Chess Champion** Mark 6 by Scisy's, world champion computer, incredibly strong, supplied boxed with instructions, with Mark 5 module plus Executive Chess computer, £130. Tel: 01-527 5493

**Any offers** for PCN back issues Nos 24 to Date? Tel: Southampton 0703 694856.  
**C+VG back issues** 20 to 50 pence each. All star video game, six games, light rifle and power pack, £15 ono. Tel: Matthew on Brighton 513671.

**Hornby '00' Gauge** train set, loads of track and accessories, Inter-City 125 train, power and power clips included, £45. Tel: Wakefield (0924) 366363.

## Wanted

**Wanted** Interface 1 and two Microdrives, will pay half recommended price. Tel: 01-735 9332 after 7pm.

**Wanted Microprofessor** MPF-1B £35 or MPF-1P £70, good condition, P&F, extra prices are max. Tel: Jim Mpoire, Delhi, Greece 33054.

**Wanted back issues** of What Micro January to May 1983, and Practical Computing April 1983, in good condition. Tel: Graham on 0334 53290 after 5pm.

**Wanted back issues** of Acorn User: February, March, April and August 1983, in good condition. Tel: Graham on 0334 53290 after 5pm.

**If you want** to swap hints tips and games for Spectrum and CBM64 Write: Steve, 377, Winchester Rd, Bassett, Soton SO17DJ. Tel: (0703) 767580.

**Magazines Galore**, weekly and monthly, covering last 7 months, sell or swap for s/w, interested? Contact: John Humphreys, 33 Ringsbury close, Purton, Swindon, Wiltshire.

**Originals for swap** or sale, Arcadians, Arcade Action, DACC, Sprite, Gen, also other games to swap. Tel: Welwyn Garden City 34513 after 5pm.

**Wanted: Starpath** supercharger + cartridges, also non-Atari 2600/VCS cartridges: Send List/prices, postal replies only, SAE's essential. Charles Trager, 7 Grantley Street, Glasgow, Scotland, G41 3PT.

**Wanted for UK101** software to buy, sell or exchange. Tel: Sheffield (0742) 384474 after 6pm.

**Wanted for UK101**, new premier Basic 1/3 Toolkit II/X, Word Wizard, 32x48 board, mother board. Tel: Sheffield (0742) 384474 after 6pm.

## Billboard Buy & Sell Form

**Free forever** — from now on you can advertise your second-hand equipment and (almost) anything else you want for free in PCN. To place your Billboard ad, fill in the form on the left with a maximum of 24 words. Send the completed form to:

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Note that we cannot guarantee that your ad appears in any specific issue, and that we cannot accept ads from commercial organisations of any sort.

Your name: .....

Address: .....

Telephone: .....

It's Audience Participation week on the UK's liveliest sign-off page, PCN's ever-popular Quit. We're looking for the country's most original Christmas Carol writer, on the grounds that all the old favourites are too old to be relevant to the vibrant new world of microcomputing.

If you want to supply your own tunes we take our hats off to you. But it might be easier if you use existing ones — like *The Holly and the Ivy* to this one:

The Oric and the Spectrum,  
When their ROMs are full-blown,  
Of all the keyboards in the shops  
They're the ones that make us groan.

You can surely do better than that. As in this version of *God Rest Ye Merry Gentlemen*:  
God rest you merry programmers,  
May nothing you dismay  
Not bugs or breaks or line errors  
That crop up every day  
As, struggling over abject code,  
You shuffle on your way  
Just remember, the pubs are open soon,  
Pubs open soon, and imagine that  
Santa might bring you a Cray.

Get the idea? We look for-

ward to seeing some from you — and if enough come in before Christmas we'll put them together on a song-sheet so you can wassail them and amaze your neighbours by turning up on their door-steps at dead of night demanding a mince pie with menaces.

It's also Home Survey week. This is in response to a piece of hokum that came through the post from IBM last week.

IBM's Travelling Technology Exhibit parked itself outside the Natural History Museum in London recently and asked people for their views on compu-

ters. Most said that computers make jobs interesting and life exciting, as well as being convenient and producing more leisure time.

These were people who visited the said Exhibit, which suggests to us that the sample might have a slight bias. It would be nice to know how many visitors to the Natural History Museum think that a re-constructed brontosaurus makes life exciting, as well as being convenient, but it's probably close to 100 per cent. What do you think about computers? You're not biased, are you?



In a nationwide appeal the software/hardware distributor Micro Dealer UK has released this picture of two of its delivery men. The hunt is on for a suitable donor to give the one on the right a torso transplant, or failing that a pair of stretch jeans so that he isn't reduced to his underwear every time he loses his temper. Perched on his shoulder is a parrot with an identity crisis — it thinks it's Spiderman, with the result that it refuses to fly and is becoming obese for want of exercise. If you can help, contact the Micro Dealer Delivery Man Appeal, and they'll send you a Spiderman graphics adventure for a small fee. The company can be contacted on Welwyn Garden City (07073) 28181.

