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Sony's Mini Disc

How it works
The Video-camera

Multimeters
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Three circuit sims

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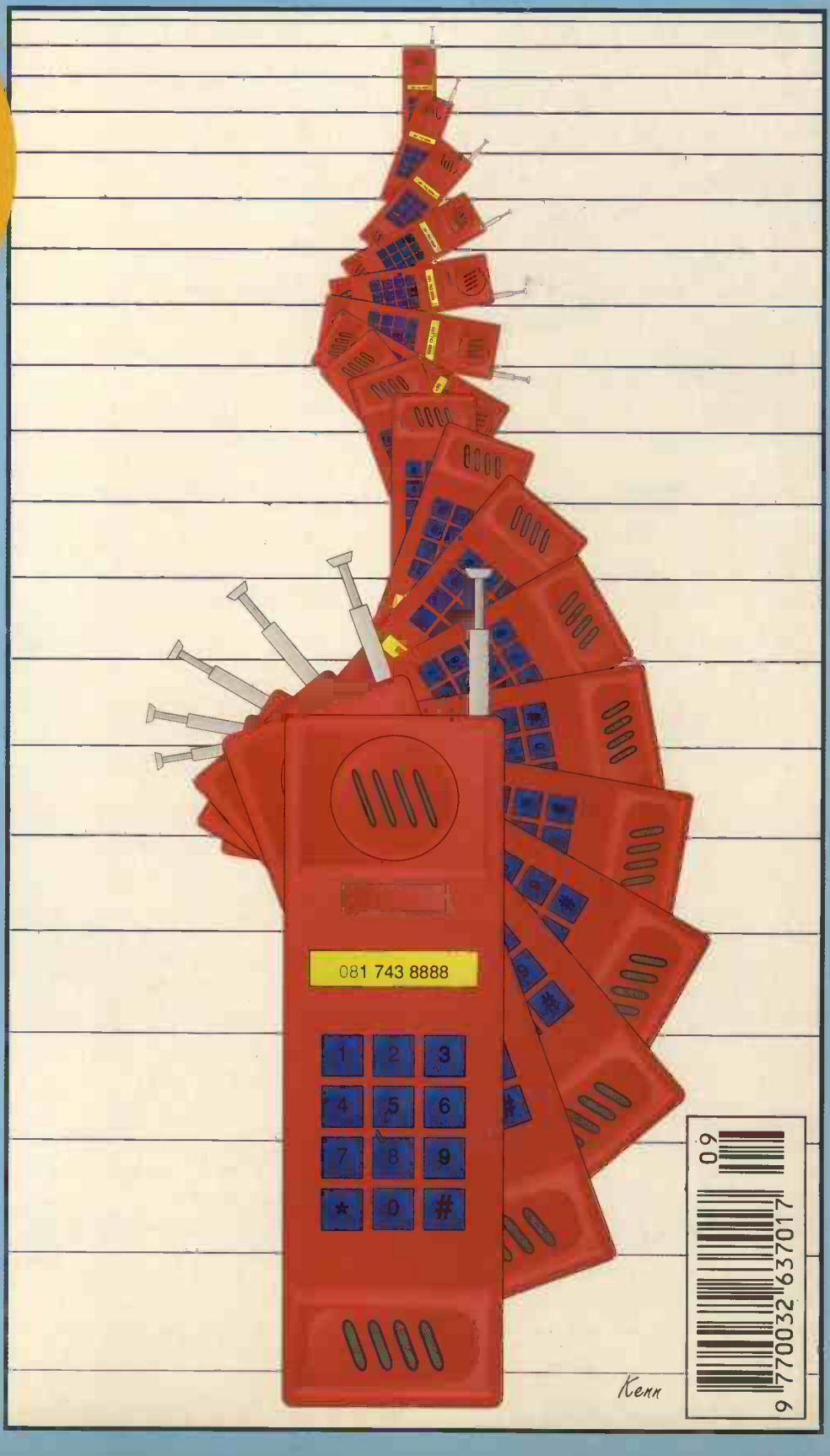

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Take the Sensible Route!

BoardMaker is a powerful software tool which provides a convenient and fast method of designing printed circuit boards. Engineers worldwide have discovered that it provides an unparalleled price performance advantage over other PC-based and dedicated design systems by integrating sophisticated graphical editors and CAM outputs at an affordable price.

NEW VERSION

In the new version V2.40, full consideration has been given to allow designers to continue using their existing schematic capture package as a front end to BoardMaker. Even powerful facilities such as Top Down Modification, Component renumber and Back Annotation have been accomodated to provide overall design integrity between your schematic package and BoardMaker. Equally, powerful features are included to ensure that users who do not have schematic capture software can still take full advantage of BoardMaker's net capabilities.

BoardMaker V2.40 is a remarkable £295.00 (ex. carriage & VAT) and includes 3 months FREE software updates and full telephone technical support.

AUTOROUTER

BoardRouter is a new integrated gridless autoroute module which overcomes the limitations normally associated with autorouting. **YOU** specify the track width, via size and design rules for individual nets, BoardRouter then routes the board based on these settings in the same way you would route it yourself manually.

This ability allows you to autoroute mixed technology designs (SMD, analogue, digital, power switching etc)in **ONE PASS** while respecting **ALL** design rules.

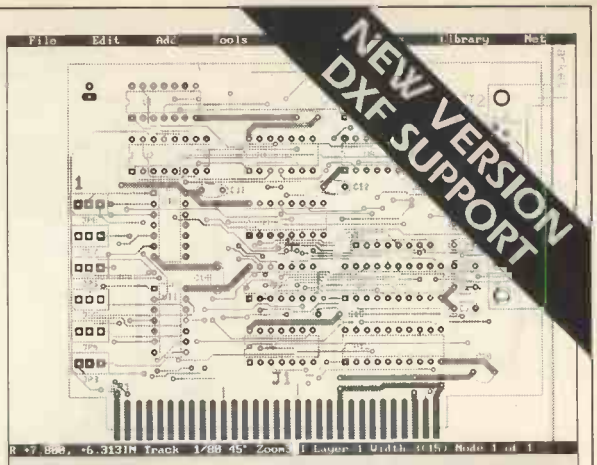
GRIDLESS ROUTING

No worrying about whether tracks will fit between pins. If the track widths and clearances allow, BoardRouter will automatically place 1, 2 or even 3 tracks between pins.

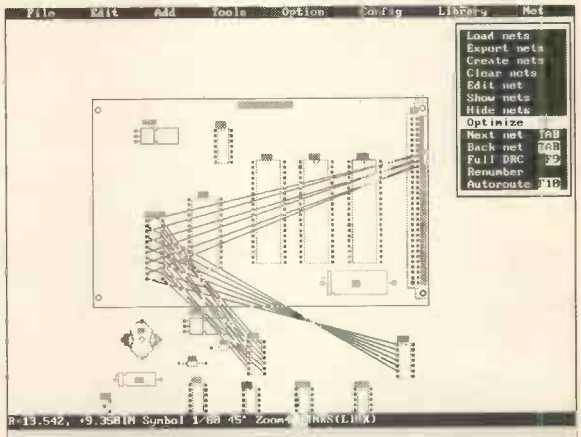
FULLY RE-ENTRANT

You can freely pre-route any tracks manually using BoardMaker prior to autorouting. Whilst autorouting you can pan and zoom to inspect the routes placed, interrupt it, manually modify the layout and resume autorouting.

BoardRouter is priced at £295.00, which includes 3 months FREE software updates and full telephone technical support. BoardMaker and BoardRouter can be bought together for only £495.00. (ex. carriage & VAT)



Full analogue, digital and SM support - ground and power planes - 45 degree, arced and any angle tracks with full net-based Design Rule Checking.



Optimized placement by displaying ratsnest per component. Lines indicate the unrouted nets.

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Access VISA

This month...

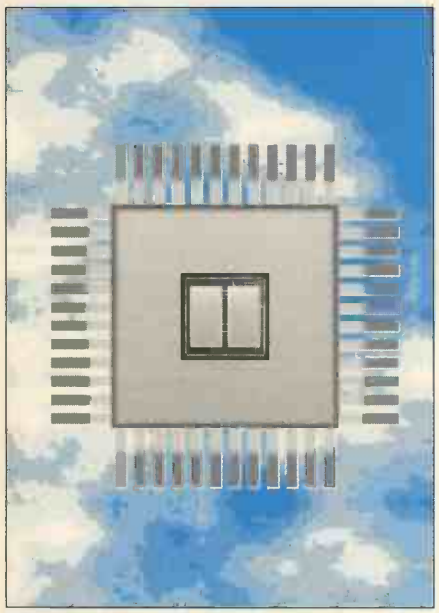
Computer aided design doesn't only apply to creating circuit schematics and PCBs. A couple of other applications are looked into this month with reviews of Pulsar and Protolab. Both of these are circuit simulators, the first dealing with digital and the second with analogue circuits.

The interesting point about simulation of electronic circuits is that when computers become small enough and fast enough, there should be no need to create a circuit out of discreet components. Instead, a black box with the required inputs and outputs will do the job. Inside will be a microprocessor that runs a simulation of the circuit.

However, that's in the future, anyone interested in getting into CAD now should turn to page 53 (after reading this) and enter our Seetrax Ranger competition. There is over £1500 worth of CAD software to be won.

Kenn Garroch, Editor

Next month...



Surface mount devices; how, what, where and why plus a project that uses them. AM stereo radio. How it works: we look inside a radio. All in the next issue of Practical Electronics.

Build It

Features

Regulars

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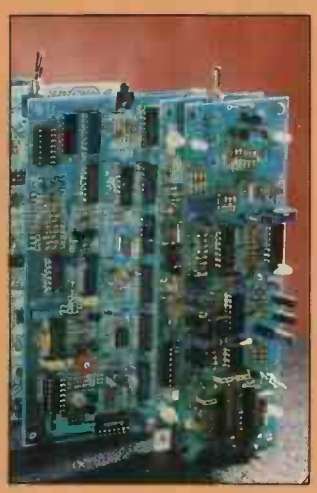

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Wavelengths

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

With relation to the article by Mike Saunders in the November 1990 issue about lasers. I would like to know what happens if two lasers intersect. Is it possible to have two infrared lasers operating invisible beams and then make the intersection visible or, put another way, create a movable point of light in midair?

If this was possible, control of aircraft could be made three-dimensional instead of the present flat radar screen. Each moving light point would be an aircraft and it would be simple to see its light point in relation to other aircraft, its height, distance from the runway, even its position on the runway.

Using pulsed lasers it may even be possible to code a selected lightpoint to identify a particular aircraft.

H G Hartog
Lower Hutt
New Zealand

After asking our in-house optical experts on Astronomy Now, it seems that because the are coherent, laser beams do interfere with each-other when the intersect. Unfortunately, this has no visible manifestation at the point of intersection and can only be seen when the beams strike a surface.

As far as I know, light beams can't be seen unless they reflect off something – all the eye sees are reflections. Another way of looking at the whole idea is that if nobody has done this so far then it probably can't be done (unless somebody knows better?).

Transparent Translation

Reading through your article on constructing printed circuit board in the July issue of PE, I must admit to being a little confused. The circuit is obviously from the Frost Alarm in PE Feb 90 and appear to be printed upside down, or at least back-to-front. Looking at the photographs of the finished PCB, the tracks have the same orientation as those showing the layout over the page. Is this correct? It seems to me that they should really be reversed laterally so that when the transparentiser spray is used, the dark track lines are closest to the board giving a good image.

Can you clarify the situation?

A H Wills
Hampstead
London

You are quite right in saying that the image should be reversed so that the dark tracks end up closest to the board. The answer seems to be that the tracks are printed in the magazine so that transparencies can be made from them. These will be the right way around for this purpose but, as you point out, wrong for transparentiser. In the end, the only way to be sure of getting the correct image is to examine the board layout and reverse as necessary.

Radio Request

I have noticed recently that you have introduced a regular page called how it works. Can I make a request for something to cover? I would like to know about the humble transistor radio, can you oblige?

T Smith
Royton
Lancs

We aim to be of service, look out over the next few months and your request should be granted.

Fuzzy Logic

In the August issue of PE I noticed that page 28 tried to show the improvement of HDTV over standard PAL. Was there a printing mistake or is there no difference? All of the pictures are rather blurred and have lines across them.

A James
Norwich
Norfolk

There is a definite difference between the original photographs but, alas, production problems cause interference, the result of which is the lines and blurring – sorry.

Bad Boards

The quality of the PCBs on page 38 of the August issue of PE left quite a lot to be desired. Is this the best you can do? I would have thought that with all of the latest technology, computer aided design and so forth, you would be able to produce perfect images.

P Williams
Colchester

The problem here was that the artwork came from the original masters provided by the author. Fortunately, you should be able to provide better boards from Lys Electronics (see the advert later in this issue).

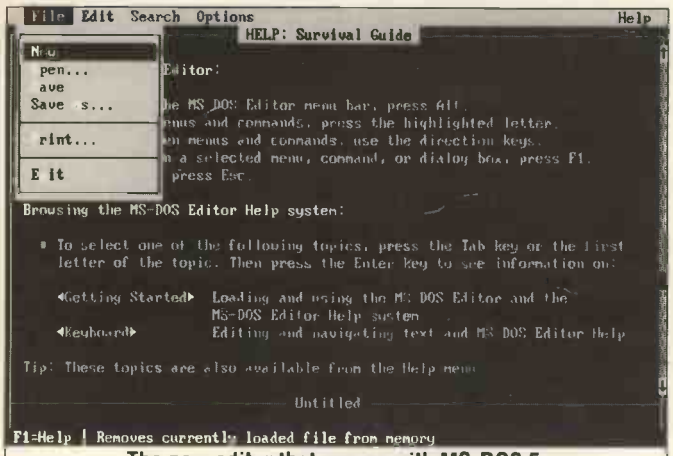
Sony's New Product

It was nice to see Ian Burley back with the New Product Developments replacement for Home Base. I like to keep track of what is new in the world of consumer electronics and your's is the only magazine that, now, seems to be covering this on a regular basis.

What I would like to know is whether the magneto optical technology used in the Sony mini-disc will be available for use with computers? It seems to me that this is the ideal media to store computer programs on. It is based on a digital system and appears to be small and quite rugged. The 74mins of music sampled at 44.1MHz should give 182 thousand mega words (at 16 bits per sample) or so – if my arithmetic is correct. This is a great deal larger than the average floppy or even the average hard disk.

A Henson
Stafford
Staffs.

All The Latest News From the World Of Electronics And Beyond...



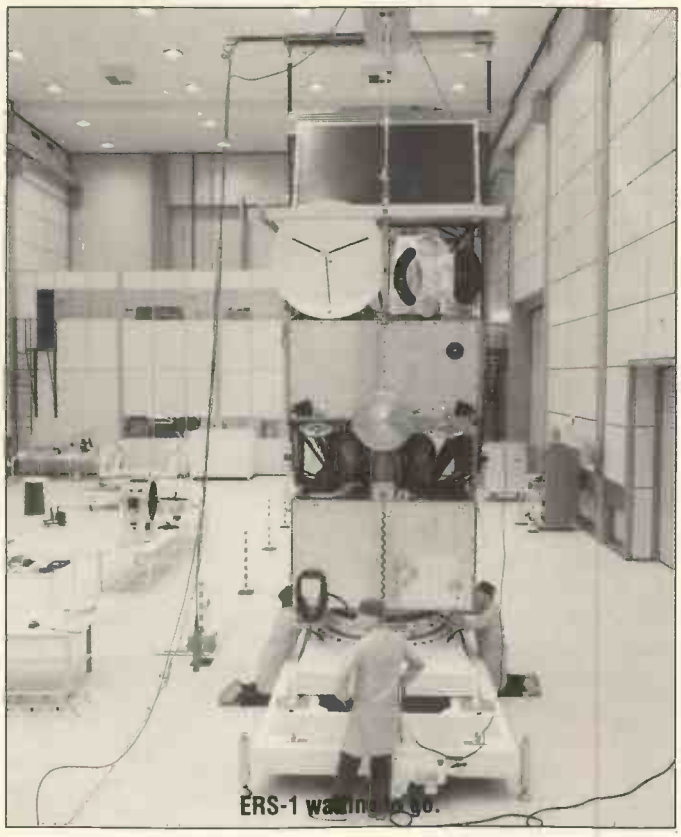
The new editor that comes with MS-DOS 5.

The Latest DOS

MS-DOS 5, the latest version of Microsoft's well known PC operating system was announced recently. Previous upgrades went some way to removing the bugs and making things easier to operate but, version 5 is a complete overhaul. While attempting to retain backward compatibility many software packages work without a hitch. However, some have a few problems and some, apparently, don't run at all.

Among other features, a new DOS Shell has been provided to help anyone who doesn't like typing in long commands. This is basically a file management system like Xtreepro with the addition of context switching. It allows a number of applications to be started up at once and enables the user to move between them without exiting. Leaving one and moving to another is simply a matter of pressing a key – the current state of the program is saved to disk and the next program loaded in and activated. Although this is rather slow it can be used to run sa,y a wordprocessor, CAD system and, perhaps programming interpreter (such as the bundled Quick Basic) at the same time.

The other major improvement of DOS 5 over older versions is the improvement of memory management. If there is extended memory available on the machine – that is, memory above 640kb, say 2Mb – then 639k is left for applications. On the basic XT this is reduced to 591kb which is not bad. Other main additions are increased help on the various commands, a full screen editor to replace EDLIN and a QuickBasic interpreter. The upgrade pack is available from Microsoft (0734 500741) for £69.



ERS-1 waiting to go.

ERS-1 Takes Off

The launch of the first European Remote Sensing Satellite, ERS-1 was originally planned for 3rd May 1991 but, due to various hardware problems was put back and back. It has now been re-scheduled to take off on 16th July from the European Spaceport in Kourou, French Guiana.

Fortunately, there was nothing actually wrong with the satellite itself, it was the third stage of the launcher that caused the problems. This has now passed its tests and should perform to specification during the launch.

ERS-1 is the largest satellite ever to be launched by ESA and it carries sophisticated sensing devices that will reveal any environmental problems both at sea, on the ice caps and on land. The synthetic aperture radar will be able to take high resolution pictures of strips of the earth's surface 100km wide as well as measure the direction and length of sea waves from 100 to 1000m.

The satellite, after going through exhaustive electrical tests, will be mounted on the launcher at the beginning of July ready for launch on the 16th.

Three days later, ESA will be celebrating the 10th birthday of Meteosat 2, the second in the series of European weather satellites launched a decade ago.

Originally designed to have an operational life of three years, Meteosat 2 is still active and will take its final image on 19th July 1991. Its operational life was actually only the seven years between taking over from Meteosat 1 and being replaced by Meteosat 3. Many people will have seen images from this spacecraft as it was used in TV weather forecasting throughout its life.

After taking its final picture, Meteosat 2 will be de-orbited allowing its position in the crowded geostationary orbit to be used by someone else.

Project VADIS

Project VADIS has just been announced as part of the Eureka programme for collaborative research. Aptly code named Eureka 625, VADIS is an acronym for Video-Audio Digital Interactive System and aims to develop the

enabling technology to allow digital television with full 625 line resolution to be carried by bitstreams with speeds from 5 to 10Mb/s. The project will be divided up into five main sections.

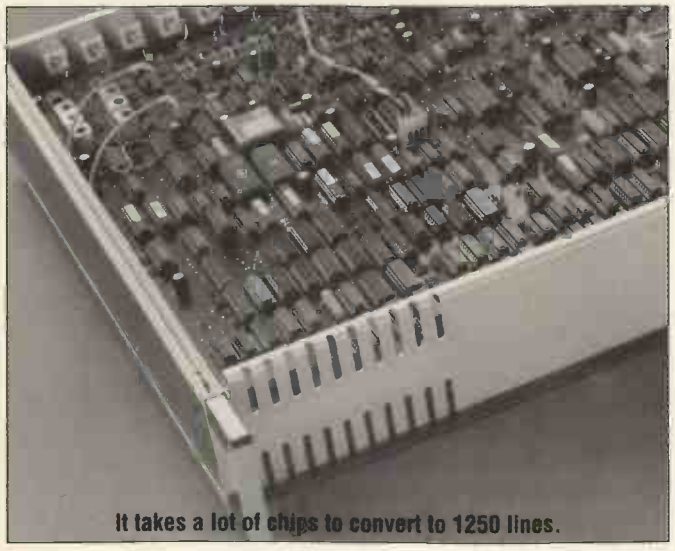
The first job will be to define the range of applications to be considered by the VADIS project as well as the quality, data rates, video formats, security encryption and overall compatibility. Following this the algorithms necessary to compress the 216Mb/s video and audio data by 20 to 40 times to achieve the target 5 to 10Mb/s will be worked out.

The development of systems to multiplex video, audio and data into a single bitstream will follow on from the algorithm development until finally the hardware and software will be designed into VLSI chips to allow real applications to be created. After field trials are completed the eventual aim of the project will be to apply the technology in terrestrial and satellite broadcasting. An international partnership including most of the big names in telecommunications such as BT, the BBC, Olivetti, Philips, National Transcommunications, and Siemens, has an interest in the project which should see field trials underway by 1993.

Up to 1250

To cater for the transfer between current and HDTV systems, the EDTV 1000 upconvertor from National Transcommunications is designed to convert from 625 to 1250 lines.

The usual chicken and egg syndrome means that someone will have to produce an HDTV monitor before anyone transmits an HDTV signal or vice-versa. To overcome this and encourage the release of HDTV monitors, National Transcommunications new device converts from interlaced to sequential scan (double line-rate) which reduces the line visibility and increases the vertical resolution.



It takes a lot of chips to convert to 1250 lines.

Children On CAD

Part of the fun of being a child is getting your hands and face covered in paint when "learning to become an artist". For the new child that fun has been replaced by electronics.

Getting into CAD

The latest toy from Vtech is an electronic paintbox called Video Painter. Designed as a child's introduction to computer aided design (CAD), it sports a palette of 12 colours and a pen which can be used as either a brush or a crayon. Lines can be thick or thin, coloured or erased. The improvements over the standard paint and brush include a choice of six different patterns, an alphabet, a selection of backgrounds and a library of 50 predrawn images. These include shapes, animals, fantasy characters, vehicles and people, all of which can be used to make up a picture. Images can be enlarged, reduced, copied and animated.

When finished the art can be stored on video tape for later viewing – bringing a whole new aspect to home video.

Priced at £79.99 it will be available from department stores throughout the country.

RGB Interface

Converting from RGB to composite video and UHF is now quite easy with the Wild Vision Chroma 100 series PAL coders.

Many modern computers, Commodore Amiga, Atari ST, IBM PC to name but a few, output their colour video images in analogue RGB. The separation of the red, green and blue signals from the synchronisation improves the image by cutting down inter-channel interference – it also makes the video output circuitry of the computer somewhat simpler. Most computers use DACs to convert the numbers in memory into voltages that represent the colour shades on a monitor. The drawback is that RGB is generally incompatible with most TV and video equipment which uses a combined signals made up from red, green, blue colours plus the vertical and horizon synchronisation information. Converting to composite video, as it is known, has, in the past, usually meant constructing some sort of special circuit.

The 100 series PAL coder takes 50Hz RGB and outputs PAL encoded composite video for both direct and UHF operation. The Chroma 135 has one composite and one UHF output. The Chroma 150 outputs two composite signals, two RGB and one UHF and incorporates a colour bar test pattern.

Priced at £129 for the 135 and £185 for the 150

Yet another portable from Toshiba, the T2000SXe has a 386sx processor and a VGA display.

they are available from Wild Vision, 15 Witney Way, Boldon Business Park, Boldon Colliery, Tyne and Wear, NE35 9PE, Tel 091 519 1455.

BT Gets Halfway

BT converts 15 telephone exchanges to digital operation every week and recently announced that it had converted half of the country.

Using the touch-tone dialling system the new exchanges offer much faster connect times plus a host of new facilities. Call diversion, call waiting, three way calling, repeat last call, call barring, charge advice, code calling and reminder call are just a few.

The trunk network which forms the backbone of the telephone system became all digital last year and was the first in the world to do so. It uses more than 1,500,000km of optical fibre allowing voice, data and images to be transmitted at high speed – it has another 10,000km added every week. The 3319th exchange, the halfway stage, was reached on 20th June this year when the Dean of St Paul's Cathedral in the City of London officially closed the old meachanical exchange and opened the new digital one.

Petit Duo

Toshiba, well known for producing portable computers has just announced the launch of the "smallest printer on the market". Citizen, known perhaps for its watches, has also launched the World's smallest printer. According to the specs, they appear to be based around the same engine.

Both machines have 24 dot matrix heads and can print on standard office stationary. The only difference seems to be in the sizes, the Toshiba measures 303x80x44mm and weighs 0.85kg whilst the Citizen is just 297x90x50 and weighs 1.17kg. The speeds, battery life and noise output appear to be just about the same as are the prices. The Toshiba Expresswriter 201 and the Citizen PN48 both cost £325.

No Tax

Back in July, PE reported that the new mobile telephone tax may apply to the telepoint phone. However, we can now confirm that this is definitely not the case.

The Telepoint system is not classed as a mobile phone according to Roger Best MD of Phonepoint. Telepoint connects into the standard telephone network and does not make any use of radio frequencies set aside for mobile use.

The idea of the tax on mobile telephones was designed identify the mobile phone as a business perk. According to PhonePoint, the CT2 phone is a viable alternative for both residential and office communications, it costs less to operate and there is no comparison to mobile phones.

RSGB Mag

The Radio Society Of Great Britain announced the launch of a new bi-monthly full colour magazine. DIY Radio aims to introduce the fun of amateur radio to school children, housewives, disabled and senior citizens. Each edition will feature construction projects, equipment reviews, news stories, a wall poster, competitions and special offers.

The magazine is only available on subscription at £9 a year from DIY Radio, RSGB, Lambda House, Cranbourne Road, Potters Bar, Herts, EN6 3JE. ■

The Toshiba Expresswriter 201

Citizen PN48

Animated Electronic Circuits

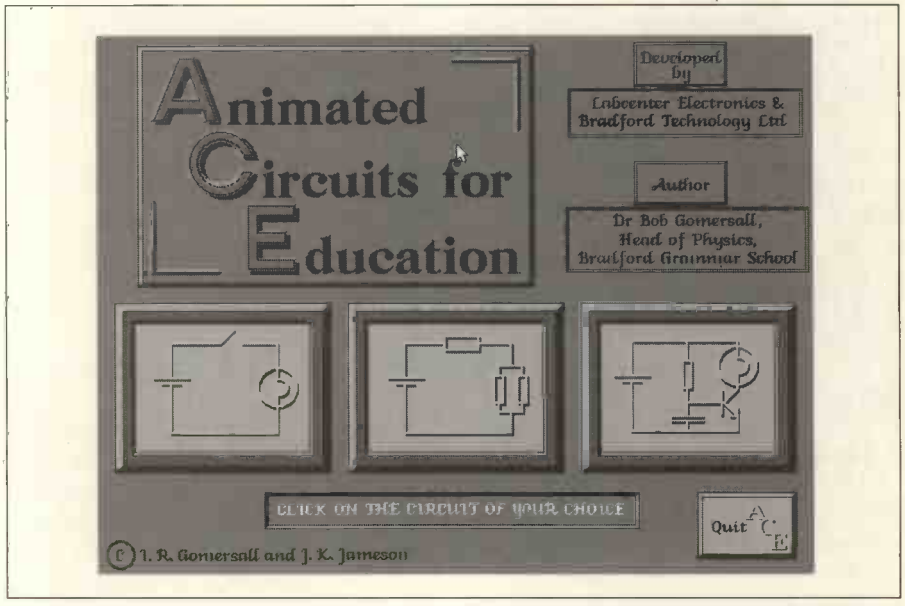
A new piece of software from Labcentre Electronics may revolutionise the way in which the concepts of electronics are taught.

ACE, a forthcoming product from Labcentre is breaking new ground in terms of animated electronic educational software. Circuits are displayed in an animated form that shows the current flowing through the components, meeting resistances, charging capacitors and triggering transistors. As the national curriculum for England and Wales states:

"Pupils should understand the behaviour of a circuit and its components in terms of a model of charge flow"

ACE sets out to do just this. The topics that will be covered in the package include:

- Conductors and insulators
- Series and parallel circuits with bulbs and resistors
- Measuring voltage, current and resistance
- Fuses
- Variable resistors
- Current voltage characteristics
- Internal resistance
- Capacitors
- Diodes and rectification
- Basic transistor circuits



The operation of the software is fully mouse driven and allows the user to point to components such as switches and click them on and off. Current flow is displayed in the form of animated dots with the various potentials in the circuit shown in different colours with different dot spacings. At the bottom of the screen are tape-recorder-like controls which start the current flow, stop it, single step it and eject to the next project.

Designed mainly for use in schools either as an "electronic book" or "dynamic blackboard", the software will also be available for the hobbyist.

Unfortunately, there is a major drawback with the system in that it will only work with an IBM-PC 286 (AT) or higher with MCGA or VGA graphics, it also has to have a mouse. Not too many schools will have these to hand and, although the authors are confident that the software will do well, it remains to be seen if there are enough machines available to allow widespread use.

For more information contact:
Labcentre Electronics
14 Mariner's Drive
Bradford
BD9 4JT
Tel. 0274 542868 ■

An animated transistor circuit.

Pump Up The Voltage

This month's trip down silicon valley examines a VGA LCD driver some new serial memory and high side power supply circuits.

Single Vision

The quest for the best personal notebook computer is driving the silicon industry to produce more compact and lower power chips. The latest is an LCD VGA controller from Cirrus Logic. The CL-GD6410 allows a complete VGA subsystem to be implemented using only five chips occupying less than four square inches.

On a monochrome system, the system provides 64 levels of grey and is capable of directly driving 512 colours using an active matrix LCD. In addition, the Simulscan feature enables the chip to drive an analogue CRT at the same time as the LCD.

The additional components required for a complete system are two DRAMs for the video memory, a clock synthesiser and, if a dual panel LCD is used, a 64kx4 "frame accelerator" memory. The latter can be used to run a 70Hz refresh rate with an input clock of only 14MHz, comparable systems must used a 28MHz clock. The reduce rate allows lower power consumption as does the shutting down of circuitry associated with the CRT when it is not being used.

Serial Interchange

Being able to access memory in a serial fashion is nothing new. However, where most systems have used three or four wires, the Xicor serial EEPROM family uses two. The idea is to allow the same chip socket to be used by devices offering 1k, 2k, 4k, 8k or 16k of memory. The same two pins are used on every chip to communicate with the microprocessor so changing from chip to chip is just a matter of changing the software. The two wire communications protocol also frees up a couple of controller input/output ports to be used for something else. Currently available from Micro Call Ltd (0844 261939) are the X24C01A 1k byte EEPROM and the XA24C08 8k byte EEPROM.

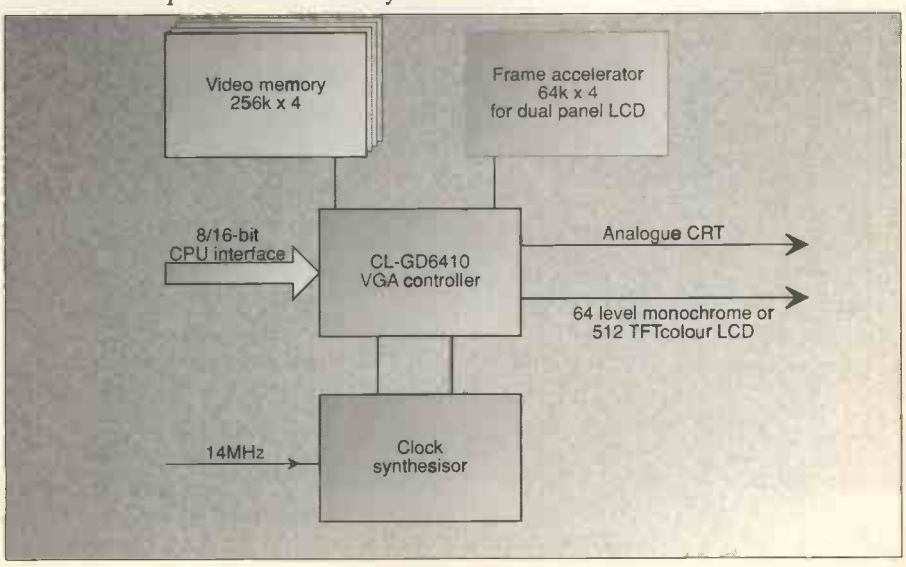
Pump Up The Voltage

The new high-side power supply integrated circuits from Kudos Thame are able to produce regulated 11V output from a 5V power supply. The term high-side refers to positioning of a switch between the positive supply and the load – low side switching is the opposite, the switch goes between the load and the negative supply.

The MAX622 and MAX623 are ideal for providing the higher gate voltages required by low-cost N-channel MOSFET switches. The high-side aspect of the system avoids the requirement for costly P-channel MOSFETs, PNP transistors and logic level MOSFETs in switching and control applications where only low supply voltages are present.

The chips operate around charge pump convertors which eliminate switching regulators and the associated cost, size and EM (electro-magnetic) interference of inductors. The MAX622 requires only three inexpensive capacitors for a complete circuit while the MAX623 has them built in and needs no external components.

Able to operate from supply ranges from +3.5V to +16.5V and having a quiescent supply current of only 70µA, they are ideal foe battery powered switching applications such as changing over from mains adaptors to internal batteries and battery load management. A useful facility is the power ready output which indicates that the high side supply has reached an operational level. For more information contact Kudos Thame on 0734 351010. ■



In The Beginning Was The Telephone

The modern office uses more technology than ever before. James Carter observes the current trends and looks at some of the latest gear.

Before the telephone the height of office technology was probably the fountain pen. The telephone revolutionised communications, especially business communications and forced the start of a technology race that started with the typewriter and has so far reached the personal computer.

Jack Of All Trades

The first computers were huge unreliable affairs built up from hundreds of valves and taking up whole rooms. To begin with they were mainly used by scientists for research purposes but, by 1951, the first business computer had been built. The Lyons Electronic Office or LEO was custom built by J Lyons & Company to run the payroll and by 1957 was producing the weekly payslips for 15,000 employees. This machine was a far cry from the sophisticated desktop machines that are now commonplace and it was not until the advent of large scale integrated circuits in the1970s tha the size revolution began.

When microprocessor based systems first appeared the maximum memory was around 64k with 8in disk drives using an Intel 8080 and the CP/M operating system. Things moved on to 5.25in disks and a Zilog Z80 microprocessor but the basic operation was still the same. Many of the early PC applications appeared at this stage. Wordprocessing took off with the infamous Wordstar and databases and spreadsheets started to become commonplace. However, until the increase in processing power enabled high resolution video screens to be catered for, graphics applications and games were quite rare and nothing compared to what is available nowadays.

Mac IIfx.

Modern personal computers fall into three main categories, those built around the IBM PC architecture using the Intel 80x86 range of microprocessors, the Macintosh range, manufactured by Apple and the rest; Unix, Xenix, CCPM, Sun workstations and so on.

The IBM PC compatible is the main workhorse of the small and medium sized office. The bottom of the range machines, known as the PC XT, use the Intel 8088 or 8086 microprocessor and have between 512kb and 640kb of memory. Disk storage is mainly on floppy disks though small hard disk drives capable of holding 10Mb to 20Mb are now cheap enough to be added on. These machines are generally used for wordprocessing, running small payroll and accounting systems and small spreadsheets. Unfortunately they are slow and have now been superceded by the IBM AT which comes with a hard disk drive as standard and an Intel 80286 (i286) microprocessor. Giving up to ten times the processing speed it is able to run reasonably sized databases and large spreadsheets. A limitation is the

Compaq Deskpro 486/50L runs at 50MHz providing very high performance.

i286's inability to run programs properly in areas of memory larger than 640kb.

One of the big advantages of the PC type machine is its expandability. By placing extra printed circuit boards or cards in the back, its capabilities can be considerably enhanced. Cards are available for a wide range of applications from high definition video displays and MIDI (Musical Instrument Digital Interface) controllers to extra hard disk drives and modems.

Most of the latest PCs use the i386 microprocessor which improves the processing speed dramatically and gives access to more memory.

At the top of the range are PCs using the latest Intel microprocessor, the i486. These are still in the minority but are finding applications in banking with large spreadsheets and other applications that require very high performance in a small desktop computer.

Although not as widely used as the PC, the Apple Macintosh range of computers has had a very large effect on the way in which software is presented to the user. The GUI or graphical user interface was pioneered by Apple in its early Macs. Instead of the command line interpreter and the dreaded A> prompt, windows, icons, a menus and a pointer (WIMP) are used to manipulate files and data. By setting standards for ways in which things are done, the time taken to learn a new application is dramatically decreased. In addition, the inhearently graphical nature of the machine means that it finds many applications in desktop publishing (DTP). The difference and rivalry between the Mac and the PC is such that dedicated users of either machine won't even consider the other – Mac users are among the most evangelical of computer people.

The future of the office computer seems to be heading towards smaller and more powerful machines. Laptop computers offering the similar power to large desktop PCs are becoming common and they have the advantage that they can be folded up and put away when not in use instead of taking up a large chunk of desk space.

Getting It Out

The essential add-on or peripheral for the office computer is a printer. This provides a way to reproduce the results of an application in hard-copy form. In the early days, the quality was not considered too

Canon LBP 4 laser printer.

