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PRACTICAL ELECTRONICS

SCIENCE AND TECHNOLOGY

Fusion Power

Exploring the technology that powers the Sun

Product Reviews

Canon S-50
Wide Imaging Speakers

Tandy Pro-41
Searching the radio waves

Panasonic FX-RS307
Image scanner

ACE
Animated electronic circuits

Plus

What's New

Psion Series 3 portables
Refalo and GRiD Palmtops
DR DOS 6
Canon and HP colour printers
Double decker VCR from Alba
Amstrad Videophone
PC on a chip

Free This Month
Greenweld Catalogue
Plus
The Latest Bargain List

Barry Fox on BT
Build a valve headphone amp
Christies electronics sale
Christmas Trivia Quiz

9 770032 637017 12

Finally... an exceptional PCB and Schematic CAD system for every electronics engineer!

BoardMaker 1 is a powerful software tool which provides a convenient and professional method of drawing your schematics and designing your printed circuit boards, in one remarkably easy to use package. Engineers worldwide have discovered that it provides an unparalleled price performance advantage over other PC- based systems.

BoardMaker 1 is exceptionally easy to use - its sensible user interface allows you to use the cursor keys, mouse or direct keyboard commands to start designing a PCB or schematic within about half an hour of opening the box.

HIGHLIGHTS

Hardware:

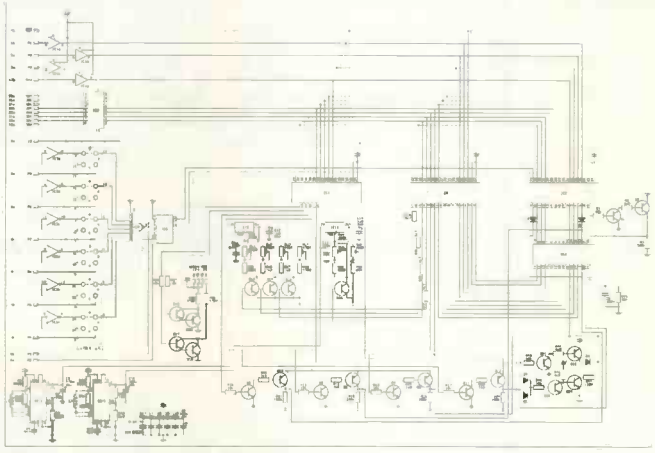
- IBM PC, XT, AT or 100% compatible.
- MSDOS 3.x.
- 640K bytes system memory.
- HGA, CGA, MCGA, EGA or VGA display.
- Microsoft or compatible mouse recommended.

Capabilities :

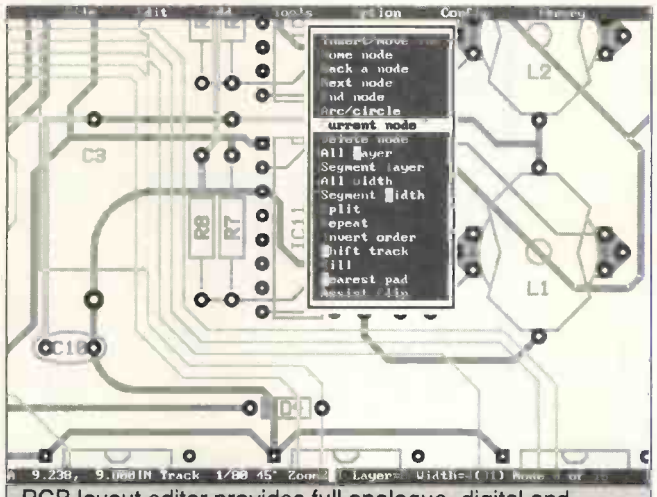
- Integrated PCB and schematic editor.
- 8 tracking layers, 2 silk screen layers.
- Maximum board or schematic size - 17 x 17 inches.
- 2000 components per layout. Symbols can be moved, rotated, repeated and mirrored.
- User definable symbol and macro library facilities including a symbol library editor.
- Graphical library browse facility.
- Design rule checking (DRC)- checks the clearances between items on the board.
- Real-time DRC display - when placing tracks you can see a continuous graphical display of the design rules set.
- Placement grid - Separate visible and snap grid - 7 placement grids in the range 2 thou to 0.1 inch.
- Auto via - vias are automatically placed when you switch layers - layer pairs can be assigned by the user.
- Blocks - groups of tracks, pads, symbols and text can be block manipulated using repeat, move, rotate and mirroring commands. Connectivity can be maintained if required.
- SMD - full surface mount components and facilities are catered for, including the use of the same SMD library symbols on both sides of the board.
- Circles - Arcs and circles up to the maximum board size can be drawn. These can be used to generate rounded track corners.
- Ground plane support - areas of copper can be filled to provide a ground plane or large copper area. This will automatically flow around any existing tracks and pads respecting design rules.

Output drivers :

- Dot matrix printer.
- Compensated laser printer.
- PostScript output.
- Penplotter driver (HPGL or DMPL).
- Photoplot (Gerber) output.
- NC (ASCII Excellon) drill output.



Produce clear, professional schematics for inclusion in your technical documentation.



PCB layout editor provides full analogue, digital and surface mount support - ground and power planes (hatched or solid)- 45 degree, arced and any angle tracks.

£95 Despite its quality and performance, BoardMaker 1 only costs £95.00 + £5.00pp + VAT. Combine this with the 100% buy back discount if you upgrade to BoardMaker 2 or BoardRouter and your investment in Tsien products is assured.

Don't take our word for it. Call us today for a FREE demonstration disk and judge for yourself.

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181A Huntingdon Road
Cambridge CB3 0DJ
Tel 0223 277777
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tsien

This month...

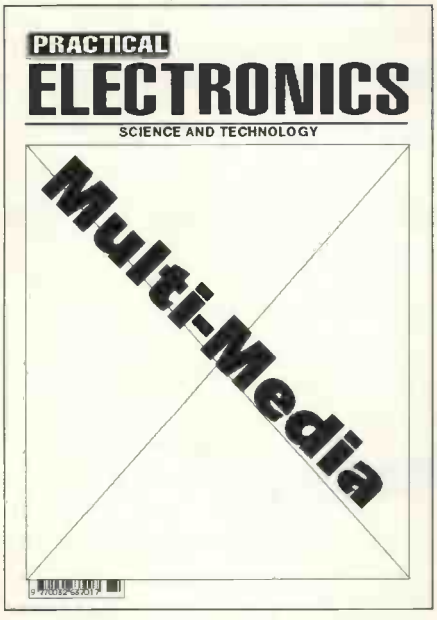
PE has gone through something of a transformation this month. Due to popular demand, we are looking at more new products and fewer projects – anyone who wants the final details of PE Chronos should send in a large SAE.

This month's cover feature is an examination of the JET Joint Undertaking. This atomic fusion experiment is probing the frontiers of research that will lead the way to virtually unlimited cheap electrical power for the future. My thanks go to everyone who showed me around the faciity and helped with the various details and pictures.

Our project this month is a follow-up to Jeff Macauley's power valve amplifier. For those who don't have the space or lack of neighbours to blast away with 100W of raw power, this valve based system uses the same technology but is designed to be used with headphones.

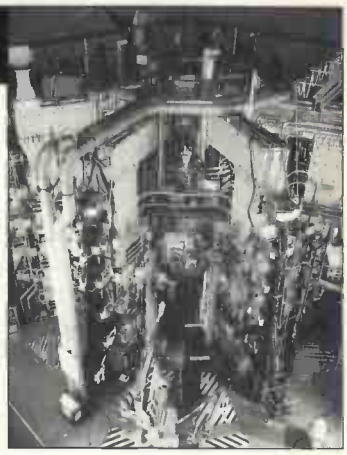
Kenn Garroch, Editor

Next month...



We examine the latest craze that involves the combination of computers, video, sound and presentation, Multi-media.
Out On 5 December

Features



Reviews

Regulars

Editor: Kenn Garroch Advertisement Manager: David Bonner Production Manager: Richard Milner Production Assistant: Dino Digioacchino Office Manager: Laura Esterman Office Secretary: Wendy Rhodes Publisher: Angelo Zgorelec • **Practical Electronics Intra House 193 Uxbridge Road London W12 9RA Tel: 081-743 8888 Fax: 081-743 3062 Telecom Gold: 87: SQQ567 • Advertisements** The Publishers of PE take reasonable precautions to ensure that advertisements published in the magazine are genuine, but cannot take any responsibility in respect of statements or claims made by advertisers. The Publishers also cannot accept any liability in respect of goods not being delivered or not working properly. • • Practical Electronics is typeset at Intra Press on Macintosh computers using Quark Xpress. Reproduction by Circle Rule Ltd. Printing by Andover Press, St Ives plc. Distribution by Seymour Press • **ISSN 0032-6372** •

Wavelengths

If you have any comments, suggestions, subjects you think shoul d be aired, write to PE

I have been a keen reader of Practical Electronics since your very first issue and it has always fascinated me to read over old copies and marvel over the changes over the years.However, not until now have I been moved to make any criticism.

In the September issue, Mr. Ian Burley writes about new items seen at the Chicago US Consumer Electronics Show. His comments on the Sharp active-matrix LCD screens infuriated me and I am sure many others are positively longing for these screens to become available in reasonable sizes and at reasonable prices so that we may see the end of the ugly, bulky CRT-dominated boxes. So there is "apparently" a sizeable market for these in Japan. And I expect there would be in England, too, were they available. And why his snide comment "So what?". I don't care if the frames are ugly or tasteless. There have been plenty of tasteless TV cabinets designed. Why could we not have had a few details on the sizes being manufactured, the current costs and a projection of future costs should these become popular – as they must. Or it is perhaps that we, the consumers – and maybe the critics – are to be dominated by the great CRT-manufacturing industry?

Ray M Boorman
Madrid
Spain

Sticking Sharp's world-beating active-matrix screen technology into those horrid picture frames was an insult to that technology. It was an unnecessary marketing gimmick, which I hope Sharp thinks twice about in future. Of course I keep a close eye on screen developments and I'm convinced flat panel LCD-based screens will quickly replace CRTs in all but the larger screen sizes once the technology has been honed.

Ian Burley

Viewing Troubles

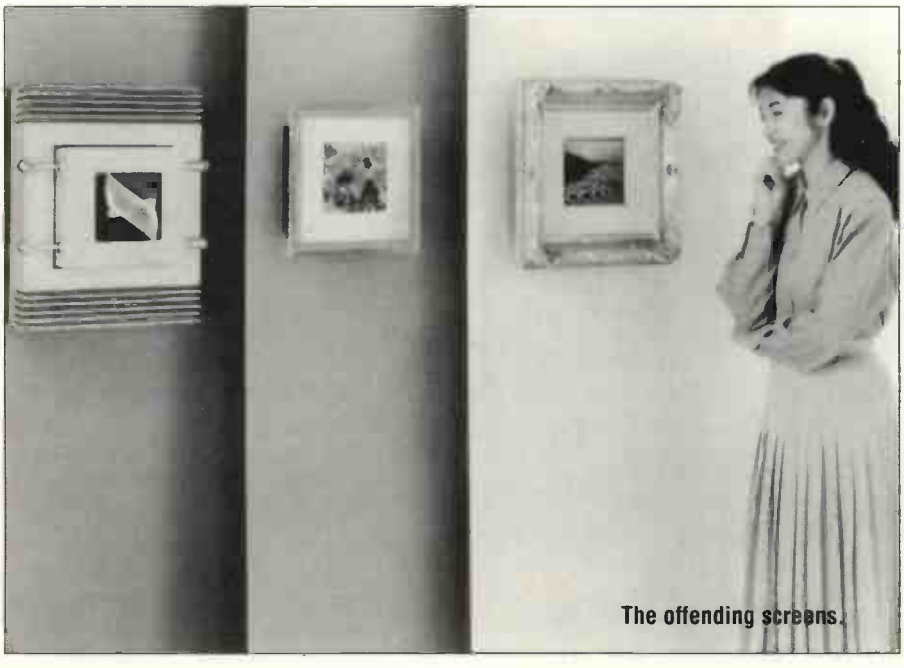
I look forward to the PDC system discussed by Barry Fox in September 1991 PE. It should solve some problems but does not seem able to avoid the major weakness, already present but ignored, in the Panasonic bar code system.

What happens when timing changes causes unexpected programme overlap? TV broadcasters apparently assume that we are still in the 1940s with only one TV channel. We watch this single channel 24 hours per day and are always fully aware of all the variation announcements!

Programme clashing is treated as being completely irrelevant. Despite the wonders of modern microsecond timekeeping and prerecording of most programmes, it seems impossible for published times to be achieved on a regular basis.

A recent attempt to record two series, on separate channels, over several weeks failed. The first ran late every week and up to ten minutes was lost at every changeover. Even with a VCR it is impossible to go out for the evening.

R G Silson
Tring
Herts



The offending screens.

Why MultiMedia?

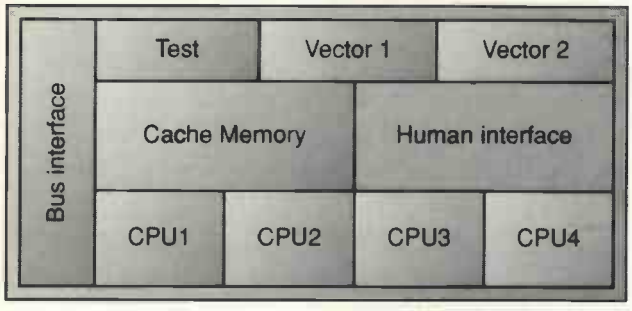
What is all the fuss about multimedia? I can't see that it has any real applications. If you want sound you get a HiFi with LPs, cassettes or CD. For vision, the VHS video recorder seems to have settled down as the main system for image recording and playback. Video cameras are also available for those who want to record their own moving images. For a mixture of both sound and vision, try TV with Nicam stereo from either the standard terrestrial stations (BBC1 and 2 and ITV 3 and 4) or satellite. These cover all the possibilities, apart from smelly-vision which never got off the ground.

Why would anyone want presentation graphics and sound interfaced to a computer system unless, of course, they are giving a seminar.

A Stanley
Brighton

Innovations

This month, Intel's latest chips, BT's new premium rate number and a boost for the home taping campaign.



Intel's Micro-2000 shows what could be in the i586.

Towards The 586

A recent report from Intel pointed the way towards the next generation of microprocessors. Following on from its successful i386 machines the i586 should have four CPUs each rated at 700 million instructions per second, two vector processing units that would speed up numerical calculations, cache memory for frequently used programs and data and a human interface providing interactive video and voice recognition. All of this would be squashed into one chip using 100 million transistors in one square inch of silicon. With a total throughput of 2 billion instructions per second and complete compatibility with the i386 range, it should prove a worthy opponent to the IBM/Motorola chip destined to power the next generation of IBM PCs.

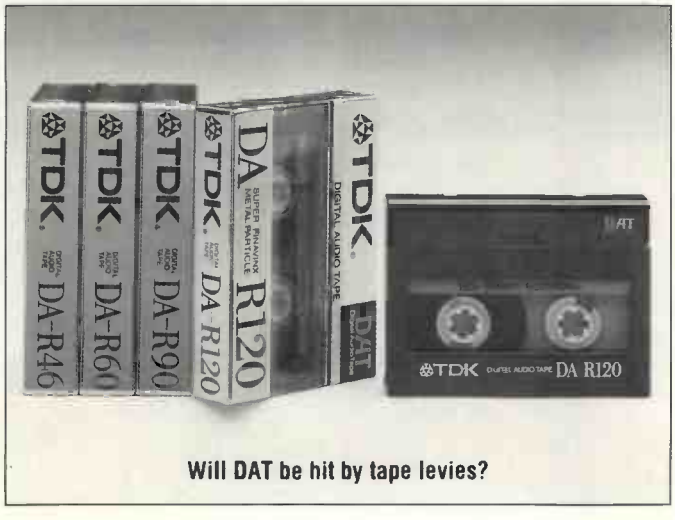
Intel has been making microprocessors since the early days of 1970 when there were only about 1000 transistors per chip. The co-founder of the company Gordon Moore made the observation some time ago that the number of transistors on a chip doubles every two years and that by the year 2000 there should easily be over 100 million per chip.

Intel's current microprocessors are the i386 range. The 386SX is the bottom of the range and has a 16-bit data bus rather than the 32-bit standard. The 386DX is the mid range member which conforms to the full standard and is available in speeds from 16 to 33MHz. At the top of the range is the i486. This uses a 386 microprocessor and incorporates a 387 maths co-processor, 385 cache controller and 8kbytes of static RAM on the same chip.

Taping Support

A recent report published by the Consumer's Association(Which? magazine October 1991) gave a boost to the Home Taping Rights Campaign (HTRC). It vindicated the long held suspicion that most people who recorded copyright material onto cassettes did so from records or CDs that they already owned. This does not really cause a loss to the record industry and its effect on sales has been exaggerated. The Consumer's Association also concluded that, "the case for a levy on videotapes is non-existent", since only 4% of people survey copying videos.

The HTRC has been campaigning since 1986 to defend home taping and oppose any levies imposed on blank tapes. These would go to the record industry which claims that it is losing sales as a result of this flouting of the copyright laws. Legislation is currently being prepared by the European Commission to impose levies on recording equipment as well as blank tapes.

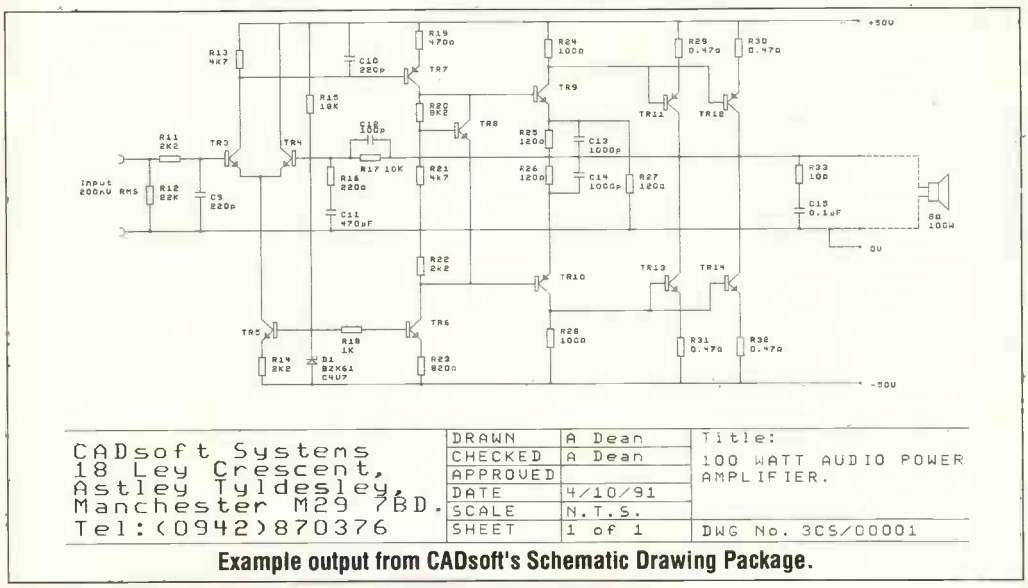


Will DAT be hit by tape levies?

CAD On A PCW

Now CAD systems are not only available on IBM PCs, Amstrad PCWs are getting in on the act. CADsoft Systems recently announced the release of its Schematic Drawing Package for the Amstrad CPC6128 and PCW8256/8512 machines. Running under CP/M+, the package consists of a schematic editor, a print program and a symbol library. The latter supplies most of the more commonly used component symbols such as capacitors, resistors, transistors and logic gates and an editor is provided so that more can be added. Diagrams of up to 50in x 50in can be drawn with around 5000 objects per drawing. The printing package provides output on even the most basic dot-matrix printer.

Costing £29.99 with a £5 discount for registered users of other CADsoft products, it is avialble from CADsoft Systems, 18 Ley Crescent, Tyldesley, Manchester M29 7BD.



Example output from CADsoft's Schematic Drawing Package.

£1000 To Be Won

After sawing through a chair thirty years ago, Ron Hickman developed a flexible bench known as the Workmate. Now a competition has been launched, sponsored by British Fuels, to "find the next brilliant idea that will revolutionise out lives".

The first prize is £1000 and British Fuels, the country's leading supplier of coal and oil, will also give free practical advice for the development and marketing of the new product as well as legal protection and suggestions on where to get the appropriate funding. The second and third prizes are £500 and £250 respectively and a panel of experts, including Sir Cyril SMith MBE MP will examine all entries in strict confidence. Anyone who thinks they have a world beating idea and would like to have a stab at winning the prize should write to:

BFL Innovations Award
Freepost
The BRAHM Building
Alma Road
Leeds
LS6 2AH
or
telephone 0532 304000 and ask for an entry pack.

0898 Solution

After catching so much flak from the media as well as those who had to pay some pretty huge telephone bills, BT has announced a new premium rate prefix number.

Under the old system the, now notorious, 0898 number was used to access a wide variety of telephone services from chatlines to heavy breathers (adults only lines). The callers had to pay a higher rate for these services and there were a number of situations where parents had had to pay BT for the telephone abuse committed by their gregarious offspring. From BT's point of view,the numbers were rented out to companies who provided the actual services and controlling the situation proved to be difficult.

There was so much trouble over the telephone abuse that the Independent Committee for the Supervision of Standards of Telephone Information Services (ICSTIS) had to draw up a code of practice for anyone wanting to provide a premium rate service. BT has now announced that it will being doing its bit to help with the problem by providing another premium rate number, 0891, to be operated along side the 0898, which will conform to the ICSTIS standard.

The ICSTIS code forbids the provision of adult, chatline and most live conversation services over lines using the 0891 prefix. Customers on the new digital exchanges will be able to stop their telephones accessing any or all of the premium rate numbers – 0898, 08364, 0839 and 0881 – so that huge unforeseen bills should no longer arise. There is no charge for the call barring service, the only problem is that just under half of the population won't be able to use it – BT has, as yet, only converted just over half its exchanges to digital operation. ■

Ron Hickman with his invention, the Workmate.

SURVEILLANCE
PROFESSIONAL QUALITY KITS

No. 1 for Kits

Whether your requirement for surveillance equipment is amateur, professional or you are just fascinated by this unique area of electronics SUMA DESIGNS has a kit to fit the bill. We have been designing electronic surveillance equipment for over 12 years and you can be sure that all of our kits are very well tried, tested and proven and come complete with full instructions, circuit diagrams, assembly details and all high quality components including fibreglass PCB. Unless otherwise stated all transmitters are tuneable and can be received on an ordinary VHF FM radio.

UTX Ultra-miniature Room Transmitter
Smallest room transmitter kit in the world! Incredible 10mm x 20mm including mic. 3-12V operation. 500m range £16.45

MTX Micro-miniature Room Transmitter
Best-selling micro-miniature Room Transmitter
Just 17mm x 17mm including mic. 3-12V operation. 1000m range £13.45

STX High-performance Room Transmitter
Hi performance transmitter with a buffered output stage for greater stability and range. Measures 22mm x 22mm including mic. 6-12V operation, 1500m range £15.45

VT500 High-power Room Transmitter
Powerful 250mW output providing excellent range and performance. Size 20mm x 40mm. 9-12V operation. 3000m range £16.45

VXT Voice Activated Transmitter
Triggers only when sounds are detected. Very low standby current. Variable sensitivity and delay with LED indicator. Size 20mm x 67mm. 9V operation. 1000m range £19.45

HVX400 Mains Powered Room Transmitter
Connects directly to 240V AC supply for long-term monitoring. Size 30mm x 35mm. 500m range £19.45

SCRX Subcarrier Scrambled Room Transmitter
Scrambled output from this transmitter cannot be monitored without the SCDM decoder connected to the receiver. Size 20mm x 67mm. 9V operation. 1000m range £22.95

SCLX Subcarrier Telephone Transmitter
Connects to telephone line anywhere, requires no batteries. Output scrambled so requires SCDM connected to receiver. Size 32mm x 37mm. 1000m range £23.95

SCDM Subcarrier Decoder Unit for SCRX
Connects to receiver earphone socket and provides decoded audio output to headphones. Size 32mm x 70mm. 9-12V operation £22.95

ATR2 Micro Size Telephone Recording Interface
Connects between telephone line (anywhere) and cassette recorder. Switches tape automatically as phone is used. All conversations recorded. Size 16mm x 32mm. Powered from line £13.45

★★★ Specials ★★★

DLTX/DLRX Radio Control Switch
Remote control anything around your home or garden, outside lights, alarms, paging system etc. System consists of a small VHF transmitter with digital encoder and receiver unit with decoder and relay output, momentary or alternate, 8-way dil switches on both boards set your own unique security code. TX size 45mm x 45mm. RX size 35mm x 90mm. Both 9V operation. Range up to 200m.
Complete System (2 kits) £50.95
Individual Transmitter DLTX £19.95
Individual Receiver DLRX £37.95

MBX-1 Hi-Fi Micro Broadcaster
Not technically a surveillance device but a great idea! Connects to the headphone output of your Hi-Fi, tape or CD and transmits Hi-Fi quality to a nearby radio. Listen to your favourite music anywhere around the house, garden, in the bath or in the garage and you don't have to put up with the DJ's choice and boring waffle. Size 27mm x 60mm. 9V operation. 250m range £20.95

UTLX Ultra-miniature Telephone Transmitter
Smallest telephone transmitter kit available. Incredible size of 1mm x 20mm! Connects to line (anywhere) and switches on and off with phone use. All conversation transmitted. Powered from line. 500m range £15.95

TLX700 Micro-miniature Telephone Transmitter
Best-selling telephone transmitter. Being 20mm x 20mm it is easier to assemble than UTLX. Connects to line (anywhere) and switches on and off with phone use. All conversations transmitted. Powered from line. 1000m range £13.45

STLX High-performance Telephone Transmitter
High performance transmitter with buffered output stage providing excellent stability and performance. Connects to line (anywhere) and switches on and off with phone use. All conversations transmitted. Powered from line. Size 22mm x 22mm.
1500m range £16.45

TKX900 Signalling/Tracking Transmitter
Transmits a continous stream of audio pulses with variable tone and rate. Ideal for signalling or tracking purposes. High power output giving range up to 3000m. Size 25mm x 63mm. 9V operation £22.95

CD400 Pocket Bug Detector/Locator
LED and piezo bleeper pulse slowly, rate of pulse and pitch of tome increase as you approach signal. Gain control allows pinpointing of source. Size 45mm x 54mm. 9V operation £30.95

CD600 Professional Bug Detector/Locator
Multicolour readout of signal strength with variable rate bleeper and variable sensitivity used to detect and locate hidden transmitters. Switch to AUDIO CONFORM mode to distinguish between localised bug transmission and normal legitimate signals such as pagers, cellular, taxis etc. Size 70mm x 100mm. 9V operation £50.95

QTX180 Crystal Controlled Room Transmitter
Narrow band FM transmitter for the ultimate in privacy. Operates on 180 MHz and requires the use of a scanner receiver or our QRX180 kit (see catlogue). Size 20mm x 67mm. 9V operation. 1000m range £40.95

QLX180 Crystal Cointrolled Telephone Transmitter
As per QTX180 but connects to telephone line to monitor both sides of conversations. 20mm x 67mm. 9V operation. 1000m range £40.95

QSX180 Line Powered Crystal Controlled Phone Transmitter
As per QLX180 but draws power requirements from line. No batteries required. Size 32mm x 37mm. Range 500m £35.95

QRX180 Crystal Controlled FM Receiver
For monitoring any of the 'Q' range transmitters. High sensitivity unit. All RF section supplied as a pre-built and aligned module ready to connect on board so no difficulty setting up. Outpt to headphones. 60mm x 75mm. 9V operation £60.95

A build-up service is available on all our kits if required.