## SYNTAX ERRORS

We said (issue 88) that for output to printer the Amstrad uses a 7-bit serial port, and is unlikely to work with the Tandy printer/plotter. In fact, you don't measure serial ports bit-wise; the Amstrad has a 'standard' Centronics interface, so it drives any Centronics compatible printer including the Tandy.

Late adjustments to the running order left the Next Week preview in last week's issue looking slightly sickly. The Entrepo Pro-Test will now appear in issue 91 and the BBC sine waves listing is being re-scheduled.

## NEXT WEEK

### One for the road

PCN Pro-Tests The One, Data General's new 16-bit machine. Is this the ultimate portable computer?

### Entrepo re-reported

We Pro-Test the Entrepo wafer drive for the Commodore 64.

### Spectrum bubbles

Extend your sort repertoire with this machine code bubble sort routine.

### Games galore

Buying software for Christmas? Consult our guide first.

### 64 ways to print

For those intricate printouts, we offer a high-resolution printer driver for the Commodore.

### Sideways Spectrum

Multi-tasking on the Spectrum? We test a sideways RAM that holds out this unlikely possibility.

PAL2000

by Mollusc



## PCN DATELINES

Event	Dates	Venue	Organisers
Electron & BBC Users' Show	Dec 6-9	New Horticultural Hall, Westminster, London SW1	Database Publications, 061-456 8383
CADCAM Intl Show	Jan 8-10	NEC, Birmingham	EMAP Intl Exhibitions, 01-837 3699
Mini/Micro Computer Exhbn Conf	Jan 13-16	Stockholm, Sweden	Sollentuna Massan, Box 174, S — 191 23 Sollentuna, Stockholm
Which Computer?	Jan 15-18	NEC, Birmingham	Clapp & Poliak 01-891 5051
High Technology & Computers Education	Jan 23-26	Barbican, London	Computer Marketplace Exhibitions, 01-930 1612
Computer Exhbn — Computer Thai	January 23-26	Bangkok, Thailand	Conf & Exhbn Management Services Ltd, 61/5 Langsuan Soi 2, Ploenduit Road, Bangkok 10500
Intl Microcomputer Fair	Jan 29-Feb 3	Frankfurt, Germany	Collins & Endres, 01-734 0543
Apricot & Sirius Computer Show	Feb 5-7	Kensington Town Hall, London	Paradox Group, 01-241 2354
Intl trade show for home comps, software, etc — LET	Feb 17-19	Olympia, London	Turret-Wheatland, 0923-777000
MEXCOM	Feb 25-28	Mexico City, Mexico	AESI Ltd, 01-379 7628

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# MATCH DAY



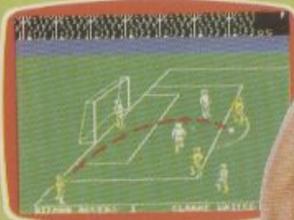
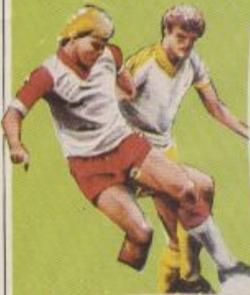
Match Day is no ordinary soccer game. Blistering 3-D action, total animation and automatic camera scan are just some of the intricate techniques which make Match Day the league leader of soccer games. Now follow the "Action":

his powerful half-volley rattles the cross-bar, the ball returns, floating menacingly above the penalty

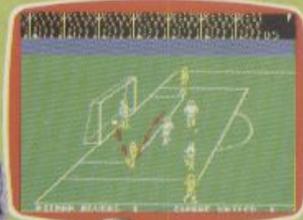
leader of soccer games. Now follow the "Action":

Your striker traps the ball from a perfectly placed corner-kick, takes on the defender and dribbles neatly round him making space to

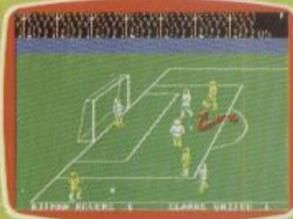
area and your star striker seizes this half-chance



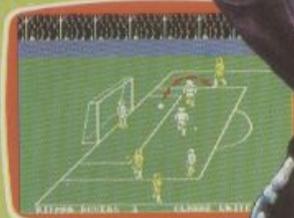
chip in a teasing cross-ball to his advancing team mate in the



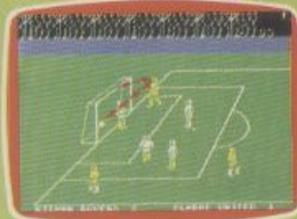
to head the ball decisively into the back of the net... GOAL!



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