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important since printouts were only for payslips, account listings and so on. As wordprocessors developed the quality of printouts had to improve to compete with typewriters. The first high quality systems employed daisy wheels – a rimless spoked disk with a letter on the end of each spoke. Spinning the daisy wheel until the required spoke was in position and then using a solenoid to punch it onto the paper through a ribbon allowed print of the same quality as typewriters to be produced. The main drawbacks were speed and noise pollution – a daisy wheel printer in action sounds a bit like the start of a revolution.

The main competitor to the daisy wheel, the dot matrix printer, originally produced poor quality output since the characters were made up from a matrix of points and the resolution was only about 72 dots per inch (dpi) vertically and horizontally. This could be improved by overprinting characaters so that the dots didn't show too much but was still not as good as the noisy daisy. The major improvement for dot matrix printers came with the increase of the number of dot wires in the print head from 9 to 24, increasing the resolution to around 210 dpi. Unfortunately by this time, the laser printer had come to the fore and was falling in price offering 300 dpi at much higher speeds – up to 18 pages a minute – all very quietly. In addition they offered a selection of printing fonts allowing output that was almost indistinguishable from professional printed matter.

Most offices are now able to produce very high quality documents but are limited by the laser's monochrome output.

Colour printers, though still expensive, are now available that give 300dpi resolution and 16.7 million colours in a box the same size as a laser printer and at only a quarter of the speed.

Computer Speak

Communications is what holds modern commerce together. Since its invention in 1876 by Alexander Graham Bell, the telephone has been the mainstay of business. It has evolved far beyond the wildest dreams of the early pioneers with its ability to reach pretty well anywhere on the globe in under a minute. Obviously there has to be a telephone at either end of the link but the system has now become so widespread that, in many countries it is taken for granted.

Apart from simple voice contact, the telephone is also used for the transfer of data and images. The modem (moduator demodulator) is the device which allowed high speed communications between computer to become commonplace. The facsimile or fax machine depends upon it for its operation.

The Fax uses a long CCD (charge coupled device) sensor positioned at right angles to the paper to scan

IBM is one company with its eye

the image as it is moved past. The data is coded up either as ons and offs for black and white, or as a representation of the darkness of the image, and then pushed through a modem and converted into tones compatible with the telephone line. At the other end another fax pulls in the signals in through its modem and converts them back into an image using an electronic print head that generates marks on heat sensitive paper. A single page of A4 can be transmitted in under a minute allowing both text an images to be efficiently transferred from place to place.

The other main use for the modem is in communicating between computers. Until recently this was used mainly to send data from a host of satellite computers to a central system which could, for example, collate the days sales from around the country.

On a mainly amateur basis, the bulletin board has been around for some years. It provides a central computer upon which data can be stored and messages (E-Mail or electronic mail) left to be picked up by other computers as they ring in. This has developed into the on-line information service which provides data on everything from a synopsis of the days's newspapers and stock market reports to multi-user interactive games such as MUD (Multi-User Dungeon). The other development has been the rise of the on-line conferencing system. Pioneered by Byte, the US computer magazine. The UK version, CIX, has conferences covering a wide range of subjects.

Data Stores

The next major innovation which will change the operation of the modern office is the CD-ROM. This provides a vast amount of data in a small compact unit. Although not widely used, disks containing the UK telephone directory and the Oxford English Dictionary provide quick access to vital data.

The main problem with CD ROM units is that there is no set way in which to access the data onthe disk. Each tends to have its own programs to do this, some are good, others are pretty awful. Hopefully increased demand will force the manufactuers and publishers to get together to create a standard format.

The End of The Office

The increased capability and decreased price of office technology could eventually spell the end of travelling to work.

It is now quite possible to set up an office at home with all the essentials, computer, printer, fax, telephone and modem, all fitting on a single desktop.

Whether the advantages outweigh the disadvantages isn't known yet as working at home is still on a small scale. However, not having to commute to work every day definitely has its plus points. ■

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Who Said The Valve Was Dead?

Jeff Macauley's high quality audio amplifier has been tested by the most discerning listeners we could find. The verdict? "Excellent".

What makes a good power amplifier? A simple enough question you may think but the answer depends on who you ask. There are many in the audio fraternity who would suggest that only valve amps posses good sound. Others believe that valve sound is a load of hokum and would point to solid state reliability and minuscule THD (Total Harmonic Distortion) figures. Yet others believe that any amp can be improved by stuffing the circuit with expensive components.

The first thing to realise is that an amplifier is a device which makes an enlarged copy of an input signal. To so this without violating the laws of physics the extra energy is supplied by a DC power supply. Obviously in order to produce a good copy the first requirement is that the power supply voltage should not vary with the changing signal level. This is a tall order and the reason why many people have expended a great deal of money on super power supplies. An easier and definitely cheaper method is to design the circuitry so that it ignores power supply variations. Properly done this is much more effective.

Another train of thought suggests that amplifiers should be designed with the minimum amount of components on the principle that the less circuitry there us, the less sound degradation there should be. This is the minimalist approach. Certainly it is quite possible to build equipment with very few components but Hi-fi, they are not. How good an amplifier is is determined by how closely he output resembles the input. Unfortunately most active devices are far from linear so to do a good job of copying a fairly complex circuit is required to compensate for any shortcomings.

A similar school of though suggests that negative feedback should be banned in audio design. Again, this would be okay if active devices were truly linear. Unfortunately, this is the real world and they're not. Furthermore, many feedbackless designs incorporate local negative feedback to linearise the individual devices.

In The Beginning

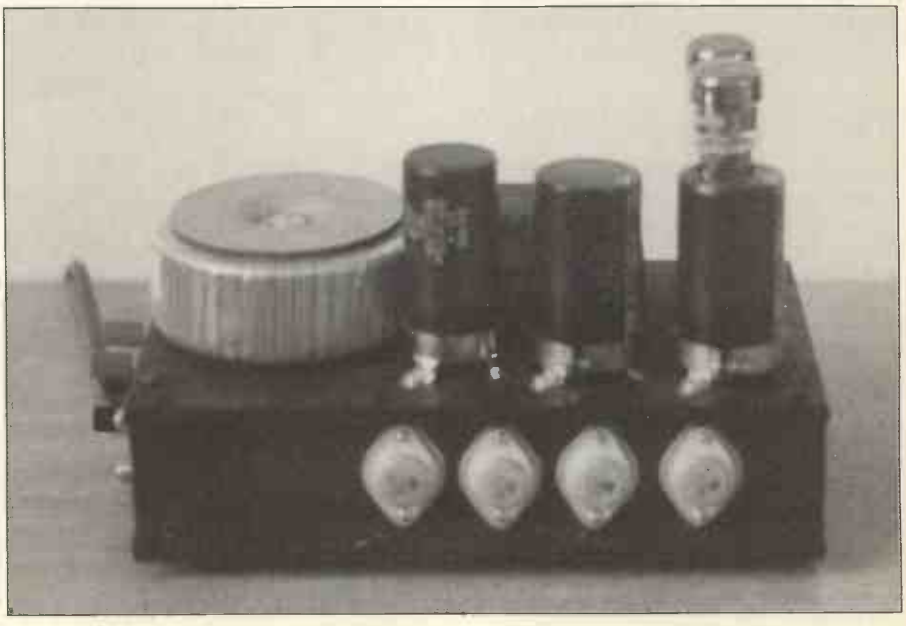
The starting point for any circuit is the engineering specification. The design objective was to supply 80W into 8Ω loads. At this point we can work out the required RMS (Root Mean Squared) from the relation:

$V_{RMS}=\sqrt{(PR)}$

where P is the required power and R is the load resistance. This works out at just over 25VRMS. The peak to peak voltage is some 2.8 times greater at about 71V. Similarly the peak current requirement can be calculated at 4.5A. Obviously these are the bare minimum figures and any practical circuit will require extra margins to cope with stage saturation and power supply regulation.

These considerations set the parameters of the output devices which in turn set the driver stage specifications. It is customary, with power amp circuits to describe operation from the output stage backward. This convention has, presumably, come about because the output stage is the heart of an amplifier. Indeed the rest of the circuitry merely supports the output stage's critical rôle.

There are plenty of suitable power transistors that could have been used but for this circuit VFETs were chosen. When these were first introduced a few years back they were heralded as the successors to



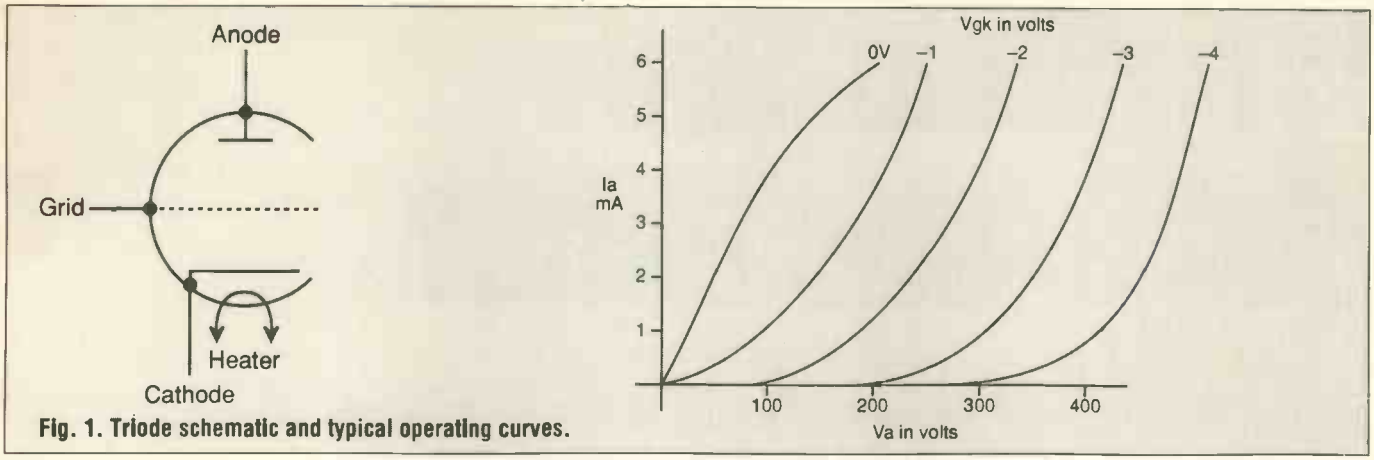


Fig. 1. Triode schematic and typical operating curves.

bipolar transistors.

They certainly have a lot going for them. For starters, they are immune to short circuits, have exceptionally high input impedance and tend to turn themselves off when they get hot. This latter feature is extremely significant.

It means that the amount of heatsink required is determined solely by how hot you can tolerate the heatsink. Normal bipolars on the other hand will self-destruct unless elaborate precautions are taken to ensure that the temperature rise stays within strict limits.

Another advantage of the VFET is that its operation at low currents is far more linear than normal transistors leading to better crossover performance. In fact the only fly in the ointment is the large gate to source capacitances of these devices. These need to be charged and discharged with every signal cycle. However, by using the devices in the source follower mode this capacitance is effectively bootstrapped reducing drive requirement. Probably the only reason that we still use bipolar output stages at all is one of economics. VFETs, at present, cost about three times more than equivalent bipolars.

The devices chosen for the output stage are a complementary pair rated at 140V and 12A peak current. More than adequate.

In The Circuit

Starting at the output if the system, Q4 and Q5 are used in the source follower mode. Equivalent to the more familiar emitter follower configuration found in bipolar circuitry. Together they form a fully complementary output stage. The only additional components, R5 and R6 are included to ensure stability. Output signals are coupled to the speaker by C3. An important point here is the DC blocking action of this capacitor.

Although a fault in the output stage is almost unheard of with these devices, it's still possible. If, for example, Q4 or Q5 were to become short circuited a directly coupled speaker would not last long enough for the plug to be pulled out. Speaker systems are very expensive compared to VFETs...

In order to drive the output stage properly, the driver circuit must be capable of charging and discharging the gate source capacitances whilst maintaining correct bias to avoid crossover distortion. For this reason the driver stage operates with 5mA of current.

The driver itself is a hybrid cascode comprising Q1 and V1. The first needs to have a high gain and low noise. The device used is actually half of a SSM2210 dual transistor per channel. This device features a noise voltage of only $0.7nV/\sqrt{Hz}$ and a guarenteed high current gain of 550 at 10µA collector current. The high gain means that the device makes an excellent voltage to current convertor. Note the absence of an emitter resistor. This is because the transistor is being used 'open loop'.

The only resistance in the circuit is the internal emitter resistance. In a silicon transistor this is equal to $26/Ic\Omega$ where Ic is in mA.

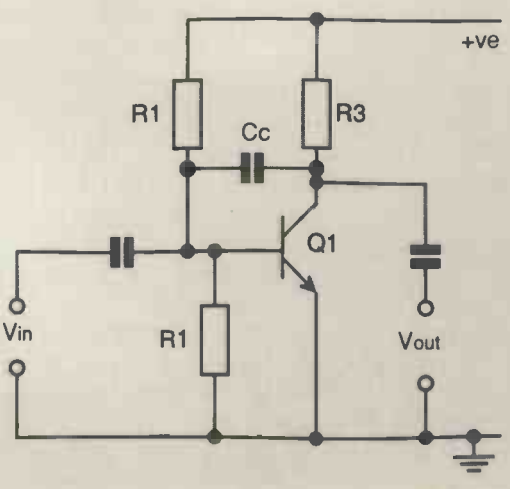
The series pass element is the valve V1. This needs to be a device of rather special qualities to accurately transmit the current

The Cascode Amplifier

The cascode circuit first saw the light of day as an RF amplifier and has a substantially better response than the usual common emitter stage normally encountered as a voltage amplifier.

Fig. 2a shows both a common emitter amp with a simple cascode in 2b. Looking first at the common emitter stage, this acts as an efficient voltage amplifier but suffers from a couple of disadvantages. The major one is that the parasitic collector to base capacitance Cc allows high frequencies to to find their way back to the base. This gives unwanted negative feedback at high frequencies and is known as the Miller effect. This gives premature curtailment of high frequency response.

From the point of view of an audio amplifier the overall performance of the common emitter stage is disappointing. Apart from the high frequency drop off, the input impedance

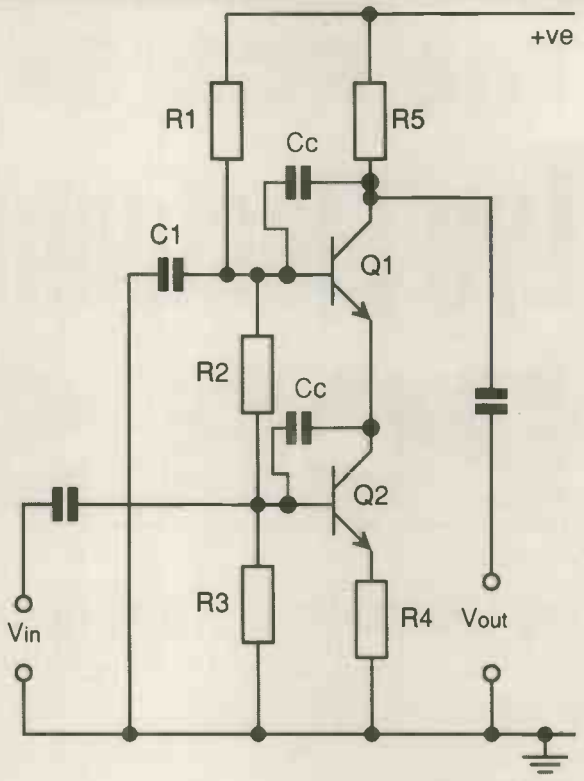


is low and the distortion, especially at high output levels will be high. Output impedance is also quite high depending on the value of the collector load resistor.

Fig. 2b shows the basic cascode stage. This has two transistors connected in series. Q1 and Q2 are biased from the resistive divider R1, R2 and R3. C1 removes any AC signals from the base of Q2. Due to normal transistor action the emitter will sit at about 0.6V below the voltage applied to its base. It therefore provides a smooth DC level for Q1. Q1 is actually operating as an emitter follower. Signals across R4 will mirror input signals applied to the base both in amplitude and phase. Q1 has two functions. Firstly it converts the incoming signal into current variations to drive Q2 – it is a transconductance amplifier. Second, it provides a fairly high impedance to the input. Because the voltage at Q1's collector is held constant by Q2's emitter Miller feedback through the parasitic capacitance Cc cannot occur.

Q2 is operated in the common base mode . Current from Q1 appears across R5 as an output voltage. Because of the high drive impedance produced by Q1's collector, the operation of this transistor is extremely linear. Again, the parasitic capacitance between the collector and base has no real effect because C1 effective;y earths signal voltages fed back to its base.

The cascode is a fair imitation of a perfect amplifying stage from the viewpoint of linearity. The HF response is also many times more linear than the common emitter stage.

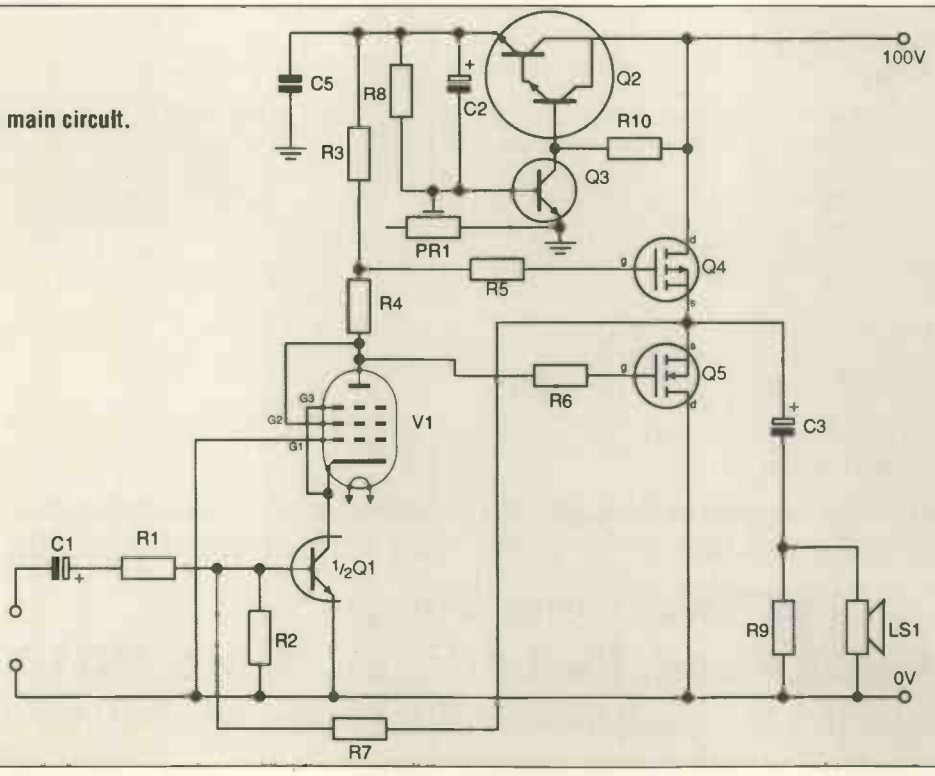


signal provided by Q1.

At this stage it is as well to describe exactly why a valve is being used in the circuit at all. To start with, a transistor would have lost signals due to the base current since a transistor operates by current amplification. The base current will therefore vary during each signal cycle resulting in distortion.Using a suitable;le FET instead of V1, would introduce the problem of source gate capacitance. Although the input impedance is low, most available devices would suffer from loss of top due to this capacitance shunting high frequencies to ground. Lastly, valves are very linear devices, more so than the majority of FETs and their characteristics are nearly constant from device to device – something that cannot be said of either transistors or FETs.

The valve is essentially the ideal device for this application. When used correctly the cathode current equals the anode current at all signal levels. Very low grid cathode current ensures that all the signals get to the output regardless of frequency. By using this hybrid configuration the best of all possible

Fig. 3. The main circuit.



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The Triode

The electronic age started in 1907 when an engineer name De Forest produced the world's first amplifying device, the triode. It had been known from Edison's experiments that a current flow could be produced between a heated filament and a metal plate inside an evacuated glass bulb when the plate was held at a positive potential compared to the filament. It was also observed that the current wouldn't flow when the plate was made negative with respect to the filament.

The reason for this rather puzzling state of affairs is that a heated filament in a vacuum ejects free electrons from its surface. A nearby positively charged plate will attract these so a current flows between them. Conversely, a negatively charged plate would repel these electrons and no current is able to flow.

All of this describes the operation of a diode and for years the main use of this device was detection of spark gap transmissions. What De Forest did was to introduce a third electrode in the form of a fine wire mesh between the filament and the plate. By varying the DC voltage on this new electrode, the grid, the current flowing could be altered. A relatively small grid voltage causes large variation in current. Connecting a suitable resistor in series with the plate creates a voltage amplifier.

This basic device is the simplest valve possible, a triode. Modern components use an indirectly heated cathode but basically the circuit is the same. As an amplifying device the valve is some ten times more linear than a transistor although the gain it produces is relatively small, between 10 and 100 times depending on the type. The separate heater is obviously a disadvantage compared with a transistor. However, the input impedance of the valve grid is very high.

The nearest equivalent device in the solid state arsenal is the junction field effect transistor (JFET). However, the valve, being a mechanical device can be made with very little gain variation between samples of the same type, even when obtained from different manufacturers. Compare the average 10% variability of a valve to the 4:1 gain ratio expected between different samples of transistors of one type. Also valves are high voltage devices giving much greater signal swings than transistors and generally suffer from less parasitic capacitance than either transistors or FETs.

worlds is obtained with very high linearity before feedback is applied.

The valve, an 6CA7, is an output pentode more normally encountered in the output stages of high power amps. Here, to improve the linearity of the circuit, the valve is being used as a triode.

This is achieved by connecting G3 to cathode and G2 to the anode. G1, which would normally be the input terminal is connected directly to ground. The consequence of this is that the cathode voltage is raised above ground by a few volts and this voltage acts as a low impedance stable supply for Q1.

Triode connection ensures that the anode and cathode currents are identical. It also alters the characteristics of the valve which become far more linear. The choice of the 6CA7 is deliberate in that it is one of the few valves on the market that can supply the high voltage swings necessary when operated from a low voltage source. Also, this allows the whole circuit to be directly coupled ensuring better transient response and no phase problems at the frequency extremes.

The performance graph of the valve is shown in Fig. 4. Note that the load line, the line which cuts the anode current/voltage to grid voltage lines, intersects the current axis at twice the quiescent value and the voltage axis at 95V. The limits of performance are indicated by the points at which this load line crosses Vg1=0V line.

The rest of the driver circuit consists of R4 and R3, connected in series. Here the simplicity of a VFET output circuit comes to the fore. Bias is set simply by the voltage drop across R4. Similarly there is no need for the usual small value resistors in series with the output devices to prevent crossover distortion.

Because we have open loop gain in the driver circuit it is possible to produce a very simple high quality amplifier by using shunt feedback. The output voltage at the source of Q4 and Q5 is applied to the voltage divider comprising R7 and R2. As a result the voltage at the output will rise until 0.6V is applied to Q1's base where it stabilises. By suitable choice of R7 and R2, the output is held at the correct voltage for maximum linear output voltage swings.

With a shunt feedback amplifier of this kind, the feedback reduces the input impedance seen at the base of Q1. As far as signals are concerned it's virtually at earth potential – which is why its called a virtual earth amplifier. The voltage gain is set by the ratio of R7 to R1.

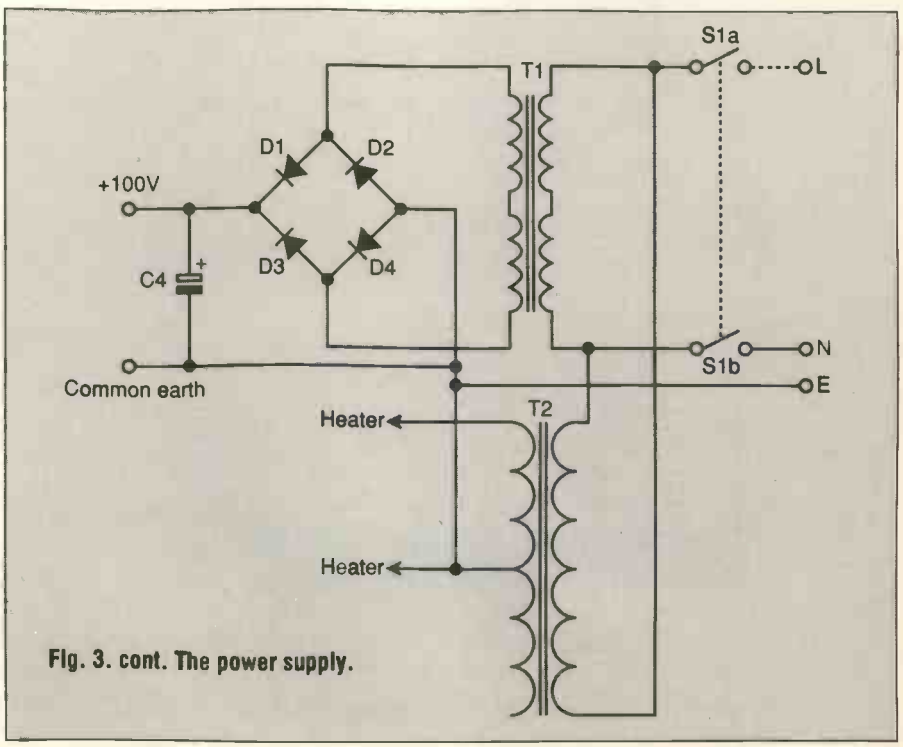


Fig. 3. cont. The power supply.

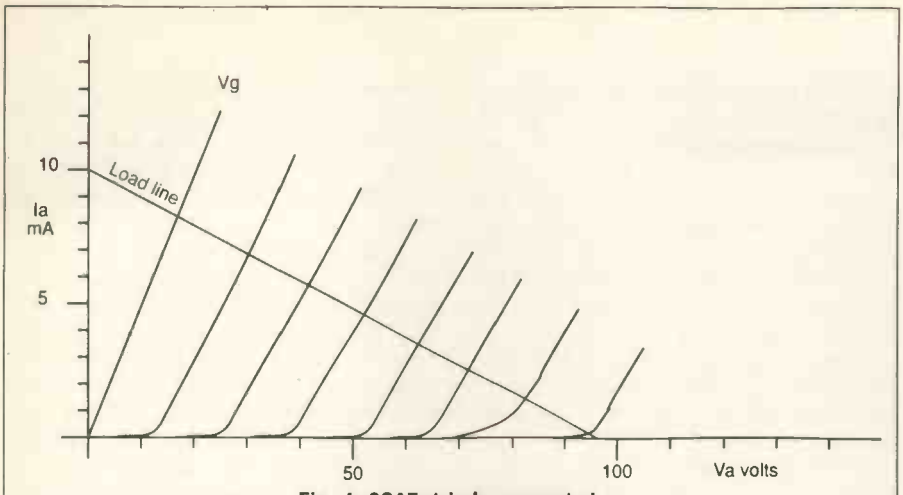


Fig. 4. 6CA7, triode connected.

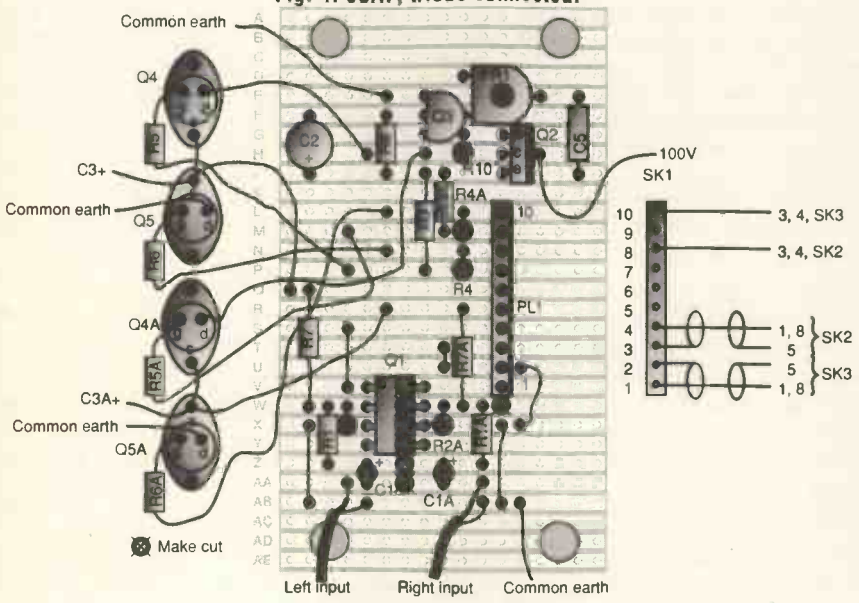
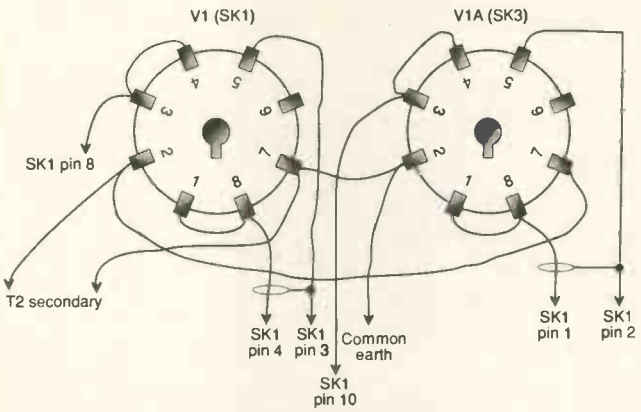
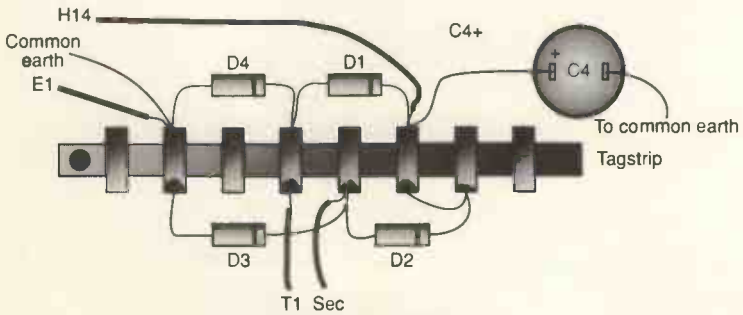


Fig.6. Stripboard layout.



Valve base connections.



Tagstrip connections.

C1 simply acts as a DC block for input signals while providing a short circuit at audio frequencies.

Having described the main amplifier circuitry in outline there are some practical aspects which also need attention. Because we are using a valve as one of the active elements it follows that it will be some seconds before this device switches on. It takes time for the heater to reach operating temperature and this has serious consequences for the speaker.

If no special precautions are taken, the full line voltage would find its way onto Q4's gate. This would switch hard on and C3, be initially discharged, would pass an enormous current pulse to the speaker. With 100V on the line and an 8Ω load, theoretically a 12.5A pulse would be coupled into the speaker. This is obviously undesirable and some method must be devised to prevent it occurring.

The solution is to supply the line voltage to the driver stage gradually. This is the purpose of Q2, Q3 and the associated circuitry. At switch on C2 is discharged and appears as a short circuit between Q2's emitter and Q3's base. The voltage across it rises until prevented by Q3s base and R8. The Q2 darlington pair emitter follower is supplied with base current by R10. As C2 charges, the voltage across R8 and at the emitter of Q2 rises gently. By the time this voltage has risen to near its final value it has reached its operating level.

One slow start circuit is required to power both channels. What isn't apparent from the circuit diagram is the hidden function of the circuit. It operates as a super smooth supply for the driver circuitry and isolates the performance of the amplifier from the rest of the power supply. It has a performance comparable to a 317 regulator chip.

Turning to the other end of the circuit, the power supply. This falls naturally into two parts. T1 is the main transformer which, for reasons of compactness and low external magnetic field, is a toriodal component. The secondary voltage is full wave rectified by D1 and D4 and applied to the main smoothing capacitor C4.

T2 is a 6V secondary transformer rated at 4A and supplies the heater voltage for the valves. Each of these takes over one amp of current and

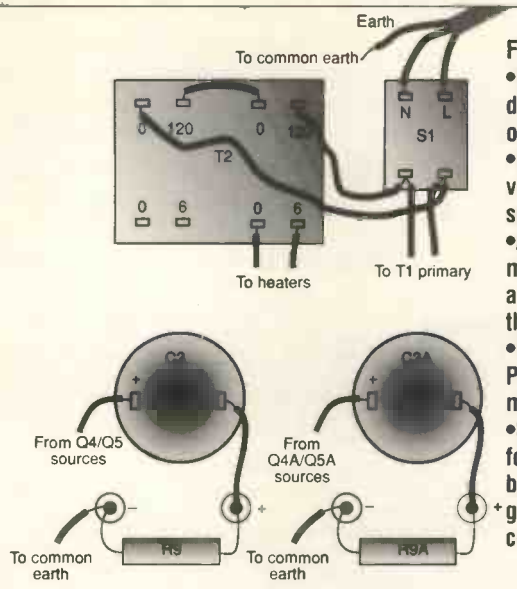


Fig. 6. cont.
•Mount R5/6/5A/6A directly on the gate pins of Q5/6/5A/6A.
•Mount tagstrips and veropanel on 0.25in spacers.
•All connections marked common earth are taken to a point on the chassis.
•PL1/SK1 are 10 way PCB mounted plug and mating socket.
•Screened lead is used for connections between SK1 and grid/cathode connections.

would be a logistical nightmare with regulated DC. Thankfully this is not required. There is no audible hum from the circuit using pure AC provided that the wiring diagram is properly followed. Note especially that one end of the heater circuit is connected to common earth.

Despite the fact that valve heaters are usually specified at 6.3VAC slightly underunning them extends valve life and has little effect on performance.

Building It

Originally a low profile case was to be used with this project. However, getting a ready built case proved impossible. The custom case is made from 2mm aluminium sheet and sections of aluminium channel for the end and side pieces.

Fig. 5. shows the dimensions of the case panels together with the cutout positions. A 10 way PCB connector is used to connect the board, valve-holders and power supply.

Connect the output stage flying leads to the VFETs as shown and make sure that these power devices sit flush against the heatsink. Ensure that there is no electrical connection between the heatsink and the case.

A thin piece of screened lead is used to connect the cathode and grids to the board whilst the other wires are simply hookup cable. First order of business is to mount the board on the bottom panel of the case. Set this aside and complete the panel wiring. The heater wires are required to carry a considerable current continuously and so, 5A twin speaker wire are used. There is no need to twist these wires together, simply run them close to the chassis.

Having finished the panel wiring, check the work thoroughly and then connect the rest of the flying leads to the points shown apart from the line from the tagstrip to H14, and attach the PCB connectors.

Setting Up

Before testing the device it is as well to take a few safety precautions. First, put insulating tape across all mains connections including the primary of T2. Double check all the wiring and temporarily disconnect the earth wire from the main plug. Set the slider of PR1 at halfway. Now connect a 100Ω resistor between the plus terminal of C4 and the drains of Q4/4A. Connect a multimeter, switched to a voltage range which will clearly show 100VDC, between ground and Q2's emitter.

Switch the circuit on. The voltage should gently rise to a maximum set by PR3. If this doesn't occur, or worse, the 100Ω starts to smoke, switch off immediately. You have a wiring fault. Assuming that all is well, slowly adjust PR1 or 95VDC. The voltage will continue to rise after any adjustment so it needs to be done slowly.

The valve heaters should begin to glow a few seconds after switch on. Measure the voltage at the sources of Q4/5 and the other channel Q4A/5A. This should measure around 55V. A couple of volts either way is of no consequence. Assuming all is well, remove the 100Ω resistor and replace it with a wire link and the amplifier is now functional. All that remains is to screw the case together and test it out with some music.

The sensitivity of the amplifier, for full output, is some 500mV. This can be easily obtained from almost any preamp. If you have a CD system, the amplifier can be used via a passive preamp – simply a potentiometer arranged as a potential divider will do. Any loudspeakers rated at 80W and up can be used with the amp including 4Ω types although the output level will be reduced. ■

Components

Resistors
1% metal film unless indicated.

R1	27k
R2	15k
R3	8k2
R4	150
R5, R6	220
R7	1M
R8*	150k
R9	100
R10	150k
PR1*	10k horz preset min

Capacitors

C1	10µ/16V
C2*	100µ/100V
C3,C4*	4700µ/100V
C5*	100n/250V

Active devices

Q1	SSM2210
Q2*	BDV65C
Q3*	MPSA42
Q4	2SK135
Q5	2SJ50
V1	6CA7
D1, D2, D3, D4	1N5404

Miscellaneous
T1* 240VAC pri, 35-0-35V sec 160VA transformer
T2* 6-0-6V, 4A sec
2xOctal sockets
2x10mm grommets
4x4mm bannana sockets
4xlarge self adheisive feet
1x6mm P clip
1*xDPST mains switch
1x10 way PCB mounted plug and mating socket
24x10mm no 8 self tapping screws, case, PCB or stripboard
1x8 way tag strip.
* devices common to both channels.
Note that these are for one channel only. Channel 2 components are indicated in the diagrams with an A suffix.
A full kit of parts can be obtained from: Hobtek, The Cottage, 8 Bartholomews, Brighton, East Sussex, BN1 1HG for £189+£5p&p.