UK customers please send cheques, POs or registered cash. Please add £1.50 per prder for P&P. Goods despatched ASAP allowing for cheque clearance. Overseas customers send sterling bank draft and add £5.00 per order for shipment. Credit card orders welcomed on 0827 714476.

OUR LATEST CATALOGUE CONTAINING MANY MORE NEW SURVEILLANCE KITS NOW AVAILABLE. SEND TWO FIRST CLASS STAMPS OR OVERSEAS SEND TWO IRCS.

SUMA DESIGNS

THE WORKSHOPS, UNIT PE, 95 MAIN ROAD,
BAXTERLEY, NEAR ATHERSTONE,
WARWICKSHIRE CV9 2LE

0827 714476

What's New

Gadgets

A new section this month takes a quick look at the latest electronic products.

The Refalo from Kyocera is a palm-top computer which, instead of a keyboard, uses a pen based system to recognise handwriting. Measuring 190mm x144mm x42mm when closed, it weighs just 750g and is designed to take the place of a Filofax – it even has ring binders so that filofax pages can be attached.

The computer side of things is based upon the well known 8086 (aka V30) which was at the heart of some of the early IBM PCs. Like these machines, its operating system is MSDOS and is held in 256k bytes of ROM. On-board RAM is 256k, split into 192k user area and 64k video RAM.

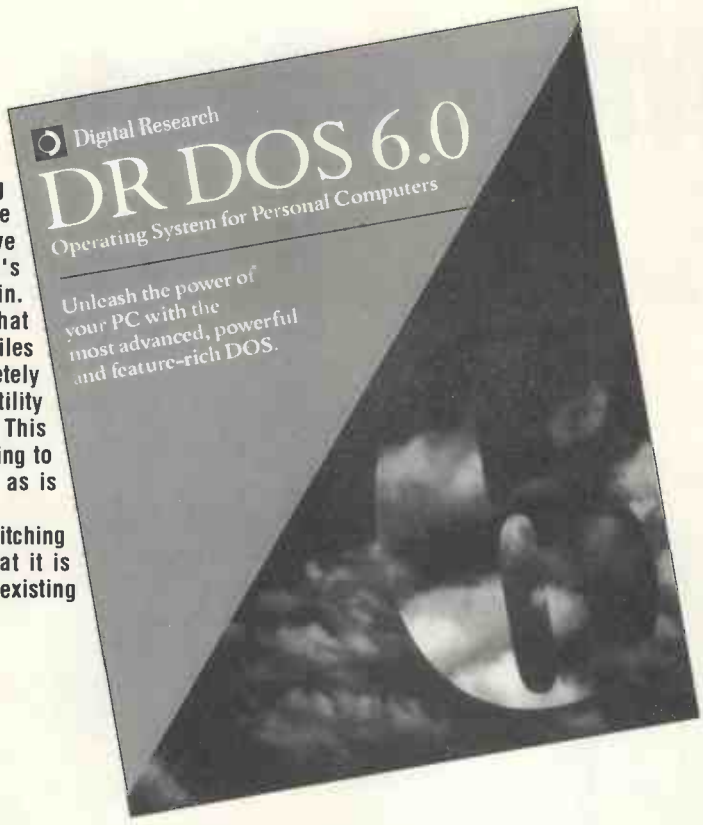
Applications software will be loaded via an IC card that conforms to the Japan Electronic Industry Development Association (JEIDA) standard. Built in software is planned to be of the usual organiser type, diary, notebook, scheduler, and so on. The user interface is pen based using a pressure sensitive LCD screen with a resolution of 240x320. For those who can't manage without a keyboard, one is available as an optional extra – measuring the same size as the Refalo itself. To connect to the outside world, an RS232 serial interface is provided. The whole thing will cost around £1000 and should be available by April next year.

Integrated Services Digital Network, better known as ISDN could soon be available to many more people if the new Dataflex Pocket ISDN adapor takes off. Offering data transfer speeds of up to 64k bytes per second, the device, which is smaller than an Sony Walkman, is fully BABT approved and compatible with ISDN-2. Initially aimed at reatil and financial institutions to speed up electronic funds tranfer, the modem, priced at £595+VAT, should broaden access to the high speed communications network.

Callbox 2 is another gadget that should make communicating via the telephone a lot easier. Designed to be linked to a PC, it allows completely hands free operation of the phone with auto-dialling, voice-mail, light-weight headset plus numerous other applications. A programmers interface is also available that uses the industry standard Hayes command set. Costing £825, the system is currently being designed into a number of telephone applications such as information response suystems, technical support and credit control.

Computers

The PC operating system competition is gathering pace with DR DOS 6 being released at about the same time as MS DOS 5.0. Offerring an alternative operating system for PC users, Digital Research's versionis better than Microsoft's by quite a wide margin. Improvements include a data compression utility that allows up to twice a much data to be stored on a disk – files are accessed in the normal way so operation is completely transparent. Also available is a twenty-task switcher utility that allows up to 20 programs to be loaded at once. This allows the user to switch between them rather than having to quite from one application and then load up another as is generally the case with other versions of DOS.
Anyone who uses PCs a lot should definately consider switching or upgrading to DR DOS 6. The only drawback is that it is relatively expensive at £79 or £24.99 as an upgrade for existing DR DOS users.

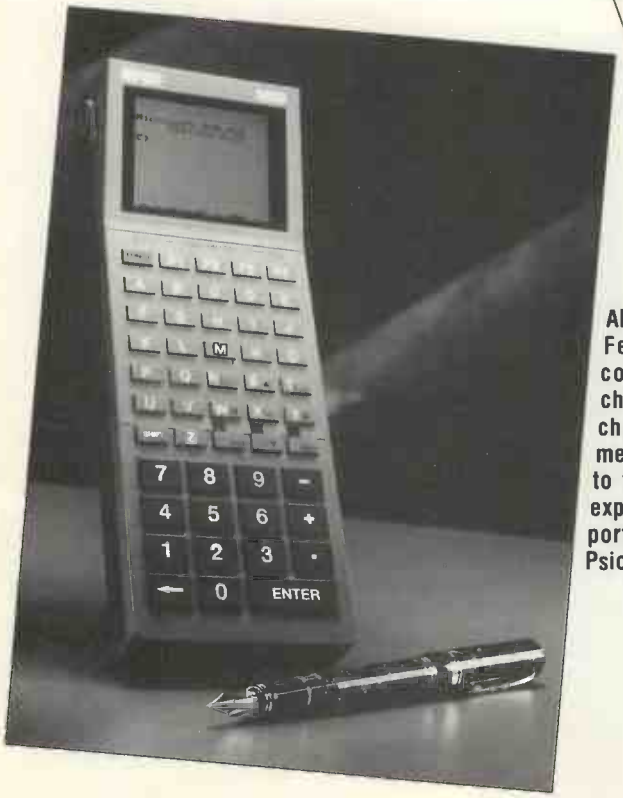


The new range of computers from Elonex all feature 32-bit microprocessors and range from the PC-320XM to the PC-450B. The first comes with 20MHz 386SX, 16kbyte cache, 1Mbyte of RAM, 40Mbyte hard disk and 512kbyte Super VGA and is the basic system. The top of the range has a 50MHz 486 microprocessor with 64kbyte cache, 2Mbyte RAM, 40Mbyte hard disk and 512kbyte Super VGA. Starting at £995 for the lower end model, the PC-450B costs £2195 with eight models between them offerring a wide election of platforms and prices to choose from.

At 360dpi, Canon's BJC-800 colour bubble-jet printer offers some of the best printing capabilities around. Four individual cartridges using yellow, magenta, cyan and black feed their ink to a 64 nozzle print head to create the high resolution colour images. Unlike other colour printers, black printing quality is just as good as any other colour. The cartidges are said to last for approximately 400 pages and can be replaces individually.
The printer will be available in the UK by March 1992 and will be priced at around £1995.

Another printer offering laser quality colour output is the Hewlet Packard Deskwriter C – priced at £749. Boasting 300dpi resolution, it uses one ink cartridge which can be either a tri-chamber design incorporating cyan, magenta and yellow, allowing any colour to be reproduced, or a single chamber black for monochrome output. Aimed mainly at Apple Macintosh users, the printer has a number of standard fonts built in as well as an Appletalk interface allowing it to be used on a network.

The Psion Series 3 is a new range of pocket computers featuring 80C86 microprocessors, 240x80 pixel double layer LCD, 640kbytes of RAM and 385kbytes of ROM. A full Graphical User Interface, wordprocessor, database, calendar, programming language and calculator are bundled with the system and the basic model costs around £200 including VAT.



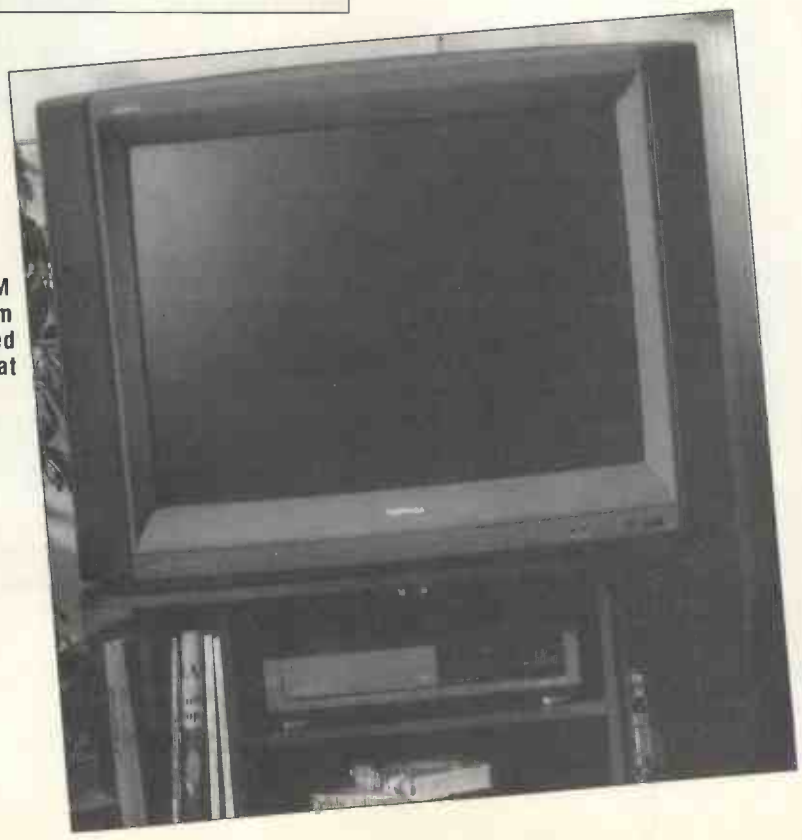
Also new in the area of pocket portables is the GRiD M88. Featuring MSDOS 3.22 in ROM, the display is a CGA compatible LCD screen offering either 8 lines by 20 characters, 15 lines by 20 characters or 25 lines by 20 characters. The 50 key keyboard, 80C88 and 640kbyte memory allow it to run virtually all DOS software. Connection to the outside world is via RS232, a barcode reader or expansion bus. Priced at £999, GRiDs name for tough reliable portable computers should enable it to compete with the Psion and Poqet PC compatible palmtops.

Visions

The Alba VCR2222 solves all of the problems that arise due to video tapes being too short. Because it has two video transports, it can record and playback up to 20 hours of program material. Other features include recording on both tapes at once, recording one tape while watching another, duplicating tapes, a four week/eight event/99 channel memory and tape to tape editing.

The new V711B from Toshiba in the flagship of the company's VCR range. Featuring NICAM stereo, long play, on-screen programming, comprehensive searching and timing facilities, picture quality enhancer, a dynamic bass switch and simulcast recording, its weighs in at a mere £499.99

Also from Toshiba is the 34in Super Screen NICAM Delux TITAN TV with Dolby Surround. Available from October 1st, it features 100 channel tuning, unified remote control and on-screen display. Priced at £1999.99 it is the top of the Toshiba TV range.



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Data Acquisition System On A Chip

Silicon Valley this month looks at Nat Semi's new single chip DAS, the shrinking of telecoms equipment and the fastest dual port RAM in the world.

The ease with which data can be monitored has taken a step forward with the introduction of National Semiconductor's LM12458 single chip data acquisition system (DAS). This incorporates a 12-bit self-calibrating analogue to digital convertor (ADC), storage for up to 32 conversions, internal RAM that stores instructions on which conversions should be performed when, an eight input multiplexer (MUX), watchdog facilities to compare inputs against preset limits, programmable conversion rates and built in reference voltages, all powered from a single +5V supply.

Conversion times are rated at 8.6us for 13-bits and 4us for 9-bits on the eight programmable channels. The on-board digital control system consists of an 8x48 instruction RAM that stores the acquisition instructions for up to four differential or eight single-ended input channels. These can be used to specify the data gathering channels, their sequence, speed and data output format resulting is a highly flexible system.

Designed to be interfaced directly to a microprocessor, the LM12458 can take some of the processing load off the main system by means of its programmability. It is aimed at applications in data logging, energy management, industrial process control, instrumentation, medical and portable systems, robotics and signals analysis.

For more information contact National Semiconductor, Industriestrasse 10, D-8080 Furstenfeldbruck, Germany

More Portable Comms

Portable communications systems such as cellular and cordless phones are set to become even smaller than they are now. A pair of chips from Signetics offer advanced FM mixer-IF systems that should reduce the size of a PCB by 15%. As well as offering more facilities per square centimeter, the NE606 and NE607 use lower supply current and offer more facilities than competitive products.

Included on each chip is a mixer oscillator, two operational amplifiers, IF amplifiers, limiter amp, voltage regulator and quadrature detector. All of this allows the facilities of a portable FM communications system to be squashed into an even smaller space.

More information can be obtained from Signetics, a subsidiary of Philips on 071 580 6633

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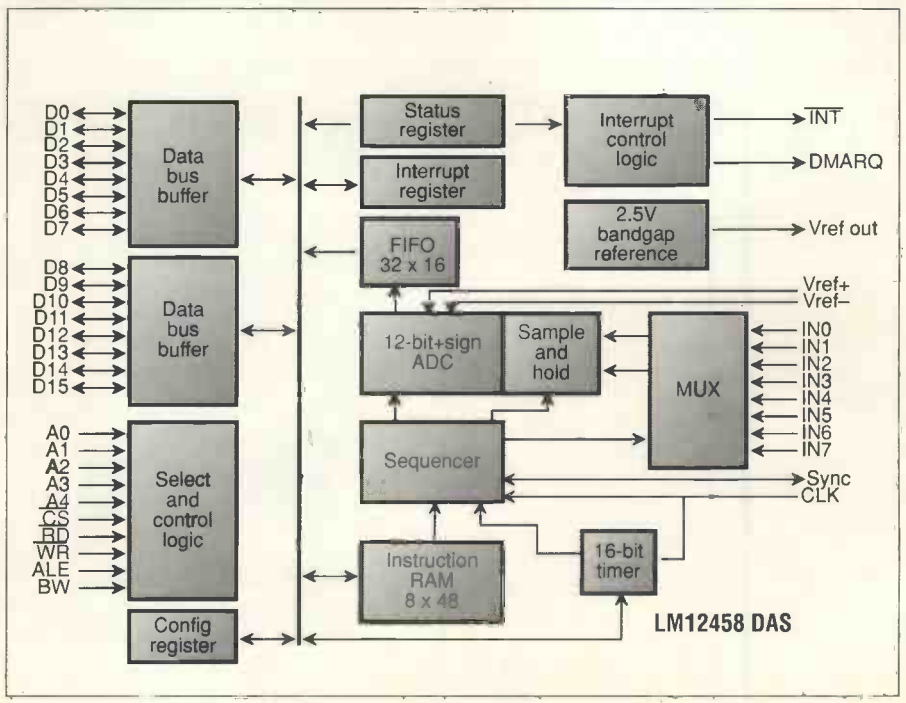
Claiming to be the densest dual-port SRAM available today, the IDT7M1002 offers 512k of memory with an access time of 25ns. The package is designed to be used with 32-bit RISC (reduced instruction set computer) or CISC (complex instruction set computer) memory systems to simplify design. The high speed of the system makes them ideal for use in applications such as telecommunications, networking, digital signal processing, and image or graphics processing.

Contact Integrated Device Technology Europe, 21 The Crescent, Leatherhead, Surrey, KT22 8DY, for more information. ■



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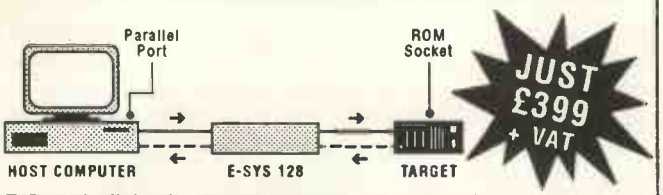

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All I Want For Christmas

Barry Fox and Ian Burley join the editor in getting their present lists off to Santa nice and early so that a reply is assured

One of the best things about being editor of PE is that I get to see, or at least hear about, all the latest electronic gadgets. The problem with this is choosing between them all for something I'd like. In the end, I decided on some of the more recent pieces of kit that caught my eye.

Kodak's digital camera system, a snip at $20,000.

Editor's Choice

The first is the Philips Scopemeter. This is, perhaps, the ultimate electronic test instrument. Combining the features of a sophisticated digital multi-meter with those of a 50MHz oscilloscope and a signal generator, this gadget is also built into a super ruggd case – there aren't many oscillocscopes that can be dropped one metre onto concrete without doing them some damage. The top of the range model costs a mere £1095, well beyond my pocket but, if anybody is looking to buy me a present...

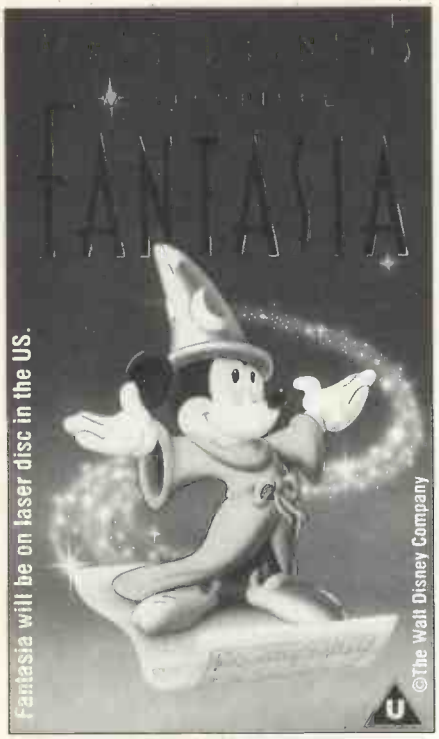
The Philips Scopemeter.

Some say it is bad to combine business with pleasure but one of the things that makes my job easier and is a lot of fun to use is the Apple Macintosh used to put the mag together. I have a huge one on my desk (a IIcx plus 19in monitor) which is great for most things but is in no way portable. It would be nice to be able to work at locations other than the office and I have always hankered after a decent portable computer. The trouble is that although there are a number of laptop machines available, none are fully Apple Mac compatible – anyone who has used both PCs and Macs will know there is no going back to a PC. Fortunately, there is a rumour going around that Apple will be launching a full feature laptop in the near future – the company denies all knowledge of this but stories in Mac User, the Financial Times, plus third party software houses boasting that they are going to publish software for it can't all be wrong. With any luck it will be out by Christmas, in which case it will be at the top of my list.

One of the more fascinating and expensive items covered recently in PE was Kodak's electronic camera. The Digital Camera System operates in the same way as a normal Nikon 35mm but produces 1280x1024 pixel images that can be loaded onto a computer for storage, display and editing. I may not be much of a photographer but one of these babies might make the difference, especially when coupled to a high quality graphics machine like a portable Mac...

Get Away

Trying to get away from it all is one of my main hobbies. To help with this I like to listen to the odd bit of music and with this in mind, I



Fantasia will be on laser disc in the US.

would like to upgrade my CD system to a Philips Bitstream and my speakers to Canon S50s (see review this issue). With these installed, I can sit back and enjoy the New Year in sonic comfort.

Barry Fox

The Japanese have grown rich on consumer electronics. Mass production is the key to low price and high reliability; and digital circuitry is easier to integrate into a few chips. The main cost of a calculator or digital watch is now in the packaging and distribution. So stalls in Hong Kong sell them for 50p and firms round the world can give them away as free promotions, even though the shop price is several pounds.

Now the Japanese majors, with sights set on the long-term future, are recognising that the world is saturating with electronic trinkets. They must think of new novelties that people will buy on impulse, or electronic equipment which answers a genuine need.

They know that what we DON'T want for Christmas is another portable stereo, car radio or world time clock and calculator.

So what do I want?

Having struggled with CD-ROM, I have seen the potential of the medium but been driven to distraction by the lack of compatibility between CD-ROM discs, drives, computers and control software. What I want for Christmas is Sony's new Data Discman, a table-top data bank that is ready to read data from a CD-ROM at the flick of a single on/off switch. They should be on sale this Christmas in the USA at around $500.

No Mangled VHS For Me

Walt Disney is releasing Fantasia on video for the first and final time this Christmas. After that the original version will never be seen, on video, again. In the USA the release is on VHS tape and laser video disc. In Europe it looks like being on VHS tape only. I want it on laser disc, because that way I should still have a good copy of Fantasia long after other people have mangled their tapes.

Often I want a single photograph of something, or few slides to project at a talk or lecture. I also want to be able to photograph small objects at close range. Most modern 35mm cameras have a macro facility which allows close-ups. But you have to shoot and process a whole reel of film. So what I realy want is a sensibly priced Polaroid camera, with a macro facility; better still I want one that will shoot instant slides instead of instant prints. But I fear there is nothing yet like that.

Likewise I fear I can't have the simple gadget I would like that could plug into a TV set and display on screen a positive image of a photographic negative. I could already do this, by using a video camera with neg/pos reversal switch. But the camera would cost the best part of £1000 and I would have to rig up some kind of adaptor in front of a macro lens to hold and illuminate the negative. What I want is a custom designed slide viewer which includes an image sensor and negative/poitives switch.

I also want something that I have already got but others keep asking to borrow. It's a neat little plug-in transformer which converts US and Japanese 110 volt mains up to 220 volts so that I can run European electrical equipment in those low voltage countries. The shops are knee deep in droppers which reduce 220V to 110V, but what use are they to anyone in Europe? I bought my plug-in up converter in America for $10, but have never seen once since.

Finally I'd like a nagger. This is a telephone with a last number redial facility which registers when the number is engaged, hangs up and keeps on trying again, and again, and again every half minute or so until the line is clear. The British authorities won't let us have these, because they reckon it clogs up the telephone system. But some foreign phones have them and anyone who has tried using a nagger will know what a boon it is.


Could Canon's slip-video system solve Barry's problem?

Ian Burley

When I was first asked to write this article, my immediate reaction was to run riot with an imaginary credit card endowed with an infinite credit limit. To be asked what half dozen bits of consumer electronics one would like for Christmas, money no object guv

An Amstrad Fax for Ian.

visions of shiny new gadgets from wide screen TVs, multi-standard hi-band videos, HiFi, phones, you name it! Actually settling on a selection of six proved much more difficult. Not being related to Paul Getty, I am actually quite cautious about what I buy for myself in the real world, despite what some friends might say. It was difficult to justify some of the more outrageous gadgets, even though I am self-confessed gadget-mad. So you may be surprised to find that the following electronics products are, on the whole, useful rather than extravagant, though I still couldn't afford half of them.

I would like an Amstrad 9600 Fax. A fax machine? These marvels of telephony are already considered boring and utilitarian by most office workers; a fate of popular apathetic attitude which befell the personal computer some years back. In the States, fax machines are rapidly becoming established in a surprising number of homes. This is a trend which, like many others, we will see over here sooner or later. As I do a fair amount of freelance writing, I am constantly asked if material can be faxed to me. Until now, I have resisted the temptation to buy a fax – I use the Telecom Gold Email service for sending text-only faxes directly from my computer. However, I will be giving in soon, and will take the opportunity to pension off my 8-year old Binatone answering machine by buying a combined fax and answering machine. I can't justify the installation of a second phone line, hence the combo unit. The Amstrad 9600 is excellent value, save one omission – a remote control for the answering machine section. I hear this due to be remedied quite soon. Now, did anybody mention discounts...?

The security robot on show.