Advertisers Index

The Summer Consumer Electronics Show

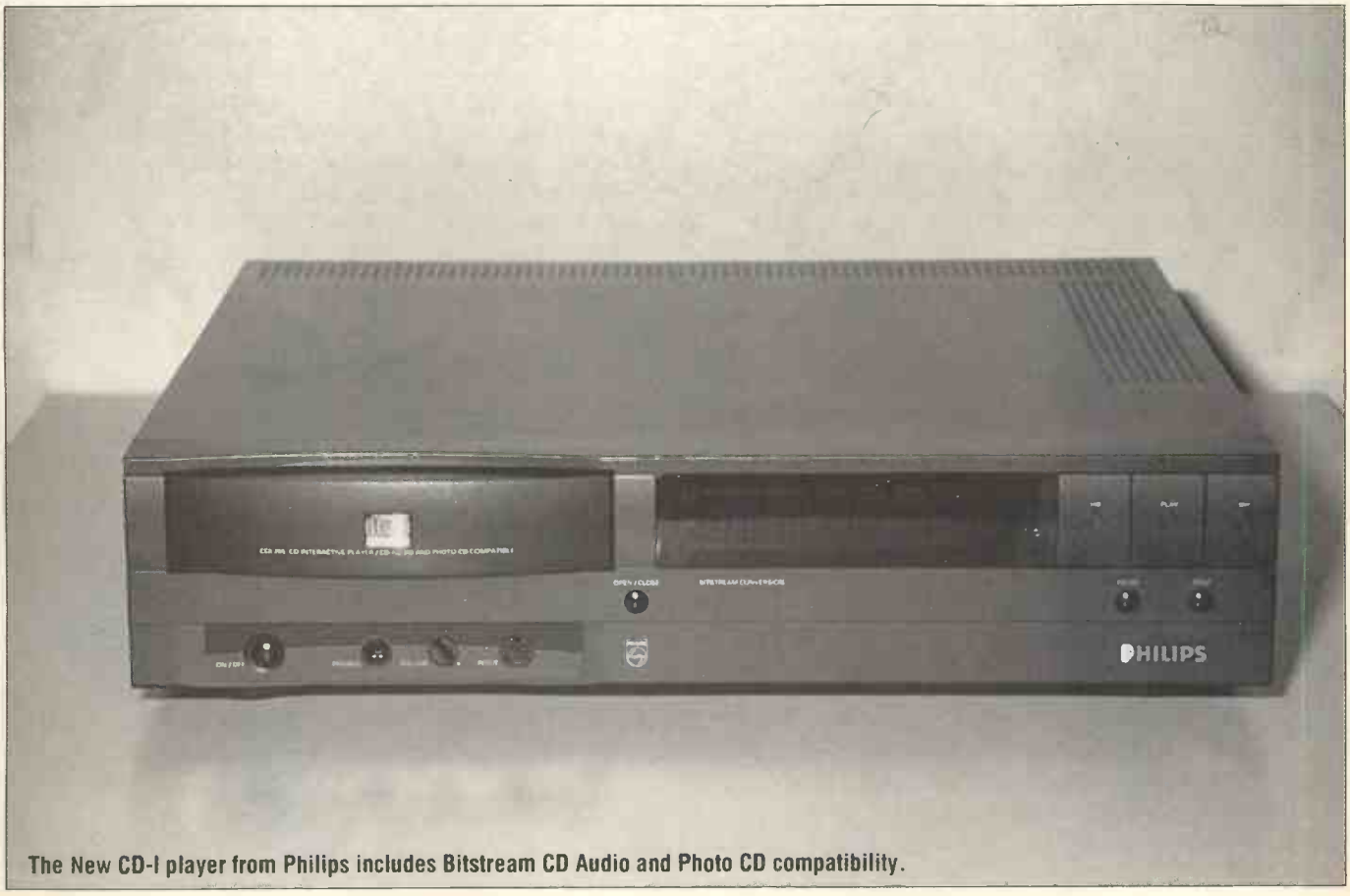
Ian Burley touches the new Sony Mini-Disk, takes control with SIRCS II, examines the latest in multi-media all while dodging the security robots in Chicago.

The twice-yearly US Consumer Electronics Shows, which alternate between Las Vegas (winter) and Chicago (Summer), are a highlight of the electronics calendar.

The latest show in Chicago certainly lived up to expectations. Among the notable new products this year was a first-look at the Sony Mini Disk (MD). Sony also previewed SIRCS II, its intelligent networking system for Hi-Fi and video units. Philips officially launched its domestic CD-I multimedia player, Sharp exhibited the first wall-hanging flat-panel LCD colour TVs and Samsung had a domestic robot on show, to name but a few of the attractions.

Sony pulled off the impressive feat of being the star of CES without actually having a show-floor exhibit. Instead, it rented a plush suite at a nearby hotel to show, in a more intimate atmosphere, its MD player alongside an improved version of last year's star Sony CD innovation – the Data DiskMan electronic book.

Reading about the MD is one thing. Giving a working one (even a prototype) a shake while it is playing is another. The 1Mbit anti-skip buffer memory really works. In fact, it is possible to eject the 2.5in MO (magneto-optical) disk with perfect playback continuing for about three seconds afterwards. If the price is right when the MD goes on sale at the end of next year, joggers will be queuing up for one of Sony's new babies. Unfortunately, we weren't treated to a demonstration of the MD-player's recording capabilities. Apparently the prototype isn't quite ready to do that in public yet. However, playback quality from sample pre-recorded disks sounded fine.



The New CD-I player from Philips includes Bitstream CD Audio and Photo CD compatibility.

Some of the exhibitors at the Chicago CES

Meanwhile, Philip's show-stopper from the Winter CES in January, DCC (digital compact cassette) didn't make a big public showing this time. A futuristic Memorex ghetto-blaster mock-up based around a DCC player was the only show-floor evidence of DCC I spotted, however behind the scenes plenty of support emerged for DCC.

Matsushita (Technics and Panasonic brands) now publicly admits it is the major Japanese backer of DCC. Even Sony has indicated it is seriously researching the possibility of producing DCC-based products even though this could be at the expense of its own DAT (digital audio tape) standard. The major German tape manufacturer, BASF as well as the Tandy Corporation were yet more big names to pledge support for DCC.

The future for personal digital audio is now becoming a bit less confused. DAT looks destined to be restricted to the big-spending hifi perfectionist as well as professional studios and even computer storage applications. MD will fit in the middle as a not exactly cheap recording medium at about a tenner for blank 74 minute MO disks, but will be attractive for its shock-proofing, compact dimensions and random track access features. DCC really does look like fulfilling Philips' strategy of replacing the venerable compact cassette as the every day affordable digital recording medium.

Sony wasn't content to sit on its Mini Disk laurels at the show and followed up the MD marvel with an innovation we'll surely be seeing a lot more of in the future; intelligent and automatic interaction between hifi and video components. This is SIRCS II, the MkII Sony Infra Red Control System. SIRCS originally came about in the early 80s when Sony decided to standardise its infra-red remote controllers. This enabled a single remote to be used with several different units, say an amplifier, CD player and the TV or VCR. SIRCS II is a bit of a misnomer as the infra-red aspect takes a back seat to computer-style networking. At the heart of the system is a remarkably small custom IC developed by Sony to provide intelligent inter-component control.

A SIRCS II set up sees all your Sony Hi-Fi, video and TV components linked up by wires with 3.5mm stereo jack connectors. Insert a video into your VCR and not only will the VCR switch itself on, but it will alert the TV and even the Hi-Fi amplifier, if fitted. When you get bored with the video and press play on your CD remote. The Video section of the system will go to sleep – unless it's recording, in which case the TV will switch off but the VCR will remain unaffected. Audio tape sections have similar priorities when in record mode, so if you're recording off a radio tuner this will remain unaffected by the system being prompted to play your laser video disk. What's more, if you try to play, say your CD and there's no disk loaded, the TV will light up with a polite message informing you of the situation.

SIRCS II was demonstrated to a fascinated audience at the Sony hotel suite. Apparently, all Sony's up-market Hi-Fi will have SIRCS II capability as standard quite soon. Whether it's a genuine step forward in home automation or a rather sophisticated gimmick, remains to be seen. No doubt the Hi-Fi purists will reject it out of hand. Unfortunately, Sony isn't offering its SIRCS II technology to anybody else, so inter-make compatibility will be a problem when the competition eventually catches up. JVC exhibited a simpler intelligent components system for its VCR systems called AV Compulink and Bang and Olufsen has been selling an infra-red link system for its Hi-Fi components for some time, though this isn't nearly as advanced as Sony's. Although admitting that an extension of SIRCS II to other household appliances and even a personal computer was technically feasible, Sony won't be producing anything like this in the near future, if ever.

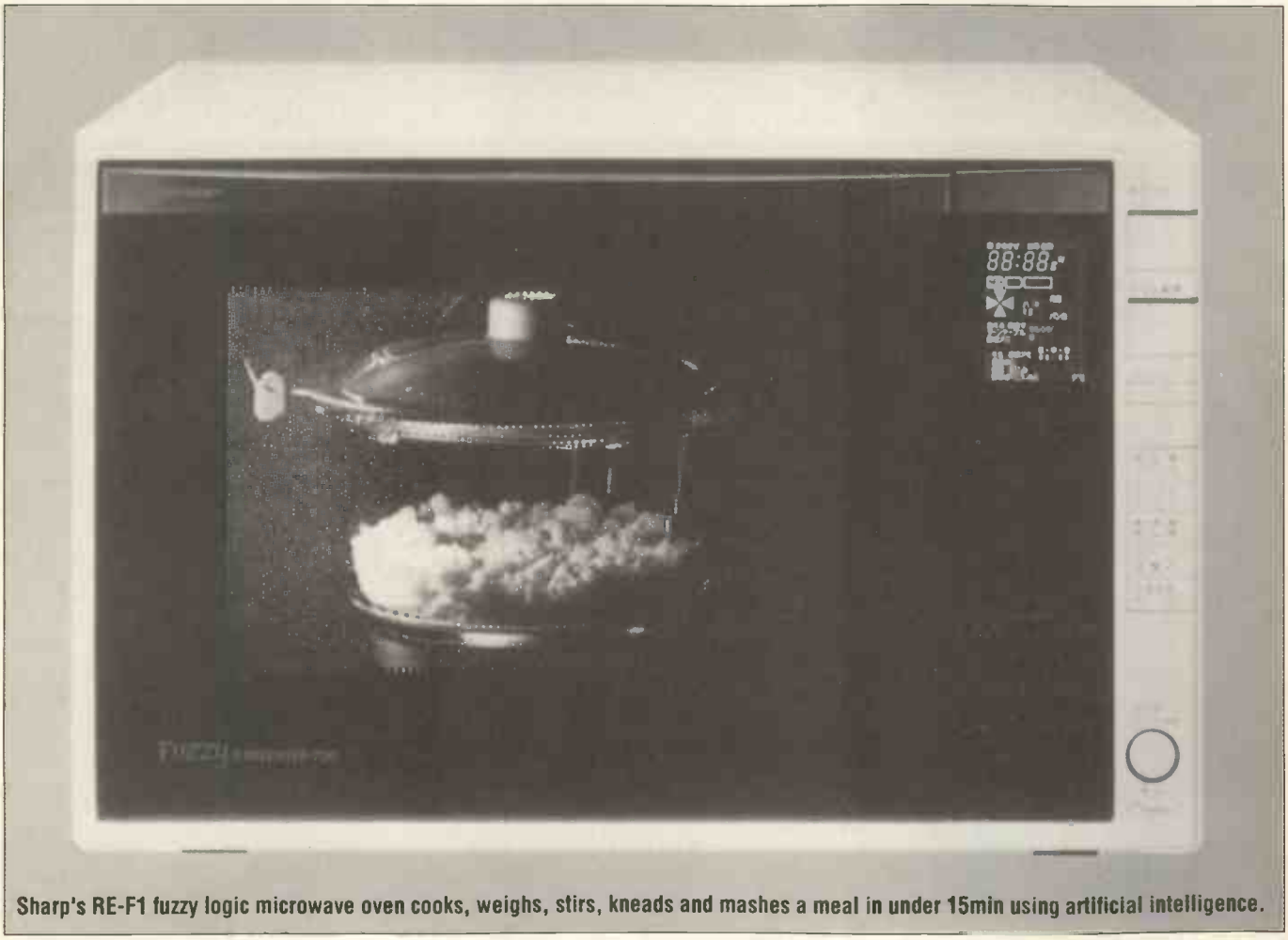

The Pioneer CLD-M90 multi-play CD/Laserdisk player.

Enough of Sony and on to Samsung, the huge Korean electronics firm. Not usually noted for its innovation, Samsung surprised many at CES with its new domestic robot called Scout-About. This is a dome-shaped device weighing 16lbs and about ten inches high which scuttles about on wheels. It's a bit like the top of a Dalek! Scout -Abouts aren't designed to bring you your slippers or a cocktail, instead they're seen as a robot replacement for the household pet come guard dog. A battery of sensors in the robot makes it a mobile fire and intruder detector. Scout-About can communicate with a static base-unit to call the police or fire service, if necessary, speaking in a pre-recorded digitised voice. The idea is that you position your Scout-About in the middle of a room, which it will patrol up to a radius of thirty feet. Scout-Abouts won't fall over edges like stairs and another sensor prevents collisions with obstacles lower than 2 feet. Battery charge life is 50 hours and the unit can be used in a static position with an AC adaptor. At an estimated selling price of $1,000 (£625), the Samsung Scout-About is set to be a hot seller in US department stores this Christmas.

Philips has finally done it. Almost five years since its introduction and after countless delays, Compact Disk-Interactive (CD-I) has been launched as a consumer product at last – though in the States only. The European launch won't be until Spring next year. Under Philips' Magnavox brand name, the first consumer CD-I player will be on shop shelves in October for the recommended price of $1400 (£875). That's considerably more expensive than Commodore's rival CDTV system ($1000) which is based on Commodore Amiga computer internals. However, CD-I is technically superior and it has the backing of industry heavyweights like Matsushita and video-game leaders Nintendo. Those facts alone rated it as most likely to succeed according to many show-visitors . The fact that Nintendo has jumped onto the CD-I bandwagon was a great fillip for Philips if you'll pardon the pun. Nintendo, which controls a multi-billion dollar video

The Samsung Security Robot.

game empire, ditched a rival CD-multimedia development with Sony called Playstation by switching allegiance to CD-I. Another plus for CD-I is that Kodak's Photo CD standard is to be added to the CD-I specification. CD-I full-screen motion picture video is not yet

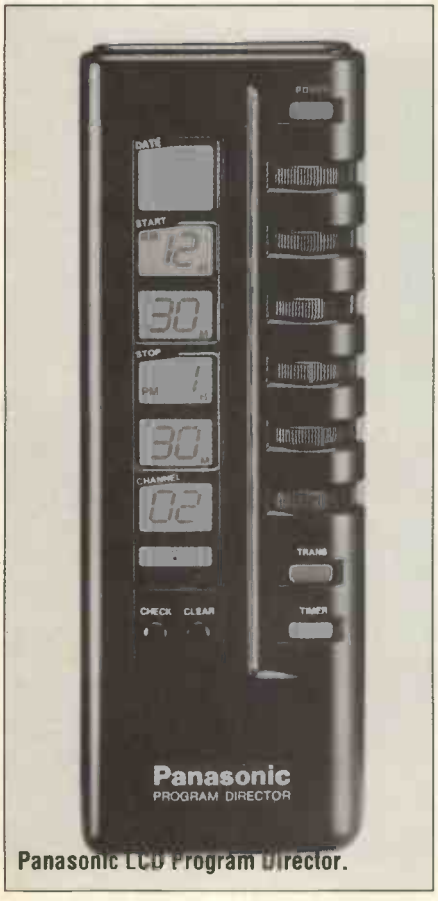


Sharp's RE-F1 fuzzy logic microwave oven cooks, weighs, stirs, kneads and mashes a meal in under 15min using artificial intelligence.

ready, which is partly why the European launch has been delayed, but upgrades will be available to initial CD-I buyers in the States hopefully early next year.

Commodore started shipping their CDTV system six months late in May. It has more software out now than Philips, but it will never be able to match the specially developed CD-I hardware for motion video playback quality. In fact some of Commodore's partial-screen motion video demonstrations at the show were decidedly grotty. After the show opened, Commodore announced that Kodak Photo CD compatibility would also be added to the CDTV spec. but this was soon countered by a statement from Kodak questioning if this was technically possible without a major hardware redesign of the CDTV. CES saw just the first of several major battles to come between CDTV and CD-I in the war to find a consumer multimedia victor...

NEC had a tiny corner of its video-game exhibit showing something far more interesting than any PC-Engine or TurboGrafx console. Here I stumbled across NEC's NID, which stands for New Interactive Display. Yes, this is another entrant in the CD ROM-based multimedia race but so far the only one to display a working full-screen motion video system destined for a consumer product and vastly superior looking to Intel's DVI (digital video interactive) full-screen video.



Panasonic LCD Program Director.

NID has an incredible 100:1 compression ratio using techniques similar to those of enhanced definition TV (Pal Plus for example). Only parts of the screen which change are digitally captured and portions of the screen which exhibit movement over a certain threshold are digitised in space-saving lower resolution – the human eye can't tell the difference. The result was very impressive, despite some odd colours produced by prototype hardware which was slightly damaged en route from Japan. NID will offer up to 72 minutes of continuous motion video at a resolution of 256x240 pixels as well as a stereo sound track. Exactly where NID will end up as a commercial product remains to be seen.

As for the rest of the show, JVC had a massive 36in diagonal 16:9 aspect ratio TV set, similar in appearance to a wide-screen HDTV. However, this was a decidedly below-average resolution standard 525 line NTSC tube. Why wide-screen? To get rid of the pillar box effect of cinemascope-style movies of course. In ordinary TV mode the spare picture space is used for viewing other channels simultaneously in miniature.


Sharp's latest wall hanging flat screen LCD TVs with their tasteful designer frames.

Sharp got the vote for the least taste award at CES. Apparently there is a sizeable market in Japan for its impressive range of ever larger active matrix colour LCD screens, used as wall hanging TVs. So what? To hang an LCD on the wall, you need to put it in a picture frame according to Sharp – and you should have seen some of the frames they're offering.

Panasonic might have at last solved the seemingly insurmountable problem of designing a infra-red remote control which even Mensa members can figure out how to use. Panasonic's Program Director dispenses with buttons and incorporates thumb-wheels instead. It's a brilliant idea and should have been thought of ages ago.

Finally, how about using the mains electricity wiring in your home as a telephone extension? The Utah-based firm, Phonex, has done just that. Using the mains for intercoms and even computer networks is old hat, but this is the first time I've seen a cordless phone extension system like this. The advantages are obvious: no excessive REN (ringer equivalence number) loading and a phone socket in every room. A mains extension cable becomes a phone extension! Range is said to be 1000 feet. The problem of neighbours listening in to your calls is apparently solved by an attenuator at the electricity meter. Future plans include a security encoded link and a UK version for BABT approval. ■

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How It Works... The Video Camera

Derek Gooding zooms around inside a video camera and describes the operation of the various circuits.

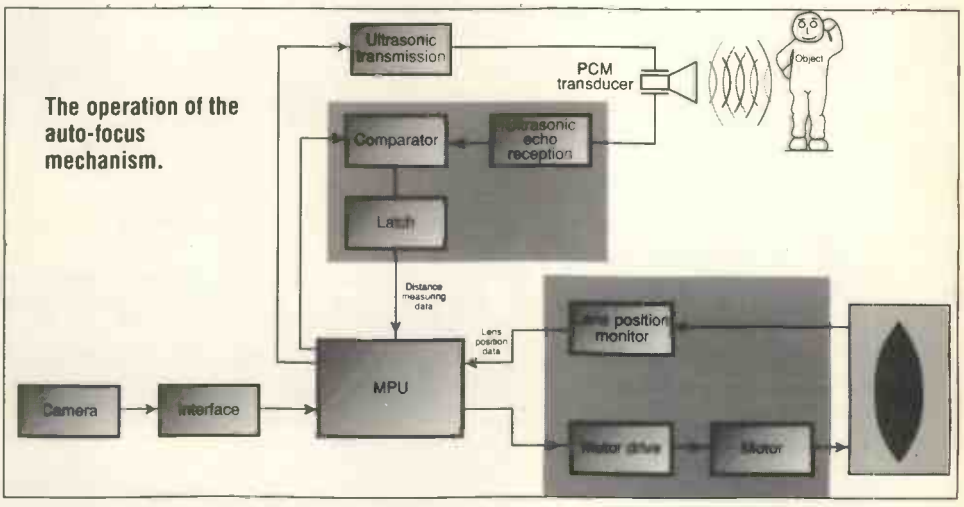
Incoming light reaches the surface of the integrated stripe filter after passing through the automatic iris control lens (AIC), the colour trmperature conversion filter (for artificial light or sunlight conditions variation) and finally through the crystal filter.

The white balance switch inserts a diffusion filter in the light path between the automatic iris control lens and the colour conversion filter to enable a computation of "white" diffused light in the available illumination.

The crystal filter helps to eliminate any false interference patterns when fine detail is viewed.

The stripe filter converts the incoming light into a 5MHz modulated signal containing the red and blue components and the green signal.

The pre-amp takes the pick-up tube signal (0.2µA to 0.3µA) and amplifies it for delivery to to the signal processing circuits using a low output impedence and negative feedback low noise FET input amplifier with a "Percival" low noise circuit to improve the signal to noise ratio for the relatively high

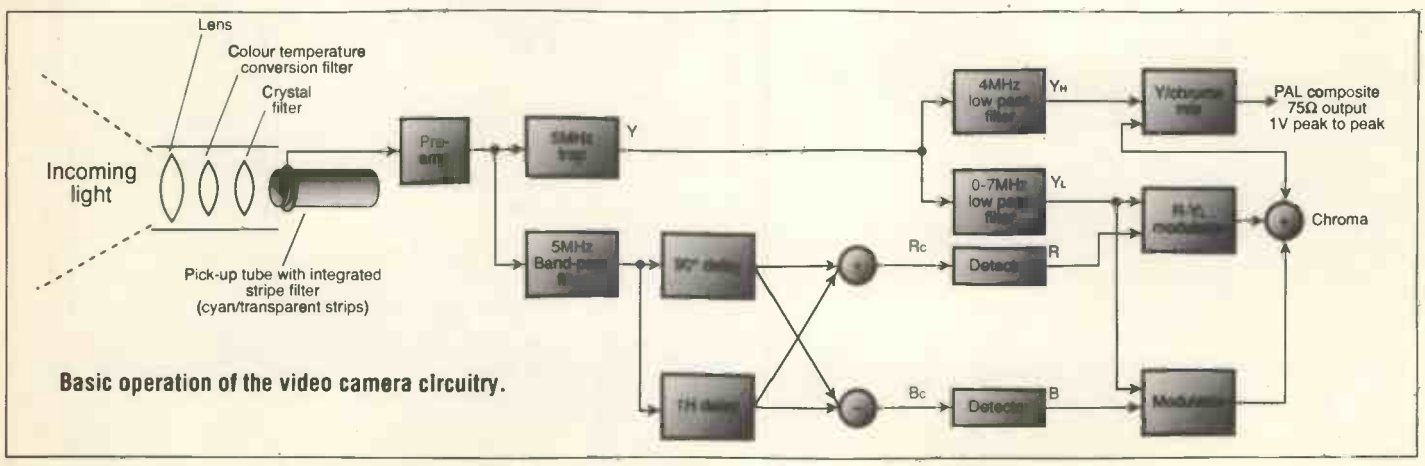


The operation of the auto-focus mechanism.

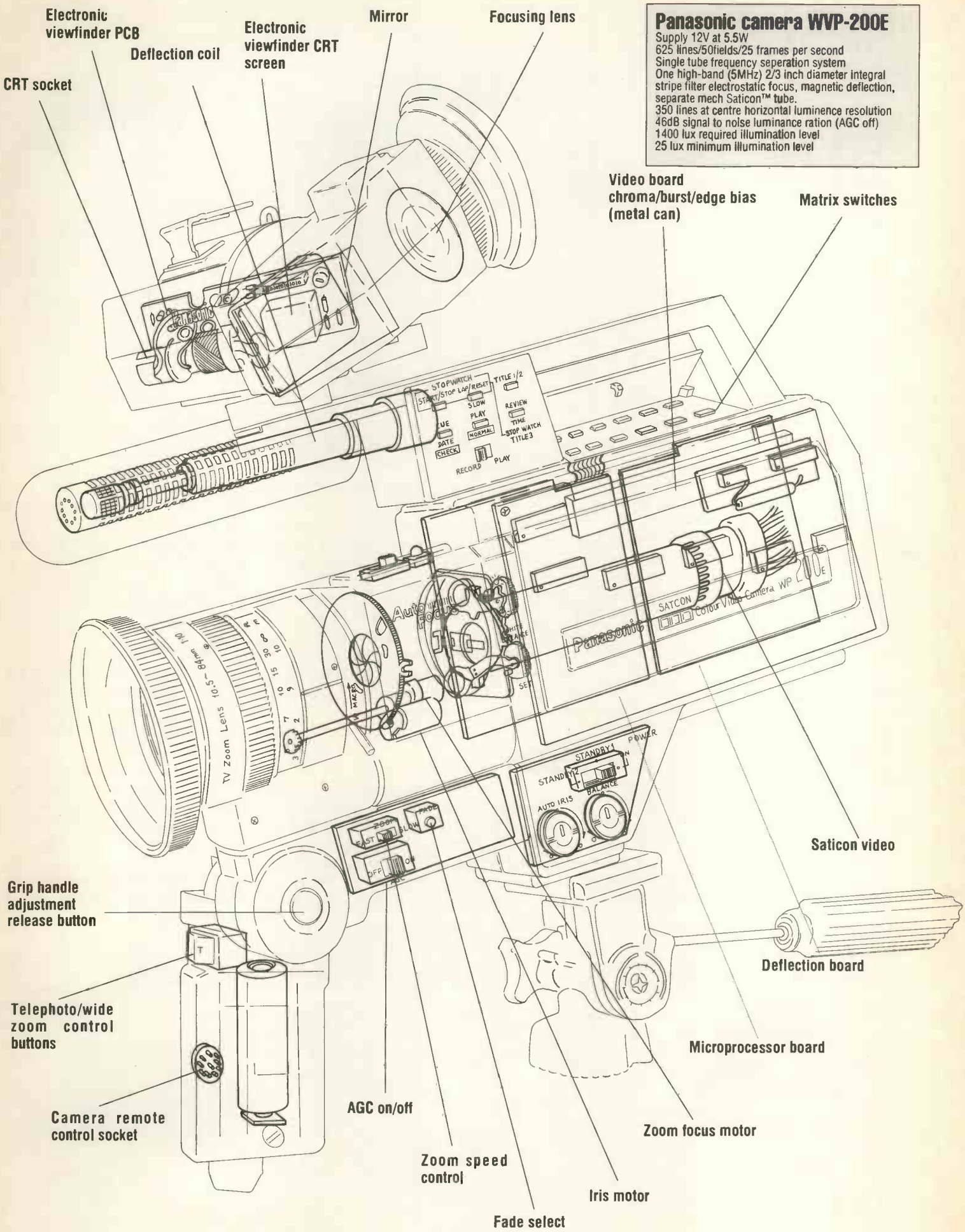
frequencies. Only the luminance (Y) signal passes through the 5MHz trap together with the mean value of red and blue signals (modulated). The Y signal passes to the 4MHz and the 0.7MHz low pass filters. The high frequency response (Y_H) passes to the Y/chroma mix circuit and the low frequency (Y_L) signal to the R-Y_L and B-Y_L modulator circuitry.

The 5MHz band pass filter allows only the 5MHz frequency zone to pass to the 90° phase shift and 1H delay circuity – inverting the 1H delayed modulated signal and adding it to the 90° delayed signal creates the Rc signal and subtracting the inverted 1H-delayed modulated signal from the 90° delay signal creates the Bc signal. The detector circuits provide the modulators with the R-Y_L and the B-Y_L signals to create the chrominance (chroma) signal, by mixing.

The PAL signal composite is created by mixing the chroma signal with the luminance (Y_H) signal.



Basic operation of the video camera circuitry.



Panasonic camera WVP-200E

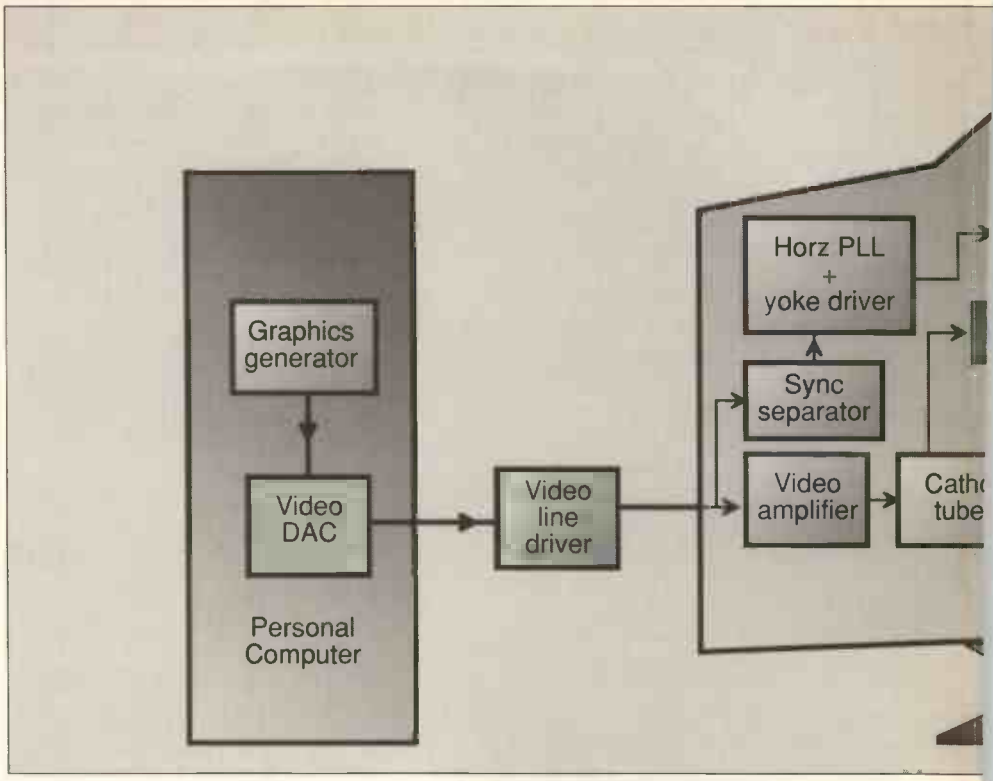
Supply 12V at 5.5W
625 lines/50fields/25 frames per second
Single tube frequency seperation system
One high-band (5MHz) 2/3 inch diameter integral stripe filter electrostatic focus, magnetic deflection, separate mech Saticon™ tube.
350 lines at centre horizontal luminence resolution
46dB signal to noise luminance ration (AGC off)
1400 lux required illumination level
25 lux minimum illumination level

The demand for increased monitor resolution for use in Desktop Publishing, CAD and other graphics applications has lead National Semiconductor to develop some specialised video driver chips. Amongst them are the LH2426 and LM1201. The first is a triple 80MHz driver which can provide the red, green and blue signals directly to a cathode ray tube (CRT). The second is a wideband video amplifier which contains a brightness control and DC restoration voltage for the video signal.

Many modern computers provide analogue video output signals that allow access to a large range of colours or grey scale. These signals usually come from a digital to analogue convertor (DAC) controlled by a graphics processor within the computer. In the monitor these signals have to be amplified and conditioned from the 1V peak to peak (pp) of the computer to the 40Vpp needed to drive the cathode of the CRT.

The monitor's operation is split into two main sections, a low voltage video amplifier and a high voltage CRT driver. Each pixel of the display has to be energised by a varying amplitude pulse in a time that depends on the resolution. The higher the resolution, the shorter the pixel time and the wider the bandwidth needed. The popular monitor standards and resolutions are shown in table 1. These start at the basic 600x400 VGA PC and go up to the workstation 1280x1024 pixels. The corresponding pixel times for each system is also shown along with the overall rise and fall time for the video channels. There is no hard and fast rule for these times and they can vary between 1/3 and 1/2 of the pixel time depending on performance requirements.

A single complete channel is shown in Fig. 1 with independent adjustment for contrast and brightness included. For the latter, the voltage from the brightness control is sampled by the clamp comparator at the beginning of every line and the use of a feedback loop forces the DC voltage at the cathode to be at the level set by the black level adjust. The clamp comparator is controlled by the back porch pulse derived from the line sync pulse and occurs during the black level reference period of the video waveform.



LH2426

This chip contains three wide bandwidth, large signal amplifiers each designed for large voltage swings at high frequencies. The amplifiers work on a transconductance principle – an input current swing of ±4.38mA results in an output voltage swing of ±25V. Features include:

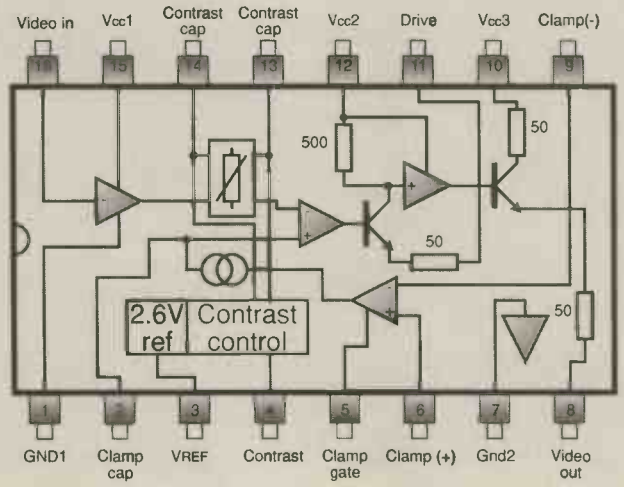
- Operation from an 80V power supply
- 80MHz bandwidth at 50Vpp swings.
- Rise fall time of less than 4ns.
- Output signal swing of 70V.
- Drives a CRT directly.

LM1201

Designed for use with high resolution RGB or monochrome monitor applications, this wideband video amplifier has a number of features that help reduce chip count.

The chip contains a gated differential input black level clamp comparator for brightness control and an attenuator circuit for contrast control. The main features of the circuit are:

- 200MHz @-3dB wideband amplifier.
- Attenuator circuit for contrast control.



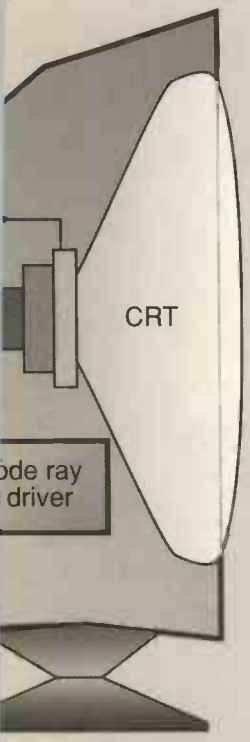
Operational Ratings

LM1201

Supply voltage Vcc, Pins 10, 12, 15, to gnd pins 1, 7	12V
Max voltage at any input pin	Vcc
Video output current	28mA
Power dissipation	1.56W
Operating temperature range	0°C to 70°C

LH2426

Supply voltage	+80V
Power dissipation	10W
Operating temperature range	-20°C to +90°C

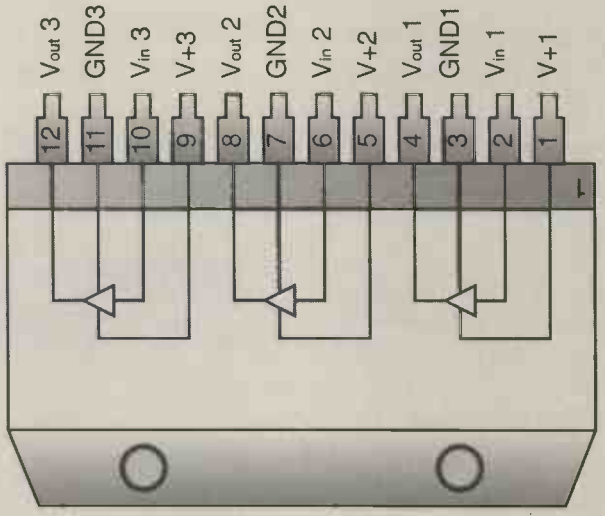


Monitor Standards

System	Resolution	Chip set	Pixel time	Rise and fall time
VGA	640x480	LM1203+LM2416CT	42ns	21 - 14ns
Super VGA	800x600	LM1203+LM2416T	29ns	14.5 - 9.6ns
8514/A interlaced	1024x768		22ns	11 - 7.3ns
PC-CAD non-interlaced	1024x768	LM1203+3xP43+LH2426	16ns	8 - 5.3ns
Work Station	1024x900	3x(LM1201+P43)+LH2426	14ns	7 - 4.6
Work Station	1024x1024	LH2440, LH2422	12ns	6 - 4ns
Work Station	1280x1024	LH2440A, LH2424, LH3424	9.8ns	4.3 - 3.3ns

P43 is a process 43 transistor 2N5770 or PN2564

Table 1.



- Externally gated comparator for brightness control.
- Provisions for external gain and peaking of video amplifier.
- Video input voltage reference.
- Low impedance output driver.

Also available is the LM1203, a triple version of the 1201, which is designed for use with resolutions up to 1024 x 768 and RGB. ■

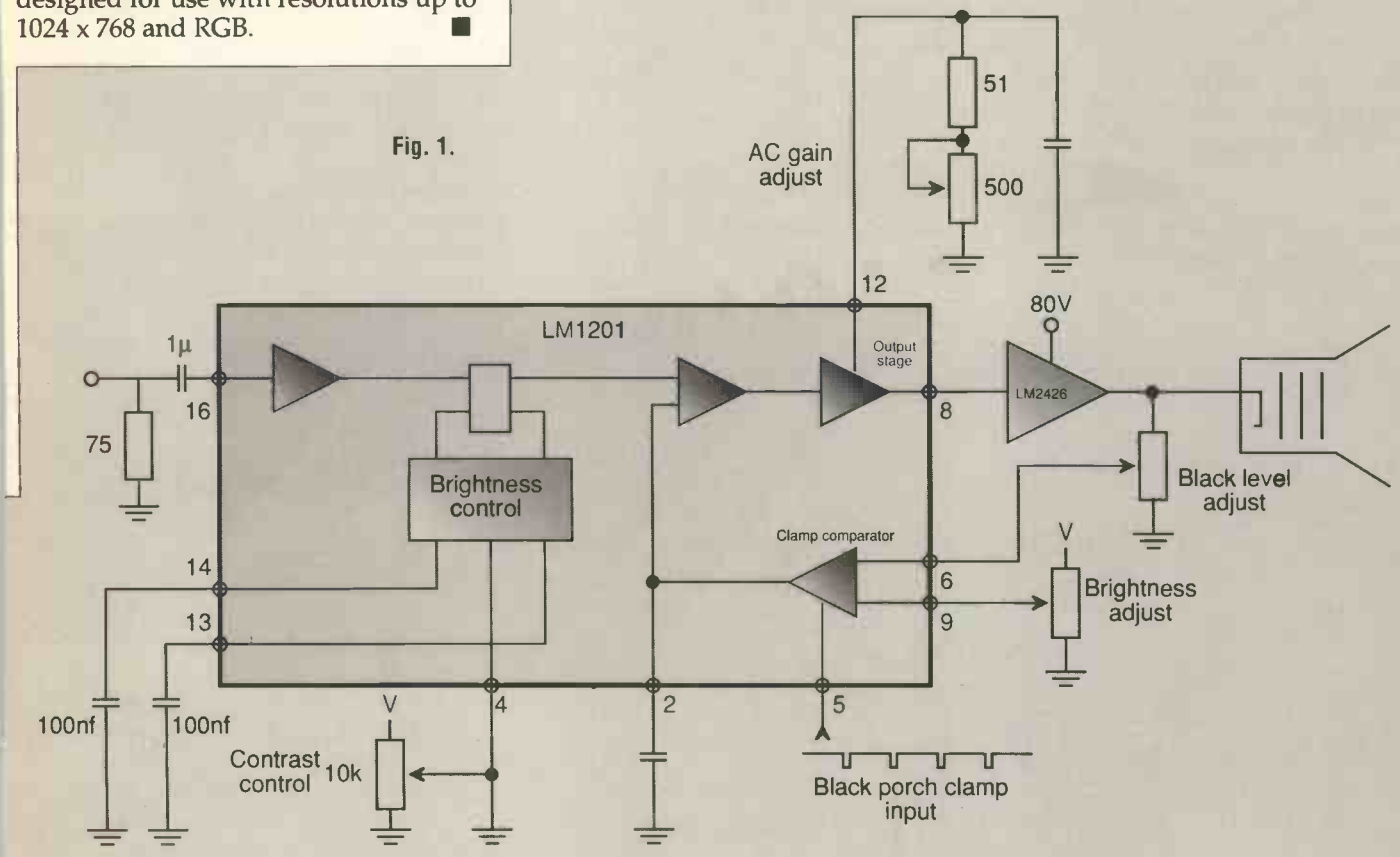


Fig. 1.

Practical Components.

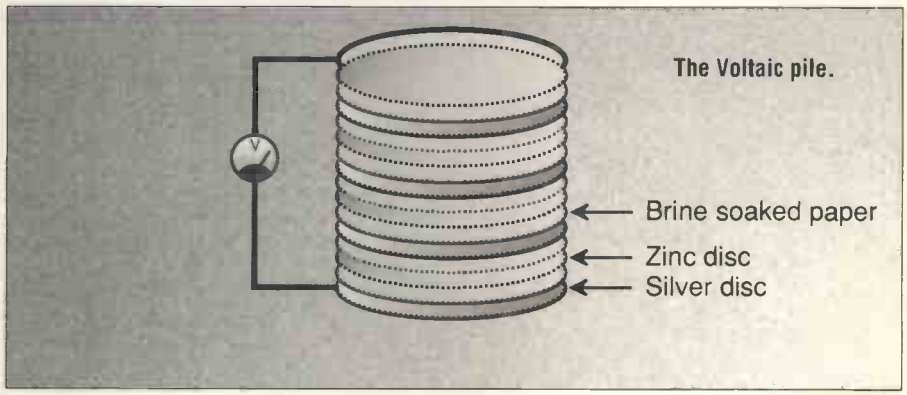
The Battery

Batteries are an indispensable part, necessary to all portable electronic equipment. This month's components looks at the variety available.

Invented around 200 years ago, the battery has become a vital part of modern mobile electronics. The first battery was a stack of zinc and silver coins separated by discs of paper soaked in brine. It was invented by Alessandro Volta who eventually gave his name to the unit of electromotive force, the Volt.

Batteries come in two main types, primary and secondary. The first are one-shot and an irreversible chemical reaction produces the energy. These are the most common types but are gradually being replaced by secondary or rechargeable cells. The most commonly used of these are lead acid and nickel cadmium.

Another device that can be classed as a battery is the solar cell. This makes use of the photo-electric effect in a semiconductor. When the junction of two differently doped pieces of semiconductor have light shone on them, electrons are liberated causing a a small voltage to be generated. Solar cells have to be placed in series and parallel to provide energy in workable quantities.

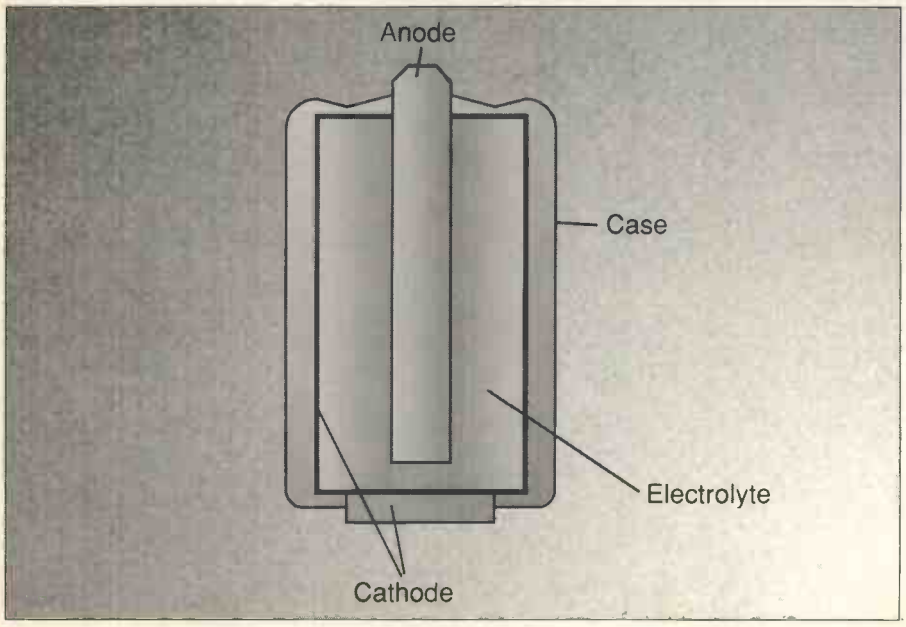


The Voltaic pile.

Elements Of A Battery

A battery is made up from a series of cells connected in either series or parallel to increase the resulting voltage or current. The main features are:

- The electrodes, the anode and cathode, which also form the electrical contacts
- The electrolyte which allows the movement of electrons from cathode to anode and aids the chemical reaction
- The case, which may be sealed to prevent leakage or open to allow gases to escape

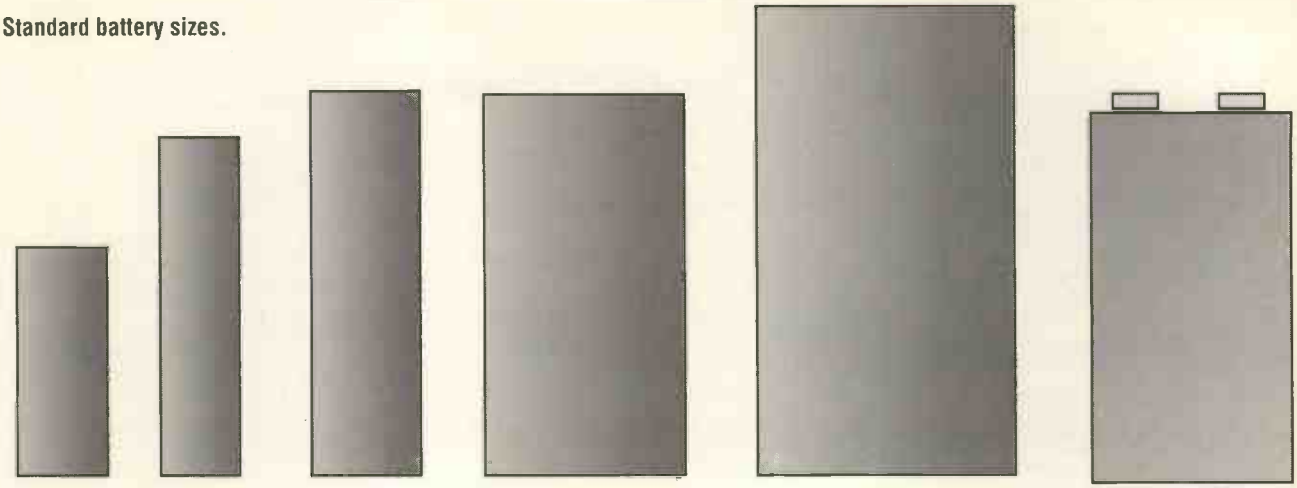


Recharging

The most popular rechargeable batteries are on the lead acid and nickel cadmium types. The first are used mainly in cars and are generally quite bulky. NiCd's, on the other hand, offer direct replacements for all of the standard sizes used in modern portable electronic equipment.

Charging up a NiCd is not simply a matter of connecting it up to a source of power. A constant current source must be used giving 45mA at the correct cell voltage of around 1.55V. For a faster charge, 150mA current can be used but this reduces the discharge time – the longer it takes to charge a battery, the longer it lasts. ■

Standard battery sizes.



N
UM5
Lady
1.5V

HP16
AAA
UM4
Micro
1.5V

HP7
AA
UM3
Mignon
1.5V

HP11
C
UM2
Baby
1.5V

HP2
D
UM1
Mono

PP3, Neda
E-Block, 1604
006P, 6F22
6R62
1.5V

Battery types

Zinc carbon or Leclanché cell.
Commonly found in torches, transistor radios and other relatively short term applications, the zinc carbon cell cannot be recharged. It has a zinc cathode and a carbon anode with an electrolyte of ammonium chloride paste. A depolariser of manganese dioxide id distributed around the anode and mixed with powdered carbon (graphite) prevents the build up of hydrogen gas. Another name for this type of cell is a dry cell and it produces a voltage of about 1.5 volts.

The Daniell Cell
This has a zinc cathode and a copper anode. These were placed in a jar with a porous pot barrier in the middle. The cathode side was filled with sulphuric acid and the anode with copper sulphate and the electrodes inserted. This operates as follows:

At the cathode a zinc atom gives up two electrons as it enters the cathode electrolyte as a zinc ion Zn2+. This gives the cathode compartment extra charge plus two. To compensate for this two hydroxide ions (H0) with a charge of plus one each pass through the porous separator into the anode compartment. This allows a copper ion to accept two electrons from the anode and deposit itself on the anode as a copper atom. The electrons are made available at the anode because of the external circuit through the load to the cathode

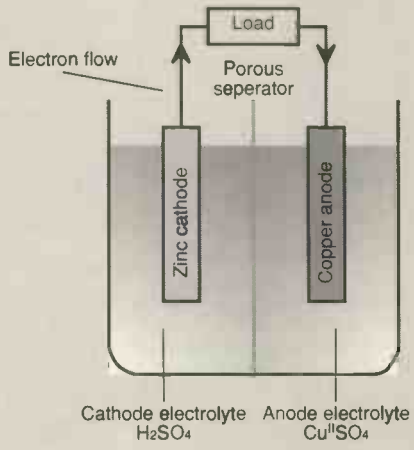
Lead Acid
Most cars have a battery of this type to turn the starter motor to get the engine going. It is made up from two electrodes of lead, one of which is coated in lead IV oxide, dipped into an electrolyte of sulphuric acid. The output voltage from each cell is around 2V so six cells are connected in series to get a 12V car battery with about 90AHrs capacity – it can supply 1A for 90 hours or 90A in one hour. Three cells are put together to make a 6V motorcycle battery.

Nickel Cadmium
NiCd batteries are the mainstay of the modern portable rechargeable battery industry. Available in all the popular sizes, a single cell gives out roughly the same voltage as a zinc carbon cell, 1.25V.

Alkaline
Similar to zinc carbon batteries, alkaline cells offer much longer life at higher current drains. Other advantages are longer shelf life, constant output voltage and protection against leakage.

Mercuric Oxide
Usually found in cameras and hearing aids, these offer an output voltage of 1.35V in a very compact package.

Lithium
Made from lithium manganese these cells have an output voltage of 3V and will last for very long periods at low currents. Applications include battery backup for low power CMOS RAM memories.



The Leclanché Cell.

UNIDEN SATELLITE RECEIVER Brand new units (model 8008) £60.00 ref 60P4 also some 7007s also £60.00 ref 60P5
SPECTRUM +2 COMPUTER Built in data recorder, 128K, psu and manuals £59.00 ref 59P4
SPECTRUM +3 COMPUTER Built in disc drive, 128K, psu and manuals £79.00 ref 79P4
AMSTRAD CPC464 COMPUTER No manuals but only £79.00 ref 79P5
AMSTRAD CPC6128 COMPUTER Again no manuals but only £149.00 ref 149P4
AMSTRAD GT65 Green screen monitor £49.00 ref 49P4
AMSTRAD PORTABLE PC'S FROM £149 (PPC1512SD). £179 (PPC1512DD). £179 (PPC1640SD). £209 (PPC1640DD). MODEMS £30 EXTRA. NO MANUALS OR PSU.

AMSTRAD PC BARGAIN!!!!!!
PC 1512DD COMPLETE WITH CGA COLOUR MONITOR, 2 DISC DRIVES, MANUALS ETC ONLY £249.00 REF 249P4

HIGH POWER CAR SPEAKERS. Stereo pair output 100w each. 4ohm impedance and consisting of 6 1/2" woofer 2" mid range and 1" tweeter. Ideal to work with the amplifier described above. Price per pair £30.00 Order ref 30P7.
2KV 500 WATT TRANSFORMERS Suitable for high voltage experiments or as a spare for a microwave oven etc. 250v AC input. £10.00 ref 10P93
MICROWAVE CONTROL PANEL. Mains operated, with touch switches. Complete with 4 digit display, digital clock, and 2 relay outputs one for power and one for pulsed power (programmable). Ideal for all sorts of precision timer applications etc. £6.00 ref 6P18
FIBRE OPTIC CABLE. Stranded optical fibres sheathed in black PVC. Five metre length £7.00 ref 7P29
12V SOLAR CELL. 200mA output ideal for trickle charging etc. 300 mm square. Our price £15.00 ref 15P42

PASSIVE INFRA-RED MOTION SENSOR. Complete with daylight sensor, adjustable lights on timer (8 secs -15 mins), 50' range with a 90 deg coverage. Manual overide facility. Complete with wall brackets, bulb holders etc. Brand new and guaranteed. £25.00 ref 25P24. Pack of two PAR38 bulbs for above unit £12.00 ref 12P43

VIDEO SENDER UNIT Transmit both audio and video signals from either a video camera, video recorder or computer to any standard TV set within a 100' range! (tune TV to a spare channel). 12v DC op. £15.00 ref 15P39 Suitable mains adaptor £5.00 ref 5P191
FM TRANSMITTER housed in a standard working 13A adapter (bug is mains driven). £26.00 ref 26P2
MINATURE RADIO TRANSCEIVERS A pair of walkie talkies with a range of up to 2 kilometres. Units measure 22x52x155mm. Complete with cases. £30.00 ref 30P12

FM CORDLESS MICROPHONE. Small hand held unit with a 500' range! 2 transmit power levels reqs PP3 battery. Tuneable to any FM receiver. Our price £15 ref 15P42A

---

10 BAND COMMUNICATIONS RECEIVER. 7 short bands, FM, AM and LW DX/local switch, tuning 'eye' mains or battery. Complete with shoulder strap and mains lead **NOW ONLY £19.00!! REF 19P14.**

WHISPER 2000 LISTENING AID. Enables you to hear sounds that would otherwise be inaudible! Complete with headphones. Cased. £5.00 ref 5P179.
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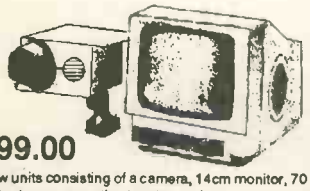
LOW COST WALIKIE TALKIES. Pair of battery operated units with a range of about 150'. Our price £8.00 a pair ref 8P50

7 CHANNEL GRAPHIC EQUALIZER plus a 60 watt power amp! 20-21KHZ 4-8R 12-14v DC negative earth. Cased. £25 ref 25P14.
NICAD BATTERIES. Brand new top quality. 4 x AA's £4.00 ref 4P44. 2 x C's £4.00 ref 4P73, 4 x D's £9.00 ref 9P12, 1 x PP3 £6.00 ref 6P35
TOWERS INTERNATIONAL TRANSISTOR SELECTOR GUIDE. The ultimate equivalents book. Latest edition £20.00 ref 20P32.
CABLE TIES. 142mm x 3.2mm white nylon pack of 100 £3.00 ref 3P104. Bumper pack of 1,000 ties £14.00

VIDEO AND AUDIO MONITORING SYSTEM



£99.00

Brand new units consisting of a camera, 14cm monitor, 70 metres of cable, AC adapter, mounting bracket and owners manual. 240v AC or 12v DC operation complete with built in 2 way intercom. **£99.00 ref 99P2.**

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SINCLAIR C5 MOTORS 12v 29A (full load) 3300 rpm 6"x4" 1/4" O/P shaft. New. £20.00 ref 20P22.

As above but with fitted 4 to 1 inline reduction box (800rpm) and toothed nylon belt drive cog £40.00 ref 40P8.
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MOSFETS FOR POWER AMPLIFIERS ETC. 100 watt mosfet pair 2SJ99 and 2SK343 £4.00 a pair with pin out info ref 4P51. Also available is a 2SK413 and a 2SJ118 at £4.00 ref 4P42.
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PHILIPS LASER. 2MW HELIUM NEON LASER TUBE. BRAND NEW FULL SPEC £40.00 REF 40P10. MAINS POWER SUPPLY KIT £20.00 REF 20P33 READY BUILT AND TESTED LASER IN ONE CASE £75.00 REF 75P4.
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TIME AND TEMPERATURE MODULE A clock, digital thermometer (Celcius and Farenheit (0-160 deg F) programmable too hot and too cold alarms. Runs for at least a year on one AA battery. £9.00 ref 9P5.
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TRANSMITTER RECEIVER SYSTEM originally made for nurse call systems they consist of a pendant style transmitter and a receiver with telescopic aerial 12v. 80 different channels. £12.00 ref 12P26
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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 8P51.
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LED PACK .50 red leds, 50 green leds and 50 yellow leds all 5mm £8.00 ref 8P52
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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 20P34. Additional sensors (max 5 per alarm unit) £11.00 ref 11P6.
WASHING MACHINE PUMP. Mains operated new pump. Not self priming £5.00 ref 5P18.
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TV LOUDSPEAKERS. 5 watt magnetically screened 4 ohm 55 x 125mm. £3.00 a pair ref 3P109.
SPEAKER GRILLS set of 3 matching grills of different diameters. 2 packs for £2.00 (6 grills) ref 2P364
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4 CORE SCREENED AUDIO CABLE 24 METRES £2.00 Precut into convenient 1.2 m lengths. Ref 2P365
TWEETERS 2 1/4" DIA 8 ohm mounted on a smart metal plate for easy fixing £2.00 ref 2P366
COMPUTER MICE Originally made for Future PC's but can be adapted for other machines. Swiss made £8.00 ref 8P57. Atari ST conversion kit £2.00 ref 2P362.
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ALARM PIR SENSORS Standard 12v alarm type sensor will interface to most alarm panels. £16.00 ref 16P200
ALARM PANELS 2 zone cased keypad entry, entry exit time delay etc. £18.00 ref 18P200
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STEAM ENGINE Standard Mamod 1332 engine complete with boiler piston etc £30 ref 30P200

TALKING CLOCK What more can we say??£14.00 ref 14P200.

PE Chronos V
The Main Board

This month Tony Smith looks at the the main board of his universal counter timer with details on hopw to put it together and test it.

Fig. 1 shows a photograph of the completed main board, the component overlay is illustrated in Fig. 2. Begin construction by inserting the through board links and rather than installing them all together, it is a good idea to do them in blocks of 15 to 20 – remember to solder both sides of the board.

Insert the diodes and resistors next, again, soldering leads on both sides of the board. Note that there is a choice between the standard crystal oscillator or a ready built DIL oscillator module to act as the Chronos' timebase. Until the choice is made, all relevant components, XTAL1, R79, R80, R81, C57, C58, C59, C60 and VC4 can be omitted. There is also a choice to be made about C50 and C68 so these should be left out for the moment as well.

Solder all the IC sockets into place and then insert the small capacitors. There are several tantalums and a small electrolytic all of which are polarised and must be inserted the right way around.

It is important to solder several capacitors on both sides of the board, C32, C33, C38, C39, C46, C53 and C56. Many capacitors – particularly disk ceramics – are supplied with pre-formed leads. These kinks should be straightened out before the device is inserted since they add unwanted inductance which can be troublesome, especially where decouplers are concerned.

Next, insert the larger components such as fuseclips, bridge rectifiers, connector plugs and veropins.

Wherever polarised connectors are used in the Chronos, take care that they are inserted so as to match the polarity of their corresponding connectors on the other boards. If this is done correctly, there can be no chance of twisting the interconnecting cables which might otherwise cause considerable circuit damage.

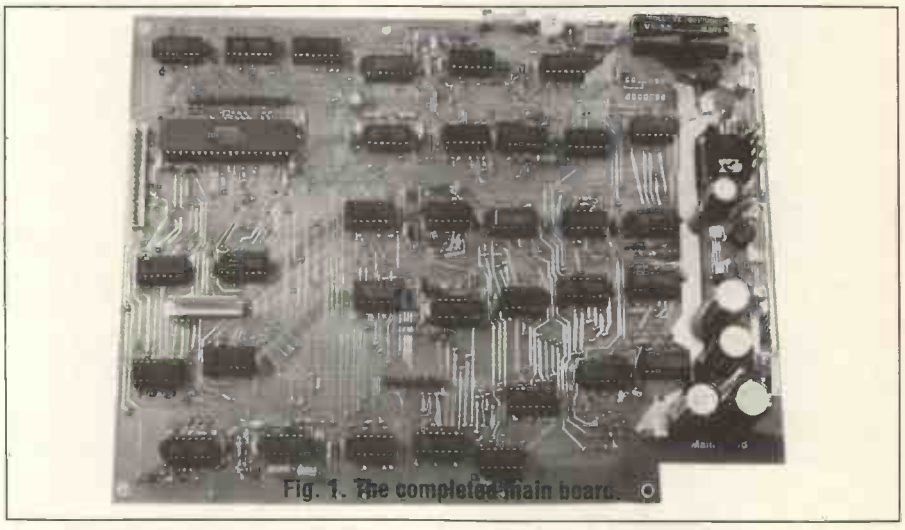


Fig. 1. The completed main board.

The 5V regulator, IC33, should now be fixed into place and the heatsink seated before bolting it to the board.

Finally, solder in the six large electrolytics into place (C81, C82, C84, C85, C86 and C87). This concludes construction of the main board. Note that the component leads should be cropped right back so as prevent short circuits.

Power Supply

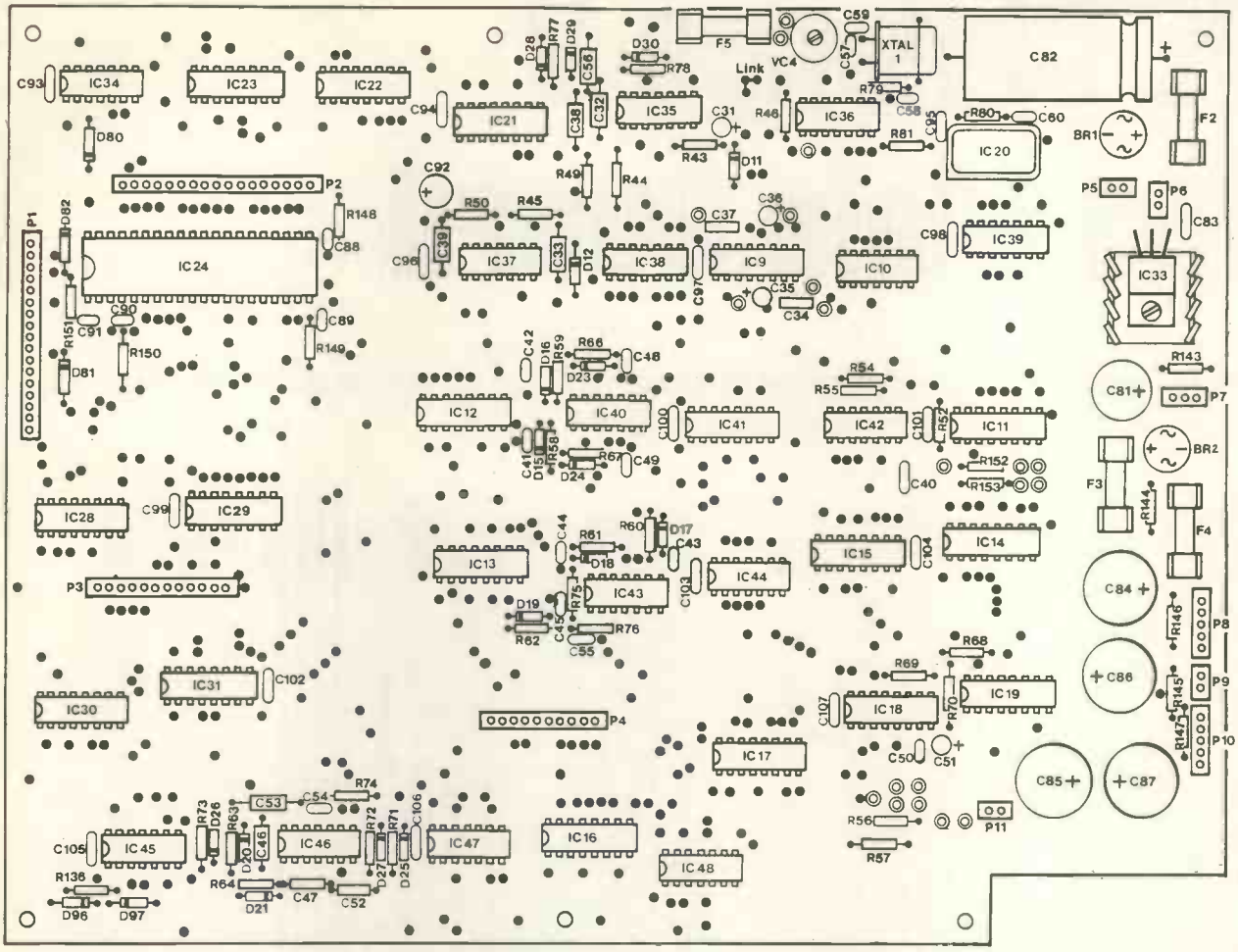
The next step is to connect the transformer secondaries to the main board as in Fig. 3. Temporarily place the rear perpendicular to the top edge of the main board and locate the panel such that the ext. clock BNC socket is directly above the ext. clock input pins marked ①. There is no need to assemble the rest of the case as yet.

Now, take the wires from both transfomer secondaries along the rear panel and bend them out at right angles to the panels so that they pass over the PSU section of the main board. Then, bend them perpendicularly downwards to the relevant connectors and cut to length.

Next, attach the connector sockets to their wires. It is not important which way round the wires from the 9V transformer go, but the centre-tap wire from the 12V transformer must be connected to the innermost terminal (not the centre terminal) of the three-way connector which attaches to the plug P7 (the other wires can go to either of the other two pins).

Insert the anti-surge fuses F2, F3 and F4 on the main board (See Fig. 2) and also the anti-surge fuse F1 in the rear fuseholder and connect the transformer plugs P5 and P7.

The PSU section of the main board is shown in Fig. 4. Transformer T1 provides power for the entire digital circuitry of the



●=Link through board. ◎=Veropin terminal.

Fig. 2. Main board component overlay.

Chronos, whilst T2 drives the split-rail analogue circuits of the main board.

The 9V RMS output of T1 is full-wave rectified by BR1 whose output is smoothed by C82 and C83 such that the input to the 1A 5V regulator IC33 is nominally +10VDC with around 1V of ripple. The output of IC33 is a stabilised 5V DC level having typically 30mV of ripple under heavy load conditions. As well as supplying the digital circuits of the main board, IC33 also provides a separate supply for the input board's trigger LEDs.

The output of BR1 is also filtered by R143 and C81 to provide an unregulated DC supply (nominally +10V) for the 78L05AV, +5V regulators on the input board.

Under full-load conditions, the current taken by the 5V sections is around 400mA. However provision has been made in the PSU design for an auxiliary +5V output to supply extra digital section.

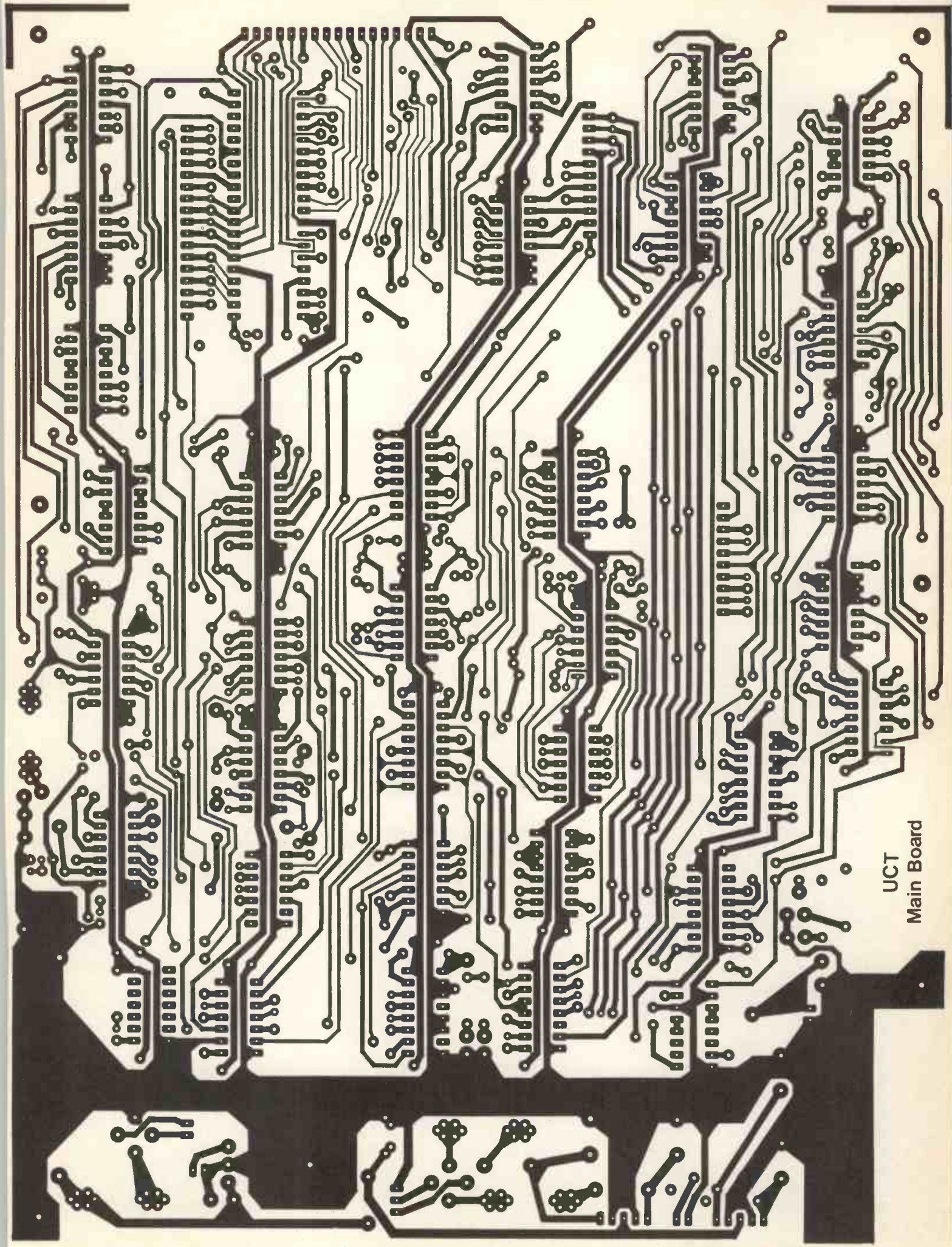
As the auxiliary supply can source around 200mA, the maximum 5V rail current can be as much as 600mA. Thus IC33 must be a 1A device with adequate heatsinking and both the fuse F2 and the secondaries of T1 must be rated at 1A.

The split rail analogue section is referenced to zero volts via the centre tap of T2's secondaries, such that the two 12V windings are each full wave rectified by BR2 providing positive and negative voltages at fuses F3 and F4 respectively. These potentials are smoothed by the RC filters so as to supply each input channel with unregulated DC voltages of ±14V. These are then stabilised by the regulators on the input board, with each rail taking no more than 100mA. Thus, a combined capacity of around 200mA max for the positive and negative supply currents is easily catered for by the 250mA fuses and secondary windings.

The 250V VDR (V1) is fixed across the main supply line to provide the Chronos with protection against excessive mains-bound transients. Under normal conditions, the resistance of V1 is very high and has no effect on the circuit at all. However, should a transient spike greater than the 250V clamping voltage of V1 appear on the lines, the resistance of V1 drops dramatically shunting the transient and absorbing the energy. If a series of excessive transients should appear the fuse F1 is likely to be blown providing protection against further damage.

Testing The PSU

Connect mains power to the main input socket and turn on S18 WARNING: MAINS VOLTAGES CAN BE LETHAL. Take care not to touch any live terminals on the rear panel. Note that no ICs should be inserted yet or the input board connected up via plugs P8, P9 and P10.


UCT
Main Board

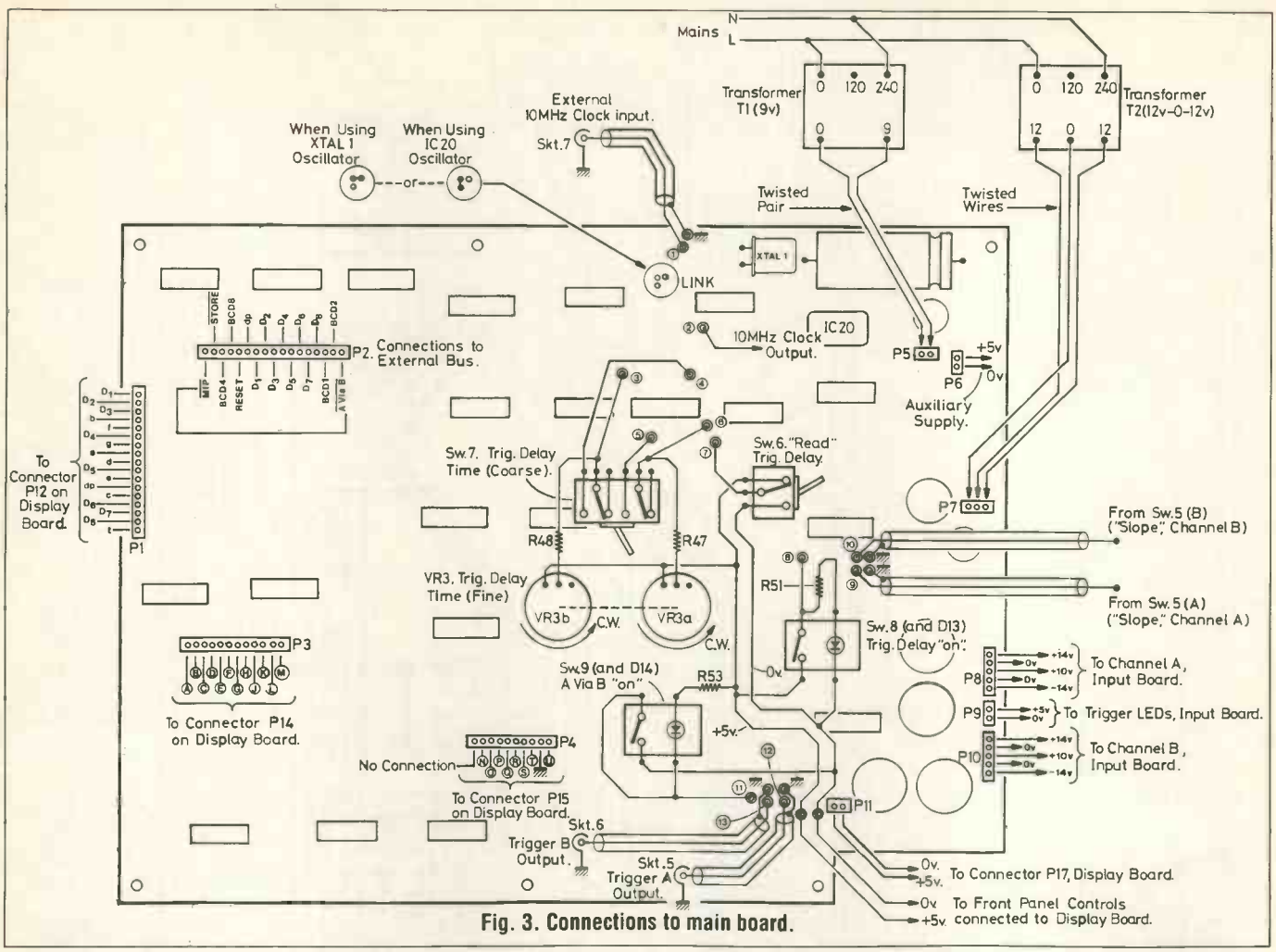


Fig. 3. Connections to main board.