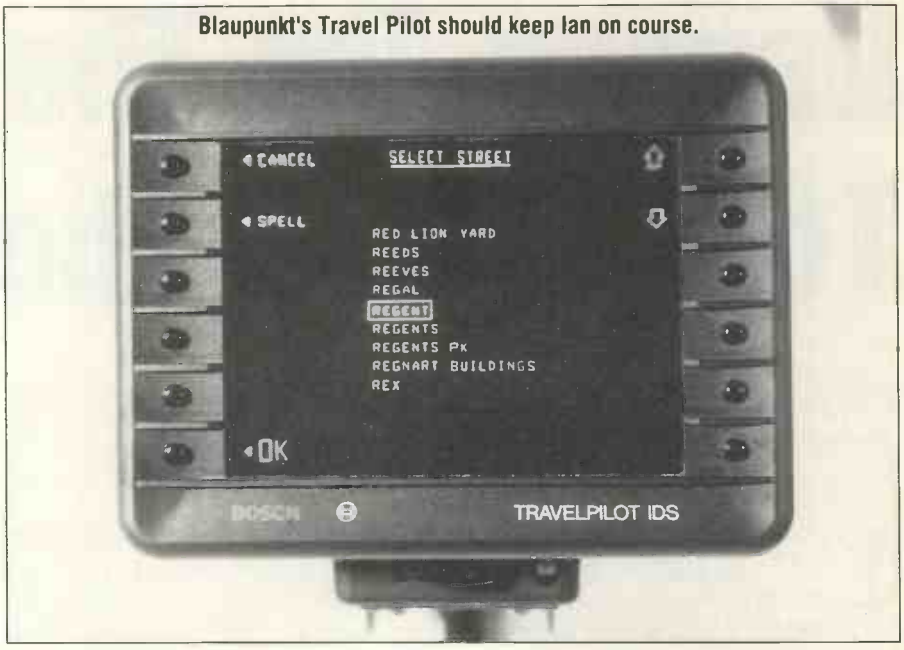
. I joined the camcorder generation earlier this year and now find I need a pocket-sized TV to view, in colour, footage I've shot on location. Until recently, miniature portable TVs were sad gimmicks. Even Sony's first stab at the black and white Watchman was neither truly pocketable or much fun to watch. The quirky Sinclair flat-

screen TV was a step in the right direction, though in my opinion the advent of the first rather smeary and too-minute colour LCD TVs only hinted at the future possibilities. With the arrival of active-matrix thin film transistor technology, the better portable LCD TVs are now serious alternatives to conventional 14" portable tellys. Citizen, Sharp, Sony, Panasonic and others have some very nice looking models, but as a frequent-ish traveller I'm disappointed not to have found a world-standard model yet. Oh yes, at around £300 for a 4" screen, they're rather expensive – but that doesn't matter here, does it? Prices should drop next year.

I get around quite a bit behind the wheel of my car. Not only am I a proponent of the paperless office but I'd like a paperless car interior as well. No more fumbling with bits of paper or maps at 70MPH on the M25, thankyou very much. The Blaupunkt TravelPilot system shows a remarkably detailed and dynamically updated map of the local vicinity you are travelling through, even taking into account your heading as you turn corners. Those who know me will leap at the opportunity of confirming how abysmal I am at finding my way anywhere, so this would be an IDEAL Christmas present.

If there is one thing I have been convinced of totally in the last 18 months, it's that interactive video or multimedia is going to be as important to us as the printing press was to Caxton in his day. The advantage Caxton had was that he didn't have to fight to establish his hardware standard over a posse of others. I'd like a Kodak Photo CD compatible CD-I player which I could have permanently linked to both my computer as a CD ROM drive and the HiFi as a conventional music CD player. OK, make that two of the... Oh, and it would have to have Bitstream digital sound shaping and if only it could integrate into the rest of my hifi like Sony's SIRCS II system.

Blaupunkt's Travel Pilot should keep Ian on course.



Assuming it works as well as it's expected to do, Sony's new recordable audio disc system, Mini Disc, should be a big commercial success. Unfortunately, history tells us that technical niceties in the league of random-access digital sound recording at an affordable and pocketable price, aren't guarantees of commercial success. 74 minutes of audio on one disc is only just adequate, though it does beat Philips' Digital Compact Cassette which looks like only offering 45 or 60 minutes per side. DCC will be out first and be cheaper. I will almost certainly get a DCC deck anyway as I have a sizeable collection of conventional cassettes with which DCC remains compatible and the old Aiwa deck I have is getting on a bit.

With DCC practically assured of commercial success, I still hope Sony makes it with the MD standard, and I want one!

Although I've broken the rules slightly with the last two selections, neither of which will be available by Christmas, here's a slightly more outrageous Christmas present idea which is scheduled for Christmas stockings in the US at least; Samsung's Scout-About domestic robot. Launched at the big Chicago Consumer Electronics Show back in the Summer, this dinky dome-shaped intruder and fire detector will patrol your house without falling down stairs (it can't climb them either, alas) or bumping into the furniture. If it needs to sound an alarm it will even phone the police. Above all, it would be the ideal gadget to stay that one step ahead of the Jones's! A snip at just $1,000 (£590), even if it can't make the tea, just yet. ■

Everyone awaits DCC with baited breath.

Harnessing The Power That Drives The Stars

The JET fusion experiment operates at temperatures in excess of 300 Million °C. Is this the power source of the future? Kenn Garroch investigates

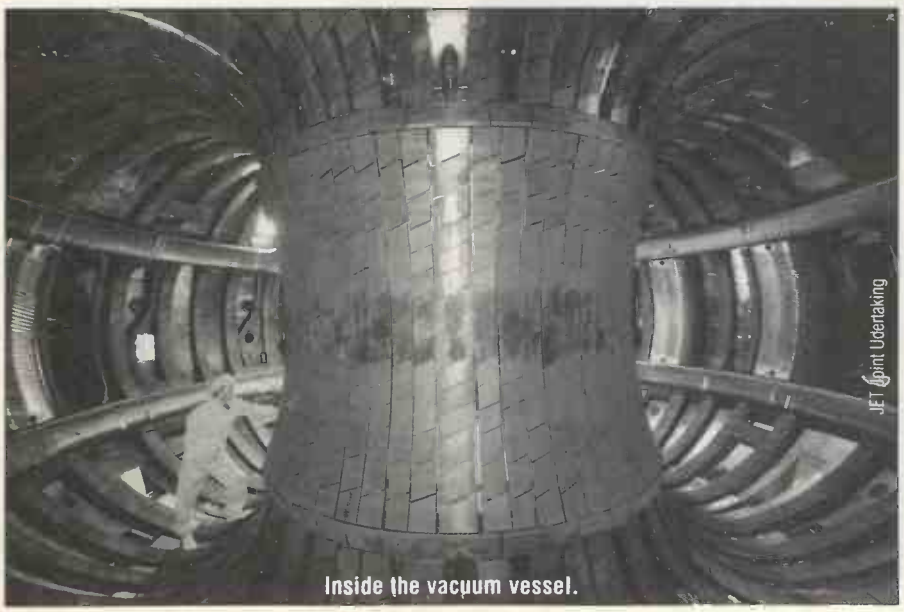
Three minutes to go and 40 mini-computers check and synchronise the diagnostics and control equipment. Signals travel around the 19 fibre-optic loops at a rate of 25 Mega-bits per second confirming that everything is ready. A few seconds before zero the toroidal magnetic field is turned on and a small quantity of Deutrium gas is let into the evacuated torus. As the countdown reaches zero, the current is switched on rising swiftly to 1 million Amps, ionising the gas and turning it into a plasma. More Deutrium gas is added followed, five seconds later, by a pellet of the same material in solid form. The temperature of the plasma is now around 30 million degrees Centigrade. An additional 11MW of heating increases this to over 100M°C. A small sun will exist for just two seconds in the heart of England.

This process takes place every twenty minutes between 6am and 10pm six days a week at JET, the European fusion research project based near Oxford. The Joint European Torus is the biggest experiment of its kind anywhere in the world. It aims to study the various methods of plasma heating, containment and density control with a view to using thermonuclear fusion as a practical form of energy production sometime in the next century.

Fission And Fusion

There are two main types of nuclear reaction that produce energy, fission and fusion. The first forms the core of today's nuclear power industry and works by bombarding large atoms with neutrons causing them to split up producing more neutrons which split more atoms, thus forming a chain reaction. This process also produces a lot of energy which can be used to heat steam and spin turbines to generate electricity. A couple of undesirable aspects of the process are the considerable amounts of radiation produced and the cost and difficulty in handling the Uranium or Plutonium fuel.

Nuclear fusion is an alternative reaction that also produces heat but uses abundant fuels and creates relatively little long lived radioactive waste. Instead of using heavy atoms, fusion smashes together special forms of hydrogen, Deutrium (D) and Tritium (T). This reaction forms Helium (He) ions and energetic neutrons. In a reactor, the neutrons are slowed down in the surrounding "blanket" to provide the heat source for electricity production. By including Lithium in the blanket, Tritium will be produced to refuel the reactor. Unfortunately, getting the reaction to take place requires a huge amount of energy and the Deutrium and Tritium fuel must be heated to over 100 Million °C; in so doing, the gas is turned into a plasma – the fourth state of matter, the other three being solid, liquid and gas. In a plasma, the encircling electrons of the atoms are so energetic that they are forced out of their orbits to roam free.



Inside the vacuum vessel.

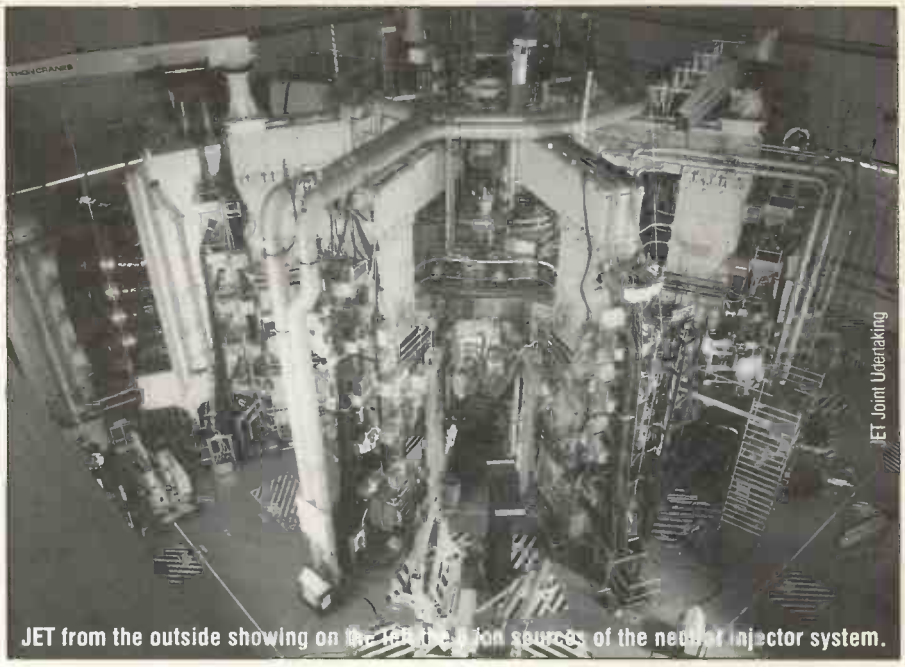
The Participants

The JET Joint Undertaking is the largest project of the European Atomic Energy Community (EURATOM). Although it is based in the UK, the technology, manpower, administration and science are supplied by the 12 members of the EC plus Switzerland and Sweden. Created in 1978 to run for 12 years, JET's

objectives were to construct and operate a large Tokamak fusion experiment in order to explore controlled thermonuclear fusion to the stage where it could be used in a thermonuclear reactor. Three main aspects of this experiment can be expressed as the triple product of central plasma temperature (T), central plasma density (n) and energy confinement time (t). Typical values of these required for a commercial reactor are:

T=10 to 20keV 100 to 200 M °C
$n=2.5x10^{20}m^{-3}$
t=1 to 2 secs

When JET was being designed in the early 1970s, the best value of the triple product ever achieved was about 20,000 times away from this sort of performance; in 1990/1JET is only about six times away with a triple product of between 7 and 9 – the requirement being from 50 to 100 (in the required units).



JET from the outside showing on the left the ion sources of the neutral injector system.

Some Like It Hot

To bring the Deuterium gas up to operating temperature a number of methods are used. The first applies the electrical transformer effect to induce a large current into the plasma in the torus. The operation of a Tokamak (originally pioneered in the USSR) is based upon a doughnut shaped containment vessel in which the plasma forms the single-turn secondary of a transformer. In JET there is a stack of eight primary coils with the ability to induce up to 7.1 Million Amps into the system. This ohmic heating heats the gas up to around 50M°C at which point its central resistance is so low that further current increase has little effect.

Because the induced current tends to concentrate at the centre where the plasma is hottest, more energy can be put into the reaction by forcing the hot area to broaden. The Lower Hybrid Current Drive couples 3MW of 3.7GHz microwave power to the system and although still experimental, it is hoped that this will shortly input an extra 10MW of power giving a longer pulse length and increased stability.

The next heating method is to inject high velocity particles. A beam of charged He or D atoms is accelerated through 140,000V and then neutralised. Because of the magnetic confinement of the plasma within the vacuum vessel, charged atoms would not be able to penetrate the field. Removing the charges allows them to enter the reaction, collide with the plasma atoms and increase the overall temperature. Two such systems are used in JET to give a total 20MW of power.

Another major energy contribution to the reaction is derived from radio frequency heating. Because the ions and electrons that make up the plasma spiral around the magnetic field lines of the Tokamak at a set rate, radio waves beamed into the torus at the same frequency add to the overall energy – up to 22MW of heating is supplied by antennae on the inner walls of the reaction vessel at a frequency of 25-55MHz.

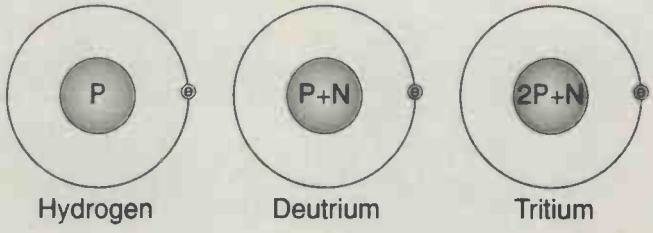
Any He nuclei created by the fusion of D and T are charged and remain in the reaction. They continue to heat the plasma and when there are enough of these being created to maintain the plasma temperature, the ignition point is reached and the plasma becomes self heating.

Having reached the high temperature required, the density of the plasma is increased by injecting pellets of Deuterium ice at speeds of 1.2 to 1.5km/s. This can instantaneously double the particle density of the plasma bringing the system nearer to the ideal triple product.

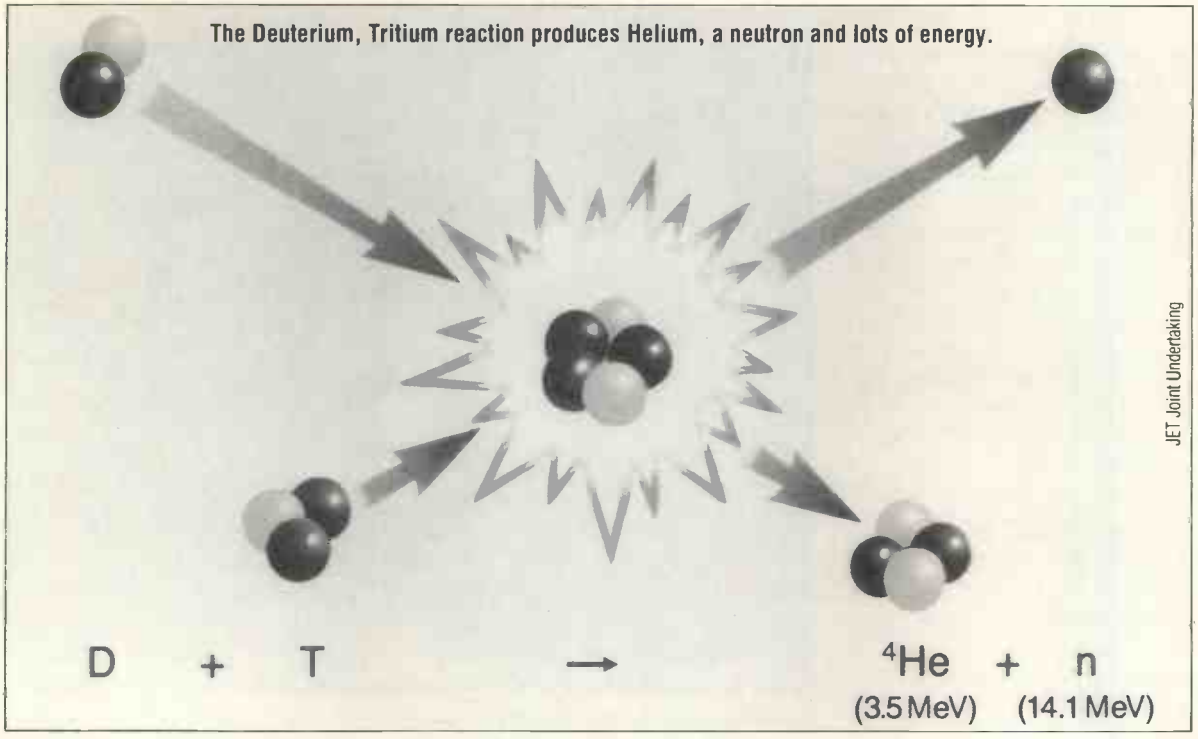
Holding Back The Heat

Having heated the plasma up to its

Atoms



Atoms of hydrogen are made up from one proton with one electron in orbit around it. Adding a neutron to the central proton makes this atom into Deutrium which makes up about .002% of all water – which may not sound like a lot but the world contains an awful lot of water. Adding another neutron makes Tritium. This doesn't occur naturally in nature but is made in a fusion reaction. The reaction of 10g of Deutrium, which can be extracted from 500litres of water, with 30g of Lithium produces 15g of Tritium and enough power to last the average person a lifetime.

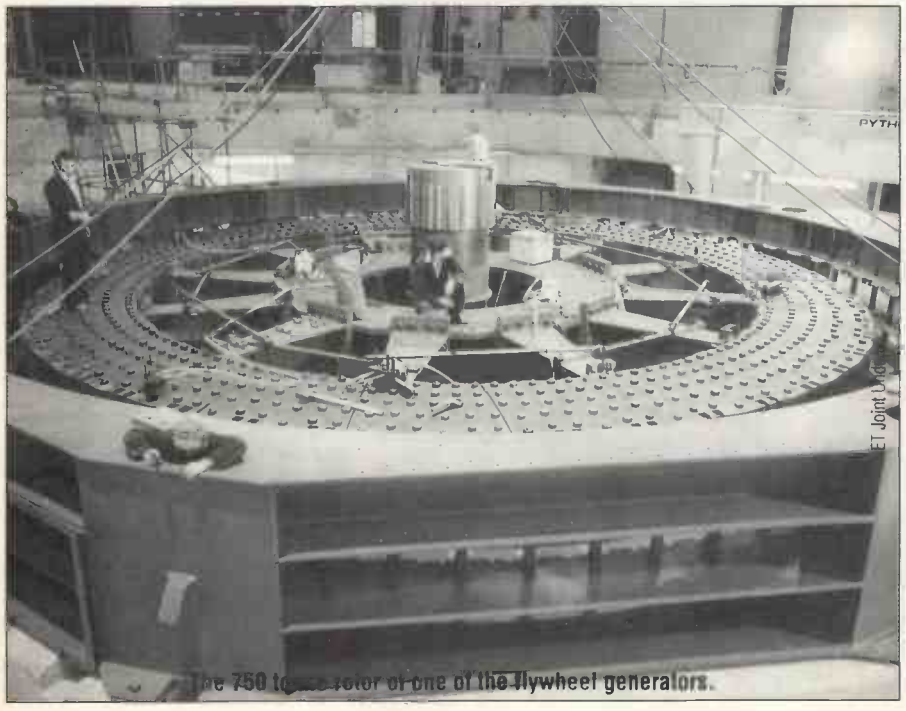


The Deuterium, Tritium reaction produces Helium, a neutron and lots of energy.

operating temperature, any energy losses must be minimised. The confinement time needs to be around 1 to 2 sec and to achieve this, the plasma inside the evacuated torus is held away from the walls by magnetic fields. A set of coils around the minor circumference produces a toroidal magnetic field around the major axis of the machine. The current flow through the plasma induced by the transformer produces a poloidal field. These two interact to produce a helical or spiral field which loops around the torus and prevents the plasma from rapidly reaching the walls. An additional set of coils is used to position the plasma within the reaction vessel. The resulting plasma shape is a doughnut with a D shaped cross-section.

The vacuum vessel is made up from eight D shaped identical modular pieces with built-in ports through which the reaction can be observed and neutral beams injected. The advantage of the modularity means that if an octant fails, it can be replaced relatively easily.

Without all of these elaborate restraining systems, the Plasma would soon loose its heat and the fusion reaction would stop – an aspect of fusion power that makes it a lot safer the fission.


The 750 tonne rotor of one of the flywheel generators.

Supplying JET

To get its reaction up and running, JET requires a great deal of power. One of the reasons for its location in Oxfordshire, apart from being adjacent to the Culham fusion labs, is its proximity to the Didcot power station. For each experimental fusion pulse, around 700MW of power is needed. Only 550MW can be drawn from the national grid, the rest comes from the on-site storage. This consists of two 9m 775 tonne flywheels, each driven by an 8.8MW motor. Between pulses these are run up to between 225 and 250rpm and on demand deliver 400MW of pulsed power into the primary of the transformer for ohmic heating and the 32 magnetic coils of the containment system. The power supply of JET is a major electrical engineering achievement that ranks alongside the rest of the experimental fusion system in terms of new technology.

Outside Looking In

The main objective of JET is to experiment with different methods of heating, power supply, fuel injection, indeed, anything that can be used to make future fusion reactors operate efficiently. Because of this, all of the reactions are observed in the minutest detail. The diagnostics use a number of

methods to examine the various plasma parameters – from lasers to X-rays. All observations are coordinated through the computerised control and data acquisition system (CODAS) which uses a network of 40mini-computers to handle the 27Mbytes of data produced from each experimental pulse. After being captured directly from the Tokamak, the data is transferred to the main computers and then sent off to a large IBM mainframe for further analysis. If JET gets the go-ahead to extend the research until 1996 CODAS will be upgraded from its 1970's computer technology to the latest workstations, significantly increasing the analysis capabilities.

The Future Of JET

Originally envisioned as a 12 year project, JET, started in 1978, is now reaching the end of its first two-year extension. Another four years are under consideration so that the effects of impurities in a gas plasma can be further studied.

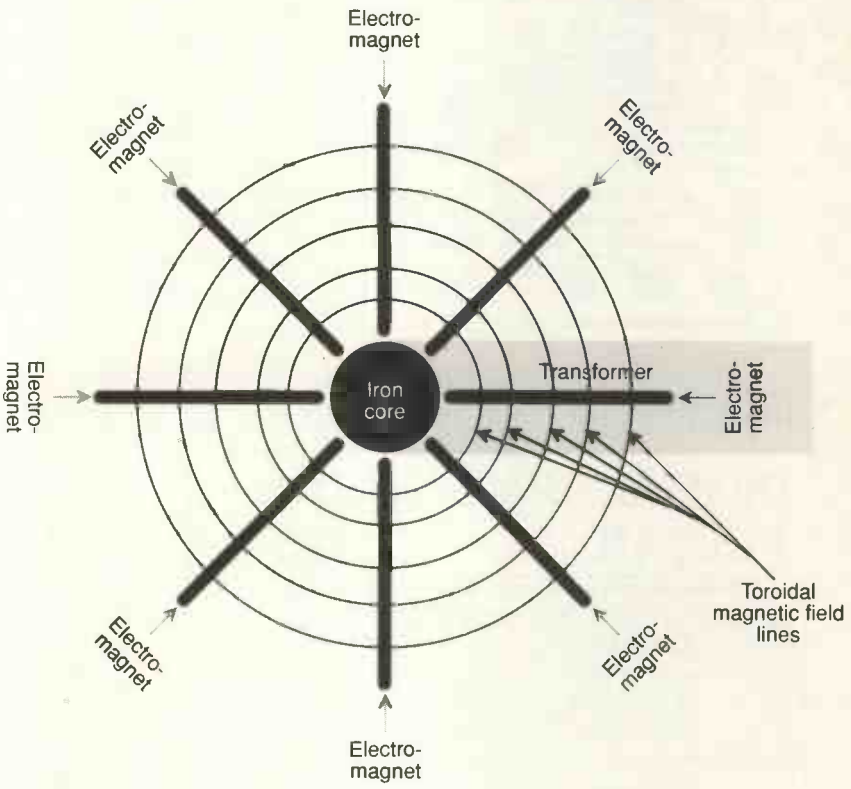
Achievements to date include a record plasma current of 7.1MA; the closest to the required triple product of any fusion experiment so far; the creation, in separate experiments, of the required plasma temperature, density and confinement for a commercial reactor – JET is too small to achieve them all at the same time.

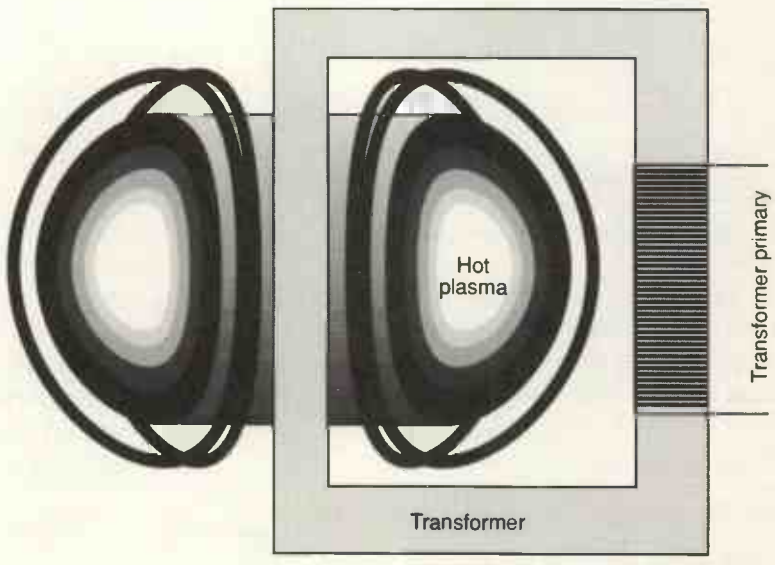
Following on from JET in the EURATOM program is the Next European Torus (NET) or participation in a worl-wide project ITER (International Thermonuclear Experimental Reactor) in collaboration with the US, Japan and the Soviet Union. This will be used to establish the feasibility of commercial fusion power. It will be about twice the size of JET with a magnetic field about 40% greater, be able to sustain a pulse for up to one hour and generate 1000MW of fusion power. If all goes to plan, construction could start as soon as 1997. By the beginning of 2030 fusion power could be a reality providing the world with cheap, clean and abundant electrical power. ■

Magnetic Fields

Two main magnetic fields are used in a Tokamak to hold the plasma in position. The toroidal field is generated by a ring of coils that encircle the torus generating a ring-shaped field. The current induced in the plasma generates a poloidal magnetic field that circles the tube of plasma. The combination of the toriodal and poloidal fields make the characteristic magnetic field configuration of the Tokamak in which charged particles spiral around the field lines. Particles, therefore, only reach the walls by a relatively slow diffusion process.

Top view showing the toroidal magnetic field





Side view showing the transformer and the D shaped plasma.

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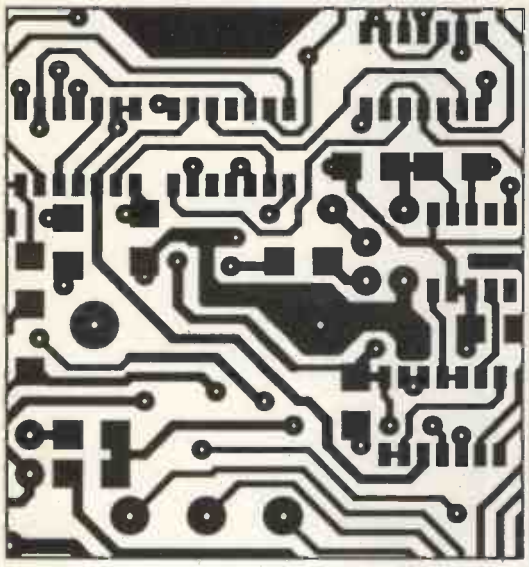

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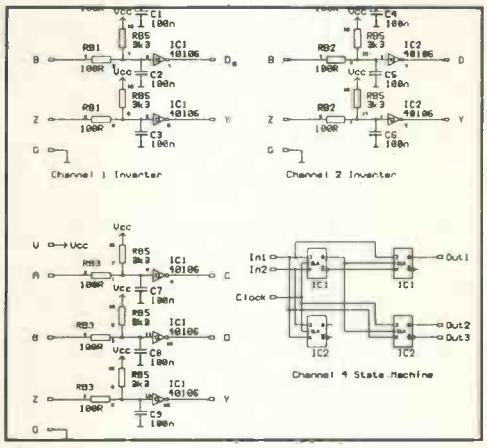

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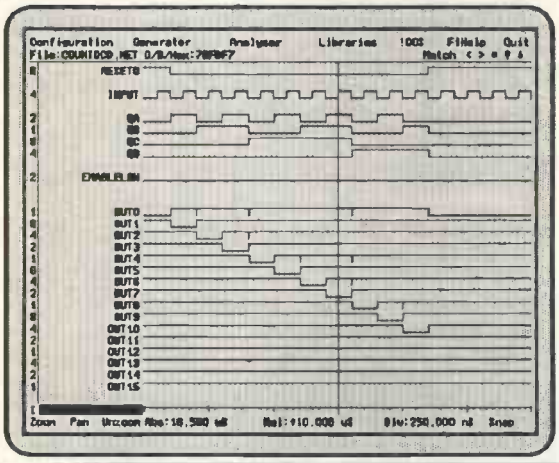

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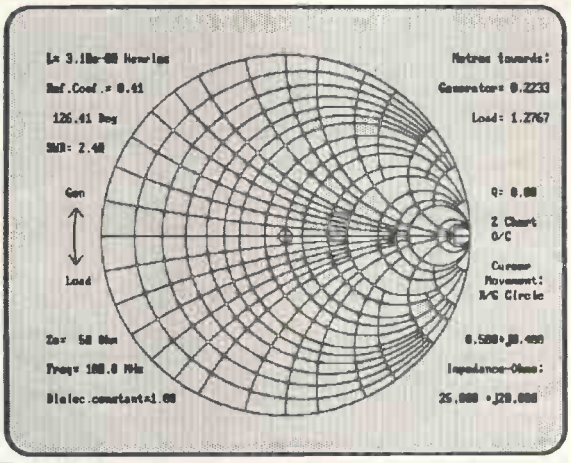

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A Visit To The Funkaußtellung Fair

This month Ian Burley reports from Berlin and has a look at the latest Psion Organiser, a single chip PC and a pair of domestically grown video telephones

The US holds two major consumer electronics fairs, admittedly trade-only, a year. Europe's biggest fair, the Internationale Funkausstellung Berlin, is held once every two years and is open to both the trade and general public. Comparing the European event with its US counterparts proved interesting and underlined some fairly basic differences in taste and technology emphasis.

Above all, the show was a strong showcase for European firms, many of whom were showing advanced technology not yet on sale, like HDTV (HD-MAC) for example. At the CES events in the US, there has been much confident talk of US HDTV standards but only the Japanese have actually exhibited working equipment there. In Berlin, wide-screen TV and HDTV and was everywhere – even if there isn't yet full agreement on which standards to go for.

The show was an excellent opportunity for the public to see tomorrow's technology, like HDTV, first hand. Philips, Nokia, Thomson, Grundig and others all showed HDTV sets working. A special theatre was set up for video-projected HDTV demonstrations and there was even an HDTV studio built into the rather cramped exhibition complex.

There were two other kinds of advanced television on display as well; standard 625-line wide-screen D-MAC satellite broadcasting and PAL Plus, the proposed enhancement to terrestrial broadcasting which will provide enhanced definition wide-screen broadcasts on existing transmitter equipment, but at the same time remain compatible with the ordinary broadcasts we enjoy today.

D-MAC wide-screen broadcasting is already available from certain European satellites. In the UK, the demise of BSB has set back the introduction of wide-screen TV. HD-Mac high definition wide screen satelite broadcasting could start commercial service as soon as next year, though with suitable TV sets still costing in the region of £5000, widespread adoption – EC policy or no policy – is some way off yet. PAL Plus is scheduled for as late as 1995. This is because the extremely complex picture processing technology required is still in an early stage of development.

So what of audio and video enhancements we can enjoy and afford in the shorter term? Attracting considerable attention was an interesting gimmick from the Finnish electronics giant, Nokia, in the form of an AV remote control which incorporates tilt switches. Nokia's so-called mouse-remote, which is now available in the UK, is designed for convenient one-handed operation; potentially a couch-potato's dream. Combined with on-screen indicators, the idea is that you select a function, volume for example, by pressing one button and then make adjustments to the setting by tilting the remote without releasing the button. The four-way tilt switch can facilitate setting adjustments and menu selections on, for example, the enhanced teletext system, Top Text. I have to admit, I found the thing tricky to use, but that's a criticism of most remote controls. It was fun though.

Toshiba showed some enhanced colour TVs which avoid moiré interference sometimes evident on fine patterns being displayed. 100Hz refresh flicker-free TVs were also evident.

Attracting rather more attention

The mouse remote.

Puzzlement over the mouse remote.

on the Toshiba stand were a pair of prototype 10in portable colour LCD TVs, similar to ones shown at the last two CES shows in the States, except these were European PAL compatible. Surely only price is holding back the introduction of these superb units.

Philips had a large presence at the show. Its stand occupied most of one hall and featured a very surreal mix of present day products and the products design students' futuristic imaginations. CD-I multimedia was on show, as was a bank of wide screen televisions. Sadly, DCC (digital compact cassette) was hidden away from public gaze, as was a novel application of the PostScript page description language for teletext TVs. PostScript is used in the world of computing for printing text and graphics – like the pages of this magazine for example. Philips is now experimenting with the use of PostScript for displaying high resolution information on a TV screen, transmitting the data via teletext.

Over at Bosch/Blaupunkt the latest RDS (Radio Data Service) car stereos were being put through their paces. To be launched early next year, the latest iteration of RDS is called EON (Extended Other Network) and introduces the facility which allows the radio to switch automatically to another station when a traffic or news report is imminent. As one wag put it, it's ideal for classical music listeners who are apparently deprived of links with reality.

Pioneer had a recordable CD deck, but this proved to be no threat to Sony's new Mini Disc recordable audio-disc syste. Instead the Pioneer deck is a write once (WORM) CD production deck designed for small volume mastering. Pioneer also revealed it is to introduce a similar deck for laser video disc production soon.

On the camcorder front, the show was a convenient place for Sony to debut the world's first hi-band palmcorder, the Hi8 TR705. Capable of video recording quality bordering on professional standards, the TR705 is no larger than the already tiny TR75 standard resolution palmcorder it looks like replacing. The TR705 will be introduced at under £1,000 in the UK by the end of the year.

Canon introduced its new UC10 and UC20 Video-8 palmcorders at the show as well and demonstrated that it was capable of coming up with good designs which didn't involve copying Sony. Replacing the old (18 months!) novel, but hardly compact Canon A9 and A10 camcorder models, the new versions are cleverly designed to acheive a very slim profile. The standard infra-red remote controller even clips onto the top of each camera.

Finally, a few things spotted around the exhibition; you've seen dancing coke cans, now ready yourself for wobbling coke bottles. Take my word for it, they're hilarious. Casio showed a Mercedes taxi with one of its LCD colour TVs installed for the benefit of the passengers. AEG Telefunken appeared to be stressing the ability of its video recorders to be used at any angle, including upside down - a conveyor belt of the dozens of the things was continuously rotating all day on their stand. Finally back to Toshiba who had their solid state camera on display. This uses high capacity memory chip cards instead of film or magnetic media. It is limited to comparatively lo-res desktop publishing applications at present but the technology is getting better all the time.

Overall, one comes away from events like these muttering things like, I wish we had shows like these in the UK...

Videophones Everywhere

Two established UK companies have announced plans to introduce video phones some time next year. One of those firms, BT (previously known as British Telecom), no surprise. The second, Amstrad, is well used to springing surprises and this is no exception, though an Amstrad PR representative half admitted that the BT announcement forced a premature revelation of the Amstrad project in conjunction with GEC Marconi.

About the only thing the two projects have in common is that they're videophones. The BT one uses ISDN (integrated services digital network) lines and a 64K bits per second image data transfer rate to feed its slow-scan black and white picture. Amstrad predictably has settled for conventional high speed modem technology for an analogue phone link and a colour LCD screen has been chosen. The Amstrad incorporates chips capable of a 14.4K bits per second data rate, though undoubtedly data compression techniques will be used to increase the throughput. It's quite likely Amstrad will enable its video phone to be used as a modem linked to a personal computer.

Although BT and then Amstrad

Could there be a show like this in the UK?

announced they are developing videophones, not much detail was forthcoming. Both products are some time from going on sale but estimates on price put them at opposite ends of the spectrum. The BT phone is expected to cost well over £1,000 and of course you will need the special ISDN phone line – at both ends of the video-link of course. Amstrad hinted that the target for its videophone was comfortably under £1000 and, of course, it could theoretically be used anywhere there's a conventional phone line. What wasn't quite clear was who exactly would want to buy one of these gadgets.

A PC on a chip

The US PC chip manufacturer, Chips & Technologies, has announced the latest development in its determined effort to integrate PC-compatible chip technology. Last year the firm produced an IBM PC/XT (Intel 8088-compatible) processor board not much larger than a credit card. Now C&T has squeezed the technology further and stuffed it all onto a single chip, the F8680 PC/CHIP. It contains an 8086-compatibe CPU, an 8529-compatible interrupt controller, 8524-compatible timer, memory controller, DMA emulator, CGA graphics controller and a keyboard controller and a 6540-compatible UART for serial communications. All you need to add for a fully working PC is some memory, a keyboard and a display. The chip is a low power static device and ideal for pocket PC applications. The announcement coincided with IBM's celebration of the PC's tenth anniversary. It's easy to be blase about ICs these days, but if you've ever peeked inside an early IBM PC and counted the staggering number of chips which as required then, Chips & Technologies achievement comes sharply into perspective. Next in line will be versions of the

The new Psion series 3.

Is this the last we will see of Zonephones?

single chip PC incorporating more powerful versions of the Intel 80xx processor series.

The Psion Series-3

Another device which tends to remind me how old I am is the Psion Organiser. The short-lived MkI version was launched 8 years ago. The Psion Organiser II launched in 1985 looked outwardly the same, but improvements to its programming language, built in applications and non-volatile memory cartridges and accessories made the units far more useful. Over a million have been sold since.

Now, with the new Series-3 Organiser, Psion has reacted to the rising success of its Japanese competitors mainly in the form of Sharp, with its IQ range (known as the Wizard in the States) and the Casio BOSS. The rise of pocket-PC compatibles like the DIP/Atari Portfolio and Hewlett-Packard's HP95LX also needed to be countered.

Obvious differences between the old Organiser II and the new Series-3 include the latter's more conventional 'clam-shell' configuration, opening up to reveal a larger 240x80 pixel LCD screen and a conventional QWERTY layout keyboard. The keys are easy enough to use but there's no claiming this is a touch-typer's paradise. A row of eight touch-sensitive icon-labelled function keys along the top summon up the Series-3's impressive line up of built in applications which are stored in 384K of internal ROM.

The applications include a personal free-format database, time and personal manager, word processor, world information base and an interesting calculator which stoes the last ten calculations on a scrollable 'till-roll' for convenient checking.

The Series-3 borrows much of the technology originally developed for the much admired but commercially unsuccessful Psion MC (Mobile Computer) laptop range. The same tiny flash-EPROM or battery-backed RAM memory cartridges are used and they are file compatible too. The same proprietary programming language common to all Psion's products, OPL, is used, as is a derivative of the MC200/400 multi-tasking operating system. Also shared is the display technology in the form of the very sharp retardation film passive matrix LCD which doesn't require a back-light. Just two AA batteries are required to power the Series-3 for 2-4 months typically.

Communication with the outside world is via a compact but very fast (1.54Mbits/second) proprietary serial interface to which things like conventional serial or parallel adapters or perhaps bar-code readers can be attached. Software for file exchange with PC-compatibles or Apple Macs is available. The built in piezo speaker also acts as a DTMF tone dialer.

At £199 including VAT for the 128K RAM version (up to 4Mb can be fitted to the two cartridge slots), Psion's Series-3 is good value and an altogether more serious a beast than the Sharp IQs and Casio BOSSs of the world.

The End Of Telepoint

Here's a topic not discussed in PE for a while; Telepoint. The last telepoint digital public cordless phone service operator, the BT-led Phonepoint consortium, had suspended service and is offering its customers refunds. Considering Phonepoint admitted it only had 800 customers – each with just over four public base stations at their disposal – you couldn't argue with their reason for pulling the plug. The eternal optimist in me notes that the service has only been suspended and the Hutchison Group, which now operates the still-to be launched Rabbit telepoint service, says it is determined to press ahead even though everybody else (Zonephone, Callpoint and Phonepoint) appear to have given up the ghost. ■

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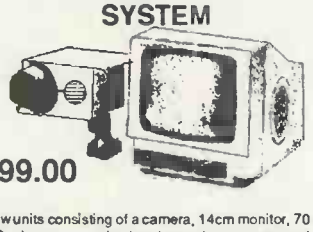

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ONE THOUSAND CABLE TIES! 75mm x 2.4mm white nylon cable ties only £5.00 ref 5P181T.

PC MODEMS 1200/75 baud modems designed to plug into a PC complete with manual but no software £18.00 ref 18P12T

ASTEC SWITCHED MODE POWER SUPPLY 80mm x 165mm (PCB size) gives +5 at 3.75A, +12 at 1.5A, -12 at 0.4A. Brand new £12.00 ref 12P39T.

VENTILATED CASE FOR ABOVE PSU with IEC filtered socket and power switch. £5.00 ref 5P190T.

IN CAR POWER SUPPLY. Plugs into cigar socket and gives 3,4,5,6,7.5,9, and 12v outputs at 800mA. Complete with universal spider plug. £5.00 ref 5P167T.

CUSTOMER RETURNED switched mode power supplies. Mixed type, good for spares or repair. £2.00 each ref 2P292T.

DRILL OPERATED PUMP. Fits any drill and is self priming. £3.00 ref 3P140T.

PERSONAL ATTACK ALARM. Complete with built in torch and vanity mirror. Pocket sized, req's 3 AA batteries £3.00 ref 3P135T

POWERFUL SOLAR CELL 1AMP .45 VOLT only £5.00 ref 5P192T (other sizes available in catalogue).

SOLAR PROJECT KIT. Consists of a solar cell, special DC motor, plastic fan and turntables etc plus a 20 page book on solar energy! Price is £8.00 ref 8P51T.

RESISTOR PACK. 10 x 50 values (500 resistors) all 1/4 watt 2% metal film. £5.00 ref 5P170T.

CAPACITOR PACK 1. 100 assorted non electrolytic capacitors £2.00 ref 2P286T.

CAPACITOR PACK 2. 40 assorted electrolytic capacitors £2.00 ref 2P287T.

QUICK CUPPA? 12v immersion heater with lead and cigar lighter plug £3.00 ref 3P92T.

LED PACK .50 red leds, 50 green leds and 50 yellow leds all 5mm £8.00 ref 8P52T

FERRARI TESTAROSSA. A true 2 channel radio controlled car with forward, reverse, 2 gears plus turbo. Working headlights. £22.00 ref 22P6T.

ULTRASONIC WIRELESS ALARM SYSTEM. Two units, one a sensor which plugs into a 13A socket in the area you wish to protect. The other, a central alarm unit plugs into any other socket elsewere in the building. When the sensor is triggered (by body movement etc) the alarm sounds. Adjustable sensitivity. Price per pair £20.00 ref 20P34T. Additional sensors (max 5 per alarm unit) £11.00 ref 11P6T.

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STRIP BOARD CUTTING TOOL £2.00 ref 2P352T.

3 1/2" disc drive. 720K capacity made by NEC £60.00 ref 60P2T

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SPEAKER GRILLS set of 3 matching grills of different diameters. 2 packs for £2.00 (6 grills) ref 2P364T

50 METRES OF MAINS CABLE £3.00 2 core black precut in convenient 2 m lengths. Ideal for repairs and projects. ref 3P91T

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ADJUSTABLE SPEAKER BRACKETS Ideal for mounting speakers on internal or external corners, uneven surfaces etc. 2 for £5.00 ref 5P207T

PIR LIGHT SWITCH Replaces a standard light switch in seconds light operates when anybody comes within detection range (4m) and stays on for an adjustable time (15 secs to 15 mins). Complete with daylight sensor. Unit also functions as a dimmer switch! 200 watt max. Not suitable for flourescents. £14.00 ref 14P10T

2 MEG DISC DRIVES 3 1/2" disc drives made by Sony housed in a 5 1/4" frame 1.2 meg formatted. £66.00 ref 66P1T.

CUSTOMER RETURNED 2 channel full function radio controlled cars only £8.00 ref 8P200T

WINDUP SOLAR POWERED RADIO! FM/AM radio takes NICAD batteries complete with hand charger and solar panel 14P200T

240 WATT RMS AMP KIT Stereo 30-0-30 psu required £40.00 ref 40P200T

300 WATT RMS MONO AMP KIT £55.00 Psu required ref 55P200T

ALARM PIR SENSORS Standard 12v alarm type sensor will interface to most alarm panels. £16.00 ref 16P200T

ALARM PANELS 2 zone cased keypad entry, entry exit time delay etc. £18.00 ref 18P200T

35MM CAMERAS Customer returned units with built in flash and 28mm lens 2 for **£8.00** ref 8P200T

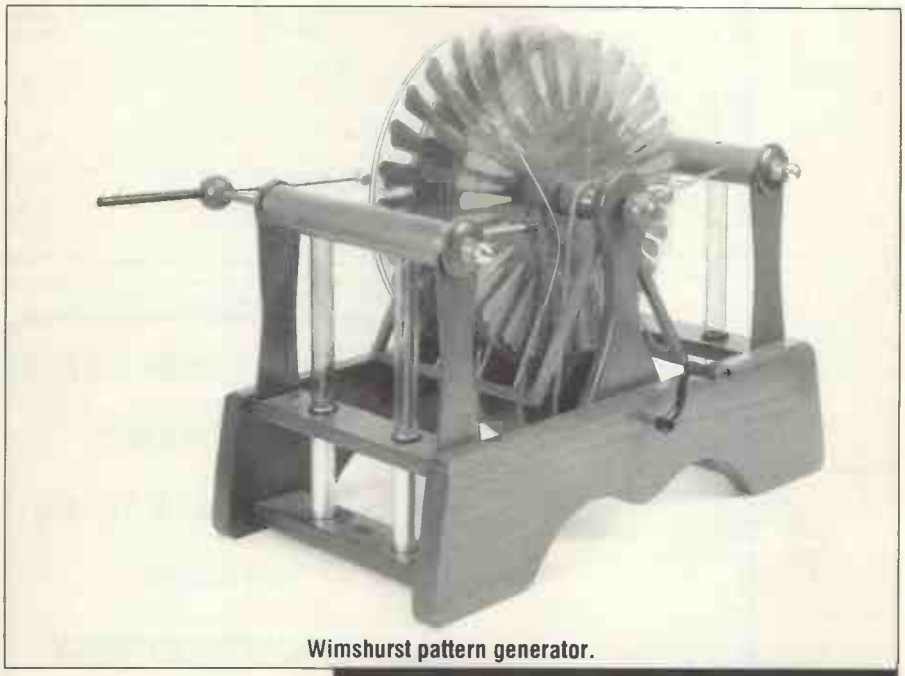
STEAM ENGINE Standard Mamod 1332 engine complete with boiler piston etc £30

Electronics Goes Under The Hammer

Old experimental apparatus has now has great rarity value as Stephen Waddington found out when he visited a recent Christies Sale.

A recent sale at Christies provided a rare glimpse at some of the apparatus, machinery and instruments used by the early electrical pioneers. The Nicholas Webster collection, auctioned in London recently, consisted of several hundered pieces of scientific equipement, discharge tubes, philosophical books and early electrical components – including the most complete collection of Geissler and Crookes discharge tubes ever seen.

Nicholas Webster was born in Birmingham and became preoccupied with science during his years at Bishop Vessey's Grammar School in Sutton Coldfield. Later employment with various electrical and scientific companies fuelled his interest in scientific and philosophical instruments and their use in education and research. Now 34, he operates his own manufacturing company concentrating on the design and production of power supplies.



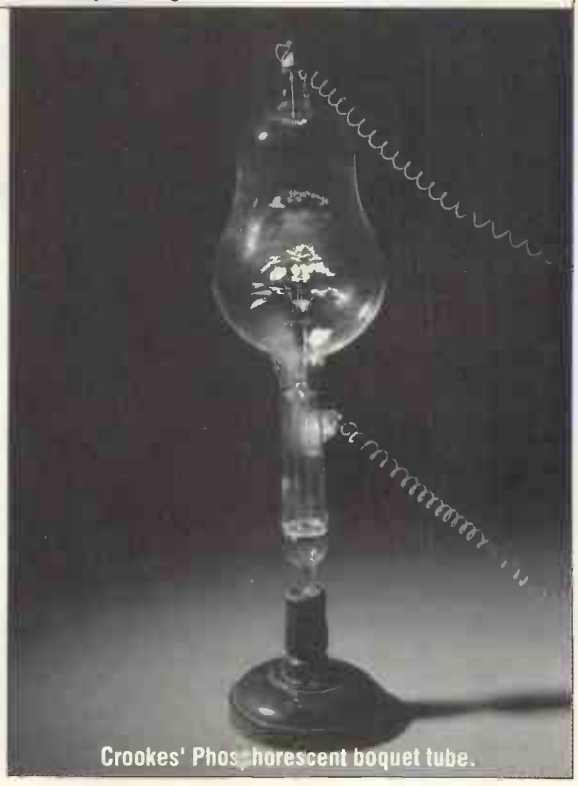
Wimshurst pattern generator.

Talking To The Experts

Christies sale rooms is supported by an impressive circle of dedicated specialists. Having decided that his collection was becoming a liability Nicholas Webster sought the guidence from an authority on scientific instruments and Christies specialist, Jeremy Collins. After scrutinising, photographing and classifying each iterm a comprehensive catalogue was produced and the whole collection was put under the hammer.

It was in the 16th century that scientists first began to observe electrical phenomena in a systematic and scientific way – the production and storage of static electricity provided great interest. Early generating machines consisted of a glass barrel connected to a handle and friction pad several examples of which were in the sale, the finest being mounted on a fine mahogany plinth. A brass conductor comb ensured that electricity could be drawn when the handle was turned. Electricity storage took the form of a Leyden Jar – a primitive capacitor.

More powerful generators such as the Wimshurst machine incorporating two contra-rotating glass plates with mounted brass fittings,



Crookes' Phosphorescent boquet tube.

Electrostatic friction barrel machine.

metallised brushes and Leyden storage jars were also on show. Of the four examples in the sale, the highest bid was realised by a machine with six rotating glass plates, copper brushes and brass conducting combs capable, it is esitamated, of generating a charge of half a million volts.

Primitive Papendorff jar batteries, graduated in pints, illustrated the operation of the first chemical batteries. A myriad of electrical meters showed the developement of such instruments over the years. Encased in mahogany, two fine examples included a voltmeter complete with matching ammeter. Clearly attention to detail was of major importance to the 19th century scientist.

Large Papendoff battery cell.

The Early Pioneers

Mention has alkready been made of the fact that the sale contained many pieces of work from both Heinrich Geissler (1832 – 1919) an William Crookes (1814 – 1879). Geissler is a well known figure in the history of scientific instruments since many of his creations remain in active service to this day. Influenced by his father, an innovative glass blower, Geissler's career in instrument design gained an international reputation providing a service to chemists, medical doctors, physiologists and minerologists.

Crookes enjoys slightly less popularity despite the fact that his work led to the discóvery of X-rays and later, the electron. Knighted in 1897 and bestowed with the Order oof the Mint in 1910 he studied science under Faraday, Wheatstone and Stokes. An active physicist, he produced a vacuum of one millionth of an atmosphere and investigated the action of cathode rays within a glass tube vacuum. He was responsible for much work which led to the development of the cathode ray tube used in modern day in televisions. He produced special tubes to examine cathode rays in various configurations and gas pressures and was one of the first to investigate the effect of magnetic fields on cathode rays. Exactly how Crookes manufactured the intricate tubes to such a high specification is now a mystery and surviving examples are extremely rare.