With the main board resting on a non-conductive surface, use an oscilloscope to check the voltage at the output of the 7805 regulator. Ensure that the voltage is in the range 4.75V to 5.25V and that there is no ripple present. If there is ripple present check that C82 is soldered into place correctly. If there is no voltage at all, check connections from T1 secondaries through BR1 and F2. If the 7805 is getting very hot, look for a short circuit at the output. If all is in order, the +5V supply should be available at connectors P6, P9 and P11, and also at the veropins directly to the left of P11.

Next, use the scope to check the voltages output at plugs P8 and P10 (the probe ground lead should be connected to zero volts when making all voltage checks). Fig. 3 shows the nominal on-load voltages at P8 and P10. However, as the input board is not yet connected, the no-load voltages should be in the region of +20V, +11V and -20V respectively. There should be negligible ripple voltage on all of these outputs. If there is ripple, check the RC smoothing filter associated with the particular output. If there is no voltage present, trace connections from the transformer through to the outputs.

Calibrating The Input

If the PSU section is in order, the input board can be set up and tested. All connections are shown in Fig. 5. The front panel components are connected to the input board using insulated hook-up wire and flexible co-ax.

For the moment it is only necessary to connect VR1 (fine atten), VR2 (trig level) and S4 (zero trig level) to each input channel. Also, connect R14 to the common terminal of S4. Don't forget to connect the co-ax screens to the relevant terminals as shown in the figure. Before connecting VR1 and VR2, it is best to cut their spindles to the required length. I found the best way to do this is to locate the pots in the front panel, then cut this length off the spindle.

The connections to VR1 and VR2 are shown as though looking at them from the rear such that the direction of clockwise rotation is as shown. It is important to make the connections correctly so that the attenuation caused by VR1 increases with clockwise motion and the trigger level is varied rom negative to positive with clockwise rotation of VR2.

Note, also, that Fig. 5 shows S4 in its zeroed position (on both channels) . To determine which terminals are which, rotate VR2 fully anticlockwise such that the switch 'clicks' and use an ohmmeter to find the closed contacts. One of them is the common terminal which must be connected to R14 whilst the other is the ground connection that will also be connected later to SK3. If the connections to S4 are mistakenly swapped around the trigger level becomes zero over the entire span of VR2 .

The input board is now ready for testing. Whilst conducting the tests, try not to flex the connections any more than necessary. Remember, also, to test and calibrate both channels.

An oscilloscope with 10MHz

bandwidth is required to carry out the calibration. A non-attenuated probe and a probe with x10 attenuation should also be available. Sine and squarewave generators are required, the first being variable from 50Hz to 500kHz with an amplitude range from 500mV to 5V peak to peak (pp). The squarewave generator should range from 10kHz to 10MHz with amplitude from 500mV to 5V.

A high impedance DVM will also be needed for some of the checks. Before starting the tests, temporarily solder a small capacitor in C7 position (both channels). A 10pF ceramic should be adequate to stop IC1 breaking into spurious oscillation.

Supply Rail Checks

Connect the three ribbon cables to the main board and switch the mains power on. Initially check that none of the ICs, transistors or regulators is getting very hot. If any start cooking or should anything go bang, switch off immediately and check for short circuits and wrong connections.

If everything is in order leave the power on for ten minutes and then use the DVM to measure the output voltage of the 78L08A regulator (IC6). The voltage should be in the range +7.6V to +8.4V. Now connect the DVM to the output of IC7 and adjust PR2 such that the negative rail voltage is equal in magnitude to the positive rail voltage measured above. If the adjustable voltage scheme is not being employed, that is, if IC7 is a 79L08A, simply check that the negative rail is in the range -7.6V to -8.4V. The voltage output of the 78L05A should be +4.74 to 5.25V.

Next temporarily short the channel input to ground . Then zero S4 (turn VR2 fully anticlockwise till the switch clicks), select all-pass filtering and set attenuation to x1. Leave the power switched on for another 20 minutes or so.

Nulling The Op-amp.

By this time the potentials in and around the op-amp (IC1) will have had time to settle to their quiescent values and the op-amp can be nulled. Monitor the output at pin 11 by connecting the scope or DVM to the high end of R12. If the scope is used here select the most sensitive range and DC couple the input from a non-attenuated probe.

Now, adjust PR1 to bring the op-amp output to zero. It is essential that S4 is zeroed during this procedure or the trigger offset will also appear at the op-amp output.

Remove the link wire from the input pins such that the input is open circuit. The aim is to find the best combination of C7 and C8 to give optimum op-amp compensation.

The procedure is to couple a 500mV squarewave directly to pin 6 of the op-amp (the junction of R9 and R10). Then at a frequency of 10MHz, observe the op-amp output on the scope and compare it with the input signal.

The aim is to choose the capacitors such that the output is a replica of the input but with ten times the amplitude. It is important that the input signal be as rectangular as possible . It is also essential to use x10 attenuated probes when comparing the signals or else the input capacitance of the scope will cause distortion. Keep the leads from the squarewave generator as short as possible to reduce ringing and connect the ground leads as close as possible to IC1.

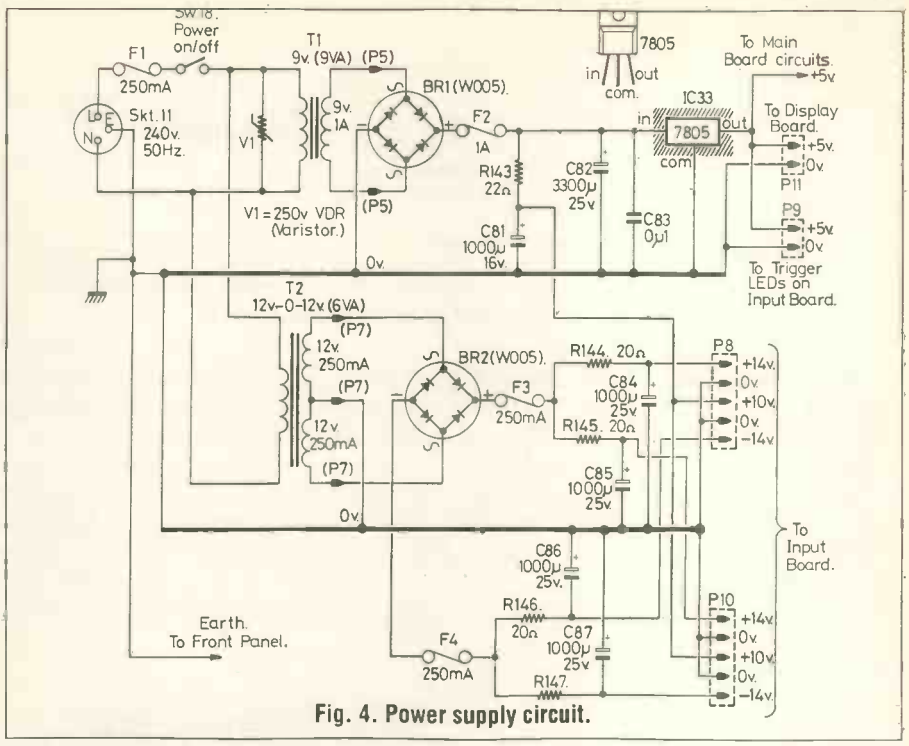


Fig. 4. Power supply circuit.

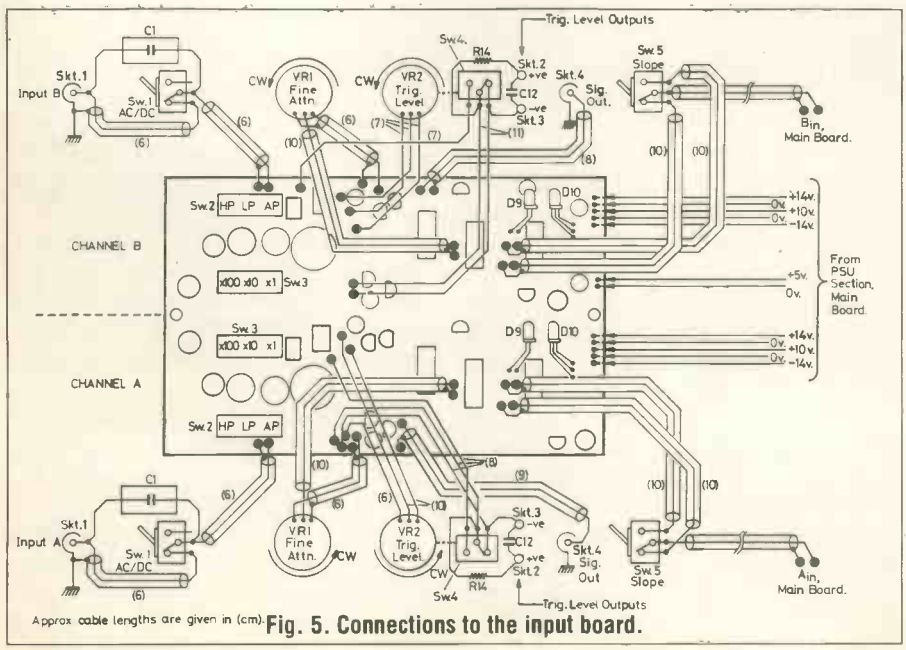


Fig. 5. Connections to the input board.

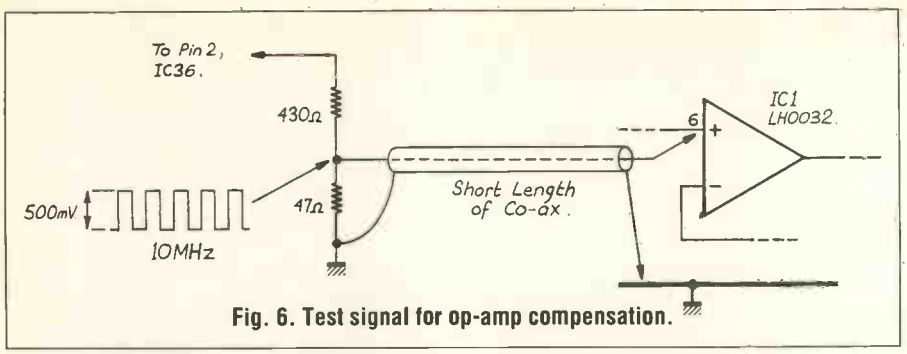


Fig. 6. Test signal for op-amp compensation.

It is possible to use the clock of the Chronos' timebase for the squarewave. This is a 5V 10MHz signal available at the pin 2 of IC36 on the main board. The signal must first be attenuated to 500mV before feeding it to the op-amp as shown in Fig. 6. The attenuated signal should be fed to the op-amp using a very short length of co-ax as shown. Remove the resistive divider when the test is completed.

Further Compensation.

The next thing to select is the optimum compensation for the network by trimming VC3. With S2 and S3 still set to AP and x1, DC couple a 500mV 10kHz square wave to the channel input. Once again, compare the input signal with the op-amp output using unattenuated leads.

Now, carefully adjust VC3 such that the op-amp output is the same as the input. When all the beehive trimmer caps have been adjusted, don't be tempted to apply any kind of sealing compound as this can change the capacitance.

Select x10 attenuation (S3 centre position) and DC couple a 5V, 10kHz squarewave to the channel input – S2 is still set to AP. Use non-attenuated probes to compare this signal with that as the op-amp output. Adjust VC2 to make the signals identical. The same should be done with the x100 attenuation by adjusting VC1.

On The Trigger

Use a short wire link to ground the channel input , select AP filter and x1 attenuation and use a DVM or scope with non-attenuated probe to monitor the output of IC1. With S4 zeroed, the output should be zero. Turn VR2 slightly clockwise so that the switch just clicks and the output voltage should jump to a value in the region of +5V to +6V. Gradually turning VR2 clockwise will cause this voltage to drop, go through zero and end up[at -5 to -6V.

For different values of trigger level offset at IC1 output, check that the voltage at the signal monitor output (junction of R20-R21) is the same. Remove the ground link from the input and repeat for the other channel.

Filter Performance

Select zero trigger level and x1 attenuation. AC couple a 500mV peak to peak sinewave to the channel input and select a low pass filter. Keeping the input amplitude constant, vary the frequency in half decade steps from 1kHz up to 500kHz, the amplitude should have fallen to around 500mV peak to peak (PP).

Now select high pass filtering and with the same 500mV input, vary the frequency from 100kHz down to 50Hz. At 10kHz and above, the amplitude at the output of IC1 should be around 4.5V pp. At 1kHz the signal should be down to 3.2V and at 100Hz down to 450mV.

With the trigger level still zero and attenuation still at x1, select all pass filtering and AC couple a 500mV pp sinewave to the channel input. For decade frequency steps from 10Hz to 1MHz or greater check that the signal output from the buffer (junction of R20 and R21) is an undistorted sinewave with 5Vpp amplitude.

If the waveform is distorted, check the signal paths from IC1 and the transistors. If only half the wave is distorted suspect TR2 and TR3 otherwise try TR1 and TR4.

With zero trigger level, x1 attenuation and all pass filtering, ensure that VR1 is set to minimum attenuation (fully anti-clockwise) and set frequency of 500mV input sinewave to about 200Hz. Observe the output of IC1 on a scope this should be a 5Vpp sinewave swinging symmetrically around 0V. The trigger LED should be flashing and the ODR detector LED off.

Now rotate VR2 slightly clockwise so that the switch just clicks. The signal at IC1's output is forced fully positive with the peaks being clipped at around +7V. Because the signal is above the trigger window, the trigger LED should be continuously on. Also, the signal clipping resulting from op-amp saturation is caused by the large trigger level pushing the signal outside the dynamic range.

Slowly turn VR2 clockwise and the clipping of the positive peaks should grow less and eventually disappear. At this point the ODR LED goes out.

Continue turning VR2 clockwise. As the negative peaks pass through zero, the trigger LED should begin to flash. Eventually, as the signal is taken more negative, the positive peaks will fall below zero such that triggering ceases. As the signal is taken fully negative it will be clipped at around -7V.

Set VR2 to its centre position and observe the output from IC5b (pin 4 IC5). This should be a squarewave in phase with the sinewave. Now rotate VR2 clockwise, the duty cycle of the square wave should reduce correspondingly.

Final Test

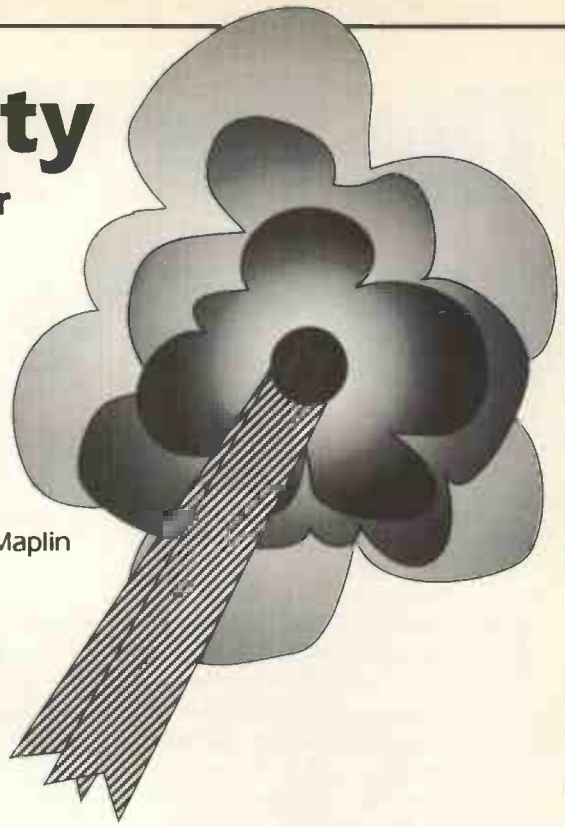
The last test is with the filters set to AP with x1 attenuation selected. Couple a 200Hz 500mV sinewave to the channel input and set the trigger level to zero. Using a non-attenuated probe, observe the signal on pin 4 of IC4. It should be around 3.5Vpp. Slowly rotate VR1 clockwise so that the amplitude decreases. Eventually there will come a point where the signal is too small to cross the Schmitt trigger thresholds and the trigger LED will stop flashing. The positive and negative peaks of the signal at this point should correspond to the upper and lower threshold voltages respectively – ±70mV give or take a few mV.

If the values are different by more than 30mV then check the level shifting network around R27 to R31 and D5 and D6.

After all of this, check the connections to the board to see that they are still firm after all that flexing around. ■

Rewarding Loyalty

You can be a winner with our Reader Loyalty Bonus.



This month's top ten readers:

P Jones of London NW6 has £150 of the money spent with Cricklewood Electronics refunded.

A Morris of Birmingham who bought £150 worth of goods from Panrix Electronics.

J Singh of Ealing receives £112.95 for buying goods from Tandy.

K Peggs of Tring has the £68.22 he spent with Greenweld refunded.

AR Tizzard-Largs of Ayrshire gets back the £67.40 he spent with Maplin Electronics.

RH Morgan of Ellesmere Port traded with Maplin and has £33.70 refunded.

K Peters of Brighton secures his £29.07 for purchasing goods from Suma Designs.

J Muir of Glasgow claims his £19.48 which he spent with Maplin.

CR Rounce from Doncaster is reimbursed £13.33 for trading with Maplin.

R Aldridge of Ramsgate has £4.27 repaid for his purchase from Tandy.

The Facsimile Machine What Are The Fax?

Kevin Jones looks at the technology that enables pictures to be sent down the phone. Now that the prices are falling, are they for everyone?

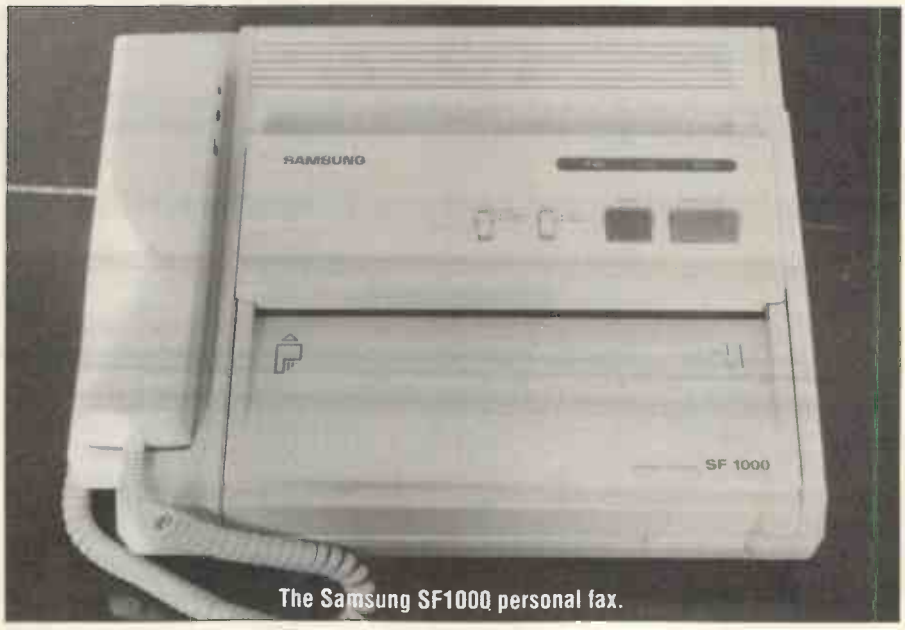
The facsimile machine or fax looks as though it will soon replace the portable phone as "the latest gadget". Prices are now falling to the point where machines can be purchased not only by businesses as standard office equipment but also by individuals for home use.

The advantage of fax over telephone is not just the ability to send pictures to your friends. It also means that messages can be left when they are out and letters can be sent in the evenings at cheap rates to be read first thing next morning. In addition, an A4 page of text can be sent in under 30sec or so – try reading out a page of text at this speed. Yet another plus is that the machine can be used as a photocopier. The only real drawback at the moment is that not everyone has one.

Until recently the problem of having a fax at home was the requirement for two telephone lines. Fortunately, the use of a fax/telephone/answerphone or a switch box means that now, systems can be run on a single line. For anyone thinking of purchasing a fax and who doesn't already have an answerphone, the combined option is the best. A machine which incorporates all of the latest telecommunications gear in one box such as the Amstrad FX9600AT, although not cheap, provides a neat solution.

Voice Or Tone

For anyone who already owns an answerphone, the switchbox is the way to go. This gadget that connects directly to the telephone line and provides two outputs, one for the telephone/answerphone and one for the fax. When a call is received, the box answers the phone and sends out its own ringing tone while it attempts to work out whether the call is from a person or a fax. When they dial up a number, fax machines send out tones for the answering machine to lock onto. The switch box, on hearing these flicks the call through to the fax machine which answers the call and receives the fax. If no tones are heard then the call is switched through to the telephone or answerphone. Most of the time this works very well, but, unfortunately, some foreign telephone voice calls seem to put tones on the line which the switch box mistakes for fax tones. In this case, the handset on the fax (if it has one) can be used to receive the voice call or the switch box can be manually made to operate with the phone. Of course, this is of no use to an answerphone.



The Samsung SF1000 personal fax.

The opposite problem also occurs occasionally and a series of bleeps can be heard on picking up the phone or on the answerphone. The reason for the switch box misunderstanding the signals is not clear though it doesn't happen very often.

Having both fax and answerphone in one box is not the

Specifications

Samsung SF1000 Personal Fax
Compatibility: CCITT group 2 and 3
Speed: 9600/7200/4800/2400 bps
Resolution 3.85 lines per mm (normal) or 7.7 lines per mm (fine)
Scanning method: CCD image sensor
Grey scale: 16 levels
Printer output: thermal Input
Document size 216mm wide
Paper roll length: 30m
Power: 220-240VAC
Dimensions 330x254x107 (WDH)
Weight 8.8lbs

Box. Inside Fax

All fax machines use roughly the same hardware and transmission/reception methods. The CCITT standards for sending fax data down a telephone line are G2 and G3. The difference between the two is one of speed and reliability. G3 runs faster than G2 but G2 is more reliable. For noisy telephone lines, G2 is the route to take, however, complaining to BT about line noise is also a possibility. Most modern machines support both standards and have modems that operate from 9600 bits per second (bps) downwards - a fallback technique uses the lower speeds if data is being lost diring transmission.

When an image is being sent, it is slowly fed through the machine and scanned by a long strip CCD sensor. In normal or fine modes, the data is in the form of ons and offs defining where the black or dark areas of the image are. This data is then coded up, usually using a variable length code where the more frequent numbers use shorter word lengths and hence transmit more quickly. A consequence of this is that more complex areas of the image tend to be sent more slowly - this is noticeable when a fax machine gets past the white space and onto the text.

As well as transmitting and receiving images as normal or fine resolution, a photographic option converts the brightness of a pixel into a value from 0 to 15, known as a grey scale. This allows much better resolution of photographic images at the expense of a decrease in speed.

At the receiving end, the fax will have set itself up to the correct speed and resolution when first contacted. The ensuing information will then be decoded and printed out onto heat sensitive paper. This normally comes on a single roll and on some machines is cut to size at the end of each transmitted sheet and on others simply left for the user to tear off.

The Amstrad FX9600AT personal fax and answering machine.

Specifications

Amstrad FX9600AT Personal Fax and answering machine

Fax

Compatibility: CCITT group 3
Speed: 9600/7200/4800/2400bps
Resolution: 3.85 lines per mm (normal) and 7.7 lines per mm (fine)
Scanning method: CCD image sensor
Grey scale: 16 levels with two styles
Printer output: thermal
Document size: 216mm
Paper roll length: 30m
Automatic paper cutter
10 page document feeder
Power: 220-240VAC
Dimensions: 380x340x128 (WDH)
Weight: 6.75kg

Answering machine

Outgoing message: 16s max
Incoming messages: stored on C30 micro-cassette
Automatic Fax/phone switching

perfect solution either. On receiving a call, the machine plays its voice message. If, when this has finished, some tones are heard, the system enters fax mode. Otherwise, a voice message is taken. Unfortunately, when sending a fax, hearing a voice at the other end of the line instead of the expected bleeps usually means a wrong number. In the case of an "intelligent" fax/answer-phone, it's just a matter of waiting out the voice message before sending the fax -- as long as you know.

Simple Or Sophisticated

There are a wide selection of fax machines available. The bottom end of the range is represented by the Samsung SF1000 personal fax. This operates with the normal G3 or G2 standards and is able to send and receive, standard, fine or photographic (grey scale) images. It has its own telephone handset with 10 memories for regularly used numbers plus a manual redial. On the minus side, it is only able to take one sheet of paper at a time though multiple sheets can be transmitted if they are fed in by hand. There is also no paper cutter so the received sheets must be torn of at the end of a message.

The other big problem is encountered when setting it up. To save money there is no message display screen. This means that optiona such as identification codes printed on the message, whether to default to G2, how many rings should occur before answering and so on, must all be set up by pressing the start and stop buttons in a defined sequence. The results can then be checked by printing them out.

At the other end of the market is the Amstrad FX9600AT which incorporates an answering machine, auto redial, 20 memories, built in parallel interface allowing connection to a computer which can then send faxes and use the thermal printer for output. This is a more complex machine with a large number of facilities. The provision of a coimputer interface will appeal to users with PCs since text can be sent directly from a wordprocessed document directly to someone elses fax, saving both time and paper.

The fax machine appears to have reached its peak technologically. All that remains is for the price to fall a little more and most people will wonder how they managed without it. ■

Counting The Pulses

Pulsar is Number 1 Systems' latest piece of computer aided design software aimed at making logic circuit design and testing easier. Kenn Garroch checks it over.

In the bad old days, designing and building digital electronic circuits was a complicated affair that required an in depth knowledge of techniques such as state machines and transition tables.

After designing a circuit and "proving" that it works on paper, the only way to make sure it works is to solder some silicon. An alternative, just released for the IBM PC, is Pulsar. This digital logic simulator allows a circuit to be checked out to the stage where it should work in reality. Digital circuits can be put through their paces with all inputs and outputs being available for scrutiny. A knowledge of digital systems is still necessary although Pulsar could be used in conjunction with some textbooks to learn all about the subject.

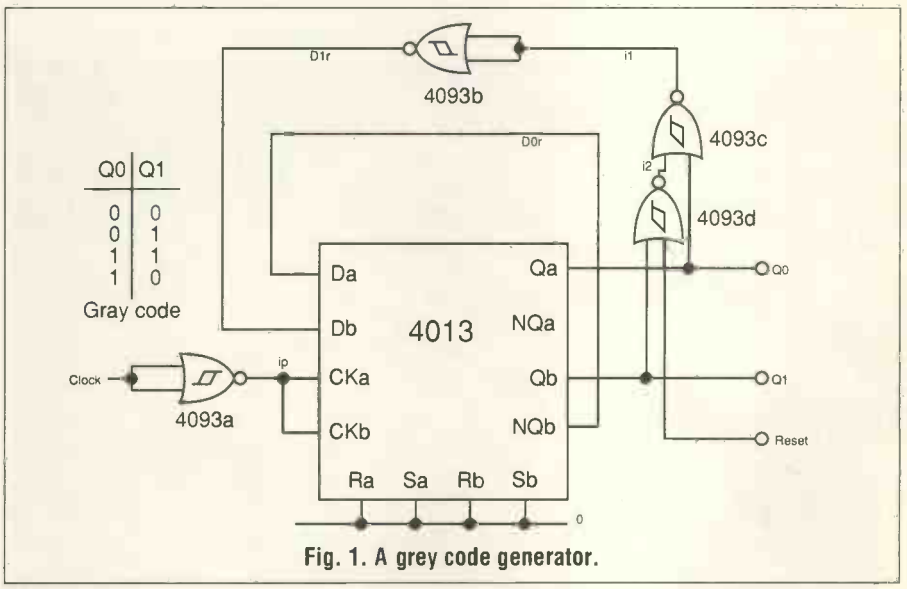


Fig. 1. A grey code generator.

Running Under A GUI

Pulsar comes on both 3.5in and 5.25in disks. Installation is straightforward and from inserting the floppy to getting the thing running takes only five minutes or so. A PCXT/AT with at least 512kb of RAM, a hard disk and either an EGA or VGA graphics card is the minimum system needed to run Pulsar. A mouse is also a pretty handy accessory to have available although it is possible to use the software via the cursor keys.

The whole package operates through a GUI (Graphical User Interface) complete with pull down menus and button clicking. In general these menus are easy to navigate and each has a help section at the bottom. Unfortunately, the help comments usually run to repeating what is already obvious and a more in-depth help system would have been a good idea. The manual is of some use in this area but it doesn't really have a reference section so trolling through it from end to end is usually the only way to find out about something.

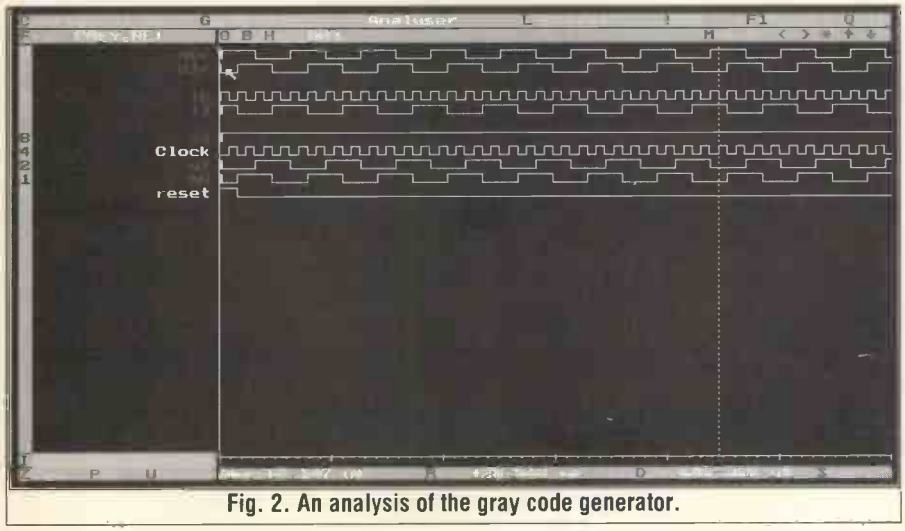
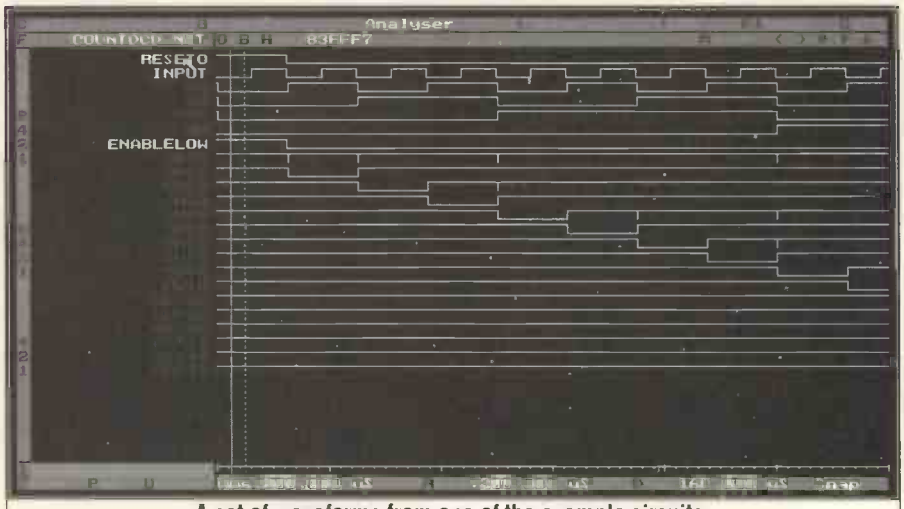


Fig. 2. An analysis of the gray code generator.

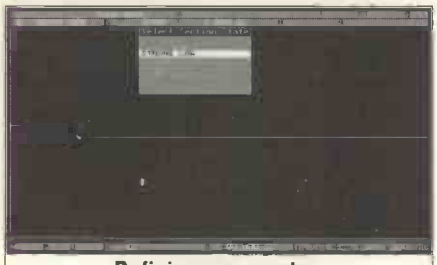
Gray Code Simulation

Circuits are set up in Pulsar by taking predefined components or modules and assigning their inputs and outputs to each other. To do this properly it is necessary to draw up a design with a pencil and paper



A set of waveforms from one of the example circuits.

before even going near the editor – a fully graphical schematic editor would have made life a great deal easier. Users of Easy PC will find that they can output netlists directly into the system making the operation a lot easier. Others will have to suffer and do it by hand.



Defining a generator.

The program has four main sections, the analyser, circuit create/modify, a generator definer and the component/module library manager.

As an example, to set up the gray code circuit shown in Fig. 1, each of the nodes of the circuit is given a name and each component is given the corresponding node names at its connections. A component not shown in the diagram is the PSU or power supply. This provides two outputs, one is assigned to "1" and one to "0". These can then be used in the rest of the circuit to tie inputs high and low as necessary.

Having completed the definition, the next step is to load up the circuit into the analyser. However, before starting any analysis a couple of external generator inputs need to be defined. The "clock" input is taken straight from a standard 1kHz signal provided with the system and the "reset" input defined especially for the the test.

The generator definer allows almost any input signal to be set up by specifying the high, low and time for each step. The reset signal is simply a short high level followed by a 10 second low, long enough to prove the circuit.

Building Black Boxes

Back in the analyser, the generators are attached and the simulation run producing the outputs shown in Fig. 2. Outputs Q1 and Q0 give the gray code as shown in the truth table.

The main requirement for designing a circuit is to put it down on paper and name the nodes and components. The libraries cover virtually all the standard CMOS 4000 range, the 74LS range and a set of system components. Simply entering the name gets the component from the library complete with connection definitions. A drawback with the system is that there is no facility to browse the libraries to see what is available – in graphical form preferably.

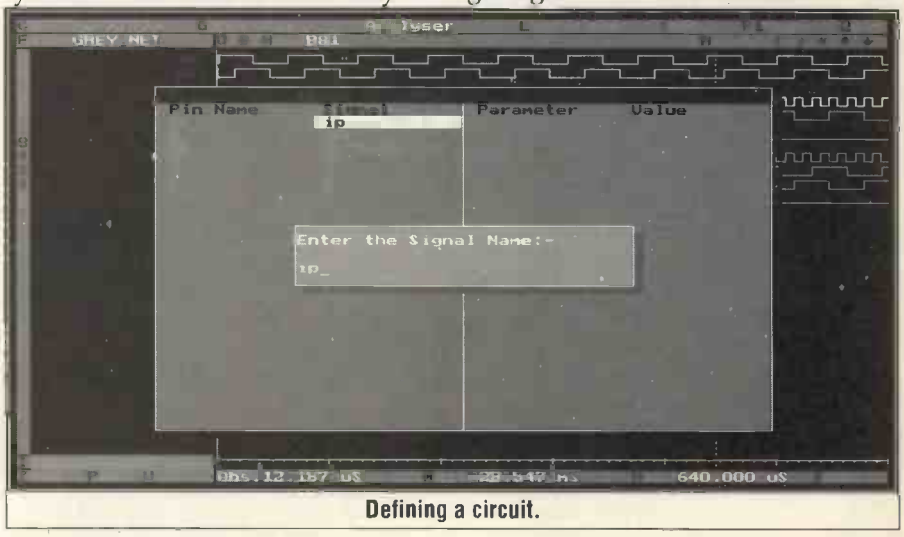
Once a circuit is proven it can be set up as a module which is, in effect, a black box with defined inputs and outputs. Modules are held in libraries and can be used in future circuits. This idea allows sections of a circuit to be designed and checked out and then connected together to form more complex systems.

When the simulation has been run all of the relevant waveforms are displayed on the screen. These can be shifted up and down the screen and grouped to make them easier to read. The controls allow zooming in on the display and panning.

The Package

The manual supplied with the software could be better. It takes the user on a "grand tour" of the software. This is quite long as there is an awful lot to see. Unfortunately, there is very little in the way of reference material. The index is reasonable and the appendices show all of the components held in the libraries.