Ranging in price from several hundred to several thousands of pounds, the tubes offered in the sale varied from the very practical maltese cross tube to the more elegant phosphorescent tubes containing intricate glass models – each carefully engineered to demonstrate a fundamental physical characteristic. To the indifferent observer, many of the tubes might be viewed as a piece of art rather than an item of electrical science. One pristine example consisted of a flower painted with a variety of different mineral dusts, each of which flouresed differently when bombarded with electrons, providing a beutiful shimmering effect.

The Nicholas Webster collection represented a piece of history which has been sadly neglected. It depicted the intermediate stage between the discovery of electricity and its emerganece as an essential part of the twentieth century. ■

Leyden Jars.

How It Works... The Mains Intercom

It is often stated that the wood cannot be seen for the trees, in the case of the mains intercom, it could be said that the link cannot be seen for the wiring. Jim Haskins explains.

All modern houses have electrical wiring used to provide power to lighting, heating, general mains appliances such as the washing machine and so on. Even though this may be on a number of "ring-mains", all of these are connected together at the mains fusebox where the electricity supply enters the house. Mains intercom circuits take advantage of this to allow information, usually in the form of speech, to be transmitted from place to place within a building. Most people would probably manage this form of communication by shouting – this was certainly the way I was brought up. However, there are applications such as baby alarms or where the building is very large or when there is a need to control mains appliances at a distance, where the built in electrical connection system of a house is an ideal information conduit. Indeed, a number of the latest home control systems use the technique to great effect and there are now a number of dedicated chips available that make the design and construction of such a circuit much easier.

The example device shown over the page is one of the original systems as can be seen from its antique transistors and switches.

High Voltage

The most obvious drawback with using the mains wiring for transmitting information is that it is already being used by a 240V 50Hz signal. Mixing this directly with sound picked up from a microphone which is usually at only a few milli-volts, may seem like a hopeless task. However, it is easier than it may seem. The first step is to isolate the unit completely from the mains circuit using a transformer. Information can be passed either way through this device without having to deal directly with the mains itself. The other advantage of this is that the mains voltage can be stepped down to a level that is easy to manage with simple transistor circuitry, say between 3V and 15V.

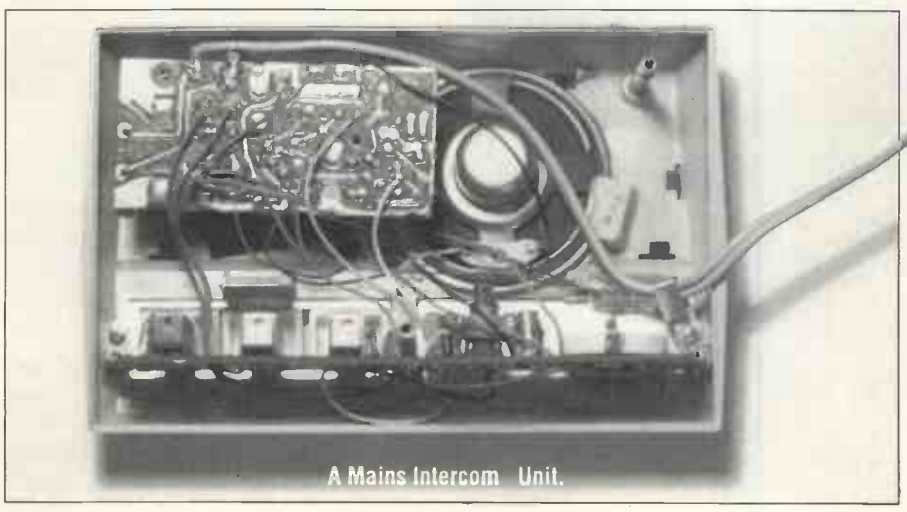
Modulation

There are a number of ways in which information can be placed upon a wire. Probably the simplest is to modulate a high frequency carrier, say around 200kHz, with the speech signal. This removes any problems with 50Hz interference and works in much the same way as radio communications. A demodulator at the receiving unit recovers the signal and amplifies it for reproduction on the intercom – another advantage of this method is that it allows a number of intercoms to operate on the same wiring system, all at different carrier frequencies.

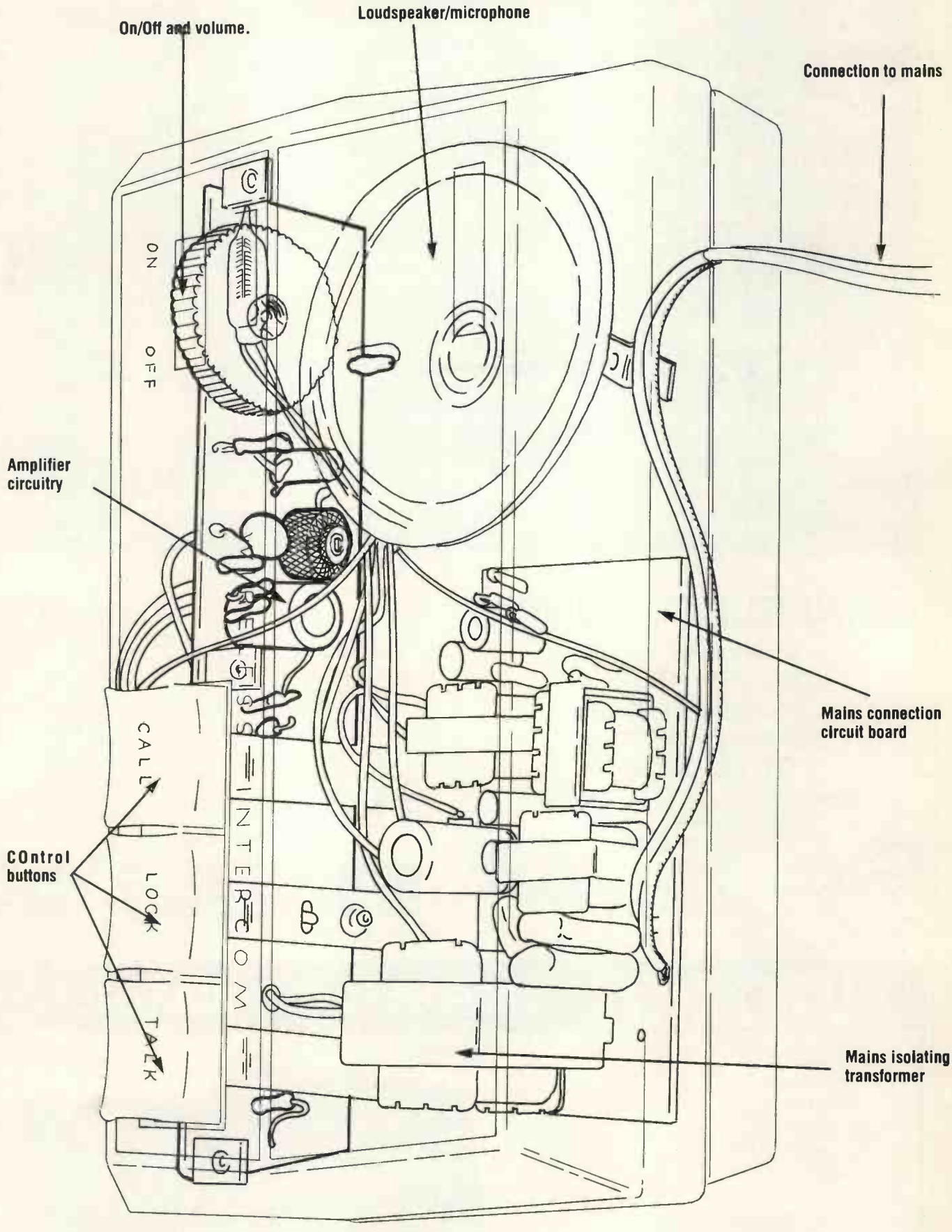
Things That Go Bump

A big problem with using the mains wiring to transfer information is that it can be a very noisy medium. All large household appliances, especially washing machines, tumble driers, drills – machine that switch fairly hefty voltage, can cause large spikes in the mains when the are switched on or off. This could cause havoc to a mains intercom, even though it is isolated from the direct mains wiring by a transformer. A large spike could, theoretically, be transferred into the circuitry and overload it.

To come with noisy mains, powerful filters are used. These allow through only the frequency being used for the information transmission. Anything else is rejected so the system is protected from mains interference that might zap the circuitry as well as simple noise that would make any voice information incomprehensible. ■



A Mains Intercom Unit.


On/Off and volume.
Loudspeaker/microphone
Connection to mains
Amplifier circuitry
Mains connection circuit board
COntrol buttons
Mains isolating transformer
ON
OFF
CALL
LOCK
TALK
INTERCOM

Putting You In The Picture

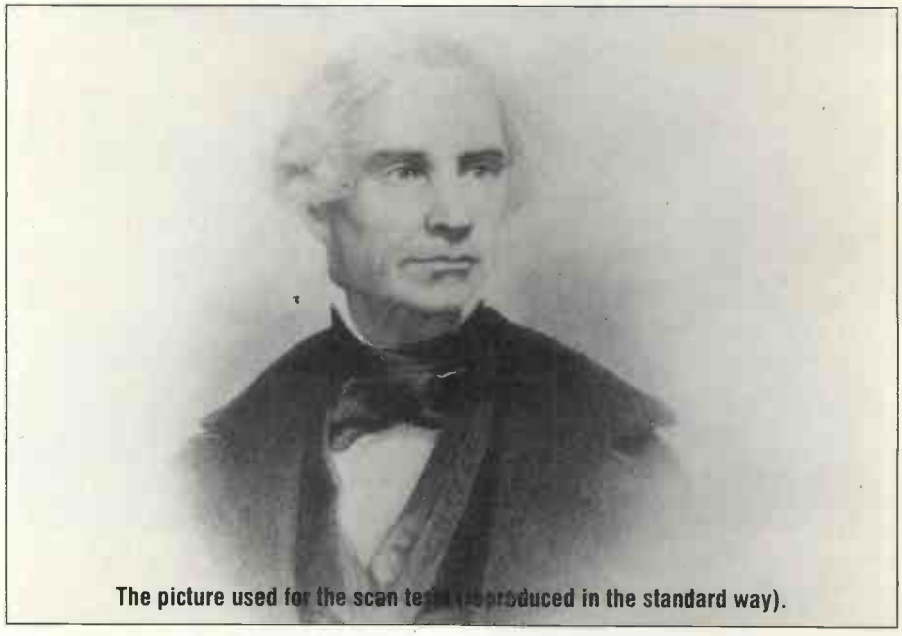
Image scanners are reaching the point where they are cheap enough and produce good enough quality to make traditional methods redundant. Karl Levine looks into the matter.

The technology that allows images to be scanned and converted to a digital format is becoming cheaper and improving in quality. It finds uses in the design of fax machines, the printing of magazines and newspapers, information storage and optical character readers, to name but a few. One industry that looks set to be revolutionised by the technology is small scale publishing.

Getting Into Print

At the moment, transferring photographs to the printed page usually requires specialised equipment which is expensive both to buy and use. The photographs are scanned at a resolution of about 1240 dots per inch (dpi – the number of dots or pixels in a square inch) and the digitised information sent to a computer for storage. The image is then combined with the image of the text on the page and the whole thing coded up, usually using some form of computer page description language (PDL) such as Postscript. It can then be sent to a printer that is able to understand the language and reproduce the page. An advantage of using a PDL is that it is independent of the resolution of the output device. A 300dpi laser printer can cope with it just as well as a 1240dpi Linotron – the standard machine used to print onto the high quality film from which the plates are made to put on a printing press.

To obtain apparent shades of grey, some of the resolution of the printer is sacrificed and dots are clumped together to form blobs – squares, circles, lines – which can be used to provide different grey densities. This is most obvious in newspapers where quite coarse dots are used. The conversion of an image into these dots uses a half-tone screen. This is effectively a grid through which the image is viewed. Each square has a different colour or grey level and is assigned a blob whose size is dependent upon this level. The halftone screen is usually measured in lines per inch and has an angle at which the lines or dots are drawn.



The picture used for the scan tests (reproduced in the standard way).

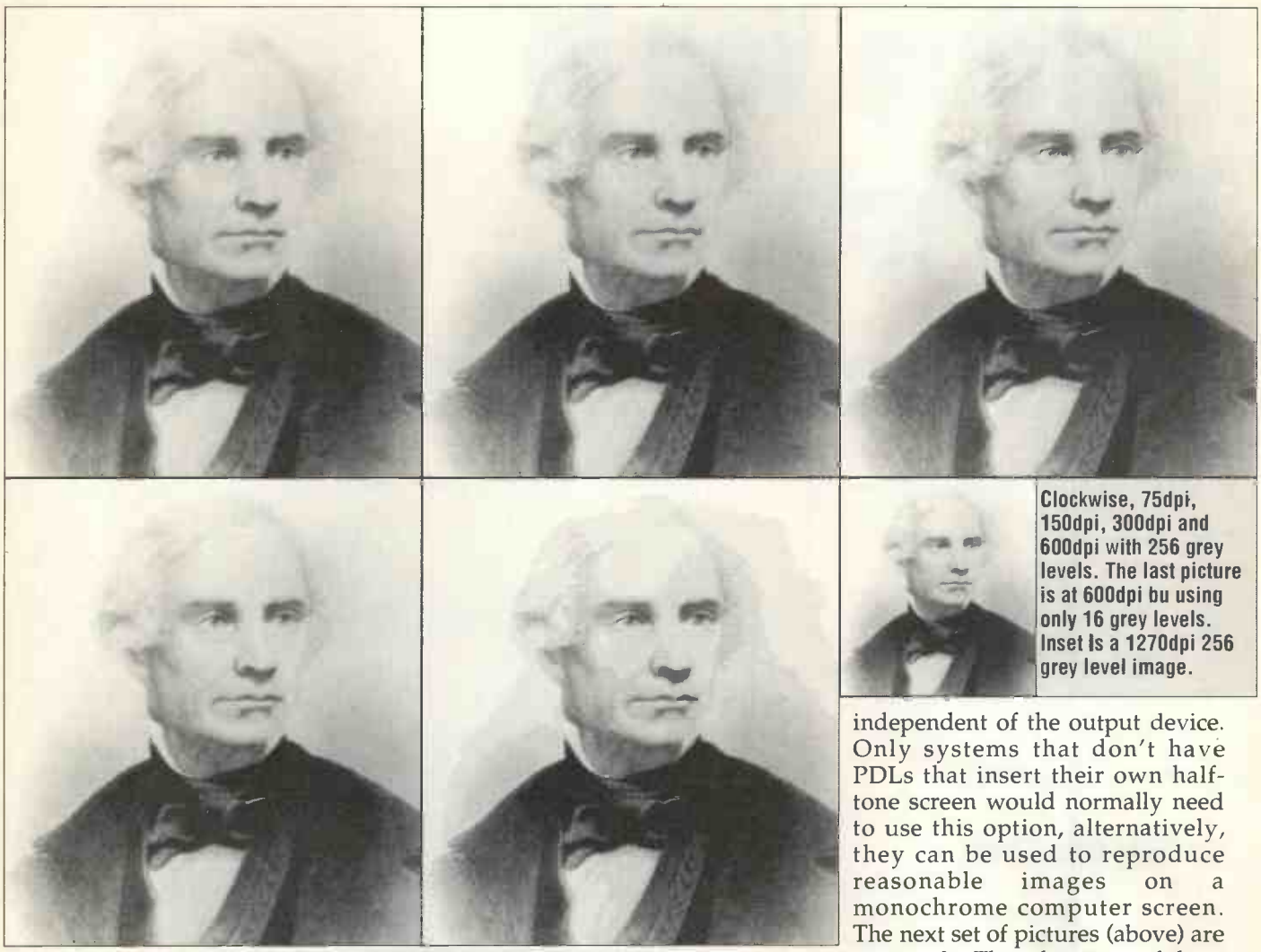
Scanning In Operation

All of the lower end and mid-range scanning systems, such as the Panasonic FX-RS307 used for this article, operate in much the same way. A bright light illuminates the page and a set of horizontal sensors pick up a line of the reflected image. The sensor moves down the picture taking in the information and feeding it to the computer or other capture device. The accuracy of the scan depends partly upon how close the sensors are spaced and partly on how good the mechanics of the system are. Obviously, the better these are, the higher the cost.

The image being scanned can either be straight black and white, in shades of grey, or colour. Most mid-range systems sense the different intensities of the image and convert them to either 16 or 256 shades of grey.

The Results

The Panasonic FX-RS307 offers 600dpi resolution in 256 shades of grey. This is the maximum specification with other, lesser, resolutions being used to speed things up. To illustrate the operation of the machine, a number of scans were taken at different resolutions and qualities. The

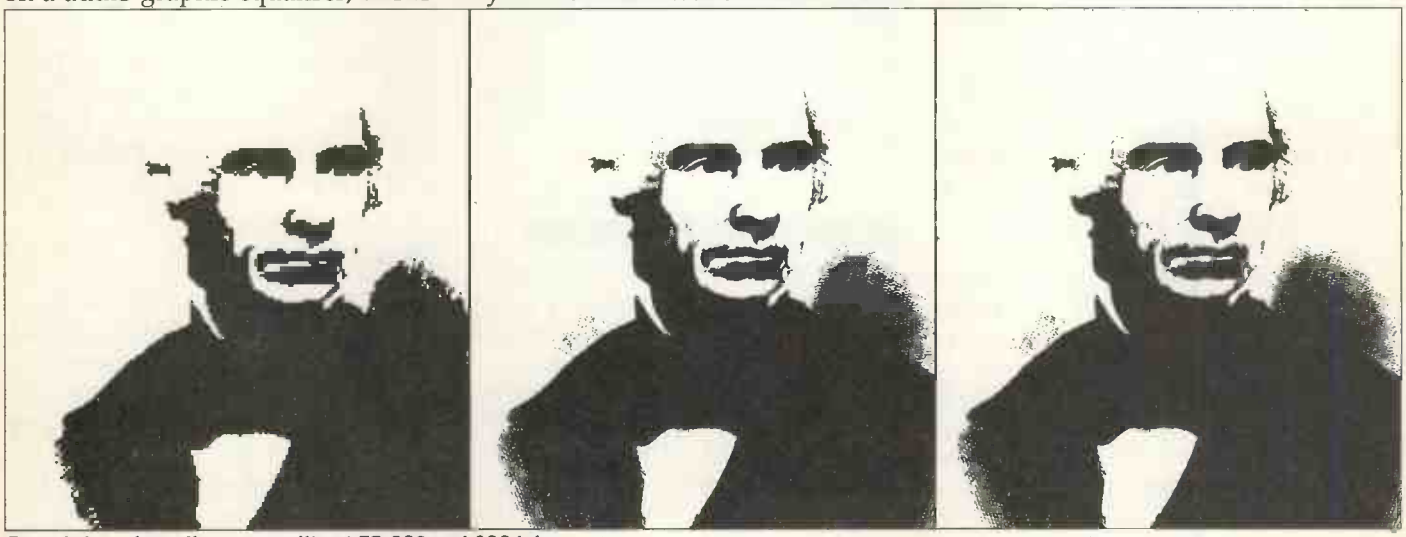


Clockwise, 75dpi, 150dpi, 300dpi and 600dpi with 256 grey levels. The last picture is at 600dpi bu using only 16 grey levels. Inset is a 1270dpi 256 grey level image.

software supplied with the system allowed either grey scale (16 or 256 levels), half tone screen or black and white. Additional controls allowed the contrast, brightness and background level to be adjusted as well as the gamma – it is possible to change the equalisation of the grey levels in a similar way to adjusting the levels of the various frequencies on a audio graphic equaliser, this is known as the gamma setting.

The first selection of scans (below) uses the black and white line-art option. The results are not brilliant but are certainly good enough for inputting into art packages and either tidying up or drawing over. The second set (over page) illustrate the half-tone screens possible – these are actually applied by the software and are independent of the output device. Only systems that don't have PDLs that insert their own half-tone screen would normally need to use this option, alternatively, they can be used to reproduce reasonable images on a monochrome computer screen. The next set of pictures (above) are grey-scale. The advantage of these is that software can be used to edit them or change their size, even improve the image by shrinking it down and effectively making the dots closer together.

The difference between the various options as far as computer processing is concerned is one of file size. An A4 image at 75dpi in line-art form takes up about 68k



From left to right, line art quality at 75,300 and 600dpi.

bytes. Increasing the resolution to 300dpi ups this to 1059k. 600dpi requires 4231k – pretty large. Changing to 16 level grey-scale increases these values to 266k, 4321k and 16920k. Moving up to 256 grey levels creates some huge files, 530k, 8461k and 33839k respectively – the latter takes up a good third of the 100M drive used to create and store PE and processing it takes quite a long time.

By comparing the image with that scanned in the conventional way, the quality of the scanner can be appreciated.

Moving Up To Colour

A resolution of 600dpi and 256 grey scales is just about good enough for very basic applications such as scanning black and white photographs. For higher quality work involving colour a more advanced machine must be used. At the moment, there are few mid-range machines that support 24-bit colour. To get some idea of what this means, 4-bits is used to store 16 grey levels, 8-bits gives 256 grey levels. 24-bits splits the colour image into component parts, red, green and blue and sets aside 8-bits for each. This gives 256 x 256 x 256 or 16,777,216 possible colours. Unfortunately, the best of these scanners only runs to 400dpi so although a wide range of colours may be available the resolution still has a little way to go to reach the 2400dpi or so needed to produce an image good enough for a colour magazine cover. The other drawback is the size of the image files created by these scanners.

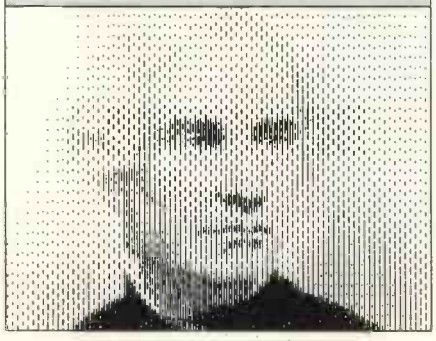
A solution to the size problem is to compress the files using data encoding techniques. In many images, there is a great deal of redundant information, especially where there are large areas of the same colour. There are two main approaches to this. The first aims to produce a smaller file which, when decompressed, will result in an exact replica of the original. Alternatively, some of the data can be discarded, usually with a loss of detail or a flattening of the colour ranges. Many realistic images have quite subtle variations in colour which, although not always directly visible to the naked eye, affect the quality of the image. These minor variations can make lossless compression very difficult. Removing the variations allows greater compression and increases throughput.

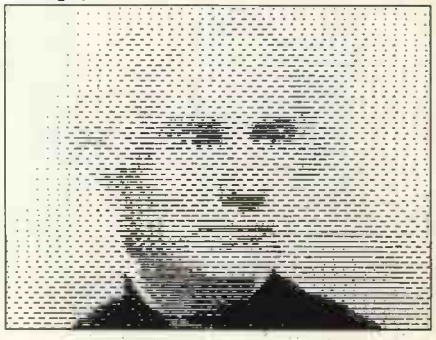
Top, 300dpi detail half-tone
Bottom, 600dpi detail half-tone

The Future

As the price falls and the quality improves, scanners should become quite common, not only in publishing but in all areas where static images have to be converted into digital form, quickly and cheaply. ■

Half-tone images at 150dpi, clockwise: Horizontal, vertical, square, detail, chain, press, bayer and spiral.





A New Wave In Sound

Canon's new S-50 loudspeakers are set to challenge traditional design, taste and sound. James Smith checks them over to see how they measure up.

Loudspeakers have been around for a long time and in that time have not really changed a great deal. In the main they are still built into large or small square boxes with the sound being directed out of the front.The new Canon S-50s, apart from looking rather startling, are rather a departure from normal loudspeaker design. Instead of directing the sound outward from single or multiple cone speakers, they beam the sound downwards and divert it into the room via a reflective surface. The idea is to give a wider image to the stereo and allow more than one person to sit in the "perfect" listening position.

Are the S-50s really magic-mushrooms?

Old Style Speakers

Most high fidelity (HiFi) loudspeakers are actually made up from one or more speaker cones mounted inside a square wooden box (Fig. 1). The aim is to reproduce recorded sounds as perfectly as possible, that is, to make the sound just like the original. Since the human ear is able to hear sounds from about 20Hz to 20,000Hz and assuming that the recording system is able to take in and store this range, a loudspeaker must be able to reproduce it as accurately as possible.

The next step is to give an image of the sound. When listening to a concert whether orchestral or pop, the sound doesn't come from one source but is spread across the stage. To get the same effect with a HiFi system, two speakers are used to give stereo. Because human beings have two ears, a speaker playing to each one fools the brain into believing that the sound is spread over a stage – feeding an equal sound into each speaker places it in the centre, feeding it to just one or the other moves to the side of the stage. Of course, things are not quite a simple as this. Human hearing is backed up by a great deal of sound processing software in the brain and modern speaker refinements, including the S-50s take this into account. Sitting in the centre of the speakers but a little way back (Fig. 2 left) should give optimum stereo. However, most people either don't sit still, don't have the space, or simply like listening to music with someone else. Unfortunately, this means that the optimum position cannot be achieved. A person sitting closer to one speaker than another will find that the sound from that speaker is louder so the stereo effect is diminished. To get around this problem, the Canon S-50s produce a wide image effect.

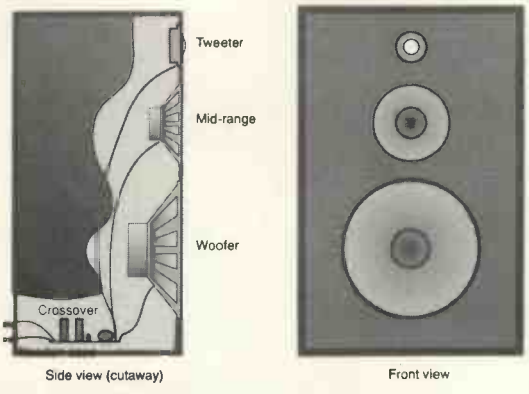


Fig. 1. Inside a normal loudspeaker.

Wider Sound

The construction of the Canon S-50 speakers means that the sound is not beamed directly to one spot but is spread out around the front of the speaker. Fig. 2 right shows the basic idea and with two speakers, a

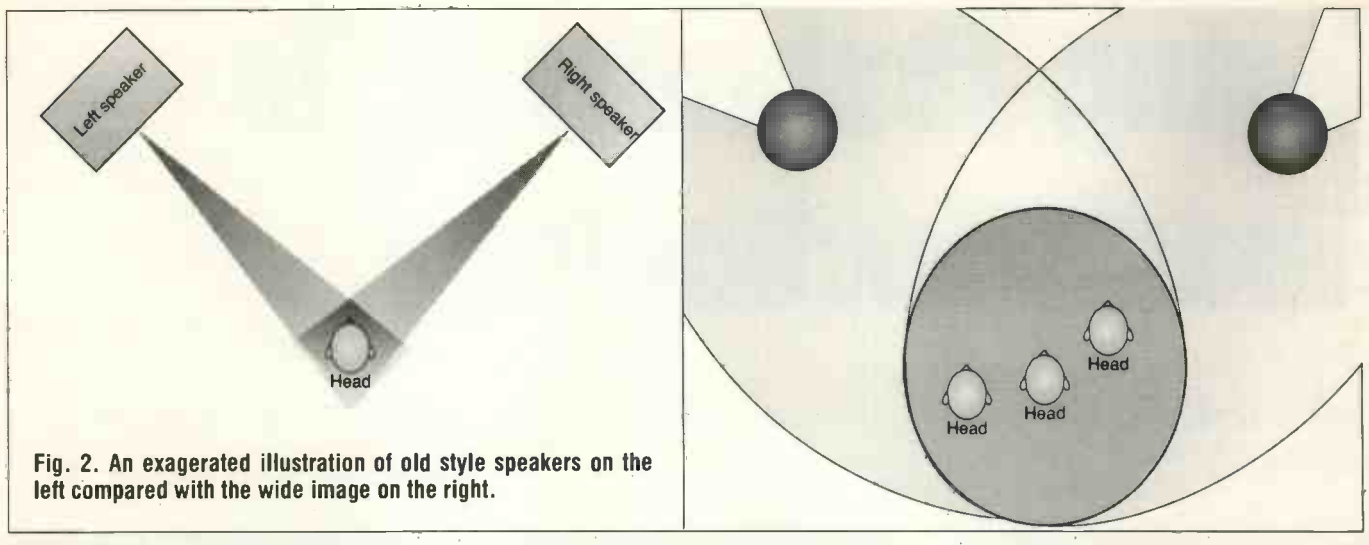


Fig. 2. An exagerated illustration of old style speakers on the left compared with the wide image on the right.

listener should be able to sit anywhere between them, even well off to one side, and still hear good stereo sound. Instead of the listening area being single point it is a circle or oval. Because of this, a number of people can listen to stereo sound from the same source and hear approximately the same thing – more like being at a concert.

On The Inside

One look at the S-50s immediately reveals their differences from ordinary speakers. The mushroom shaped dome holds the single 5in speaker in a reflex arrangement (Fig. 3). Under this is the conical reflector which directs the sound out into the room. The speaker is actually aimed off-centre so that the main direction of the sound is forward. The supports which hold the dome to the reflector also prevent sound being directed too far back. Instead. the bass reflex hole is positioned between them directing the main bass sounds directly backward.

They have a very solid feel and even when used at a relatively high volume, there is virtually no vibration of the domes. The reflectors are solid cast zinc/aluminium alloy – Canon boasts that they are the largest single zinc pressure die- castings in the UK.

Another feature of the speakers are the magnets used to drive the coils. An older technology, using an Aluminium/Nickel/Cobalt slug has been revived that allows the S-50s to be placed next to TVs and monitors without them affecting the picture quality in any way.

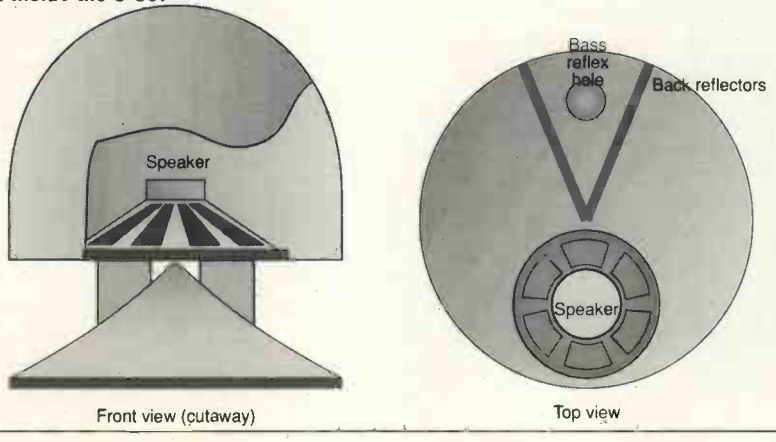
Sounding Off

No matter how technologically advanced they are, the true test of a loudspeaker system comes from listening to it. The wide image effect is definitely present and, apart from one drawback, pretty good. The problem lies with positioning and the height at which they should be placed. Unfortunately, there is a relatively narrow angle at which the sound is really good and the wide imaging effect especially noticeable. Above this it diminishes so that if the speakers are positioned relatively low down, appropriate for a low slung sofa, standing up looses the effect. Because of this it was found that the best position for them was on stands at least a metre high. Apart from this, everybody who listened to them was quite impressed, not just with the wide imaging stereo, but with the overall sound. Considering the unusual way in which it is beamed into the room, no noticeable colouring or distortion cropped up.

How Good Are They?

Whether a HiFi system, especially speakers, is any good is largely a matter of taste and experience. I was favourably impressed with their performance. They were easy to install, sounded good from low volume to high over a wide variety of music and the wide imaging worked well. They also attracted a number of comments about their shape – some puzzled, some complimentary. Although they wouldn't really suit victorian decor anything modern is enhanced by their unusual styling. ■

Fig. 3. Inside the S-50.



Specifications

Product:
Canon S-50 Wide Imaging Stereo Speakers
Anechoic frequency response:
70Hz to 18kHz ±3dB
Nominal impedance:
8Ω
Power handling:
50W – can be used with any amplifier or stereo TV with output power ratings between 15 and 100W per channel.
Price: £349.99 incl VAT
£399.99 with stands
Availability
Canon Audio Tel. 0483 740005

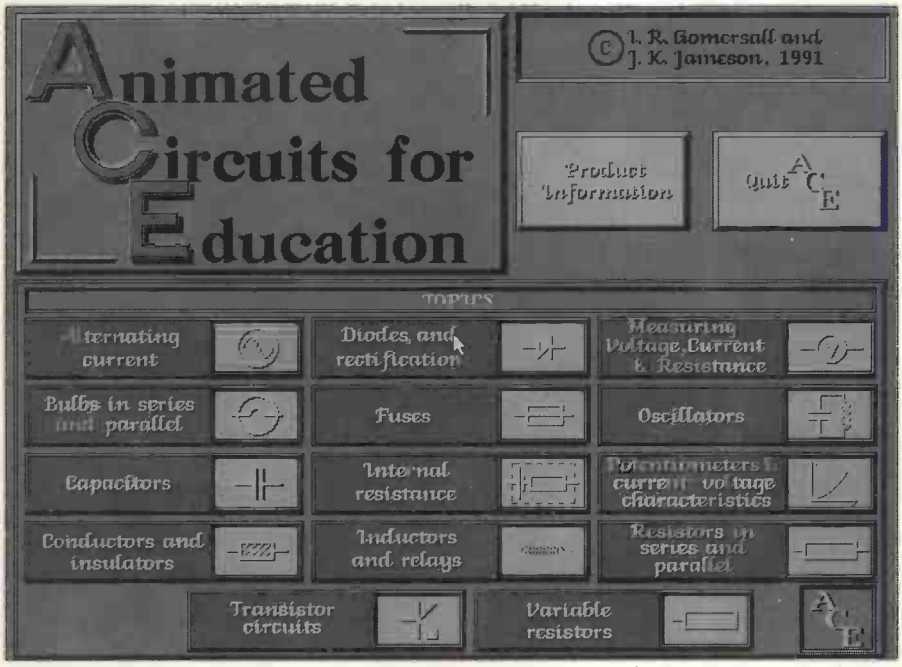
Using Technology To Teach Technology

Alfred White loads up ACE and finds that learning about the operation of electronic circuits can be fun.

Learning the basic concepts of electronics is the first step on the way to understanding a whole new world of technology. This educational process can be helped along with the addition of dynamic teaching aides such as ACE.

The package is designed to run on an IBM PC/AT (286, 386 or 486 microprocessor) compatible computer with a VGA graphics display plus mouse and hard disk drive. Installation is simply a matter of inserting a disk and typing INSTALL. This sets up a directory on the hard disk and unpacks the relevent files into it. Typing ACE starts the software and the title screen gives the user a choice of circuits to look at and play with. The mouse is used throughout to point and click at things to select them and get them moving.

The use of a graphical user interface (GUI) and standardised controls similar to a cassette recorder make ACE quite intuitive to use. There is no need to refer to the manual as far as basic operation is concerned -- a big plus for any computer program.



Moving Circuits

A wide variety of subjects are covered by the system and selecting one, such as capacitors or resistors, from the title screen gives a new screen with a selection of circuits -- these show the basic components and how they are wired together. Pointing the mouse at one of these and clicking, loads it up ready for operation. The controls at the bottom of the screen now allow the power to be turned on (start), the operation to be stepped through (step), reset (rewind), stopped and cleared (eject). Clicking the start button initialises the simulation and the battery starts to move current. The graphical analogue is a series of buckets that lift current upwards to give the idea of creating a potential difference. In situations where the circuit is incomplete, say when the switch is open, the buckets are empty showing that no current is flowing. Different components affect the current flow in different ways and colour is used to denote which parts of the circuit are at higher or lower potentials than others. A legend at the top of the screen shows the colour variation and what it means.

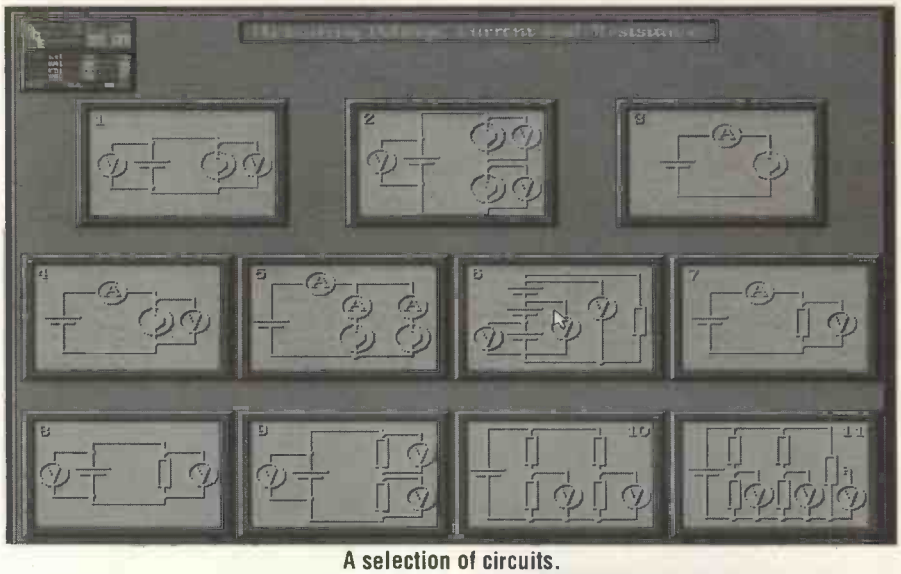
The whole simulation is graphical with the current flow being denoted by small dots moving through the wires. As the manual is at pains to point out, these do not represent electrons and their speed doesn't represent the drift velocity, they just represent

Simple resistor circuit.

the flow and how it varies when it reacts with components.

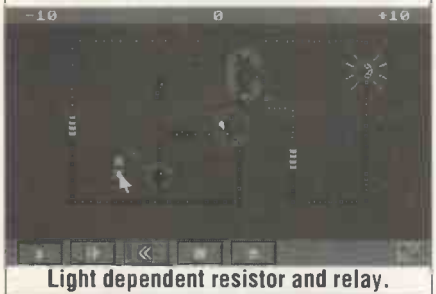
Circuit Choice

The circuits siumlated by ACE are shown in table 2. Starting off with simple bulb and battery experiments, they move on to cover resistors, capacitors, diodes and transistors as well as relays and oscillators. A number of interactive components are also provided in the form of variable, light and heat dependent resistors and switches. A couple of good examples of the operation are shown in the relay circuits and the oscillators. The first allows a variable resistor to be turned up until enough current is flowing through the relay coils so that the magnetic field closes the switch and an additional circuit with a bulb in it turns on. This illustrates graphically how such circuits operate. The oscillators are even better since they show the build up of charge on capacitors and the change of field in inductors and how this shuttles backwards and forwards to give oscillations.



A selection of circuits.

Relay demonstration.



Light dependent resistor and relay.

Oscillation in operation.

Astable Multivibrator.

Teaching Aid

There are three ways in which ACE can be used. The first is as dynamic blackboard where the teacher can use the circuits to show students what is going on. In the electronic book format, the software allows individual students to experiment with various circuits or perform course work as specified by the teacher. The third area of operation is as a revision system where students can check their own understanding.

ACE is designed to demonstrate circuits in a predefied way. All of the circuits are preset and will only perform in the way the software authors designed them to. It would have been nice to be able to take the various comonents available and design new circuits -- this is, after all, what electronics is all about. In some ways the variety of circuits in ACE allows all of the possibilities to be seen, perhaps future products will allow these changes to be made.

On the whole the animated graphics are excellent and, especially in the oscillator circuits, show the operation of the electronics with great clarity. For anyone who is an absolute beginner, ACE is definately a good way to begin understanding

Circuits simulated

Alternating current
Bulbs in series and parallel
Capacitors
Conductors and insulators
Diodes and rectification
Fuses
Internal resistance
Inductors and relays
Measuring voltage, current and resistance
Oscillators
Potentiometers and current-voltage characteristics
Resistors in series and parallel
Transistor circuits
Variable resistors
There are 78 circuits in total

Components simulated

AC generator
Ammeter
Battery
Bulb
Capacitor
Diode
Fuse
Inductor
Light dependent resistor
Potentiometer
Relay
Resistor
Thermistor
Transistor
Voltmeter

Specs

Product: ACE
Price £199
Available from:
Bradford Technology Ltd
Ripley Street
Bradford
West Yorks, BD5 7RR

Techniques

With Christmas well and truly on the horizon, Andrew looks at 3 ways to flash your lights.

This techniques column has a seasonal bias: three ways to flash your Christmas Tree lights. The first method is intended to be used with one or two chains of lights, the second with three chains and the third with four.

The circuit shown in Fig. 1 will flash one or two chains of lights by means of triacs. The circuit is powered by a mains-dropper and series diode, to avoid the cost and space associated with a mains transformer. To make this means of deriving power practical, it is necessary to minimise the current consumption of the unit. Because most of the current is used to trigger the triacs, the triac-triggering is designed to supply short pulses at around the mains zero crossing, minimising the average current consumption.

Power Supply

The reservoir capacitor, C1, is charged on positive going half cycles of the mains via R1 and D1. To minimise the ripple on the power supply, a second stage of smoothing is supplied by R2 and C2. The zener diode D2 regulates the supply to approximately 12 volts, and because the current in R2 is continuous, the ripple on the supply is very low.

The clock for the flashing cycle is provided by IC1a and b, which is connected as a conventional CMOS clock generator. The component values here have been chosen to give an output frequency of approximately 2Hz. This can be changed is required by changing the values of R4 and/or C3.

An optional light-level detector circuit disables the clock and the second output during the hours of daylight, switching the lights on at dusk and off at dawn. If this function is not required, the IC inputs controlled by it should be connected to the positive supply. A light-dependent resistor is shown as the photosensitive element in the light detector, but a phototransistor or photodiode could be used if available.

IC2a and IC2b form a trigger pulse generator whose output is active while the mains waveform is within the range -50V to +50V. Triac triggering occurs when the output of IC2b is at logic 0. When the mains is more negative than 50V, pin 5 of IC2b is below its logic 0 threshold, so that pin 4 is forced to logic 1. When the mains is above +50V, pin 2 of IC1a is above its logic 1 threshold, so that pin 6 of IC2b is at logic 0 and therefore pin 4 is at logic 1. Only in between these two extremes can pin 4 go to logic 0.

The negative gain trigger pulses are inverted by IC1c, and gated together with the flashing clock signal by IC1d. When both inputs of IC1d are at logic 1, Q1 is switched on triggering triac T1. If the light level is sufficient to raise the input voltage of IC2c above its

Continued on page 57

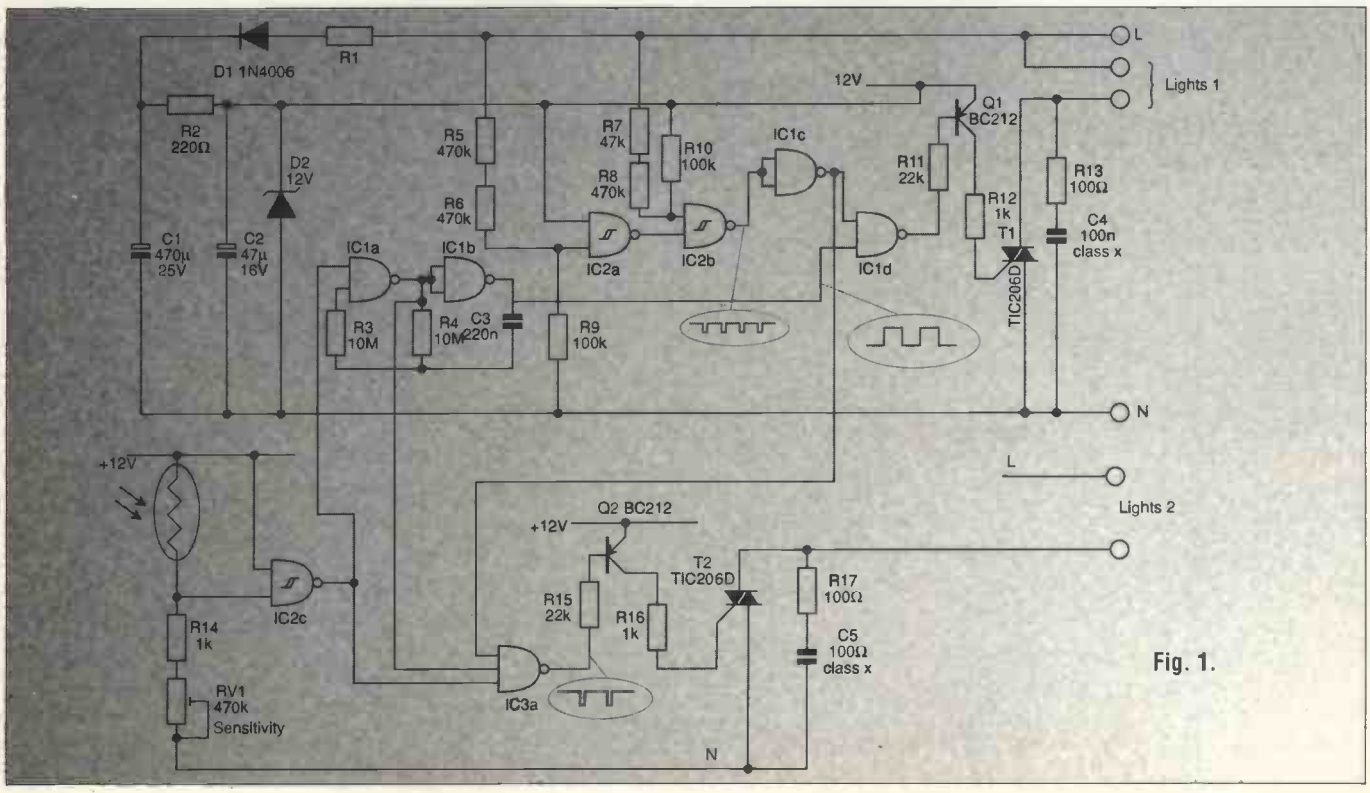


Fig. 1.

Sifting Through The Air Waves

Alan Black examines the Tandy Pro-41 radio scanner and, apart from attempting to break the law, finds a new hobby.

It must be said first of all that it is quite easy to break the law with a radio scanner. It is able to listen in on all of the radio channels that normal tuners can't. This includes those used by the Police, armed forces, ambulances, fire brigades as well as taxi companies and, believe it or not, baby alarms.

Unlike commercial broadcasting where radio channels are on the air pretty well all of the time, most other forms of radio communications are on a strictly stop/start basis. This means that there may well be long periods where nothing happens at all – hence the use of a scanner to listen to them. Instead of having a tuning knob, a scanner allows particular frequencies to be entered directly into each of the channels. It then scans them, stopping only when something interesting is happening. The hassle with this is finding something to listen to – hunting around wavebands by typing frequencies in is rather boring, especially when there is so much radio space. On the plus side, when an active channel has been found, all the effort of finding it makes listening is worthwhile. Alternatively, there are books of frequencies available for those who want to take an easier route.

The Pro-41.

The Pro-41 looks a little like a pose phone with its LCD readout, pushbutton controls and black flexible aerial – this can be removed and an external aerial attached to the BNC connector. The numeric keypad is used to enter the frequencies and select the channels in manual mode. There are ten channels in all and each can be programmed with a particular frequency (see specs table). Other controls include a lock-out function which allows the scanner to ignore certain channels – useful when a known channel is transmitting something useless and other channels are to be searched. From the opposite viewpoint, the squelch control sets the minimum level at which a signal should be accepted and cuts out any noise or hiss. At minimum, all channels are accepted, turning it up only allows through those that are transmitting clearly.

The scan button tells the internal electronics to scan through the 10 channels until something interesting crops up. On finding a busy chanel, it is switched on and can be listened to via the integral loudspeaker or a earphone, the volume control-on/off switch sets the output up to abound 260mW. When the channel goes quiet or returns to hiss, it is turned off and the system waits for three seconds before resuming the scan. This allows any replies to a particular message to be heard before scanning sets in again.

Listening in to the radio waves, especially forbidden ones, is quite appealing to the more enquiring (nosy) amongst us. The Pro-41 is a bottom of the range model with only 10 channels and limited frequency ranges but is not particularly expensive. It gets through batteries rather rapidly but the ability to charge NiCds internally from an external power supply helps a bit – the batteries and external supply will cost extra. For around £100 it should prove to be a good starter for the budding audeur. ■

Specifications

Product: Tandy Pro-41 Scanner
Frequency ranges

66-68MHz	in 5kHz steps
137-174MHz	in 5kHz steps
406-512MHz	in 12.5kHz steps

Scanning rate:
10 channels/sec
Power requirements:
5-AA batteries 7.5VDC or 5-AA NiCd batteries 6VDC or an AC adaptor 12VDC
Price £99.95
Available from Tandy Stores

New Paradigms In Physics

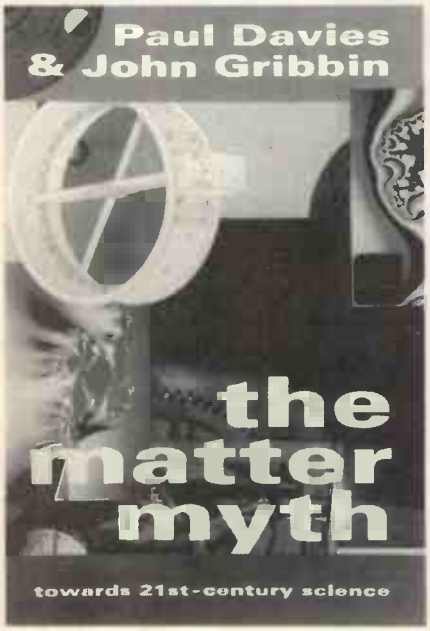
This month's books range from the a description of how attitudes to physics are changing to home security.

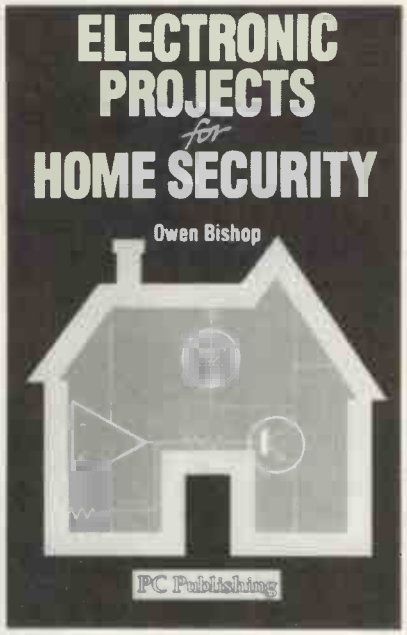
The Matter Myth: Towards 21st Century Science
Paul Davies and John Gribbin
Price £16.99 (hardcover)
Publisher Viking
ISBN 0-670-83585-4

There can't be too much popularisation of science especially of the more complex ideas such as chaos and relativity. Davies and Gribbin explore the change from Newtonian and Einsteinian physics to a holistic view of the Universe with all of its inherent randomness and uncertainty.

Although it is sometimes irritating and often contentious, the book is a good read and often un-put-downable. It should appeal to both the knowledgeable and the newcomer to science and goes some way to explaining why the world is the way it is.

Perhaps it will even follow Hawkings' A Brief History Of Time, into the best seller charts.





Electronic Projects For Home Security
Owen Bishop
Price £6.95 (paperback)
Publisher PC Publishing
ISBN 1-870775-12-0

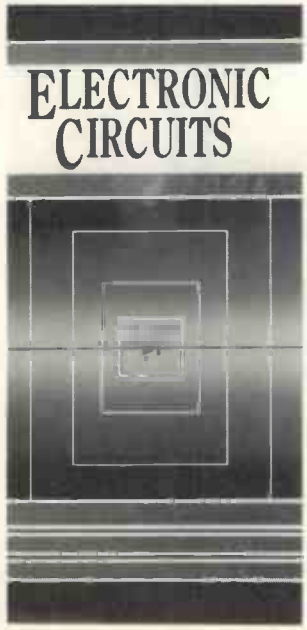
Regular readers of PE will know the work of Owen Bishop from old. His projects and articles have graced these pages for a number of years.

This book gives practical guidance for building intruder detection systems from simple light beam and pressure mat detectors through to fire detectors and tamper-proof multi-channel alarm systems.

Circuits and construction details are given throughout as are component listings. All of the systems are designed to be built on stripboard so anyone who is afraid of PCBs need not take fright. The explanations are straightforward though at times a little technical.