Pulsar is a pretty sophisticated piece of software. It can cope with complex circuits and although it looks complicated at first sight, it is not hard to get to know and use. Anyone who wants to do a lot of digital design or who is interested in learning a lot about digital circuits might be interested. However, at £195 it may be priced beyond anyone who is not going to get a great deal of use from it. ■



Defining a circuit.

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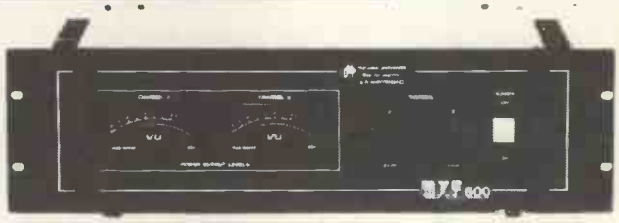

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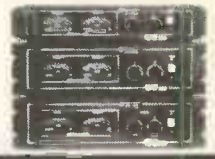

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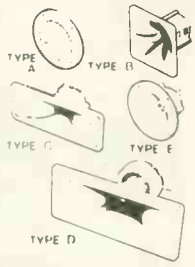

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Measuring Up Digital Multi-Meters

The number of DMMs available is on the increase. They now offer larger displays, more functions and lower prices than ever before. Jason Sumner examines a selection of seven.

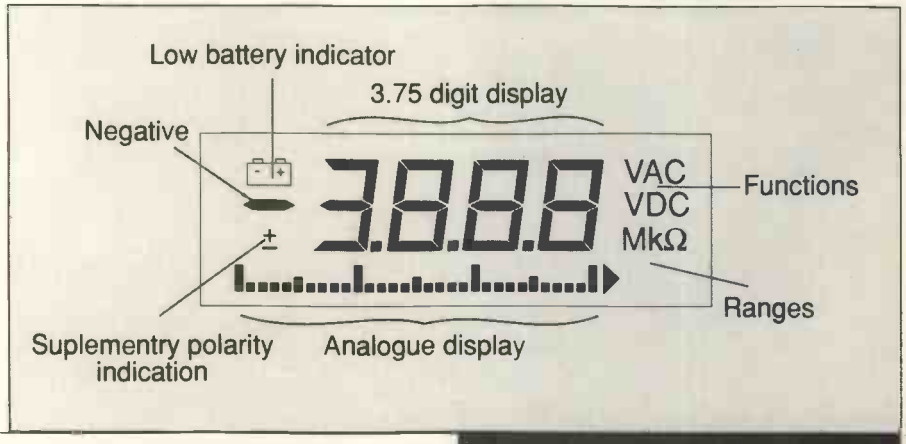
It seems that the days of the analogue multi-meter are just about over. The DMM (Digital Multi-Meter) has now come to the fore offering more facilities at a lower cost and in a more robust and compact case.

The three main functions supported by DMMs are Amps, Volts and Ohms (Ω) measuring current, voltage and resistance. Other options becoming common are diode and continuity test, with the latter usually providing eyes-free operation by means of a sounder.

In general, all the meter displays are the same (see right). The main section is the 3 (plus a fraction) digits used for the main readout. The fraction is usually half a digit in the form of a 1 giving a maximum count of 1999. Some meters offer three quarters of a digit in the form of a 3 allowing counts up to 3999. All types normally allow two to three decimal places of accuracy if the correct range is selected.

Some instruments offer a semi-analogue display in the form of a bar graph across the bottom of the readout. Other indications may be the units, the current function, the polarity of the signal and whether the battery is due to be replaced.

Since many DMMs offer pretty much the same basic facilities, any additional options should be taken into account when selecting between different makes and models.



This meter is unusual for a hand held DMM in that its on/off switch is separate from the range selection dial. The only drawback with this is that it is possible to turn the meter on while it is on an unsuitable scale – for example, when connected up to measure volts and switching on with the ohms range selected.

Other features include a memory which remembers the last two digits of the current reading. These are then subtracted from the next reading to allow measuement of voltage or current deviation. The hold button keeps the display static until released and DC/AC/Ω/Lo switch allows measurement of AC or DC voltage and current or low and high resistance.

The only real problem with the DMM735 is that due to the colouring of the case (shades of brown) it could easily get lost when put down.

Specifications

735 DMM
3.5 digits, 1999 count
Auto/manual range selection
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0 – 2MΩ	Auto

Global Specialities,Rackery Lane,Llay Wrexham,Clwyd,LL12 0PB

The first striking thing about the TM357 is that the on/off switch is very small. It is also seperate from the function selector dial and so sufferes from the same problem as the DMM 735. The display is rather basic and only shows the reading and low battery warning. All ranging must be performed by the user and there is no indication of the scale of the display – it is difficult to tell between kΩ or and Ω for example. The overrange indication is a static 1 on the display; making it flash would have made operation easier.

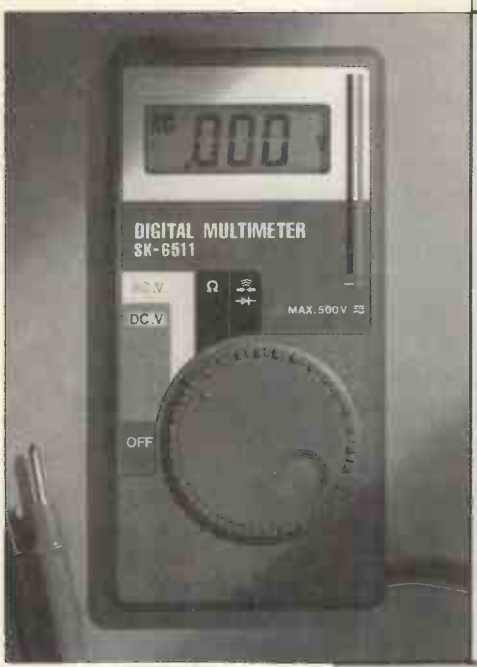
Leaving the meter on just seems to drain the battery as there is no auto-shut off. On the plus side, the instrument is relatively cheap and has a built in prop-up stand on the various elements of the display appear to be activate when they are off and there is no auto-shut down to save the battery. The manual is not particularly informative and the prop-up stand seemed particularly flimsy.

Specifications

TM357
Display 3.5 digits 1999 count
Manual range selection
Overrange indication
Sampling rate 2.5Hz
Low battery indicator
Battery type PP3 9V
Size 150x80x30mm (LWH)
Weight 240g
Continuity and diode check
Comes with test leads and manual
Price £39 (£45.83 inc VAT)

0 – 1000VDC	5 ranges
0 – 750VAC	5 ranges
0 – 10ADC	6 ranges
0 – 10AAC	6 ranges
0 – 20MΩ	6 ranges

Thurlby Thandar, 2 Glebe Road, Huntingdon, Cambs, PE18 7DX



Specifications

SK6511
Display 3.5 digits, 1999 count
Auto range selection
Overrange indication
Sampling rate 2Hz
Low battery indicator
Battery type two 1.5V LR-44
Size 108x54x8mm (LWH)
Weight 60g
Features continuity and diode check
Comes with batteries, manual, test leads and carry case
Price £19.95 (23.44 inc VAT)

0 – 500VAC	Auto
0 – 500VAC	Auto
0 – 20MΩ	Auto

Global Specialitie
Rackery Lane,Llay
Wrexham,Clwyd, LL12 0PB

Obviously designed to be carried around in the pocket this meter is about as simple as they come. One control dial selects the function with any ranging taken care of automatically.

No current measurement is supported and the probes are quite small, especially for those of us with banana fingers. The batteries are similar to those used in cameras and getting them in and out requires a very small screwdriver and some fiddling. However, they have an operational life of approximately 70 hours continuous use so they won't need to be changed too often. On the other hand, since there isn't an automatic switch off the batteries will eventually go flat if the meter is

Offering a large display (75x30mm) the TM3487B also has a few functions not normally found on a DMM. The most obvious is that it is able to measure frequencies. It also has a horizontal bar graph display which gives a semi-analogue average display of the reading. The relative option allows signals to be compared and the max/min the instantaneous maximum and minimum peak values. All ranging is done automatically with the units shown on the display.

On the minus side, when the display is viewed at shallow angles,

Specifications

Thurlby Thandar 3487B
Display 3.75 digits 1999 count
Auto/manual range selection
Overrange indication
Sampling rate 20Hz
Low battery indicator
Battery type 9V PP3
Size 162x80x30mm (LWH)
Weight 250g
Features continuity sounder, diode check and frequency counter
Comes with test leads, battery and crocodile clips
Price £89 (104.58 inc VAT)

0 – 1000VDC	Auto
0 – 750VAC	Auto
0 – 10ADC	Auto
0 – 10AAC	Auto
0 – 40MΩ	Auto
45 – 40kHz	Auto

Possibly the only drawback with this meter is the fact that it doesn't support current measurement. The casing has a very solid feel and looks as though it could take quite a lot of hammer. The display supports analogue as well as the standard 3.75 digits.

The touch hold facility allows eyes-free measuements to be taken. When in this mode the probes can be placed on the circuit and when the instrument beeps, the measuement is held until another is made. As with other devices there is no auto-shut off though battery life is rated at 1600 hours.

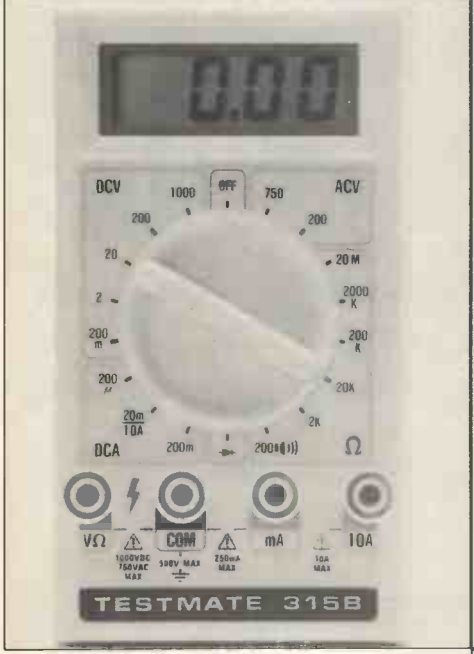
As a basic DMM the 70 has a professional air and is supported worldwide by Philips in Europe and Fluke in the States.

Specifications

Philips/Fluke 70 series II
Display 3.75 digits 3200 count
Auto/manual range selection
Overrange indication
Sampling rate unknown
Low battery indicator
Battery type 9V NEDA
Size 166x28x75
Weight 340g
Comes with battery, test leads and manual
Price £59 (£69.33 inc VAT)

0 – 1000VDC	Auto
0 – 300mVDC	Auto
0 – 750VAC	Auto
0 – 32MΩ	Auto

Available from:
STC, Edinburgh Way
Harlow, Essex



Specifications

Cirkit TM 5315B
Display 3.5 digits 1999 count
Manual range selection
Overrange indication
Sampling rate 3Hz
Low battery indicator
Battery type 9V NEDA
Size 128x72x33mm (LWH)
Weight 200g
Comes with test leads and manual
Price £19.99 inc VAT

0 – 1000VDC	5 ranges
0 – 750VAC	2 ranges
0 – 10ADC/AC	4 ranges
0 – 20MΩ	6 ranges

Available from:
Cirkit Distribution Ltd, Park Lane,
Broxbourne, Herts, EN10 7NQ
Tel 0992 444111

Being brightly coloured, small and solid feeling, the TM5135B gives the impression of being good value. It only provides the basic functions for amps, volts and ohms plus a diode check but, for the price, these are all that can be expected.

On the back of the case is a fold out stand which props the meter up a forty five degrees.

On the front, the power switch is incorporated into the function selector dial – it isn't easy to switch the meter onto a low value range while measuring a high value since the ranges either side of off are 1000VDC or 750VAC.

The display is quite small but large enough to be readable under most conditions.

The TM175 from Cirkit is a pretty high spec meter for the price. The only problems are the separate power switch, the lack of autoranging and the small display. Apart from this, it offers a number of functions not found on the other meters in this review, capacitor and transistor measurement. There are sockets for both types of component built into the bright yellow case.

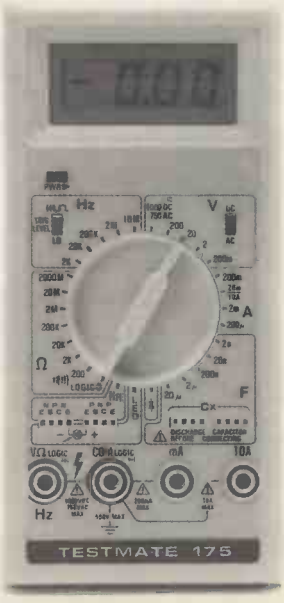
A built in stand provides either a prop or a hanger for ease of operation. An interesting display option is the up/down indication for logic testing. Whether this makes testing eaiser than reading the voltages +5V and 0V, it is difficult to say, it depends on what you are used to. ■

Specifications

Cirkit TM175
Display 3.5 digits 1999 count
Manual range selection
Overrange indication
Sampling rate 3Hz
Low battery indicator
Battery type 9V NEDA
Size 160x84x38 (LWH)
Weight 250g
Comes with test leads and manual
Price £57.96 inc VAT

0 – 1000VDC	5 ranges
0 – 750VAC	5 ranges
0 – 10ADC	4 ranges
0 – 10AAC	4 ranges
0 – 2000MΩ	7 ranges
0 – 15MHz	5 ranges
0 – 20μF	5 ranges

Transistor and diodes test built in



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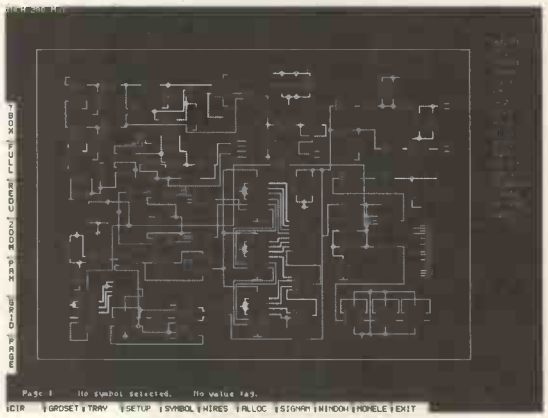
- b Single Metal Diode
- c Semiconductor Micro Device

2 What does an autorouter do?
- a draws the tracks on the board
- b places the components automatically
- c does all the soldering

3 What are the track on a PCB made from?
- a Aluminium
- b Copper
- c Iron



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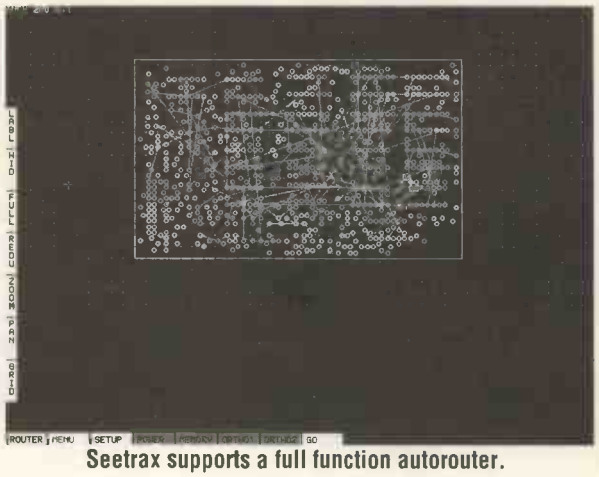

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Techniques

Andrew Armstrong explains how to dim a fluorescent tube.

Has PE published a fluorescent light dimmer circuit? I would like to dim the lighting in our kitchen/diner. I could replace the fluorescent lighting with incandescent, but I prefer fluorescent light for cooking. Ordinary light dimmers will not work, so is there a practical way to dim fluorescents?

William Jones
Barnsley
Yorks

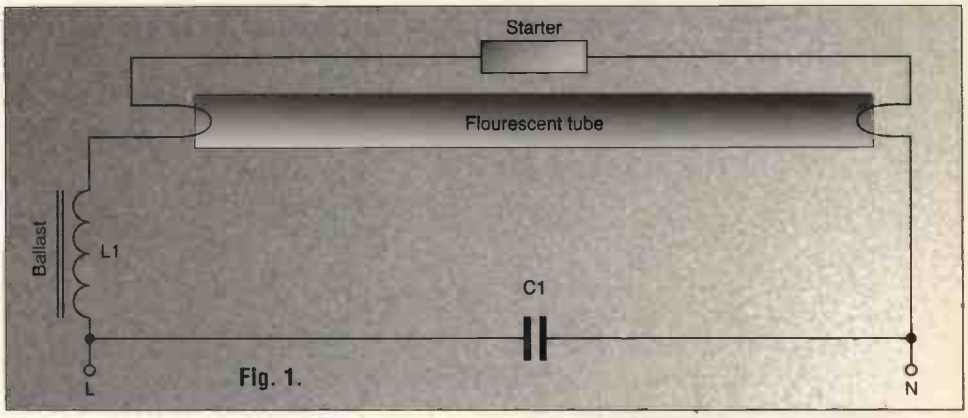

Fig. 1.

It is more difficult to dim fluorescent lights, but it can be done.

Ordinary light dimmers will not work for two main reasons. The first reason is that the current in a fluorescent tube is limited by a series inductor, so that the current is significantly out of phase with the voltage. Conventional lamp dimmers, which derive timing information to phase trigger the triac from the voltage across the triac, receive a waveform to derive phase control information from which depends on the trigger point in the previous half cycle. The best result which is usually obtained by trying to dim a fluorescent with an ordinary dimmer is that the lamp flickers visibly near full brightness, and flashes or switches off at slightly lower brightness.

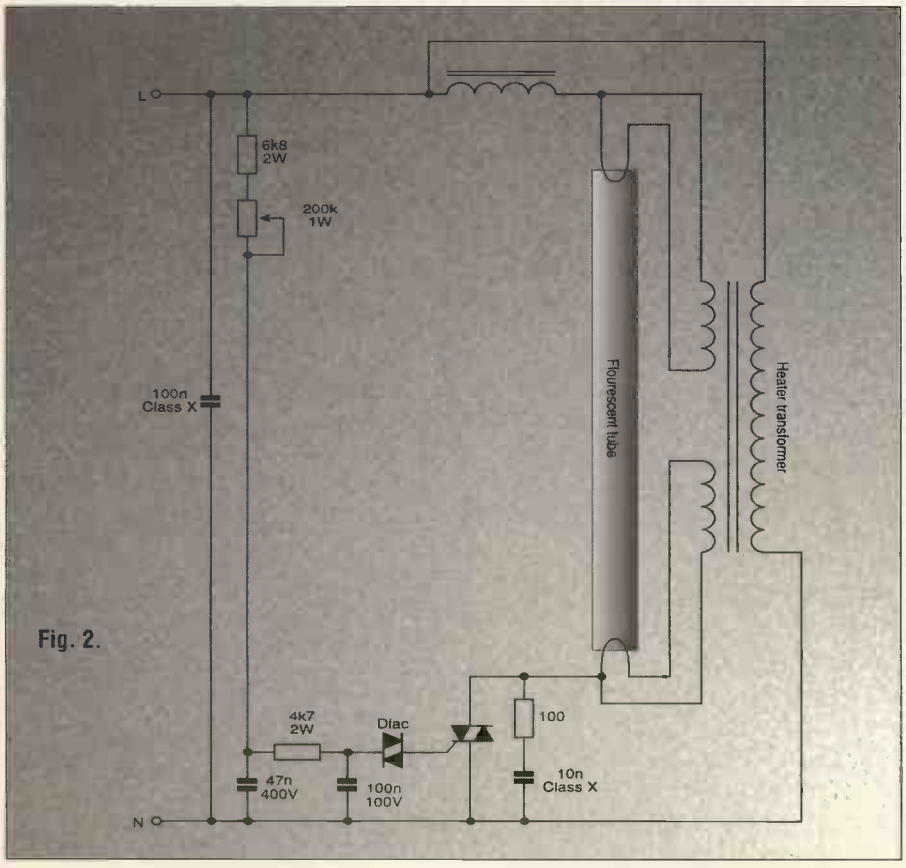

Fig. 2.

The second difficulty is that, in order to strike, a fluorescent tube requires its heaters to be energised. The normal method, illustrated in Fig. 1, is to use a starter, which switches on to conduct briefly when there is a high voltage across the tube. This draws current through the heaters, which begin to glow red. The starter then switches off, normally at a point in the mains cycle at which current is flowing in the inductor (because the current lags the voltage significantly). When the starter switches off, the current flowing in the inductor causes a sharp rise of voltage across the tube, which ionises the gas inside and illuminates the lamp. While the gas in the tube is ionised, there is a relatively low voltage across it, and the starter does not conduct.

So long as the gas remains ionised, the heaters are not required. If too little current flows, or if the current is interrupted for too long, the ionisation fades and the tube ceases to conduct or emit light. However, if the heaters are kept energised, conduction continues down to a lower current, and starts more easily. So one step towards dimming a fluorescent light is to energise the heaters continuously, as illustrated in Fig. 2.

The second necessary step to fluorescent light dimming is to derive phase information from a source which does not depend on

the load current. A simple method of doing this is also illustrated in Fig. 2.

The triggering current for the triac is drawn directly from the mains live, rather than from MT2 of the triac. This ensures that the trigger point is accurately phase-related to the mains waveform, rather than to the load current.

The drawback of this design is that the phase shift components are energised all the time, rather than only until the triggering point of the triac. This necessitates the use of higher powered components than would otherwise be required, and may be considered a disadvantage. However, this design has the advantage of simplicity and consequent reliability.

The two-stage phase shift network used in this design minimises hysteresis effects. A single stage phase shift network tends to give the effect, at least on incandescent lamps, that the brightness control must be advanced to a medium setting before the lamp will illuminate at all. The brightness can then be reduced to a lower setting if desired.

The reason for hysteresis is that when the diac fires it discharges the capacitor. the discharged capacitor will charge to a higher voltage on the next mains half cycle than it would have had it been left charged to the opposite polarity. Thus, firing on one half cycle promotes firing earlier on the next, and firing can be maintained at voltages too low to initiate it.

A more complicated but more precise approach is to use the circuit of Fig. 3. In this circuit, timing is derived not from the mains waveform as a whole, but from the zero crossings. Triac triggering is precisely controlled, and hysteresis is eliminated.

In this design, Q1 generates timing pulses derived from the unsmoothed rectified output from the mains transformer. Q1 only switches off very close to the zero crossings of the ac waveform, generating a short pulse which resets the ramp generator.

The ramp generator uses a Norton opamp. This type of opamp gives a voltage output in response to current inputs rather than, as with conventional opamps, voltage. The inputs of a Norton opamp have the voltage characteristic of diodes with the cathode to the negative supply rail. The reset pulse, therefore, raises the inverting input of IC1A to 0.6V, and resets the charge on the capacitor so that the output falls to OV. When the reset pulse disappears, the output ramps up to keep the charging current of C2 equal to the current flowing through R4 and RV1. The calculation relating to this is shown by the diagram.

To generate triac firing information, the ramp waveform is added to a direct current derived from the brightness potentiometer. The component values are calculated so that the comparator will switch on and then remain on if RV2 is fully clockwise, but will switch off for part of the time if RV2 is turned down slightly. When RV2 is set at zero, the peak of the ramp waveform should be just insufficient to switch the comparator. When the circuit has been built, RV2 should be set at zero, and then RV1 should be adjusted so that the triac just does not fire. It may be easier to test this function using an incandescent lamp as the load.

The triac suggested for this purpose is the TIC206M, a 500V 4A device. It might be thought that a 400V device would do, but with a highly inductive load being switched, the waveform could ring to a higher voltage under some circumstances. Other similar triacs would also be suitable, but the TIC206 is suggested because it has proved itself reliable in similar applications. ■

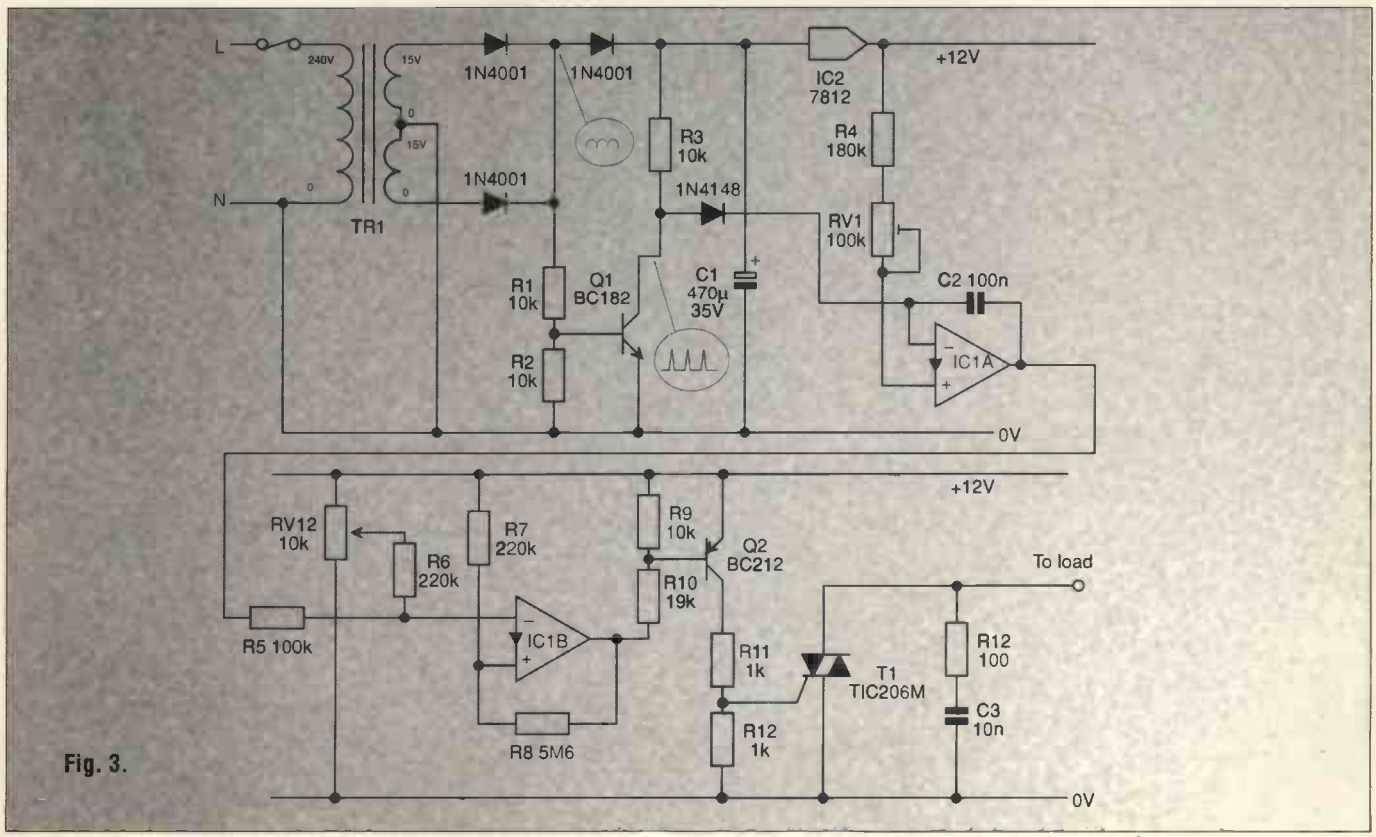

Fig. 3.

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PRACTICAL ELECTRONICS
SCIENCE AND TECHNOLOGY

This month's 25 years looks at reed switches, early Karaoke and Woodpeckers.

September 1966

It seems that European disharmony is nothing new. 25 years ago, PE had a small article on the subject of which system should be used for colour TV. At the time, only B&W was available though people were looking forward to seeing their favorite TV programs in colour. Both Italy and France wanted to use the SECAM IV system while the British were dead set on PAL. At the time it was rumoured that the British televidsion Industry was already ommitted to designing and producing PAL recevivers.

Also in this issue was a feature on reed switches. At the time they were quite new and apart from providing simple switching in the presence of a magnetic field, they can also be used as a magnetic or electronic bistable. The trick is to use a small bias magnet that keeps the contacts in their current state. A larger field is then used to oppose or assist this magnet and open or close the switch.

1976

Karaoke appears to have been developed or at least patented back in 1976. The Sony Corporation of Japan applied for a patent on a device that artificially improves the singers voice to make it resemble the sound of a voice recorded in a professional studio. The idea being that the would be vocalists could then join in with records in their own homes. Both delay and vibrato (frequency modulation) are added to the voice before blending it to the recording. This has had the real singers voice remioved or diminished by cancelling the same sounds that occur on both stereo channels.

1981

This year saw the begining of the electronic music revolution with the Casiotone 202 professional keyboard. Featured in the news section, this instrument was an upgrade of the successful 201. Featuring 8-note polyphony and a 49 note keyboard, the instrument cost a mere £275.

1986

Whatever happened to the Woodpecker? The signals emanating from Riga in the Soviet Union were described in a fascinating article in this issue. Apparently transmitted between 4.5MHz and 30MHz, this the chattering modulation was given the knickname woodpecker. Now that the cold war is over, is it still there? Can we fianlly get the answer as to what it was all about? ■

Electronics Made Easy?

Circuit modelling techniques have more uses than just designing electronic circuits. They can also be used in education as Ben Howard found out with Protolab.

The basics of electronics deal with resistors, capacitors, inductors and voltage sources. Learning about them is really a matter of assimilating the various rules/laws and techniques and applying them. Protolab from Global Specialities is designed to aid in the comprehension of basic circuits and give lessons in their basic use.

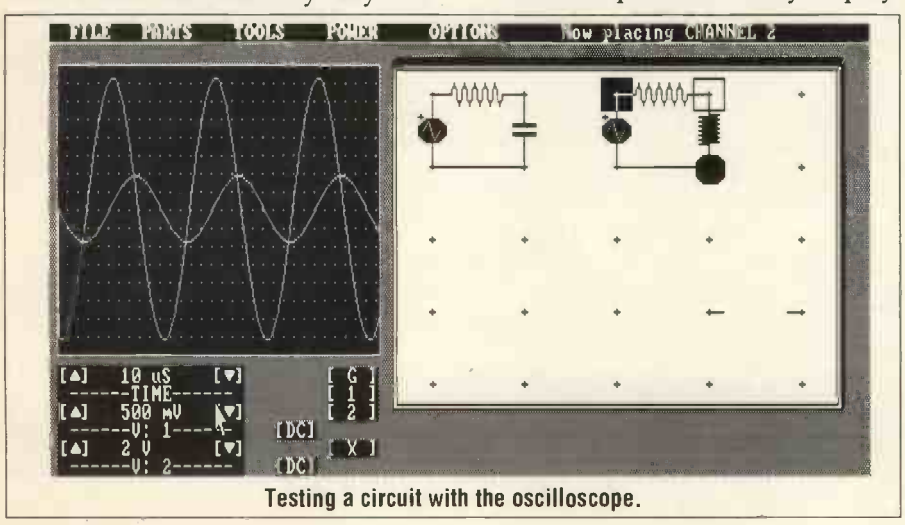
The work area is a prototype board on which components can be placed and connected together. All operations are mouse and menu based and, unfortunately, there are no short cuts via the keyboard – the software doesn't work at all without a mouse which is rather a pity. Putting a component, say a resistor, onto the board means quite a lot of clicking and mouse movement and there is great scope for improvement. Having positioned a component, various values and options can be set up – resistors for example have a value in ohms a wattage and a material such as carbon or wire-wound.

After a little practice, setting up circuits becomes relatively easy and experimentation can get underway. Testing a circuit means connecting up one of the various instruments, voltmeter, ammeter, oscilloscope, or wattmeter, to it after switching on the power. This is derived from a number of possible sources from batteries to AC current generators. The frequency of the latter can be set up to 2MHz with a wide range of voltages.

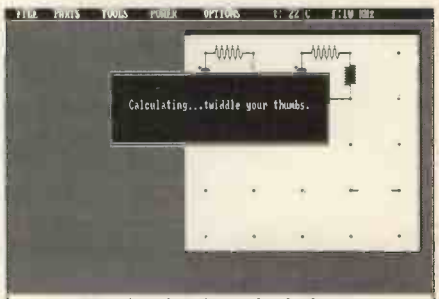
On applying the power, the rather informative message, "calculating twiddle your thumbs..." comes up. Fortunately, the test was performed on a PC with a 386-33 microprocessor so it only took a short while to examine the circuit. On slower machines the wait could be rather longer and, perhaps, quite tedious.

The manual supplied with the package is a large A4 folder with all of the instructions and a selection of experiments. One problem with this is that every time a page was turned, the ring binders spring open and pages begin to fall out. Apart from this, the quality is rather poor but readable.

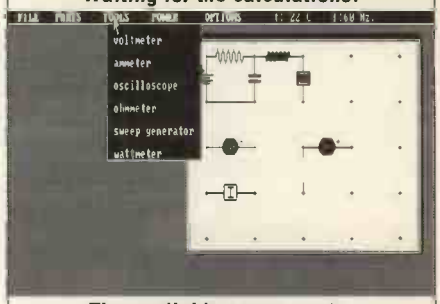
Protolab provides a way to play around with simple electronic circuits. However, the omission of transistors gives it a rather limited scope although it is not too highly priced it has a rather outdated feel to the user interface which could use a lot of improvement such as colour and a keyboard alternative to the mouse. ■



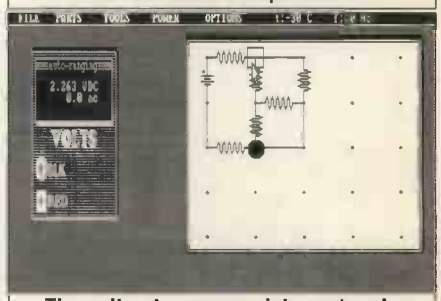
Testing a circuit with the oscilloscope.



Waiting for the calculations.



The available components.



The voltmeter on a resistor network.

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Barry Fox

Videos In The Rain

Barry looks ahead to a future where it will no longer be necessary to hire videos.

It is now clearly on the cards that by the mid-1990s the satellite industry will be doing to the video rental business just what the video rental business did to the cinema industry ten years ago.

In the 70s local cinema management was sloppy. Customers had to queue in the rain, often with no advice given on whether they were likely to get in. Once inside they suffered dirty seats, rotten sound and poor projection of old prints. The management seemed more interested in selling hot dogs and popcorn than screening entertainment.

As the video rental business boomed, with literally tens of thousands of outlets across the country hiring films for a pound or so a night, people who wanted to see films stayed at home instead of going to the cinema. Cinemas closed and the rental business got stronger. In many towns the only way to watch a film was to hire a video or travel to a city centre.

With nearly three-quarters of all homes in Britain now having a VCR, around a million people a day have been hiring videos.

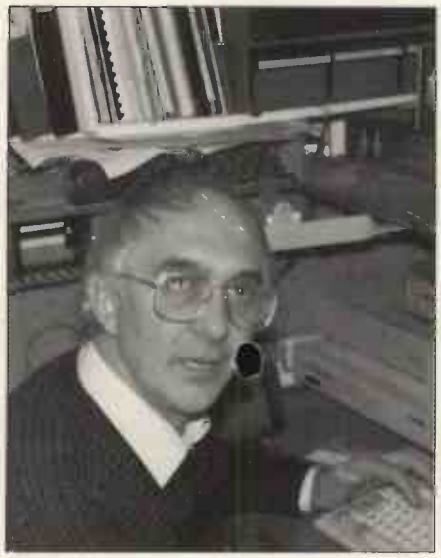
But now the cinemas are striking back, with American-style multi-screen complexes that treat films and customers with respect. A big screen with Dolby surround sound makes the cinema an experience.

The video rental business is hurting. But it will hurt a lot more as the satellite channels get stronger.

No More Programming

The key factor, which the video rental business has so far overlooked, is the use of PDC on satellite movie channels.

PDC, programme delivery control, is a very clever way of letting viewers set their VCR timers without ever needing to know how to set a timer. To cut a long story short, a conventional teletext signal will contain control codes which switch a modified VCR on when a



selected programme begins and switch it off again at the end. A primitive PDC system is already in use in Germany, Austria and Switzerland. Britain has adopted an improved system which looks like becoming the standard for all Europe. It is known as Format 2, although obviously a catchy name is needed. "Startext" is mooted.

Simply Press The Button

Channel 4 is pushing PDC, because the station already uses teletext signals to control its programme distribution round Britain. It is a small step for Channel 4 now to start broadcasting the PDC codes for home use. Channel 4 will start PDC coding this autumn and already Philips has promised VCRs with PDC circuitry. Other manufacturers, including the Japanese, have said they will follow. Although the BBC and ITV networks have agreed to the PDC standard, they have not yet committed to providing a PDC service. But the BBC already has plans to automate its distribution network, along the lines pioneered by Channel 4, by 1993.

The real breakthrough could come if BSkyB starts using PDC on Astra. This looks very likely. BSkyB recently started using Fastext, which adds colour page codes at the bottom of the teletext screen. PDC, or Startext, is natural progression. And PDC would seal the fate of the video rental business.

In the simplest form of PDC, a new VCR will display a page of teletext on the screen which gives the present and advance TV programme listings. A button on the VCR's remote control moves a cursor over the screen so that the viewer can select a programme. Pressing another button then sets the timer to record that programme. But the VCR does not actually start until it receives another code which is transmitted as the programme begins. So a VCR set to tape a film at 10pm on Monday, will sit idle until 10.30pm on Monday, or Tuesday, or next month if, for some reason, transmission is delayed.

This is only half the PDC story. When the TV station transmits trailers of programmes to come, it can bury PDC codes inside the signal. All the viewer need do is press a single button on the remote control to set the timer to tape the trailed programme. There is no need to display a teletext page on screen.

So when BSkyB trails a dozen movies, all the viewer need do to tape them is press the remote control button while the trailer is playing. The VCR will then spring to life the first time that movie is transmitted.

This completely changes the rules of the subscription TV game. The satellite movie channels already broadcast scrambled movies twenty-four hours a day. With pay-per-view access control (which advanced scrambling systems already allow) these channels can transmit movies which would otherwise only be available on rental or in the cinema. Viewers will set their recorders to tape these movies while they are out or asleep, by using the PDC push button.

When this system is up and running, who will want to go out in the rain to the local video library and find that all copies of the film you want to see are out on loan? ■

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W - 12.7
D - 8.0

H - 19.05
W - 25.0
D - 8.0

Pin spacing 2.54
Row spacing 15.24

(b) 0.5" (12.88mm) display height; luminous intensity 0.8mCd @ 10mA

Code	7/+1	DP	CC/CA	1+	25+	100+
Z1941	7 seg	RH	CA	35p	0.23	0.18
Z1942	7 seg	RH	CC	35p	0.23	0.18
Z1943	+1	RH	CA	23p	0.15	0.12
Z1944	+1	RH	CC	23p	0.15	0.12
Z1945	Dual 7 seg	RH	CA	58p	0.38	0.30
Z1946	Dual 7 seg	RH	CC	58p	0.38	0.30

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W- 19.9
D - 8.38

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Code	7/+1	DP	CC/CA	1+	25+	100+
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Z1948	7 seg	RH	CC	47p	0.30	0.24
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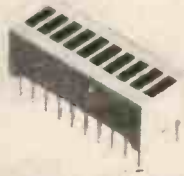

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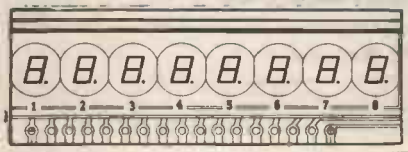

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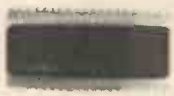

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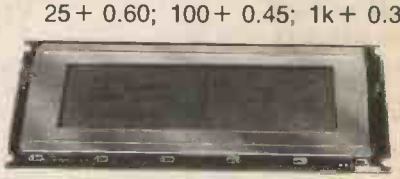
Order Code **Z2119**
Prices ..... **£1.00 each**
25+ 0.60; 100+ 0.45; 1k+ 0.35



Z4335 Dot graphics LCD Module. Hitachi type LM200. 240 x 64 dot, display area 132 x 39mm. Overall size 180 x 75mm. These can be driven by the HD6183 controller which has a built in character generator etc. Supplied with data. Farnell's price, £100.00.
Our Price **£30.00**
HD61830 chip. Supplied at our cost price **£20.00**

SALE PRICES: **Module £20.00** **Chip £10.00**

CREDIT CARD HOTLINE: (0703) 236363 FAX: (0703) 236307

BULK LED's

Now! Standard LED's at prices from less than 2p each! This parcel was supposed to contain a variety of shapes and colours for our LED packs - but there are too many standard red ones to mix in, hence this too good to miss offer!!

Code	Colour	Size	Shape	Manf'r/ Type	Lead length	Qty in £1 pack	100+	1k+
Z2089	Red	5mm	std	FDL4601	25	15	0.032	0.025
Z2090	Red	5mm	std	QTMV5752	28.5	15	0.032	0.025
Z2091	Red	5mm	std	Liton LTL9223A	29.5	12	0.038	0.030
Z2092	Green	5mm	std	-	13.5	14	0.035	0.028
Z2093	Yellow	5mm	std	-	13.5	14	0.035	0.028
Z2094	Red	3mm	min	MLR327	17	18	0.030	0.022
Z2098	Red	7 × 2.55	Rect	Senior elec SE6511D	32	12	0.038	0.030
Z2095	Red	5mm	Rect*	Phillips HR44DL	26	12	0.038	0.030
Z2096	Clear (IR)	4.5 × 1.5	Rect	Honeywell 8406	20	8	0.060	0.040
Z2099	Clear (IR)	4.5 × 1.5	Rect	Honeywell 8706	20	8	0.060	0.040
Z2097	Red	5 × 2	Rect	GIMV57123	29	12	0.038	0.030

* Square with rounded corners

10k + mix of any of the above 0.02 **100k + mix 0.016**

7-SEG LED CLEARANCE!

Type	Size	CC/CA	DP
4710	0.43"	CA	RH
4710A	0.43"	CA	
4720	0.43"	CA	LH
3719	0.3"	CA	RH
3729	0.3"	CA	LH

ALL THE SAME PRICE: 20p each

ANY 10 £1.60 100 £10.00

BULK OFFERS

BIB Accessories

BBCC8 Computer terminal maintenance kit. £2.95 in our catalogue.

Box of 10 £15

Box of 100 £100

BBCC11 Liquid static eliminator. £1.00 in our catalogue.

Box of 50 £20

BZ914 1 Watt Amp Panels. £1.50 in our catalogue.

Box of 128 £40

BZ1522 40 Channel CB Switches. List price £3+.

Box of 100 £40

BZ4132 Firing Speed Adjuster. £1.00 in our catalogue.

Box of 200 £60

Speakers

BA303 (LS010) 57mm 8R Min speaker. Catalogue price £1.10.

Box of 100 £35

BZ578 Fuji 30 × 30 × 3mm speaker.

Box of 1000 £100

Panels

BZ1815 27C256 Panel. Facilities cartridge containing above chip in socket. Catalogue price £2.00.

Box of 100 £60

Map Lights

BZ4071 Catalogue price £1.95.

Box of 100 £60

Switch Mode PSU

BZ660 Catalogue price £5.00.

Box of 180 £200

Spectrum Connector

BZ4139 Catalogue price £1.00.

Box of 100 £25

CEE22 Connector

BZ1799 Fused switched mains inlet. List £3.75.

Box of 100 £40

Pots

BZ1363 50R 2W pot ideal for speaker volume control. Standard spindle.

Box of 200 £20

Panel Clearance

BK541 20kg of assorted populated PCB's. All sorts. **£40**

FM Aerials

BX361 Ribbon aerial.

Pack of 100 £20

Wheels

Type A from Catalogue, 100mm dia × 17mm wide. 9mm dia hole.

Pack of 100 £25

Reed Switches

DTA202 Heavy duty single pole switch with 47mm long body 5mm dia. Normally 40p.

Box of 100 £8

DRA200 As above, but gold plated tags.

Box of 100 £10

PL11 Omron 11 pin valve/ relay bases. Normally 58p each.

Box of 100 £15

RSM83-1A Top quality illuminated keyswitches by Flight Refuelling. Single pole reed switch and fitted min 5V bi-pin TI lamp.

Box of 50 £7

BZ577 5k edgewise pot with switch, as used on small radios, walkmans, etc. Normally 10p.

Bag of 500 £15

BZ576 2.1mm power plug, chassis mounted. Normally 10p.

Bag of 500 £15

BZ8928 4700µ 16V Mullard can 50mm long × 25.4mm dia.

Box of 100 £5

BZ8929 11000µ 25V computer cans. 105mm long × 51mm dia.

Box of 49 £10

BA3915 9V Buzzers. Our catalogue price 80p.

Box of 50 £15

BZ4138 Microslots. In our catalogue at £2.00.

Box of 100 £75

81E Morganite cermet trimmers type 81E-TO5 size. Only one value - 50R.

Box of 50 £7.50

BZ4224 Meter cases 135 × 120 × 45mm. Normally £1.00.

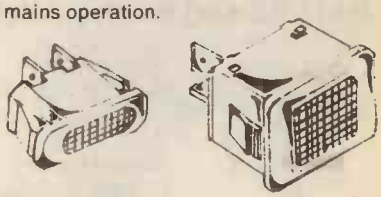
Box of 100 £25

BZ4135 Headphones - mini 'Stethophone' complete with 2 stereo jackplugs. Hinged headbands. 8R. Normally £1.75.

Box of 40 £25

NEON INDICATORS

A parcel of IMO Neon indicators and various other lamps has just been delivered and offers the hobbyist a selection of top quality components at rock-bottom prices! Why are they so cheap? They're all for 110/120V! However, that's no problem because with every indicator we supply a suitable resistor for mains operation.



Type A - Panel mounting 33 × 15mm with 0.25" tags. Clip fix, requires 25 × 12.5mm cut-out.

Z1899 Green

Price: (Any mix) 5 for £1 100+ 0.10 1k+ 0.06

Type B - Panel mounting 36.5 × 26.5mm with 0.25" tags. Clip fix, requires 30 × 22.5mm cut- out.

Z1901 Red
Z1902 Green
Z1903 Amber
Z1904 White

Price: (Any mix) 5 for £1 100+ 0.10 1k+ 0.06

Type C - Small round face 10mm dia. Clip fix, requires 9mm dia hole.

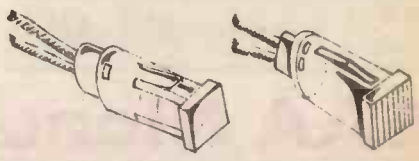
Z1905 Red
Z1906 Green
Z1907 Amber
Z1908 White

Price: (Any mix) 5 for £1 100+ 0.10 1k+ 0.06

Type D - Large round face 13.5mm dia. Clip fix, requires 12.5mm dia hole.

Z1910 Green
Z1911 Amber
Z1912 White

Price: (Any mix) 5 for £1 100+ 0.10 1k+ 0.06



Type E - Small square face 10.5mm. Clip fix, requires 9.5mm dia hole.

Z1913 Red
Z1914 Green
Z1915 Amber
Z1916 White

Price: (Any mix) 5 for £1 100+ 0.10 1k+ 0.06

Type F - Large square face 13.5mm. Clip fix, requires 12.5mm dia hole.

Z1917 Red
Z1918 Green
Z1919 Amber
Z1920 White

Price: (Any mix) 5 for £1 100+ 0.10 1k+ 0.06

Type G - Small round face 7.5mm dia, threaded body, requires 6.5mm dia hole.

Z1921 Red

Price: 5 for £1; 100+ 0.10; 1k+ 0.06

K700 Pack of Indicators, types A-G. May include any of those listed above. Great value for money! **20 for £2.50**

SALE PRICES ON ALL NEON INDICATORS 50% OFF

CREDIT CARD HOTLINE: (0703) 236363 FAX: (0703) 236307

BATTERY BONANZA!!

LEAD-ACID + NICADS AT UNBEATABLE PRICES

EX-POLICE BATTS

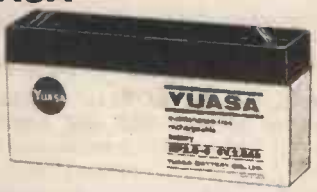
Z4150 Ex mobile radio battery. 56 × 63 × 33mm case (sometimes damaged) contains 8 × AA size rechargeable Nicads. These can be removed by breaking the case open. Each cell rate 1.25V 600mA.
Price **£3.00**
SALE PRICE **£2.50**

Z4149 As above but 84 × 66 × 33mm. There are again 8 cells but they are longer than AA size, being 73mm long. Each cell rated 1.25V 900mA.
Price **£4.50**
SALE PRICE **£3.00**

Z1951 Varta 'Memopac' PCB Nicad 8.4V 100mAh. Although new, these batteries are not in pristine condition, so are offered at way below normal costs. Size 41 × 26 × 14mm.
Price **£1.50**
SALE PRICE **£1.00**

Z1952 AA Nicads - 2 sleeved end to end. Easily split into 2 if required.
Price ..... **£1.50** 25+ 1.10 100+ 0.75
SALE PRICE **£1.00**

YUASA



Sealed lead acid batteries

Z8918 YUASA NP6-12. 12V 6Ah sealed lead acid batery. These have been regularly trickle charged whilst in store. size 150 × 95 × 65mm. List price £28.00.
Prices ..... **£14.95** 10+ 11.20
SALE PRICE **£12.50** 10+9.00

Z8920 YUASA sealed lead acid battery NP10-6 6V 10Ah Size 150 × 95 × 50mm. List £18.00
Our low price ..... **£10.00** 100+ £6.00
SALE PRICE **£8.00** 10+6.00

Nicads

Z1830 Saft 40 RF310 back up Nicad battery PC mounting on 70 × 22.5mm centres. Rated 3.6V. 10mAh (20mA). Overall size76 × 28 × 8mm.
Price **£2.00**
SALE PRICE **£1.50**

Z1829 Nicad 25mm dia × 34mm long rated 4.8V 500mA. PC mounting tags.
Price **£2.00**
SALE PRICE **£1.50**

Z4216 Much sought after 4.8V 150mA batteries with PCB mounting tags on 25mm pitch. Battery size 25 × 16 dia. Ideal for paralleling. **(Slight corrosion.)**
Price ..... **99p each** 10+ 0.75 25+ 0.60 100+ 0.52
CLEARANCE PRICE **4/ £1.00** 100+0.15

Z1409 PC mntg deac. 6V 100mA. Rating made by Memec 30 × 15 × 27mm. List £4.65
Our price **£1.50**
SALE PRICE **£1.00**

Regular Nicads

Rechargeable Nicads

Code	Type	Rating	1+	25+	100+
X131	AAA	180mA/H	£1.20	0.85	0.68
X132	AA	500mA/H	99p	0.72	0.58
X133	C	1.2A/H	£2.20	1.76	1.41
X134	D	1.2A/H	£2.30	1.82	1.46
X135	PP3	110mA/H	£3.95	3.26	3.10

SALE PRICE **10% off**

Regular Dry Cells

A range of batteries from Hi-Tech featuring long life and reliability at a competitive price.

Code	Type	1+	20+	100+
X111	AA/RG/HP7	29p	0.15	0.12
X112	C/R14/HP11	50p	0.26	0.21
X113	D/R20/HP2	58p	0.30	0.24
X114	PP3/6F22	99p	0.52	0.42
X115	1289/3R12	99p	0.52	0.42
X116	PJ996/4R25	£2.57	1.34	1.07

Low cost dry cells
2 popular sizes of battery on a card of 4 at very attractive prices.
X107
Price per pack of 4 ..... **69p** 10+ 0.46 100+ 0.31
X109
Price per pack of 4 ..... **76p** 10+ 0.51 100+ 0.34

AAA Nicads by Sanyo

SUPERDEAL PRICE!! These superb quality batteries are rated 1.2V 200mAh, and may be charged at 20mA or quick-charged at 60mA. Normally costing around £1.50 each, we can offer these at the SUPERDEAL prices below:

Z2117 AAA Nicad **£1.00**
25+ 0.75 100+ 0.60

3M COMPUTER DISKS

New boxed full spec 3M disks at low, low cost. All prices in this box include VAT @ 15%.

	Per Box	10 Boxes		Per Box	10 Boxes
3.5" DSDD	**£9.30**	**£83**	5¼" DSDD	**£6.20**	**£55**
3.5" DSHD	**£19.30**	**£171**	5¼" DSHD	**£11.20**	**£99**

MINIMUM ORDER VALUE £12 + £3 POSTAGE/ PACKING PER ORDER

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PACKS - PACKS - PACKS - PACKS

Many of the Packs listed will be increased in price when our new catalogue comes out later in the year - so take this last golden opportunity to stock up at never again prices!!!

Please note most packs are calculated by weight: quantities quoted are approximate, but we do try to ensure contents are at least the number specified.

SEMICONDUCTORS

K538 Diode Pack - untested small signal diodes like IN4148 etc at a price never before seen!!
Price/ 1000 ..... **£2.50**
SALE PRICE **£1.50**

K547 Zener Diodes. Glass and plastic, 250mW to 5W ranging from 3V to 180V. All readily identifiable, with list supplied.
Price ..... **100 for £4.50**
SALE PRICE **£2.50**

K709 Bridge Rectifiers. Another superb value pack - could include anything from ½ amp to 35A, 25V to 1000V, plastic and metal.
Price ..... **20 for £5.95**
SALE PRICE **£4.00**

K710 SCR's & TRIACS. Big mixture could include all types from TO92 plastic up to DO5 stud mounting with a chance of everything in between! 25V to 1000V, 100mA to tens of amps. Marvellous value.
Price ..... **25 for £4.95**
SALE PRICE **£3.00**

K708 Voltage Regulators. This is an excellent pack, made up from a huge variety of the +ve, -ve, fixed and variable regulators from 1.2V to 37V, 100mA to 5A, plastic and metal.
Price ..... **20 for £6.95**
SALE PRICE **£5.00**

K517 Transistor pack. 50 assorted full spec. marked plastic devices PNP NPN RF AF. Type numbers include BC114, 117, 172, 182, 183, 198, 239, 251, 214, 255, 320, BF198, 255, 394, 2N3904 etc, etc. Retail cost £7.00+
Special low price **£2.75**
SALE PRICE **£1.50**

K575 Plastic Power pack. Mainly TO126 and TO220 transistors, SCRs, Triacs etc. All new full spec marked devices offering fantastic value. Lots of TIP and BD types.
Price **50/ £7.50**
SALE PRICE **£4.00**

K576 Mixed pack of TO220 and 4 pin power mosfets with data and pinouts. Types may include: 2N7004/5/6/14, IRF620/710/720/820, IRF9520/9620, VN0300D etc.
Price ..... **Pack of 25/ £8.00**
SALE PRICE **£4.50**

K577 Surface mount FETs including SM versions of 2N4340/1, 4392, 4857, 5488/9/60/1, also 2N7001/2 etc. Big variety at a low price!
Price ..... **Pack of 50/ £4.00**
SALE PRICE **£2.50**

K536 74 Series Pack. 'On board' chips for you to desolder - containing many LS and other types. Good mix.
Price **100/ £4.00**
SALE PRICE **£2.50**

K536A Bonanza pack of 74 series chips on panels. 200+ chips, may include L, LS, H, HC, HCT etc. (These are actually the Z8900 computer panels with all the memory missing.)
Price **£7.00**
SALE PRICE **£5.00**

K711 74 Logic Pack. All brand new full spec devices from basic gates to complex logic. May include 54 & 64 types as well as 74 in L, LS, S, ALS, H, HC, HCT, etc.
Price for pack of 100 ..... **£6.00**
SALE PRICE **£4.50**

K537 IC Pack - a mix of linear and logic chips, from 6 to 40 pin. All are new and marked, but some may not be full spec.
Price/ 100 ..... **£6.75**
SALE PRICE **£4.00**

CAPACITORS

K544 Mullard Polyester Caps. Cosmetic imperfections, electrically OK. Wide range of values from 0.01 to 0.47µF in 100, 250, 400V working.
Price **200/ £4.75**
SALE PRICE **£2.50**

K546 Polystyrene/ Mica/ Ceramic Caps. Lots of useful small value caps up to about 0.01µF in voltages up to 8kV. Good variety.
Price **100/ £2.75**
SALE PRICE **£1.75**

K528 Electrolytic Pack. Axial and radial, some ready cropped for PCB mounting. This pack offers excellent value for money. Good range of values and voltages from 0.47µF to 1000µF, 6V to 100V.
Prices **100/ £3.95**
SALE PRICE **£2.50**

K518 200 Disc Ceramic Caps. Big variety of values and voltages from a few pF to 2.2µF; 3V to 3kV.
Price **£1.00**
SALE PRICE **95p**

K530 100 Assorted Polyester Caps. All new modern components, radial and axial leads. All value from 0.01 to 1µF at voltages from 63 to 1000!!
Super value at **£3.95**
SALE PRICE **£2.50**

K582 Polystyrene Caps. An amazing range of values from a few pF to .01. Tolerances 1-20%. Voltages to 500V.
Price ..... **Pack of 200/ £4.00**
SALE PRICE **£2.00**

K714 Power Supply Capacitors. All cans, mostly computer grade including popular values like 10,000µ 40V etc. Big mix of values and voltages up to 100V or more and 50,000µF.
Price for box of 25 ..... **£12.50**
SALE PRICE **£10.00**

RESISTORS

K540 Resistor Pack. Mostly ⅛, ¼ and ½W, also some 1 and 2W in carbon film, oxide etc. All have full length leads. Tolerances from 2 to 20%. Excellent range of values.
Prices **500/ £2.50**
SALE PRICE **£1.50**

K523 Resistor Pack. 1000 - yes, 1000 mainly ½W 5 & 10% carbon/ carbon film resistors with preformed leads for PCB mounting. Fair range of preferred values.
Prices ..... **Only £2.50**
SALE PRICE **£1.25**

K529 Bandoliered resistors in bulk, ideal for schools and colleges etc for soldering practice. Up to 5k (depending how they are packed) of one value. Our choice of values and types may include ¼/ ½/ 1W, 1/ 2/ 5/ 10%.
Prices
Pack of 100,000 ..... **£85.00**
SALE PRICE **£50.00**

K580 Metal Oxide resistors, TR4, 0.25W by Electrosil. Wide range of values, mostly 5%, few closer tolerances. Super value pack.
Price ..... **Pack of 200/ £2.00**
SALE PRICE **£1.20**

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- PACKS - PACKS - PACKS - PACKS -

K531 Precision Resistor Pack - High quality, close tolerance R's with an extremely varied selection of values mostly ¼W and ½W tolerances from 0.1% to 2% - ideal for meters, test gear etc.
Prices **250/ £3.00**
SALE PRICE **£1.50**

K572 Resistor Networks. Both SIL and DIL in here, from 6 to 16 pin. Plenty of popular values like 1k, 4k7 and 10k, and a good sprinkling of many other values.
Pack of 100 ..... **£4.50**
SALE PRICE **£3.00**

K503 100 Wirewound Resistors. From 1W to 12W, with a good range of values.
Price **£2.00**
SALE PRICE **£1.50**

K525 Preset Pack. Big, big variety of types and sizes - sub-min, min and std, MP, slider, multiturn and cermets are all included. Wide range of values from 20R to 5M. 100 assorted.
Prices **£6.75**
SALE PRICE **£3.50**

K505 20 Assorted Potentiometers. All types including single, ganged, rotary and slider.
Price **£1.70**
SALE PRICE **£1.20**

OPTO

K539 LED Pack. Not only round but many shaped LEDs in this pack in red, yellow, green, orange and clear. Fantastic mix.
Price **100/ £5.95**
SALE PRICE **£3.95**

K806 LED Pack Contains only Red LED's - round, square, rectangular etc, from 3mm to 7 × 2.5mm.
Price **100/ £5.00**
SALE PRICE **£3.00**

K524 Opto Pack A variety of single point and 7 segment LEDs (incl dual types) of various colours and sizes, opto isolators, numicators, multi digit gas discharge displays, photo transistors, infra red emitters and receivers.
Price ..... **25 asstd/ £3.95**
SALE PRICE **£2.50**

K801 Seven seg LED pack. Big variety of sizes in this pack. May include Red and Green, also overflow/ polarity displays, single/ double digit, also 7/ 8/ 9 digit magnified displays. Sizes from 0.11" to 0.8".
20 pieces for just **£3.95**
SALE PRICE **£2.50**

K804 Lamp Pack. A superb quality pack containing a wide variety of small lamps. Many different types - wire ended, bi-pin, slide, MBC, MES, LES, TI, wedge, miniflange etc in voltages from 2.5V to 220V. Most are marked with voltage/ current.
Pack of 50 ..... **£4.00**
SALE PRICE **£2.50**

SWITCHES AND RELAYS

W4700 Push Button Banks. An assortment of latching and independent switches on banks from 2 to 7 way. DPCO to 6PCO. A total of at least 100 switches.
Prices **100/ £6.50**
SALE PRICE **£3.50**

K587 A selection of toggle switches, mainly from page 122 of our 1990 Catalogue. Includes single pole to 4 pole sub min and min. Pack of 50, £30 at cat prices.
Price **£14.95**
SALE PRICE **£9.95**

K520 Switch Pack. 20 different assorted switches - rocker, slide, push, rotary, toggle, micro etc. Amazing value!
Price **£2.00**
SALE PRICE **£1.50**

K542 Reed relays. Mostly DIL, single pole & double pole also some changeover, these are manufacturers rejects, but a good proportion work. 5V-50V coils 50 assorted.
Price **£3.30**
SALE PRICE **£1.50**

K569 Reed Switch Pack. A selection of about 15 types of reed switch from submin 12mm long to 5A rated 50mm long, mosly form A (make), few form C (changeover).
Pack of 30 ..... **£2.75**
SALE PRICE **£1.75**

K715 DIP Switch Pack Tremendous selection of DIP switches, mostly from Page 121 of 1991 catalogue. Everything from 1-9 way at an astonishingly low price! Pack of 20
SALE PRICE **£2.00**

PLASTIC/ SLEEVING

K534 Sleeving Pack - we've now accumulated enough sleeving to offer this very popular pack again. A terrific variety of types sizes and colours form 1-20mm bore, OD's from 2-24mm. Lengths from 10mm to 76mm. Well over 25 different types, including PVC, rubber, silicone etc.
Price **200/ £2.00**
SALE PRICE **£1.75**

K564 PCB Stand-offs. A mixture of 8 different styles and sizes from 4.75 to 12.7mm high.
Price **100/ £2.40**
SALE PRICE **£1.50**

K565 Miniature PCB Supports in Nylon. 6 different styles and sizes from 6.35 to 13.24mm high.
Price **100/ £2.20**
SALE PRICE **£1.20**

K533 Silicon Rubber Sleeves. 20mm long, 2mm bore, 1mm wall.
Price **100/ 50p**
SALE PRICE **40p**

CONNECTORS

K557 Terminal Blocks. In all shapes and sizes, solder and screw from single way to 12 way in many different current ratings.
Price **20/ £2.40**
SALE PRICE **£2.00**

K803 PCB headers pack with/ without ears, straight and right angle from 10-64 way.
Pack of 20 ..... **£5.50**
SALE PRICE **£3.00**

K802 Pack of DIN41612 connectors. These popular PCB connectors come as 32/ 64/ 96 way. Both plugs and sockets, some with pins missing. Normally costing £1- £3 each.
Pack of 25 ..... **£8.00**
SALE PRICE **£5.00**

MOTOR + GEAR PACK

K579 This pack contains 10 assorted battery powered motors (mostly 3V) + 90 gears etc, 16 - 60mm dia + worms and shafts. Amazing value.
Price **£7.95**
SALE PRICE **£6.95**

Are you a Bargain List Subscriber? If not, fill in the Order Form on Page 13 and become one - then you won't miss the Bargains!!

MINIMUM ORDER VALUE £12 + £3 POSTAGE/ PACKING PER ORDER

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PACKS - PACKS - PACKS - PACKS

HARDWARE

K553 2BA screw mix. Mostly steel, few brass/nylon etc, cheesehead and countersunk, mainly in lengths from 3-38mm. Excellent selection.
Price ..... **100/£2.50**
SALE PRICE **£2.00**

K551 6BA/ 8BA screw mix. Again an amazing mixture of lengths from 3-38mm. Nearly all cheesehead and countersunk in steel.
Price ..... **200/£2.40**
SALE PRICE **£2.00**

K811 6BA screws. Nearly all pan head pozi in plated steel. Lengths to 16mm.
Pack of 100 ..... **£1.50**
SALE PRICE **£1.20**

K805 M2 screws. Good mix, this. Cheesehead, c/s, pan, mostly pozi, few slot. Lengths to 12mm. All steel with various plating.
Price **£1.80**
SALE PRICE **£1.50**

K806 M2.5 screws. Various heads - mostly pan and c/s pozi. All plated steel. Lengths to 10mm.
Pack of 100 ..... **£1.50**
SALE PRICE **£1.20**

K807 M3 screws. Good selection of sizes including a few brass. Most heads. Lengths to 35mm.
Pack of 100 ..... **£1.50**
SALE PRICE **£1.20**

K808 M4 screws. Huge variety! Pan, c/ s, cheese, set, slot, pozi. From 4-50mm long. All steel, plated, black/ hi-tensile.
Pack of 100 ..... **£1.60**
SALE PRICE **£1.30**

K809 M5 screws. As above.
Pack of 100 ..... **£2.00**
SALE PRICE **£1.60**

K820 Large bolts and set screws. Could weigh as much as 150g each (up to 16mm dia × 90mm long). Practically all are steel. Many different heads.
Parcel weighing 5kg **£10.00**
SALE PRICE **£8.00**

K816 Large washers 16mm and over (up to 30mm). Internal dia 8.5-17mm. Mostly plain steel, some shakeproof.
Pack of 200 ..... **£2.00**
SALE PRICE **£1.60**

K817 Small washers. Big variety including shakeproof, spring and plain. A few brass and non-metal. 5-16mm OD, 2.4-8mm ID.
Pack of 500 ..... **£2.00**
SALE PRICE **£1.60**

K599 Captive, shakeproof and locking nuts in sizes from 2BA to 6BA, mostly alloy.
Price per pack of 100 ..... **£3.20**
SALE PRICE **£2.00**

K598 Solder tags. Good variety of sizes from 3-11.5mm ID. Includes some small crimp types. Most are double ended. Great value.
Price **200/ £2.20**
SALE PRICE **£1.60**

K527 Hardware Pack. This has a large variety of PK (caps) and self tapper screws from 2 × 1½" up to 8 × 1 ¼" also washers, some BA, metric and Whit. Screws plus other miscellaneous brackets, captive nuts and bits and pieces. 1kg (up to 1000 pieces).
Prices **1kg/ £4.00**
SALE PRICE **£2.50**

K535 Spring Pack. Approx 100 assorted compression, extension and torsion springs up to 22mm diameter and 30mm long.
Price **£1.70**
SALE PRICE **£1.00**

K814 Roll pins in a variety of sizes from 1.7mm-5mm dia, 8-29mm long. Some are a little rusty.
Pack of 100 ..... **£2.00**
SALE PRICE **£1.30**

K815 Pillars and stand-offs. This includes conventional threaded pillars and standoffs, also unusual shaped types too, up to 60mm long. Mostly steel, some ally and non-metal. Nearly all M3/6BA or larger.
Pack of 50 ..... **£2.00**
SALE PRICE **£1.30**

MISCELLANEOUS

K555 Fuses. A marvellous selection of 15, 20, 25 and 32mm fuses both cartridge and wire ended in quickblow and antisurge varieties. May be anything from 32mA to 50A!!
Price **100/ £3.95**
SALE PRICE **£2.50**

K574 Wire link pack. A wide range of sizes from 3mm to 50mm for use with Breadboards or PCBs. Some are bare, a few are not preformed.
Price per pack of 250 ..... **£1.00**
SALE PRICE **75p**

K561 Coils and Chokes. Pot cores, IF cans, open wound coils, chokes, etc from a few µH upwards in a wide varlety of sizes and values.
Prices **50/ £2.80**
SALE PRICE **£2.00**

K573 Pack of assorted TOKO RCL coils, mainly in 10 × 10mm screened cans.
Price **100/ £6.00**
SALE PRICE **£3.00**

K541 Printed Circuit Boards. A wide variety of high quality printed circuit boards including audio, RF, digital etc all covered in components - resistors, capacitors, transistors, ICs, LEDs, switches etc, etc. A big pack of 2kg.
Price ..... **Only £7.00**
SALE PRICE **£4.00**

K712 Crystals. Mostly HC60 and HC18U in a wide variety of frequencies from a few hundred kilohertz to many megahertz and the odd crystal oscillator module or two.
Price ..... **20 for £4.95**
SALE PRICE **£4.00**

K713 Fuseholders. Panel and chassis mounting from a basic clip to high current enclosed types for 15, 20 and 32mm fuses.
Price for pack of 50 ..... **£4.00**
SALE PRICE **£3.00**

Transducer/ Sounder Parcel
Remains of STC sounder on P120 of 1991 cat + other piezo devices. A parcel of 10 assorted.
SALE PRICE **£6.00**

Power Supply Parcel
K586 This one's an absolute gem! Contains a selection of conventional and switch mode power supplies, including AA12531, Z4215, Z4311 + 7 others!! Parcel of 10 originally selling for £40+.
SALE PRICE **£15.00**

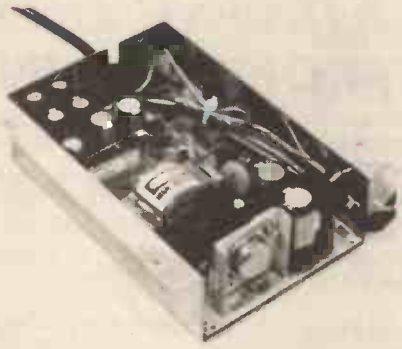
PHOTOGRAPHIC

K716 Odds and ends of Flash units, dedicated Flash Modules, Lens converters, incomplete cameras (at least 3).
Excellent value at **£10**

MINIMUM ORDER VALUE £12 + £3 POSTAGE/ PACKING PER ORDER

CREDIT CARD HOTLINE: (0703) 236363 FAX: (0703) 236307

THE POW - POW -



ASTEC Model AA12531
Switch Mode Power Supply

Input: 115/ 230V ac 50/ 60Hz
Outputs: V1 + 5V 5A
V2 + 12V 0.15A
Size: 160 × 104 × 45mm

Partially enclosed panel with fixing holes in steel case on 120 × 125mm centres. Inputs and Outputs are on colour coded leads, there is also an EEC socket on a flying lead.

ONLY £6.95 each

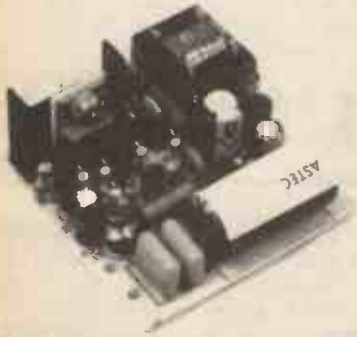
100+ £3.50+VAT 1000+ £2.80+VAT

CONVERSION KIT GIVES TWO EXTRA OUTPUTS!

Max Current from each output: +5V@ 6A; +12V@ 3A; -12V@ 300mA; -5V@ 500mA

Note: Max Total Wattage is 40W - eg +12V@ 2A; -5V@ 2.5A; -12V@ 200mA; -5V@ 20mA etc.

Complete Kit of parts + Instructions **K725** **£3.50**
Instructions only **K726** **£1.00**



Z660 Astec switched mode PSU type AA7271. This small PCB, just 50 × 50mm will accept 8-14V input and give a stable 5V dc at up to 2A output. The 6 transitor circuit provides current overload protection, thermal cut-out and excellent filtering. Offered at a remarkably low price.

Price **£5.00**

SALE PRICE **£3.00**

Over the years, we've had many different switch mode power supplies, but this latest unit is without doubt one of the finest we've ever seen! Made by Astec, it is a totally enclosed steel cased unit measuring 175 × 136 × 65mm, which has incorporated in it a switched and fused IEC mains inlet. Inside, the PCB is 160 × 80mm with output pins fitted on one end. A connector to these pins to extend the outputs to the exterior of the case is provided.

Specification:

Model Number:	**BM41012**
Input:	115/230V, 50/60Hz
Outputs:	+5V 3.75A
	+12V 1.5A
	−12V 0.4A
Total Wattage:	65W

Prices ..... **£12.95**; 100+ 9.00

- ★ 3½ digit 8mm LCD display
- ★ Fully autoranging
- ★ Display hold facility
- ★ Diode and continuity test
- ★ Probe styling
- ★ Automatic polarity and zero
- ★ Protective carrying case

A £34.95 AUTORANGING MULTIMETER (1991 Catalogue) LESS THAN ½ PRICE !! YOURS FOR JUST £16

Order Code **DM1360**

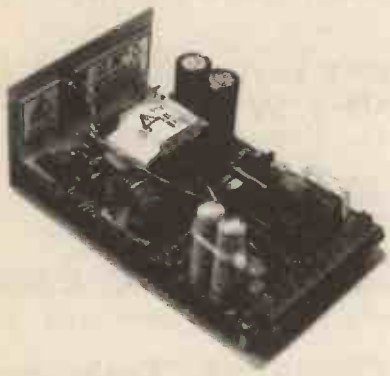
AC volts	0-2-20-200-500 Vac ±2.3%
DC volts	0-200m-2-20-200-500 Vdc ±1.3%
Resistance	0-200-2k-20k-2M-20MΩ ±2%
Dims	133 × 29 × 17mm

MINIMUM ORDER VALUE £12 + £3 POSTAGE/ PACKING PER ORDER

CREDIT CARD HOTLINE: (0703) 236363 FAX: (0703) 236307

POWER PAGES!!!

Switch Mode PSU's



Z8887 Made by STC, this 160 × 100mm panel is attached to an aluminium chassis. 165 × 102 × 65mm and has a single 5V 6A output. Supplied with connection details, we can offer these at a fraction of their normal cost!

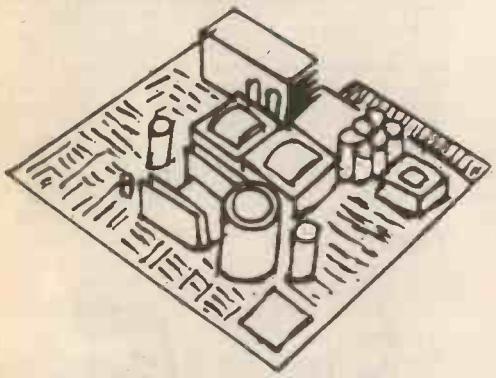
Price **£5.95**

SALE PRICE £4.95 100 + 3.00

Z8888 A larger version of the above, PCB 220 × 100mm and chassis 225 × 102 × 65mm providing a single 5V 10A output. Supplied with connection details.