Newnes Electronic Circuits Pocket Book
Ray Marston
Price £12.50 (hardcover)
Publisher Newnes
ISBN 0-7506-0132-9

The number and variety of integrated circuits available to the electronics constructor is growing all the time. This book brings together information from a wide selection of popular linear circuits. The approach taken is to give as much information as possible. Diagrams and tables abound as do application circuits and copious background information. Starting off with transistor arrays, the author progresses through op-amps, audio amps, displays, timers phase locked loops waveform generators, voltage regulators, radio ICs and sensors. This is the ideal book for anyone who regularly designs and builds electronic circuits using linear ICs.■



The Great Electronic Trivia Quiz

How much do you know about electronics? Is your background theoretical, practical or trivial? Find out by answering the following questions.

History

1 In what year did James Clerk Maxwell write A Dynamical Theory Of The Electromagnetic Field?
a – 1864
b – 1891
c – 1925

2 The first practical thermionic valve was produced by
a – Thomas Alva Edison
b – John Ambrose Flemming
c – Lee De Forest

3 To what new science did Karl G Jansky give birth?
a – radio astronomy
b – electron microscopy
c – the study of atomic radiation

4 For what were Brattain, Bardeen and Shockley awarded a Nobel Prize in 1956?
a – their work on superconductors
b – designing computers
c – their work on semiconductors

5 Lasers have been around for a long time. Who made the first true ruby laser?
a – Theodore Harold Maiman
b – Donald Arthur Glaser
c – Michael Faraday

6 When did colour TV first start regular broadcasts in the UK?
a – 1954
b – 1967
c – 1969

7 The first practical tape recorder able to record and playback sound was exhibited in 1900 at
a – the Paris Exhibition
b – the Berlin Trade Fair
c – the Albert Hall

Science

8 The formula V=RI is more commonly known as
a –Fleming's Right Hnad Rule
b – Fleming's Left Hand Rule
c – Ohm's Law

9 Which of the following is not a conductor
a – Copper
b – Magnesium
c – Sulphur

10 The Ionosphere starts at an altitude of about
a – 50km
b – 50 miles
c – 500km

11 In a cathode ray tube, electrons are produced from
a – the heater
b – the cathode
c – the anode

12 Who is this?

a – Allessandro Volta
b – John Ambrose Fleming
c – Sir Humphrey Davy

13 X-rays have a frequency range of approximately:
a – 10^6 to 10^8 Hz
b – 10^{16} to 10^{22} Hz
c – 10^{22} to 10^{24} Hz

14 The element gold (Au) is not silver coloured because of:
a – density
b – conductivity
c – relativistic electrons

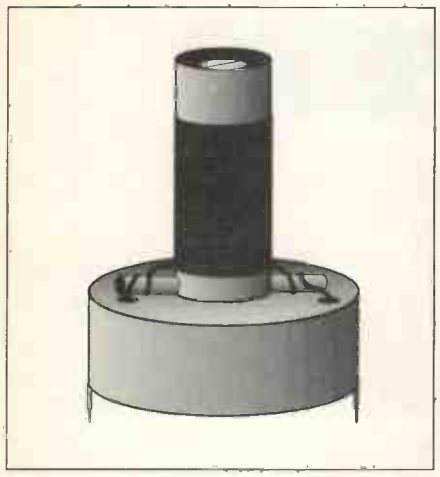
Technology

15 Which of the following is not a part of a transistor?
a – the grid
b – the drain
c – the base

16 A thyristor is made up from a number of P-N junctions, how many?
a – 2
b – 3
c – 4

17 The word modem is in common use. What does it stand for?
a – modulator demodulator
b – modular demonstration model
c – morphological operational data encryption machine

18 NTSC is a colour TV transmitting system used in the USA. What does it stand for:
a – Never Twice the Same Colour
b – National Television Systems Committee
c – New Technology for Sending Colour



19 What is this?
a – variable inductance
b – atomic power station schematic
c – Van De Graff machine

20 Which of the following colours is not used in resistor coding
a – red
b – pink
c – violet

21 Which of the following is not a form of computer memory?
a – RAM
b – flash
c – fractal

Products

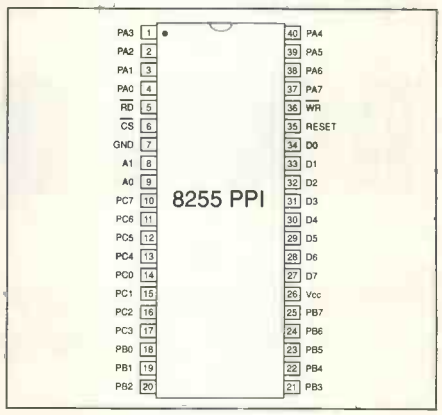
22 The 80x86 range of microprocessors was originally manufacturerd by:
a – Motorola
b – Fairchild
c – Intel

23 Bitstream technology is marketed by:
a – Philips
b – Sony
c – Ford

24 C-QUAM is a technology for
a – Stereo FM radio
b – Ham radio
c – Stereo AM radio

25 Digital Compact Cassettes were recently launched where?
a – Las Vegas
b – Frankfurt
c – San Francisco

26 Which of the following is a CAD system:
a – Ranger 2
b – Explorer 1
c – Pagemaker



27 What is this?
a – an analogue to digital convertor
b – a microprocessor
c – an interface chip

28 Practical Electronics is how many years old this issue:
a – 25
b – 28
c – 30

To see how well you did, turn to page 60.

The Purest Audio Sound Around

In a quest for audio superiority, Jeff Macauley follows up his recent power amplifier design with a high quality headphone amplifier which ranks alongside best you can buy.

Despite the fact that stereo headphones offer a far higher degree of fidelity than the best speaker systems currently available they have always been a poor relation. In many ways this is a pity since when driven from a high quality amplifier, which need not be expensive, the results can be superb. Herein lies the rub. Although most stereo amplifiers come equipped with a headphone socket, this has usually been added in as an afterthought on the manufacturer's part.

Optimum Results

The conventional HiFi amp operates in Class B mode. At the kind of level that headphones operate the distortion generated by class B amplifiers is at a maximum due to the non-linear crossover characteristics of their output transistors.

To make matters worse the headphones are usually fed via resistors to avoid overload. This removes any damping that the amp could provide. The result is increased distortion. As with all engineering problems the only way to obtain optimum performance is to study the facts and design a circuit to suit. Headphones have come a long way since the bulky 8Ω units of the seventies. Today's cans use thin mylar diaphragms and have a typical impedance of 32Ω.

Furthermore, the required power for a given sound pressure level (SPL) is desirably low. A survey of 25 types shows that the sensitivity for 1mW input varies between 86 and 97dB SPL. This implies that even the most insensitive types will provide 96dB, the accepted bench mark for a speaker systems with an input of 10mW or less.

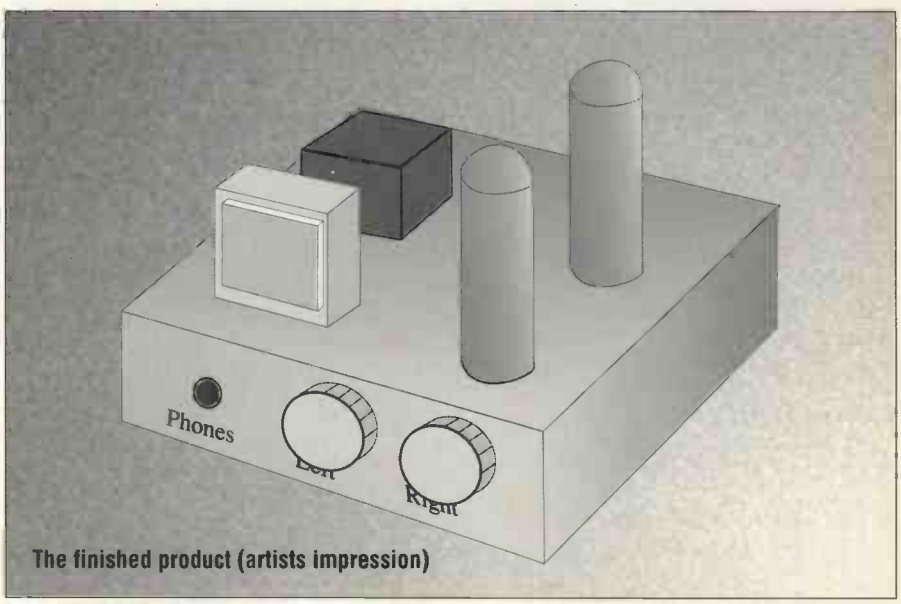
Given this information it is clear that as far as output power is concerned the requirements are modest. At the other end of the scale all the headphones examined have a maximum input of 100mW. The ideal amplifier would have an output between these extremes. As far as other parameters are concerned the performance needs to be on par with a normal amp. That is to say, as little distortion as possible combined with a satisfactory bandwidth and signal to noise ratio.

Top Of The Classes

With the small output power comes the possibility of operating the output stage in Class A, thus avoiding distortion generated by conventional amps at low output.

With the requirements defined the next stage is to produce a suitable circuit. A solid state design could be produced but I have always preferred the sound of valves. Apart from personal preferences, however, there are good technical reasons for using them. These devices have a distortion level nearly ten times lower than a transistor circuit. Furthermore the high input impedance of valves ensures that the individual stages don't load one another. There is an old audio adage about feeding low impedances into high impedances. Any amplifier stage, regardless of the technology used, will operate with less distortion as the load into which is operates is increased in value.

Valves though are inherently high impedance devices and a conventional valve amp can only feed a speaker system of low impedance via a step down



The finished product (artists impression)

How It Works

Fig. 1 shows the circuit diagram. For the purposes of description it breaks down into three parts. First the output stage. This uses an output pentode of rather special design configured as a triode. This can be done simply by connecting the screen grid to the anode. Using this valve in cathode follower mode ensures a low output impedance, high input impedance and extremely good linearity. The correct operating current is drawn from the valve by the constant current source formed by the darlington Q3 and the control transistor Q2. At switch on Q3 is turned hard on by the base current provided through R6. As a consequence Q2's base goes positive until approximately 0.6V is dropped across R9. Q2 then sinks any excess current through R6 and the circuit stabilises. The current is equal to 0.6V/R9,

Turning now to the input part of the circuit. This is based on the well known TL072 dual low noise op-amp. The reasons for choosing this device include its exceptionally good slew rate, a total harmonic distortion (THD) of less than 0.005% at 1kHz and low noise. To operate from a voltage high enough to power a valve the IC's supply voltage must be reduced to less than 35V. This is the function of Q1. This is a high voltage darlington. R7 and R8 produce a suitably low voltage on the base which appears at a low impedance on the transistor's emitter. There is a hidden function in this circuit which concerns the use of C7. This smooths the voltage on Q1's base. In conjunction with Q1 the circuit acts as a gyrator providing 70dB of ripple rejection. To this can be added the 60dB ripple rejection ratio of IC1, the result being that the circuit effectively ignores any supply voltage variations.

The most unusual feature of this circuit is the direct coupling between op-amp and valve and the latter's inclusion in the negative feedback loop. This allows the best of all possible world's to be obtained. First the op-amp sees an almost infinite impedance looking into the valves grid. This means that the op-amp's output stage will operate in pure push-pull class A so that the op-amp is generating the minimum distortion. Negative feedback which is applied from the cathode to the op-amp's inverting input via R5 is driven from the cathode's low impedance.

Applying feedback from a low impedance into a high impedance is the situation which favours lowest THD figures.

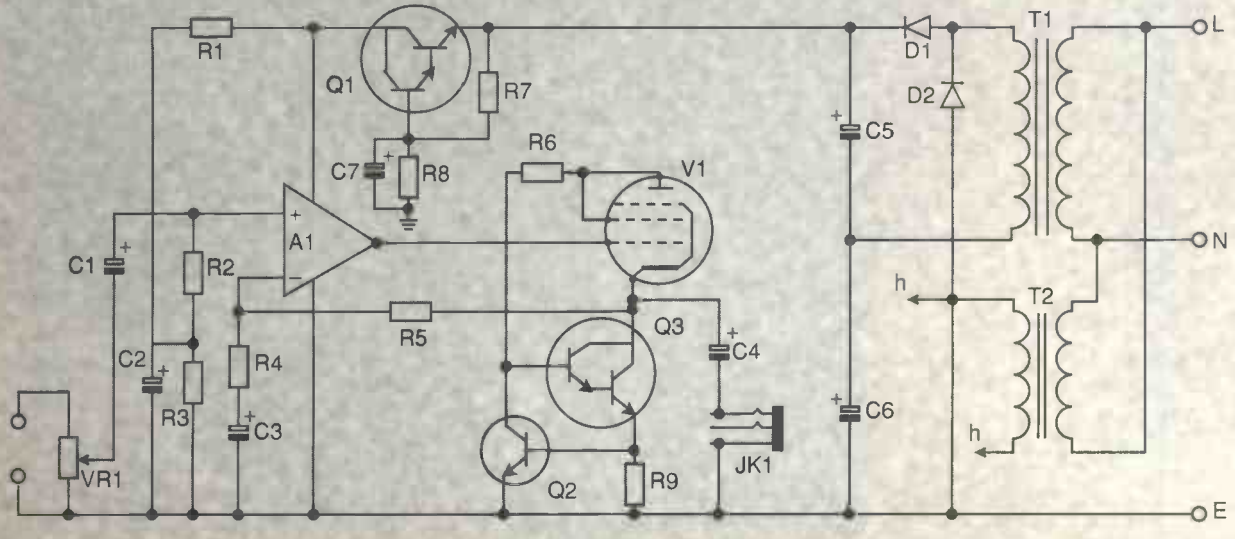
Voltage gain is set by the ratio of R5 to R4. Q3 looks like a short circuit at signal frequencies and an open circuit at DC. C3 this sets the DC gain at unity and the voltage that appears on the non-inverting input is maintained identical to that on the output. Input signals are fed into the circuit via the volume control VR1. C1 couples these signals into the non-inverting input. R1 and R3 provide bias voltage leaving an exceptionally smooth bias voltage.

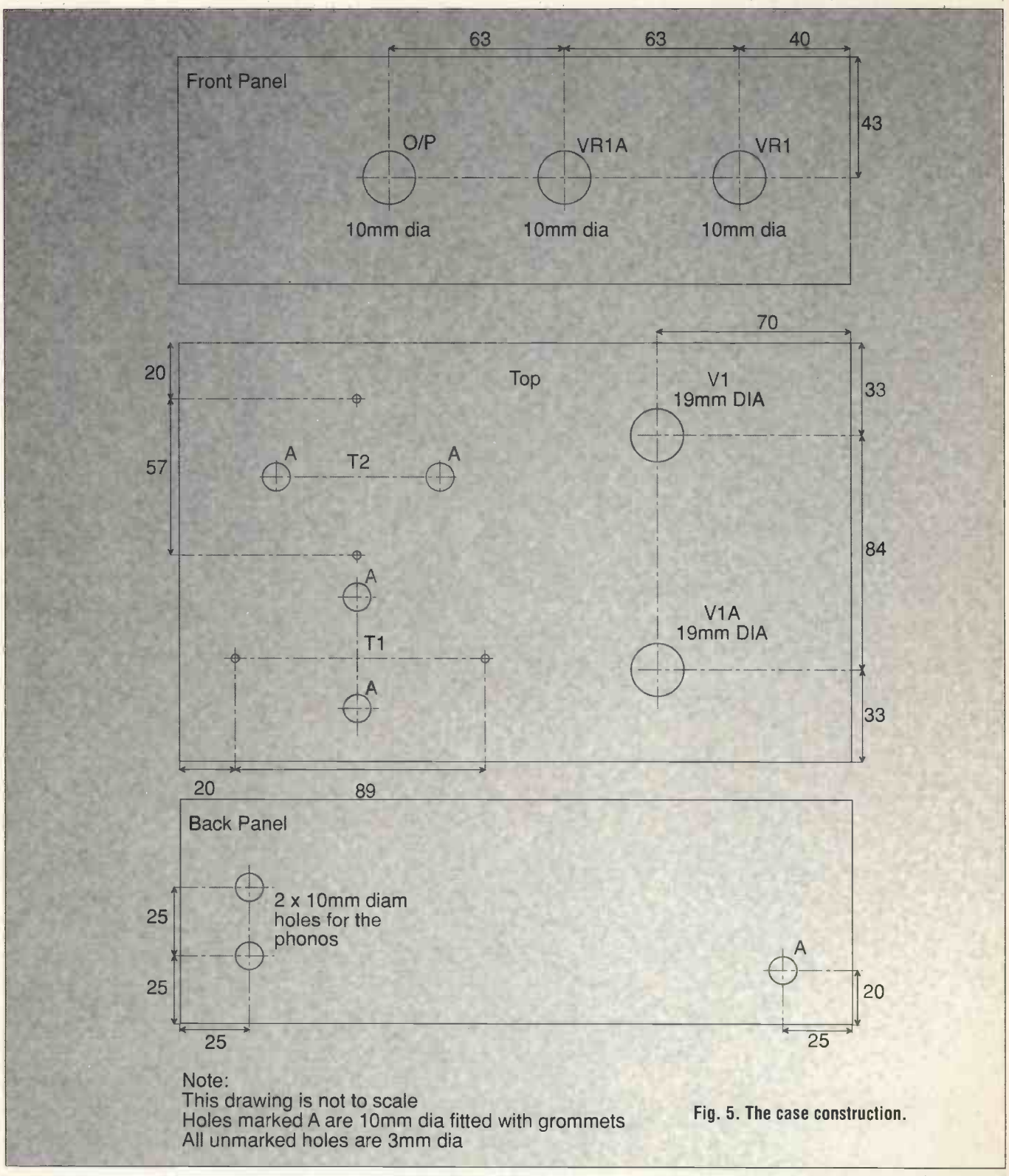
Finally, the power supply. T1 is the high tension (HT) transformer, the secondary is doubled by D1 and D2 and C6 smooths this voltage, The circuit is fed from the doubled voltage. Heater voltage is pure AC in this design. The overall negative feedback reduces any induced hum over a thousandfold. Since the hum-level produced by AC heating is about 5μV in the first place and a typical signal will be in the order of a volt, it's pretty obvious that the use of DC doesn't produce any audible benefits and thus cannot be justified on economic grounds. The heater voltage is fairly substantial at about 750mA per channel and so a separate transformer is used to supply the required power. Note that a 6-0-6VAC secondary is used. The standard heater voltage is 6.3VAC. However, the use of a slightly lower voltage extends the valve life without materially affecting the device's design characteristics.

Indeed, one of the major advantages of using a valve in a hybrid circuit of this kind is that the overall AC and DC feedback makes the circuit immune to valve aging and the consequent changes that occur in its parameters duriong its operating life. One of the most dramatic illustrations of this is to try tapping the valve with a screwdriver blade, gently of course. The feedback system reduces the microphony of the valve to such an extent that no sound will be heard through the phones.

Microphony is due to the fact that we are dealing with a mechanical structure. when tapped small movements of the internal electrodes are turned into current variations which are then applied to the output.

Fig. 1 Circuit diagram showing one channel.





Note:
This drawing is not to scale
Holes marked A are 10mm dia fitted with grommets
All unmarked holes are 3mm dia

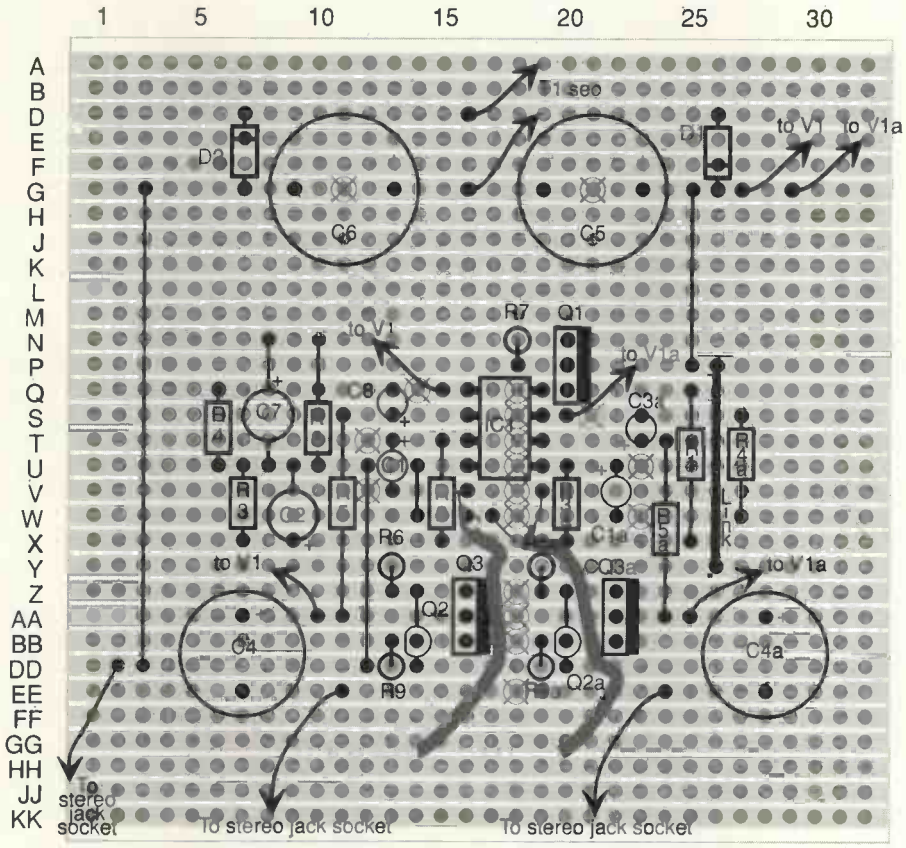
Fig. 5. The case construction.

transformer. This component ultimately limits the quality of signal that can be produced by a valve design. If this component can be removed then the quality can be substantially improved. As for low impedance drive, this depends mainly on device selection. What is required is a low impedance valve capable of delivering fairly substantial current swings, preferably with a low voltage power supply.

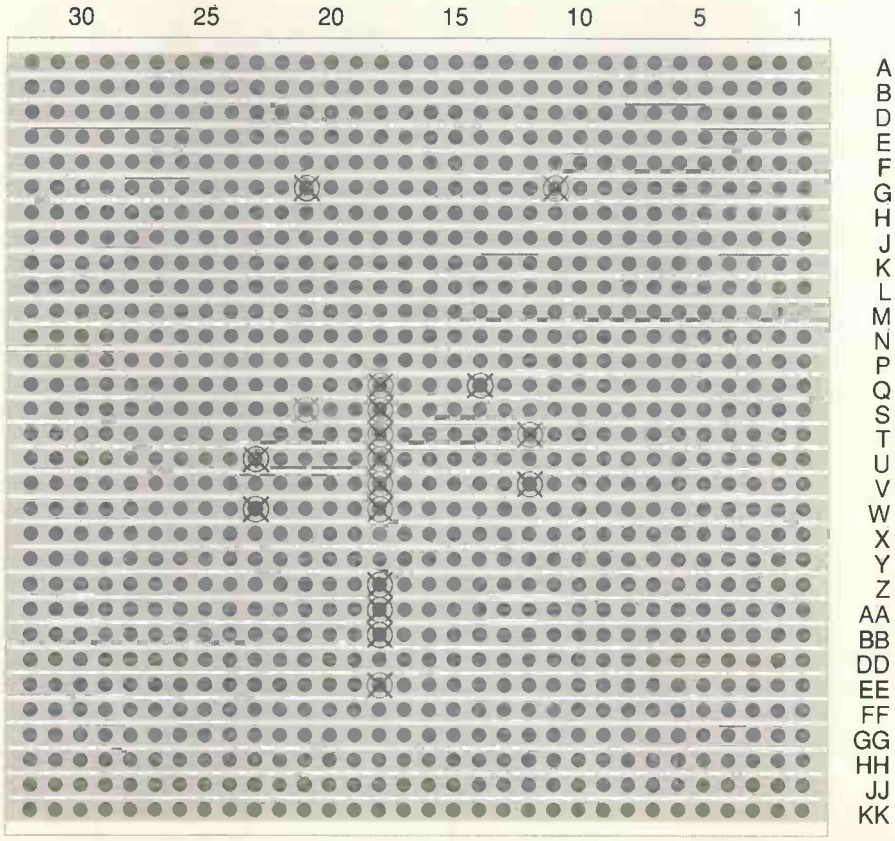
A low impedance drive can be obtained by operating the output valve as a cathode follower. This circuit configuration acts like an emitter follower with a high input impedance, low output impedance and less than unity gain. Like the emitter follower, the circuit posses very low distortion levels. Less that 0.1% at full output. Much searching through tube manuals produced two possibilities for the output valve. One of these is no longer available which lead to the selection of a 6CW5.

Without negative feedback the output impedance of the amplifier is 68Ω. Too high for our purposes but very low for a valve. By using a dual op-amp as a voltage amplifier and applying negative feedback around the whole circuit, the output impedance can be reduced to less

Placing the components on the board.



The underside of the board showing the track cuts.

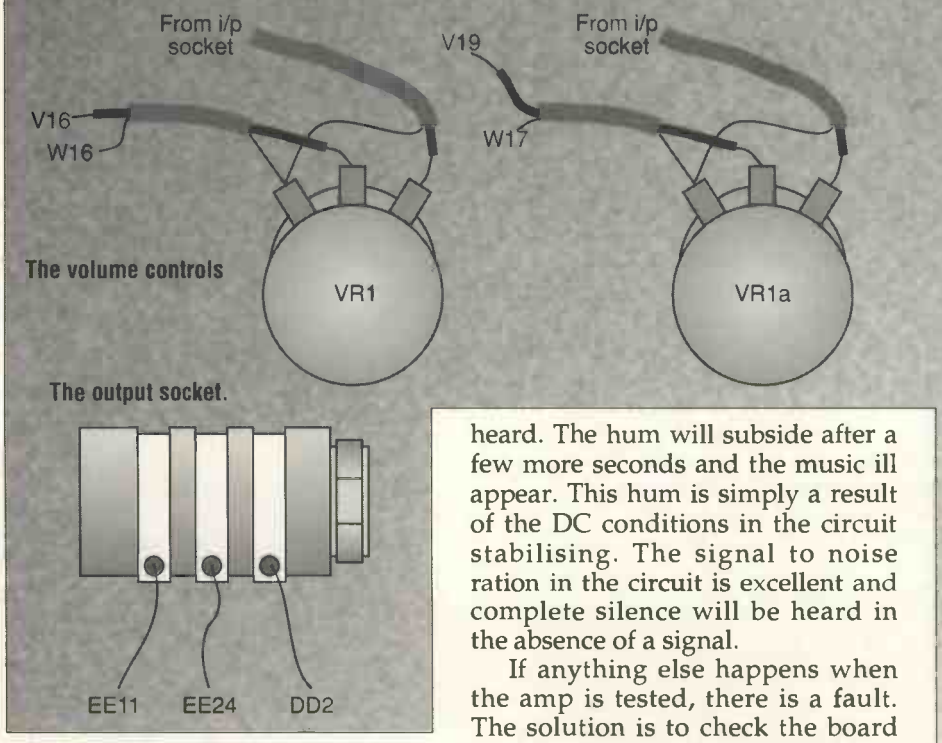


Putting It Together

The construction of the circuit falls naturally into two parts, the mechanical and the electronic. It is best to tackle the electronics first. Most of the components are mounted on a stripboard panel, the layout of which can be seen on the facing page. Note that the valveholders are mounted upon the top panel. These require 19mm diameter mounting holes. The best way to make these is to drill them out with a suitable drill.

Having done this, mark out and drill the smaller screw fixing holes and mount he valve holders into position. Next, attention can be turned to to mounting and soldering the remaining components. Little needs to be said about this. Ensure that all the polarised components are mounted the right way around. Also check your work to ensure that the breaks have been made in the correct positions in the tracks. Also that there are no unwanted blobs of solder across tracks. When all the components have been successfully mounted, connect the valveholder pins to the tracks indicated using hookup wire. Also attach the other flying leads leaving these about 12in long to facilitate easy connection. On the input phono sockets, ensure that the earthed pin doesn't come into contact with the chassis as this creates a hum loop.

Having built the electronics, attention can now be turned toward the box. Drilling details of this are shown in Fig. 3. Again, this is quite straightforward. Having attached the various pots, sockets and transformers, the last task is to interwire these following the schematic. After checking everything thoroughly the unit can be assembled making sure that enough space is left between the chassis and stripboard. Finishing is a matter of personal preference, the prototype was spayed matt back with legends applied and coated with varnish.



than an Ohm which is ideal. With this low output impedance there is no need for an output transformer, the signal is simply fed to the phones through a large electrolytic. A low ESR component is used here to ensure even frequency response and to avoid DC being applied to the phones.

There is no setting up procedure to be followed with this circuit. Provided the wiring has been done as shown, it will work first time. To check it out connect your headphones, a suitable signal source and apply power. After a few seconds the heaters should start to glow and a slight hum will be heard. The hum will subside after a few more seconds and the music ill appear. This hum is simply a result of the DC conditions in the circuit stabilising. The signal to noise ration in the circuit is excellent and complete silence will be heard in the absence of a signal.

If anything else happens when the amp is tested, there is a fault. The solution is to check the board for error, correct it and try again. The only other problem that might crop up is a hum loop. This is caused by earthing the unit when the device feeding the signal in is also earthed. The solution is to remove the earth lead from the mains plug.

After all the struggle, will the results be worth it? Definitely. I can hear nuances in my collection of CDs and records that I never realised were there before. Most importantly of all, on the very best recordings one can tell how the instruments are being played, not just what the are playing. For my money, this is the test of a good

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R8 27k
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C5, C6 1000uF 63V

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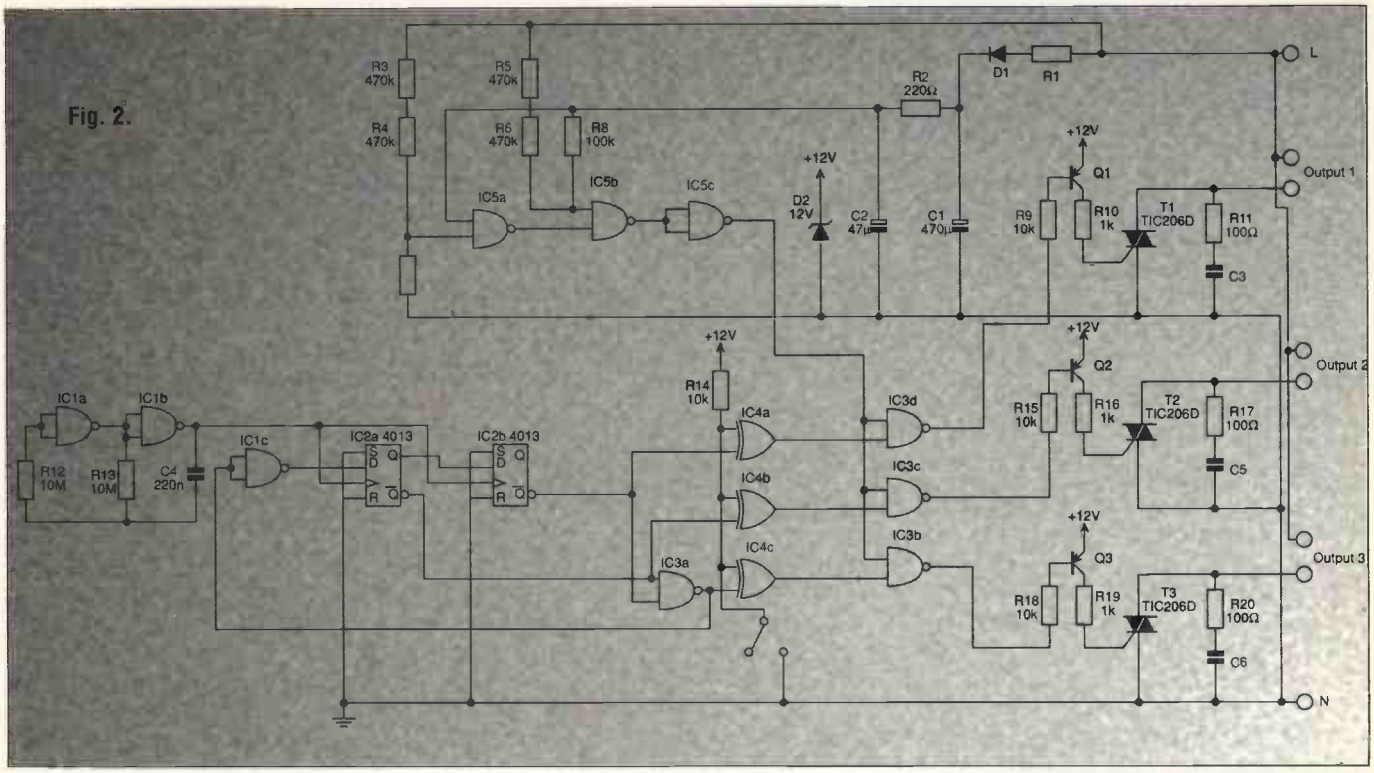
Fig. 2.



Continued from page 42

switching threshold, the output goes to logic 0 forcing the output of IC1a to logic 1 and the output of IC1b to logic 0. This prevents trigger impulses from reaching Q1.

If two chains of lights are to be used the part of the circuit incorporating IC3, Q2 and T2 should be added. IC3a is fed from the opposite flashing clock phase, so that it produces trigger pulses when IC1d does not, and vice-versa. Because it is fed from the opposite clock phase, the light sensing signal would hold this output on rather than off, if a two-input gate were used. If preferred, another quadruple two-input gate could be used to produce this function by using several parts of the IC. This is left as an exercise for the reader who wants to experiment with it.

Note that a Schmitt trigger gate is needed for IC2c in order to provide clean switching as the light-level changes. The Schmitt trigger gates are used with advantage in the zero-crossing detector, but if the light level detector is not required, then ordinary two-input nand gates (4011s)can be used in the zero-crossing detector.

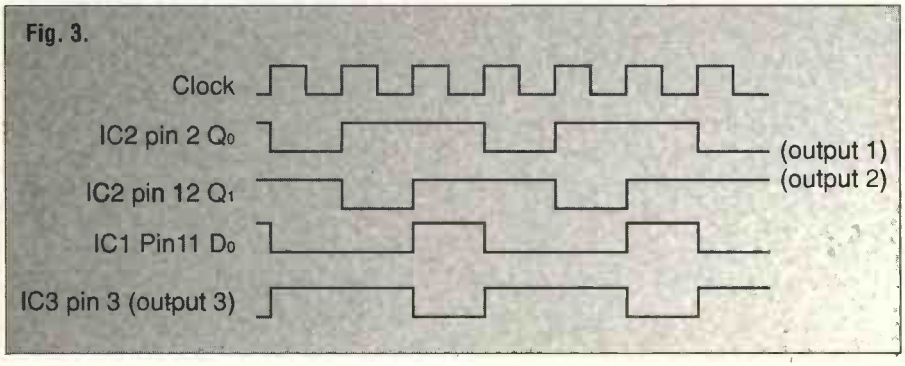
Three-Way Sequencer

The circuit shown in Fig. 2 employs many of the principles of the circuit in Fig. 1. The power supply and the zero crossing triggering of the triacs need no further explanation. The significant part of this circuit is the sequencer itself, formed from IC1, IC2, IC3a, and IC4. IC1a and b are connected as a conventional cmos clock generator, as described before. IC2 and IC1c and d are connected to form a two-bit counter which counts from 0 to 2. The action of this counter is illustrated by the waveforms in Fig. 3. Also shown on this waveform diagram are the three output signals, two of which correspond with the Q(bar) outputs from the 4013.

The outputs as shown would switch each string of lights on for two clock pulses out of three. If the waveforms are inverted, they will switch each output on for one clockpulse out of three, giving two options for the flashing regime. Exclusive OR gates are used to invert the signal or simply buffer it, as required, allowing a single switch to control the sequence.

A light-level detector is not shown in this design, but one could easily be incorporated if desired. To do this use a 4093 instead of a 4011 for IC5, and use the remaining part of IC5 as the light-level detector itself. Then, use three-input NAND gates (4023s) instead of the 4011s used to control Q1, Q2 and Q3. The third input of each gate should be connected to the light-level detector to gate off the output.

Fig. 3.



Pipelight

The circuit of Fig. 4 shows a four-way sequencer of a type which could be used for a pipelight. It is designed to sequence with either one output on at a time, or two outputs at a time. It gives a good effect with several strings of ordinary Christmas tree lights, which can be run separately, or twisted together to give a pipelight-effect. This is much cheaper than a commercial pipelight, looks more

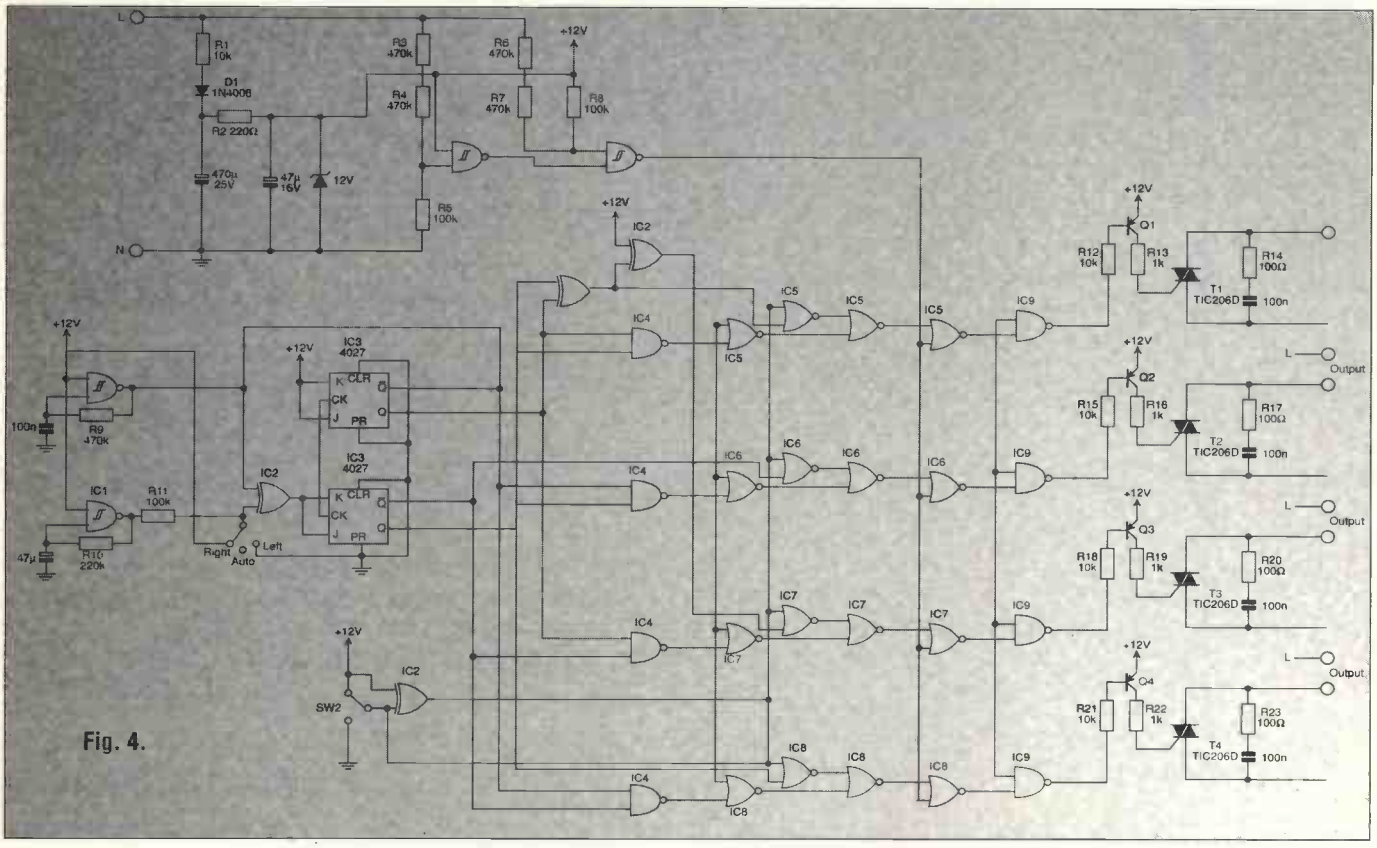


Fig. 4.

attractive as the individual lamps are not obscured by the piping, and is effective mounted in or over a window, as well as around a tree.

Once again, the power supply and zero level triggering circuitry is the same as the other designs. The optional light-level detector gates off the outputs via an extra set of two-input NAND gates which drive the triggering transistors. It is convenient to gate off the outputs in this way because the logic signal from the previous stage requires to be inverted in order to be of the correct polarity to drive the output transistors. If the light-level detector is not required, then the commoned inputs of IC9 should be connected to +12V.

Of course, if the final NAND gates are omitted altogether, then the output sequence will consist of one light or two lights off, rather than one light or two lights on. This might be preferred if you want the tree brilliantly lit up all the time, but still with a moving effect.

The heart of the circuit is a binary counter made from two JK flipflops. The signal to the J and K inputs of the second flipflop can be inverted, either manually or automatically with a fixed period, via IC2. This makes the counter count down rather than up, to reverse the movement of the sequence.

The counter is clocked by a different design of clock generator, using one Schmitt trigger gate. This design is less widely used than the two-gate design, because its operating frequency depends more on the characteristics of the gate. If the switching levels of the gate are not symmetrical, then the mark to space ratio of the output will not be even, either. This effect may be observed in some units when automatic sequence reversing is used. It may be apparent that more time is spent in one direction than in the other, though this is not likely to be considered a serious drawback.

Looking at the top row, either pin 1 or pin 5 of IC5 is held at logic 1, forcing the corresponding output to logic 0, while the other gate simply inverts the logic signal fed to its other input. This is re-inverted by IC5c, which has a signal on one input and logic 0 on the other, and is then gated together with the zero-crossing signal by IC5d. The channels incorporating IC6, 7 and 8 work in just the same way.

For the two-light-on sequence, the four counter outputs correspond with the four channels required. For the one-light-on sequence, IC4 gates together pairs of outputs to provide a signal which goes to logic 0 for one clock pulse out of four. The selector system described above selects either the outputs from IC4 or one of the Q or Q(bar) counter outputs directly.

General Comments

All of these units are powered directly from the mains, so special care should be taken when building and testing them. Some aspects of testing can be carried out using a low-voltage power supply, but the zero crossing detector only works when the unit is connected to the mains.

Note that the zero crossing detectors have two resistors in series, going to the live of the mains. This is to avoid damage in case one resistor momentarily breaks down under a mains spike.

All the triacs are shown with snubber networks to protect them. In many cases these will not be required, but if they are not fitted you may find that a sequencer which has worked very well for some time will fail soon after being plugged in at another location. For example, though my own mains supply is normally clean, switching on and off the fluorescent light in a friend's kitchen will kill any unprotected triac which happens to be plugged in at the time. ■

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Barry Fox continued from page 62

Wasted Money?

Last year BT spent over £30 million educating the public on the last change, with advertisements and over 75 million printed leaflets. Brian Haigh, BT's Director of Operations, wrote to all London subscribers reassuring them that the change would "anticipate your needs well into the future". Bryan Carsberg said the change would "provide the extra numbering capacity that is needed". Despite full knowledge of the 10 digit plan, neither BT nor OFTEL warned that there would be another change within four years.

Within months of the London change BT had secretly scheduled a national change for April 1994 and was confident that OFTEL would endorse it.

OFTEL acknowledges that the 10 digit scheme was made possible by the London change in May 1990, which ended the use of the digit 1 as the first digit of any national number. The key issue is why BT did not make a one-step change in London in May 1990, splitting London's 01 code into 0171 and 0181, instead of 071 and 081 – and why OFTEL did not insist on BT doing it.

Technically Flawed Excuses

Both BT and OFTEL claim that there were "technical reasons" why the London numbers could not be switched from 01 to 0171 and 0181 in May 1990. But neither BT nor OFTEL has been able to explain what these reasons are. When I asked BT I got a string of technically flawed excuses about not being able to intercept wrongly dialled calls.

On the day when the 10 digit scheme was announced BT's new Helpline, set up to advise the public on the number change, was blaming OFTEL, saying that BT could not make the one-step change because OFTEL "had not agreed the ten digit scheme". Earlier this year OFTEL had blamed BT, for not being sufficiently advanced in its exchange modernisation programme to cope with the extra digit.

Everything points to the simple fact that they just did not think it through. It is now too late to undo the damage.

Personalised Numbers

But it is not too late to solve a future problem on which neither British Telecom nor OFTEL has yet formulated a plan. If Lord Young's dream becomes true and everyone in the UK gets their own personalized telephone number, callers will not know whether they are making a local call to someone just round the corner or at the other end of the country or elsewhere in Europe. They will thus not know how much a call is costing them until they get their bill. ■

Answers to Trivia Quiz

1a, 2b, 3a, 4c, 5a, 6b, 7a, 8c, 9c, 10a, 11b, 12b, 13b, 14c, 15a, 16b, 17a, 18b, 19a, 20b, 21c, 22c, 23a, 24c, 25a, 26a, 27c, 28b

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Barry Fox

The Change-over To Ten Digits

Barry's bug-bear this month concerns the change over in London from 01 to 081/071 and the predicted change in 1994 for the rest of the country.

If you are one of the 4.5 million London telephone subscribers who now have to spend money on changing their stationery or repainting shop and vehicle signs, for the second time in four years, you will almost certainly be asking the same question. Why couldn't the telephone numbers in London have been changed in May 1990 in a way which left them unchanged in April 1994, when the rest of the country changes?

I have been asking that simple question for more than a year now and neither BT nor OFTEL, the government's Office of Telecommunications, can give me a straight answer. They have come up with various excuses, but none hold water.

More Numbers Needed

No-one disputes the need for more telephone numbers. That is the price we must pay for the glorious

liberalistion of the last decade. Just try remembering what it was like in those dark days before the Post Office/British Telecom lost its government monopoly. You could only rent a phone, usually with a dial; you could only rent an answering machine, at exhorbitant cost and extension sockets were an overpriced luxury.

What many people question is the way the new numbers have been liberated. It is apparently with shortsight by both BT and OFTEL.

Even before all telephone numbers in London were changed in May 1990, British Telecom had proposed a quite different nationwide change. Mercury backed the idea. Now OFTEL has approved it. Over the Easter weekend in 1994, 9 digit numbers will become 10 digit numbers.

> "When I asked BT I got a string of technically flawed excuses about not being able to intercept wrongly dialled calls."

Going Up To Nine

Adding an extra digit at the beginning of all 26 million numbers in the UK (eg 0171 and 0181 in London) increases the reservoir of numbers tenfold and lets competing services identify themsleves by the change of just one digit. Initially everyone will get an extra 1, with the digits 2-9 available (eg 0271 and 0281) for other services, such as mobile and paging, in the future.

Giving people closely related numbers for home, mobile and paging equipment comes close to realising the dream of Lord Young. When Secretary of State for Industry he proposed that everyone should have their own personal number. Incoming calls would then find them anywhere in the UK or Europe.

OFTEL took on responsibility for telephone numbering from BT on 1 April 1989. But OFTEL had been aware of the 10 digit plan since 1988 and Professor Sir Bryan Carsberg, Director General of Telecommunications, comissioned Ovum Ltd to study it. Ovum reported to Carsberg in July 1989 and gave "overwhelming support" for the 10 digit scheme.

Despite this OFTEL let BT double its pool of London numbers in May 1990 by changing all the 01 codes, to 071 in the inner city to 071 and to 081 in the outer half. BT urgently needed extra numbers because it was close to the practical limit of 4.5 million numbers available from 01 codes. There are now nearly 5 million subscribers in London. BT could have got enough new numbers by changing only half London from 01, but judged it better to inconvenience everybody than be seen to favour subscribers on one side of the Thames or the other.

Continued on page 60

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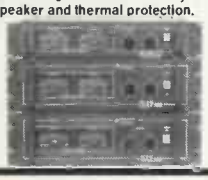

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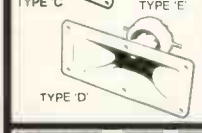

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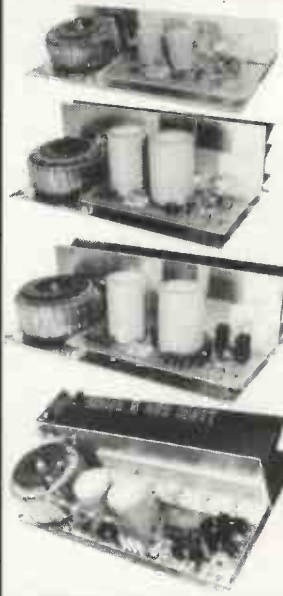

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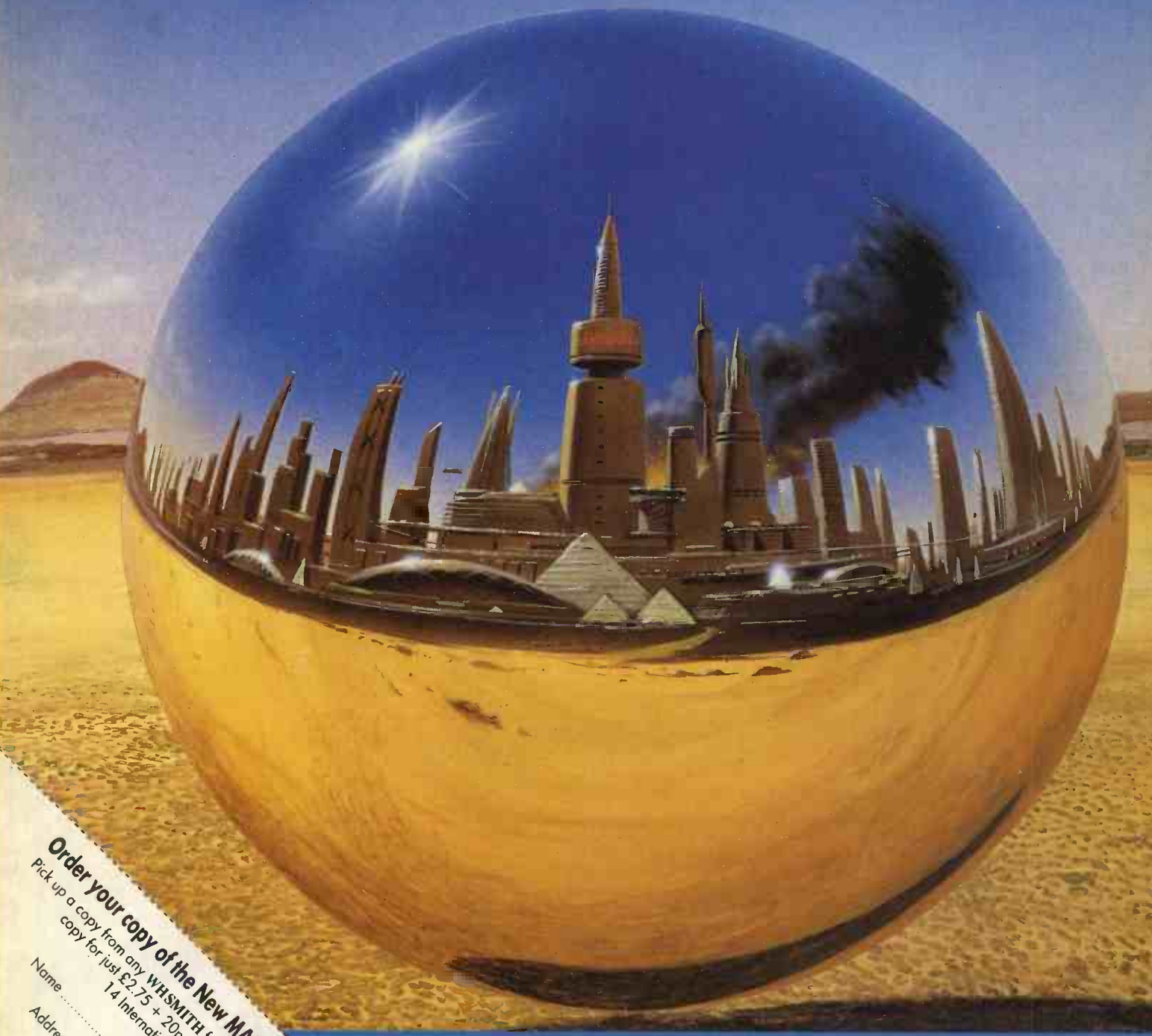

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