Price ..... **Only £8.95**

SALE PRICE £7.95 100 + 4.50



Z8890 DC-DC Converter Boards. These panels 220 × 195 require 50V DC input for a 5V 19.5A output. Inputs and outputs on DIN41612 connector. These brand new panels made by STZ are now being offered at just:

Price ..... **Only £7.95**

SALE PRICE £6.95 100 + 3.20

High Power Inverters

Gardeners square wave type **GR75108**. 50V 85A DC IN, 240V 50Hz 4kVA OUT.

Price ..... **£345 + CARR**

GR75107 2kVA ..... **£230 + CARR**

GR75106 1kVA ..... **£175 + CARR**

Constant Voltage Transformers

These give a constant 240V AC out with 1% regulation, for a wide tolerance input voltage.

Centronic Reguvolt Model 6000C.

Input ..... 240V -20 + 10%, or 220V + 20-12% (192-264V)

Output ..... 240V 1% 25A (6kVA) or 220V 1% 27.27A

Price ..... **£333.50 + CARR**

As above, but 5kVA ..... **£287.50 + CARR**

As above, but 4kVA ..... **£253.00 + CARR**

As above, but 2kVA ..... **£184.00 + CARR**

MODEL RAILWAY CONTROL & SWITCHING UNIT

This ready built versatile piece of equipment allows:

★ Full forward and reverse control of trains using regulated and smoothed supply (1.5A)*.
*Requires 3 components (supplied) to be soldered into panel.

★ Relay control of 5 separate circuits. (10A change over contacts; ideal for points operation).

★ Powering of auxillary equipment - 2 separate 5V 1A outputs.

A mains powered panel 185 × 105mm contains all electronics. All voltages are fully stabilized and both input and output are fused.

Connections, both input and output are by screw terminals which are clipped onto the on-board pins.

The five 12V relays are controlled by transistor circuits which require only 5V 30mA, supplied by the on board power supply.

Supplied uncased with circuit and wiring diagram. (SAE for free copy.)

Suitable black ABS plastic case **£3.50**

Order Code Z8897 **Price £19.95**

SALE PRICE 50% off: ONLY £9.95

STC POWER SUPPLIES

These are extremely well made linear power supplies by STC (series 15) offering exceptional value for money. Chassis size 124 × 100 × 41mm. Input voltage can be 100, 120, 220, 230, 240V. There is over-voltage protection on both models.

Z8898 Type 15AAA. Output 5V@ 3A. STC price in 1987 £43.99.

Our Price **£8.00**

Z8899 Type 15AAB. Output 15V@ 0.5A twice. STC price in 1987 £60.09.

Our Price **£10.00**

Z8915 Type 15AAC. Ouput ± 15V@ 0.5A. STC price in 1987 was £60.38

Our price **£10.00**

Z8916 Type 15AAH. Ouput 15V@ 1A with OVP. STC price £43.99

Our price **£10.00**

Z8917 Type 15AAJ. Ouput 15V@ 1A. STC price £41.69

Our price **£10.00**

Any 2 in this Box £12.00

Z975 PSU - Mains input via 13A built in plug. Output 14V 600mA ac. Case 92 × 57 × 52mm.

Price **£3.50**

SALE PRICE £2.50

Z4311 Power supply by Thorn-EMI. Built in 13A plug. Case size 95 × 55 × 50mm. Ouput 11.4-0-11.4V ac@ 0.45A. 10.3VA total. Has 3 core 2m lead attached.

Price **£2.00**

SALE PRICE £1.20

Oric Power Supply

Z4208 Moulded plastic case with built in 13A plug. Output 9V dc at 600mA delivered to 2m lead with 2.5mm power plug.

Price **£3.50**

SALE PRICE £2.50

Z425 Siliconix mains input, 4.5V dc 150mA output to 3.5mm jack plug on 2m lead. Built-in continental 2-pin plug. Size 62 × 46 × 35mm.

Price **£1.50**

SALE PRICE £1.00

Z8802 Battery charger unit. 2 part vacuum formed black plastic case 570 × 210 × 85mm with room for 10 × 2.6AH 6V sealed lead acid batteries. Inside is a neat PSU - RS torroidal transformer 207-958. 120/240V primary 0-9, 0-9 secondary, each at 10VA. There is a bridge rectifier and smoothing cap. The output is taken to a PCB 510 × 45mm containing 10 identical charging circuits. Each has a TIP31A, 741, IN4002 and couple of Rs, and a 3 pin connector.

Clearing at ..... **£8.00 each**

10 SUMMER SALE LIST — GREENWELD

CREDIT CARD HOTLINE: (0703) 236363 FAX: (0703) 236307

Power Supply Capacitors

Code	Value	Voltage	Ripple	Mnf'r	l × d	Mnf'rs Price
Z4343	2200µF	40V	2.7A	LCR	45 × 26	2.12
Z4344	4700µF	63V	4.4A	BHC	56 × 36	3.77
Z4345	10,000µF	40V	4.9A	BHC	56 × 41	3.89
Z4346	15,000µF	25V	5.5A	BHC	56 × 41	3.96

Prices:

Z4343	60p	25+ 0.45	100+0.30
Z4344	£2.00	25+ 1.60	100+1.30
Z4345	£2.50	25+ 1.80	100+1.50
Z4346	£2.50	25+ 1.80	100+1.50

SALE PRICES **50% off**

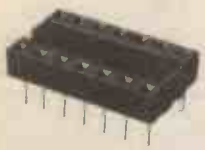
All these have screw terminals except those marked * which have tags.

Code	Value	Volts	Mnf'r	Size	1+	100+
Z4404	100	350	Novea	48 × 30*	£1.00	0.60
Z4405	220	400	Novea	84 × 36	£2.50	1.50
Z4406	470	400	Novea	84 × 51	£3.00	2.00
Z4407	680	400	Novea	116 × 51	£3.00	2.00
Z4408	2200	160	Novea	84 × 51	£2.00	1.20
Z4409	2200	250	LCR	116 × 64	£3.00	2.00
Z4410	3300	16	LCR	45 × 26*	30p	0.15
Z4419	3300	25	LCR	50 × 26	40p	0.25
Z4411	3300	80	LCR	55 × 35*	£1.00	0.60
Z4412	3900	63	Novea	115 × 35	£1.20	0.75
Z4413	5600	50	Novea	84 × 35	£1.50	0.90
Z4414	10000	6.3	Novea	50 × 35	£1.00	0.60
Z4415	10000	25	Novea	84 × 35	£2.00	1.20
Z4416	10000	85	LCR	105 × 40*	£3.00	2.00
Z4417	15000	40	Novea	115 × 50	£2.50	1.50
Z4418	15000	63	Novea	115 × 66	£3.00	2.00

SALE PRICES **50% off**

Capacitor Clearance

Code	Value	per 100	1k+
YV	220µ 10V	£3.00	0.015
KB	470µ 25V AX	£3.00	0.015
KB	4700µ 16V AX	£3.00	0.015
KB	10µ 16V R	£3.00	0.015
KB	220µ 16V R	£3.00	0.015
KB	4µ7 63V R	£3.00	0.015
KB	1µ 100V R	£3.00	0.015
KB	10µ 63V R	£3.00	0.015
KB	100µ 25V R	£3.00	0.015



DIL Socket Delights!

Low Profile, tubed.

Code	per 100	1k+
ST 8	£2.25	0.015
CS 14	£3.00	0.020
ST 16	£3.75	0.025
ST 18	£3.75	0.025
CS 20	£3.75	0.025
ST 24	£5.25	0.035
ST 28	£6.00	0.040
ST 40	£9.00	0.060

Resistors

Low value wirewound

Z1877	0R1 9W	6 for £1
Z1878	0R27 9W	6 for £1

Both available in boxes of 250 @ £15 per box.

Z0173	1R2 2⅛W	All at the
Z1086	1R5 2⅛W	same price
Z0873	2R2 2⅛W	100/ £3.00
Z0102	56R 5W	

All available in boxes of 1000 @ £15 per box.

1 Watt Carbon Film

Z0872	1R2	All
Z0703	1k	£1/ 100
Z0226	2k2	

All available in boxes of 1000 @ £5 per box.

RESISTOR STOCK CLEARANCE -
One million assorted resistors for just £300 + VAT + Carr (That's 3p/ 100)

Wire & Cable

Ribbon Cable Bonanza!

14 & 16 way Grey 100ft reels

Z30176	14 way	£6.00
Z30197	16 way	£8.00

Joystick

Z004 Skeleton Joystick, switch type. Good quality, made by AB. Brass spindle has 44mm long black plastic handle attached. Body has 4 mounting holes. These really are a fantastic bargain!!

Price ..... **Only £1.00**

SALE PRICE **2 for £1.00**

Uniqard Development Boards

E1S, E2S & E1D series are circuitry development boards for memory (both dynamic and static. RAM and ROM) and also for combined CPU-memory function.

EPB series have backplane and motherboard uses (both 3U and 6U) and the smaller lengths are also used for extender cards. A range of profiles with and without mounting flanges and extra busbars are available. Used as high density memory development boards they only require a small amount of extra wiring.

Order Code	Type	Size	Price each
129B-PCB-006SF	E1S-00	3U 0.3"	£12.62
129B-PCB-007SF	E2S-00	3U 0.6"	£12.62
129B-PCB-011SF	EBP-02	Extender 3U-220	£8.46
129B-PCB-012SF	EBP-03	Extender 6U-160	£18.18
129B-PCB-014SF	EBP-05	Horizontal Mntg 6U-112	£11.00

SALE PRICES **75% OFF**

Memorex Tape

Z9012 Memorex MRX IV ⅛" computer tape. 600ft on 175mm dia spool. 6250BPI. In case, in sealed poly bag. List £7.49.

Our price ..... **£3.50** 50+ 2.00

Audio Amplifier Panels

1W Amplifier - mono

Z914 Audio amp panel 95x65mm with TBA820 chip. Gives 1W output with 9V supply. Switch and volume control. Just connect battery and speaker. Full details supplied. Only £1.50: 10 for £12.00: 25 for £25.00: 100 for £75.00

SALE PRICES **£0.75 each**

10+ 0.50: 25+ 0.40: 100+ 0.32

1W Amplifier - stereo

Z915 - Stereo version of above 115x65mm featuring 2xTBA820M and dual volume control.

£3.50: 10 for £30.00: 25 for £65.00: 100 for £200.00

SALE PRICES **£1.75 each**

10+ 1.30: 25+ 1.10: 100+ 0.85

Tick-tock, Tick-tock Timers!!!

Z4199 60 second timer. High quality instrument by Micron. Can be set by knob on top to any time from 0-60 seconds, after which time a pair of contacts close. Although these are 110V, they work off standard 230V mains with the series resistor included. Notes about its operation are also supplied. Overall size 105 × 63 × 80mm. Individually boxed.

Price **£3.75**

SALE PRICE **£2.00**

Tape Deck

Z4274 Micro cassette mechanism 100x74x35mm as used in dictaphones/ answerphones etc. Complete with head, optical sensing and hall effect switch, solenoid and motor. Was £2.00

SALE PRICE **£1.00**

CB Aerial Eliminator

Z4081 Enables any ordinary car radio aerial to be used with a CB set. Originally sold at £7.95.

SALE PRICE **2 for £1.00**

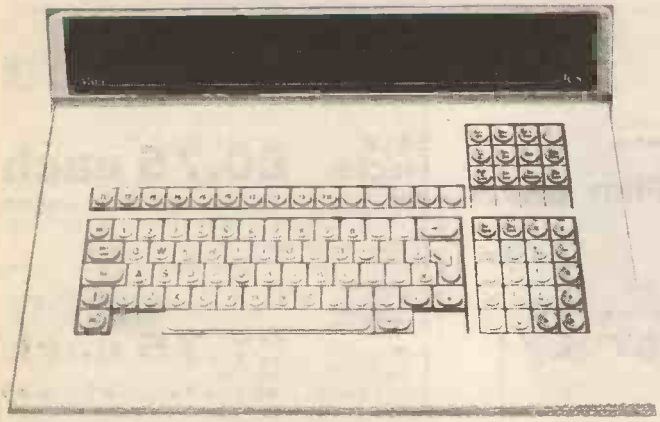
MINIMUM ORDER VALUE £12 + £3 POSTAGE/ PACKING PER ORDER

GREENWELD SUMMER SALE LIST 11

CREDIT CARD HOTLINE: (0703) 236363 FAX: (0703) 236307

VISTEL II

Total Communication for Deaf People



Vistel II is a visual telephone plus 'answerphone' which allows everyone to communicate over the telephone network.

By simply dialling a number and typing in your message you can be in touch with anyone else with similar equipment - whether they are across the road or at the other end of the country.

By pressing one clearly marked button you can send or receive typed messages even when you are out. Additionally you can prepare and send a message at a particular preset time (during cheap periods to save you money).

With Vistel II not only can you talk to other Vistel II users but Vistel I (of which there are over 1,000 already in use by deaf people throughout the UK), Telecom Gold, Breakthrough trust's BKU Mailbox Network, Mailink, the RNID telephone exchange or any other computer with a modem.

Specification

- Dimensions: 34cm × 45cm × 13.7cm
- Weight: 4.5kg
- Full 'QWERTY' keyboard plus 'function' keys for ease of use.
- 40 character screen which displays your messages quickly, clearly and quietly.
- Text editor for preparing recording and storing information.
- Memory for up to 9,500 characters.
- Auto-answering capability for receiving calls even when you are not there.
- Auto-dialling capability for sending messages during cheap rate telephone periods.
- Real time clock.
- Personal telephone directory for storing your most commonly used numbers.
- Calculator.
- Printer interface for connection to a printer.
- Telecom Gold, or BKU mail box, function key.
- Vistel II runs from mains with battery back-up so memory is retained even when Vistel II is turned off.
- For connection your only requirements are a power point and a British Telecom jack plug socket.

Options:

- Printer

These units are new and boxed, but because the company who manufactured them has gone bankrupt they are offered without guarantee. There is a comprehensive 143 page instruction manual provided. These units originally sold for over £500.

Our Bargain Basement Price £150

Sale Price £75

If you want to look through the manual first, send £12 (£10 deposit + £2 post): £10 refunded on its return.

SEMICONDUCTORS - If you're seriously into Semi's, ask for our Bulk Buyers list - Diodes, Transitors, IC's etc, all at knockout prices!!

MEMORIES ETC

Loc	Type	Qty	1+	100+
M	TC511000Z-12	349	£5.00	3.00
M	TMS4256-12	508	£2.50	1.50
M	MSL27128K	142	£2.50	1.50
M	MB81256-20	296	£5.00	3.00
M	TMM2063P-10	92	£3.00	2.00
M	MB81C68-35	624	£2.00	1.30
M	TMS4161-15NL	3102	£1.00	0.60
M	TMS2516JL	184	£1.20	0.70
M	TMS2114L-45	141	£0.60	0.40
M	MC68A50P	77	£1.00	0.60
M	HN482764-4	98	£2.00	1.30
M	HM4864-2	226	£1.50	1.00
M	MK4118N-2	33	£2.00	1.30
132	SAB8088-P	300	£4.00	2.00
OSL	27C64-2	40	£2.00	1.30
OSL	AM2952DC	96	£1.00	0.60
OSL	MM58274BN	100	£2.50	1.50
132	AM2966DC	780	£1.00	0.60
132	MC10131L	600	£1.00	0.60
132	MC8T95	188	£1.00	0.60
132	UPB8282D	180	£1.00	0.60
132	MC10109L	425	£1.00	0.60
132	M5L2732K	112	£1.50	1.00
132	R65C22P2	127	£2.00	1.30
132	SCN2681A	88	£3.00	2.00
132	LH5164D-10	400	£2.00	1.30
132	TMM2016P-1	154	£1.00	0.60
261B	D4364-12	27	£2.00	1.00
261B	HM3-2064U-5	14	£2.50	1.50
261B	HM6264-12	91	£2.50	1.50
261B	HM62256-12	176	£5.00	3.00
261B	SAA5231	55	£4.00	2.00
261B	SAB3035	41	£4.00	2.00
503	Z80A CTC	52	60p	0.40
503	Z80A PIO	68	60p	0.40
503	Z80A DART	55	£1.50	0.80
503	R6502	56	£2.00	1.10
503	M80C85A-2	144	£2.50	1.30
503	P8259A	21	£1.00	0.60

Dynamic RAM Modules

Z1985 Dynamic 256k RAM modules SIMM. 8 × 41256-12 with room for 9th chip. Similar to types costing £100+.

Our low price ..... just £10.00 each

SALE PRICE £7.50

Z1818 Dynamic RAM modules by NEC type MC41256A8A-12. These SIPs are on panels 79mm × 17mm and have 8 × 41256 RAMs, giving 256k of memory. Similar to Their price £107.00.

Our price £30.00

SALE PRICE £7.50

Bridge Rectifiers

		1+	100+
26MB20A	25A 200V	£1.50	0.75
BYW20	25A 50V	£1.00	0.50
5V4B20	4A 200V	3/£1.00	0.20

Speech Chip Bargain

The 5P0256 is probably the best known speech chip available, with lots of circuits published by various magazines. Our competitors sell this for £7.95. We'll send you one with our info pack for a lot less!

SALE PRICE £2.00 100+ 0.50 1000+0.40

Epson Serial Printer Interfaces

Z4163 Type 8148. Can be built into any Epson FX and RX series dot matrix printers for connection to any asynchronous data transmission system with bit rate from 750-9,600 BPS. Ready built PCB comes with comprehensive user manual. 2K Buffer. These cost £60.00 normally.

Our special low price £25.00

SALE PRICE £12.50

1992 Catalogue - Yes we know we're only half way through 1991, but if you want to be first with the Bargains, you can place an advance order now - just add it to your order where indicated. This will be sent to you on publication 1st October, 1991.

MINIMUM ORDER VALUE £12 + £3 POSTAGE/ PACKING PER ORDER

12 SUMMER SALE LIST GREENWELD

CREDIT CARD HOTLINE: (0703) 236363 FAX: (0703) 236307

Dual Sheet Feeder

Z8837 Exxon Dual Sheet Feeder Z200. Overall 395 × 210 × 285mm. Brand new and containing some very high class electronics. Although of little practical use as it stands, it makes a great break down unit. It contains:
3 × 12V 36R 7.5° stepper motors by Airpax and associated gear trains drive belt etc.
2 × 12V Solenoids
1 × 12V Electronic buzzer
2 extremely sensitive micro switches.
1 PCB containing 4 × TIP115; 4 × TIP110; 2 × 7407; LM3302 comparator + T's, R's, C's, plugs, sockets etc.
1 Control panel containing 4 LED illuminated push buttons + green LED on small PCB £24.95
1 × POB703A opto coupler & 1 × OPB7111 opto coupler.

SALE PRICE **£12.50**

Dragon Interface

SB9 Dragon interface - case 116 × 62 × 29mm with 2 × 9 pin D Plugs, 2 leads with 5 pin DIN plug. Inside is a PCB with 4 transistors and 20 resistors.

Box of 50 **£20.00 or 70p each**

BOOKS

K585 From page 104 of the 1990 Catalogue plus others not listed, a selection of computer books. Will include 'Sensing & control for the BBC' and 'Go Forth'. A pack of 10 books, originally retailing for £50+.

SALE PRICE **£6.00**

Sensing and Control Projects for the BBC by T Nunns
Shows how 'ANALOGUE IN' and the 'USER PORT' sockets can be interfaced to the real world. Fully explained projects in non technical language. No soldering required.
82pp. 241 × 182 £5.95

SALE PRICE **£2.00**

'Go Forth' by Paul Kail
An introduction to Forth Language. It's as easy to use as BASIC, but is much faster. This book is a complete foundation course in Forth programming, and contains a number of complete programs. Originally published at £8.95.

SALE PRICE **£2.00**

KRAZY KEYBOARD KLEARANCE

Z8842 Tatung VT4100 keyboard. Cased 85 key unit with separate numeric keypad. With circuit. Has 2 or 3 broken keys. 450 × 65 × 125mm. Was £9.95.

SALE PRICE **£5.00**

Z4116 24 way (8 × 3) membrane keypad. Large (200 × 90mm) area - these were originally used as a teaching aid. Overlay template and pinout supplied. Now only £2.00

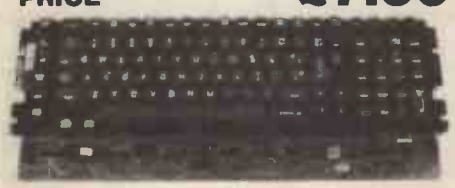
SALE PRICE **£1.00**

Z8862 Keyboard from Liberator Computer. 278 × 124mm. 62 keys. Some of these have been used. Output to 20 way connector.

Price **£5.00**

Z8852 Superb keyboard 392 × 181mm with LCD displaying 1 line of 10 characters + another line of symbols. 100 keys. Has 2 × 74HCO5 and 80C48. Was £15.00.

SALE PRICE **£7.50**



Z8848 Keyboard by Cherry. Room for 104 keys, all normal keys (65) fitted. Chips on board: LS373 × 2, LS374, LM3086 × 2. LS138 × 3, 555, LS08, 6805. Size 442 × 175mm.

SALE PRICE **£4.00**

Z8863 Keyboard. High quality unit made by Micro Switch. 69 pale grey and blue keys. 6 red 5mm LED's, 15 various LS chips and socketed D8048 by Intel. Output via 7 way plug and there's a 4 way edge connector too. Keyboard frame is 317 × 128mm. PCB on which it's mounted is 285 × 170mm. Excellent value at £12.00.

SALE PRICE **£6.00**

Z1797 Membrane keyboard 155 × 113mm with 80 × 22mm aperture for display from case Z4245. 22 keys. Output to 11 way flexible connector. Self adhesive.

Price ..... **Only £1.00**

SALE PRICE **50p**

Z4354 Computagraph Colorwriter panel 352 × 67 × 12mm. Ally frame supports a membrane keyboard which has 22keys. On the rear of the panel are 6 yellow submin LED's, a 3mm red LED and 2 × 19W edge conns.

Price **£1.00**

SALE PRICE **60p**

Z4363 Membrane keyboard 225 × 84mm with 11 keys - 1-9 & 2 others. Output (common bus) on 12 way ribbon cable. Could be cut down to 95 × 70mm if only 1-9 needed.

Price **60p**

SALE PRICE **40p**

MINIMUM ORDER VALUE £12 + £3 POSTAGE/ PACKING PER ORDER

XII

ORDER FORM SALE 1 2 3 4

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ELECTRONIC COMPONENTS

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	C1992			1992 Catalogue - sent on publication , 1st Oct 1991	UK/BFPO O'SEAS	2.00 4.00		
						Add 2.17% VAT		

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14 SUMMER SALE LIST GREENWELD

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Pages 15-23	10%
Pages 28-31	10%
Pages 39-42	5%
Pages 49-58	10%
Pages 94-97	10%
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Page 108
All ⅓ price except Z345 & 6116
Page 109
All ⅓ price except Z4190
Page 110
All ⅓ price
Page 111
All ⅓ price except PAR111 & TIC226B
Pages 112-113
See Pages 5-7 of this supplement
Page 114
All ⅓ price
Page 115
All ⅓ price
Page 116
All ⅓ price
Page 117
All ⅓ price except 5A regs
Page 118

Z4150	£2.75	
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Z802	£8.00	Rest 25% off

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See Pages 8 & 9 of this supplement
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Page 121
All ⅓ price
Page 122
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Page 123
All ⅓ price
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Z22455	20%
Z22468	20%
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Z4352	25%
Z4089	25%

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Page 26
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Page 31
⅓ price

BARGAIN LIST 68

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Page 8	25% off
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Page 12	All ⅓ price
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Except 5A regs	
Page 16	All 25% off
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All 'S' switches have now been made into packs.
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Most packs still available, but give alternatives where possible please.
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Z535
Page 16
Z1802
Z1804

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10% DISCOUNT ON ALL MODELS!

V212 £385	SALE PRICE	**£346.50**
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V522 £730	SALE PRICE	**£657.00**
V209 £860	SALE PRICE	**£774.00**

BBC 'B' SOFTWARE - FINAL CLEARANCE

This has been cluttering up our stores for far too long - now being sold at not much more than the media value. (SAE for more information, colour leaflets).

Micro Maestro - Comprises 5¼" disk + computer tape; 16 page handbook; C60 stereo cassette with backing tune of popular tracks like 'Ghostbusters', 'Chariots of Fire', and 'Superman'.
Original Price £17.95
SALE PRICE £2.00

Music Master - Comprises microphone to attach to recorder + processing device; 5¼" disk; 12 page handbook.
Original Price £52.78
SALE PRICE £4.00

Mupados Recorder Tutor - Comprises 5¼" disk; 38 page large format spiral bound handbook; C90 stereo cassette with 52 tunes.
Original Price £30.94
SALE PRICE £2.50

MINIMUM ORDER VALUE £12 + £3 POSTAGE/ PACKING PER ORDER

GREENWELD SUMMER SALE LIST 15

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Acoustic Couplers

Z8884 Acoustic coupler for use with Liberator. Made by Sendata, 700F series. One end has PCB with lots of chips plus 4 × AA Nicads to power. Other end has socket to take mains power supply (supplied). Also included is a communications cartridge and a comprehensive 46 page manual. New.

Price **£20.00**

SALE PRICE **£10.00**

Stationery products

Pentel Rolling Writers. These fine point cartridges are essentially complete pens without an outer casing, so can be used as they are. Current price is around 60p. Now look at our prices! (State 2nd choice.)

Z23199 Black
Z23201 Blue
Z23200 Red

Prices (any mix) ..... **30p each**
24+ 0.20 96+ 0.15

SALE PRICE **50% off**

Drawing ink Staedtler/Mars 23ml plastic bottles in 4 colours. Normally £1.87

Z23183 Black
Z23184 Red
Z23186 Green

Prices (any mix) ..... **£1.00 each** 10+ 0.70

SALE PRICE **50% off**

Black/ Blue/ Green Leads

Z01268 Staedtler/ Mars lumochrom leads. Pack of 12 in dispenser. Blue 2mm. Fits all standard lead holders.

Prices ..... **30p** 10+ 0.20 50+ 0.15

Z01158 Tube of 12 × 2H leads 2mm dia.

Prices ..... **25p** 10+ 0.17 50+ 0.12

Z01159 Tube of 12 Green leads 2mm dia.

Prices ..... **30p** 10+ 0.20 50+ 0.15

SALE PRICE **50% off**

BIB Accessories

BCC8 Computer Terminal Maintenance Kit + BCC11 Liquid Static Eliminator. £3.95 in catalogue.

SALE PRICE **£2.00** 100+ 1.20

Instrument Fans

Z5005 Excellent quality instrument fan by Toyo. Model TF92230A 230V AC. 92.2mm² × 25.5mm deep. Silent operation. List around £19.50.

Our price **£6.00**

SALE PRICE **£4.00** 25+ £3.00 100+ £2.40

Modem Panels

Another parcel of parcels from Dowty. These are all believed to have come from discontinued units and as far as is known are not faulty. However, please note some have missing chips or boards are cut to prevent re-use. They are therefore being sold for their component value only, not as working units.

Z4320 Kilostream Multiplexer Panel 300 × 210mm with 4 × 25 way 'D' sockets, 15W 'D' socket Z84C42 × 3, Z84C30 × 2, CMOS, Z80,CPU, 6264 RAM, 30 assorted CMOS/ TTI/ Linear chips and nice power supply comprising a potted transformer with mains input and 0-9V, 0-9V outputs both at 1A, 7812, 7915 and 7805 regs. Also Xtal, 64 way connectors, switches, etc. Great value.

Price **£6.50**

SALE PRICE **£3.50**

Z4321 Expander Panel for above. 230 × 170mm with 4 × 25 way 'D' sockets, 2 × Z84C42, Z84C30, 8 × 45406 + 7, 74 chips. Also short length of 64 way ribbon cable with IDC socket. This panel is complete.

Price **£3.50**

SALE PRICE **£2.00**

Z4322 Panel 310 × 205mm with 2 × 25 way 'D' sockets, 5 other sockets. Over 40 chips on board including Z85C3010 and TLC 32040 (both in sockets). TL074 × 2, MOC3021 × 2, ULN2803, and lots of logic, 3 DIL relays, Rs, Cs, etc, etc.

Price **£3.00**

SALE PRICE **£1.50**

Electronic Organ Kit

EK2 High quality kit by OK. All parts supplied in attractive plastic case which becomes the housing for the finished project. Covers a full octave. £3.34.

SALE PRICE **£2.00**

Knobs

Z4054 High quality collett knob in matt black 35mm dia × 17.5mm high with clip on cap and pointer.

SALE PRICE **£1.75** **Pack of 10**
100+ 0.10

Z4198 Black body, coloured top 20mm dia × 19mm high. Push on.

SALE PRICE **£2.00** **Pack of 25 asst'd colours**
200+ 0.06

Line Termination Unit

Comes in 2 parts:

Z035 Grey ABS case 197 × 106 × 60mm with lid contains PCB with 2 relays, transformer etc. A 3m lead with 4 pole plug (old type) is fitted one end and a 6 way lead 1m long the other which connects to:

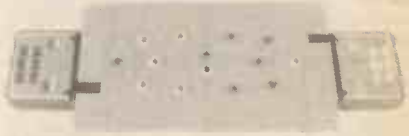
Z036 a PCB 265 × 143mm. This contains 5 × LM348, 4016, 4093 & ZNA2H006E chips + transitors, R's, C's, xtal, etc.

Both for £4, or individually Z035 £3.00; Z036 £1.00

SALE PRICES **Z035 £1.60** **Z036 60p** **Both £2.00**

'JIMMY'

the electronic football game of skill



Z817 Great fun to play or take it apart for bits. Originally £19.95

SALE PRICE **£2.50**

Map Light

Z4071 Magnetic map light with magnifier. This useful accessory is fitted with a cigar plug and has a curly cord extending to 3m. The white plastic housing for the lamp has an integral magnet and a swing-out powerful magnifying lens. £1.95

SALE PRICE **£1.00**

Remote Control

Z4134 Speaker remote control box. This is a cream case 125 × 95 × 42mm housing a 57mm diameter speaker and 2 control knobs, one for volume and one to switch main-remote-dual. The 3 core 6m long lead enables volume to be controlled from chair or bed. Simple to fit, instructions included. £3.95

SALE PRICE **£2.00**

Keyboard Enclosure

J063 High quality keyboard enclosure 550 × 225 × 70mm with black aluminium mask. Top professional quality - made by Data Packaging. Normally £38.69.

Our price **£11.00**

SALE PRICE **£5.00**

MINIMUM ORDER VALUE £12 + £3 POSTAGE/ PACKING PER ORDER

XV

16 SUMMER SALE LIST GREENWELD

CREDIT CARD HOTLINE: (0703) 236363 FAX: (0703) 236307

CAMERA CLEARANCE

Job lot of 'returns' just arrived, offering the amateur photographer a bargain buy in 110 & 35mm cameras. We've been asked not to mention the manufacturer's name, but it's well known for its equipment and available in all photographic and chemist shops (Boots) etc. There are a number of different models, but to simplify matters we've grouped them into 3 main types:
(a) 110mm manual; (b) 110mm motor driven; (c) 35mm manual. All are complete and intact and look OK, so the faults (if any) are probably minor. Because they're so cheap, you can afford to buy 2 or 3 - we're sure you'll be delighted with the value we're offering! - but please do remember these are **returns** and are sold without guarantee. NB order by Z number - there is no choice of model.

Z5028 110mm Manual models include 110LF and 110TF, many have built in flash (our choice).
Prices ..... **£3.50 ea 5 for £14.00**
Z5029 110mm Motor driven. Models include 110IF.
Prices ..... **£4.00 ea 5 for £16.00**
Z5030 35mm Manual. Models include 35HL, 806, 35CT, DL10, DL7. Most have built in flash (our choice).
Prices ..... **£4.50 ea 5 for £18.00**
Z5032 Broken cameras. These have parts missing. A parcel of 6 assorted, all 35mm including manual, motor driven, autofocus, twin lens types.
Price **£15.00**

HIGH QUALITY SLIMLINE LOGIC PROBE/ PULSER

Top quality slim (18mm dia) precision instrument for troubleshooting and analysis of logic circuits. It works as a level detector, pulse detector and pulse stretcher. It is circuit powered, has LED indicators and comes with additional probe lead and clip, and instruction sheet. An excellent addition to your Test Gear at an unrepeatable price. We have purchased all available supplies and can offer this superb instrument for around half the normal selling cost.

Order Code M625

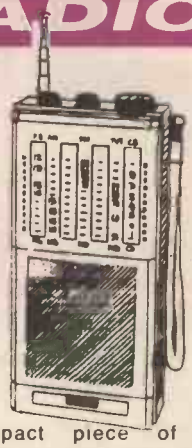
ONLY £10.00

Extraordinary Easiwire Offer!!!

The easy to use no-soldering wiring tool which makes construction of small electronic projects so simple!
All included in the kit are: Wiring pen, Utility tool, Punched wiring board, Self adhesive sheet, Spring loaded terminals and jacks, Spare spool of wire, Excellent instruction book. Catalogue price £15.00

SALE PRICE **£5.00**

MULTIBAND RADIOS!



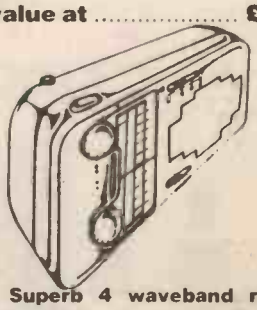
This compact piece of equipment 200 × 95 × 50mm comes in an attractive metallic grey case with controls on top - timing, on/off and volume, squelch. The telescopic aerial extends to 500mm and can be rotated in any direction. The 3 wavebands are:

1) CB, channels, 1-80
2) TV1 54-87 MHz & FM 88-108 MHz
3) AIR 108-145 MHz & PB 145-176 MHz.

The large 3" full range speaker delivers 280mW of undistorted power. There is an earphone jack and DC adaptor jack. The unit is powered by 4 × AA cells. All this technology for just **£17.95**

Order Code **MB100**

Z4357 Clock Radio by Ross. Extremely neat unit measuring 140 × 80 × 35mm. MW/FM bands, telescopic aerial, stand, carrying pouch and strap. Clock has LCD display and can be used in 12 or 24 hr mode. Alarm. Light. Earphone socket. Takes 2 × AA cells.
Great value at **£13.95**

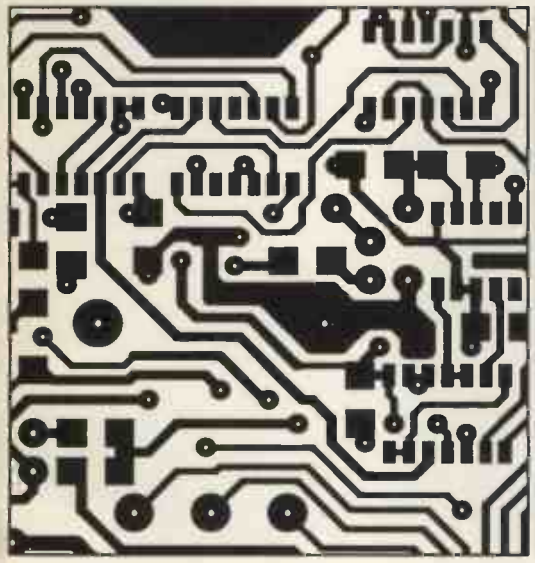


Z8891 Superb 4 waveband radio by Ross, model RR5. Covers FM 88-108MHz, MW 518-1610kHz, LW 150-275kHz SW 5.7-18.1MHz (16.5-52.6m). Nicely styled case measuring 210 × 145 × 70mm with clear scale markings. Telescopic aerial, headphone socket. Volume, tone and tuning controls. ON/ OFF switch/ waveband selector switch and AFC switch. Mains/ battery. (Takes 4 × C cells). Originally retailed at £19.95
Our Price **£14.95**

MINIMUM ORDER VALUE £12 + £3 POSTAGE/ PACKING PER ORDER

EASY-PC, SCHEMATIC and PCB CAD

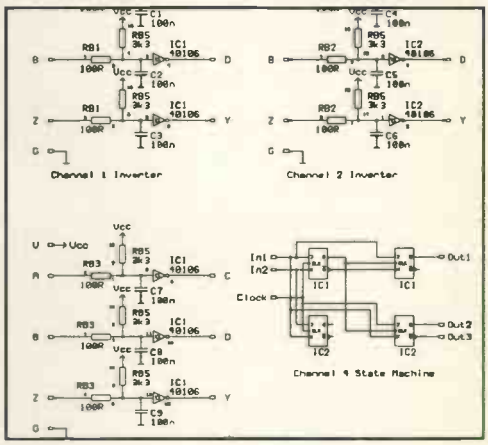
Over 9000 Installations in 50 Countries Worldwide!



- Runs on:- PC/XT/AT/ 286/ 386/486 with Herc, CGA, EGA or VGA display.
- Design:-Single sided, Double sided and Multilayer boards.
- Provides Surface Mount support.
- Standard output includes Dot Matrix / Laser / Inkjet Printer, Pen Plotter, Photo-plotter and N.C. Drill.
- Superbly easy to use.
- Not copy protected.

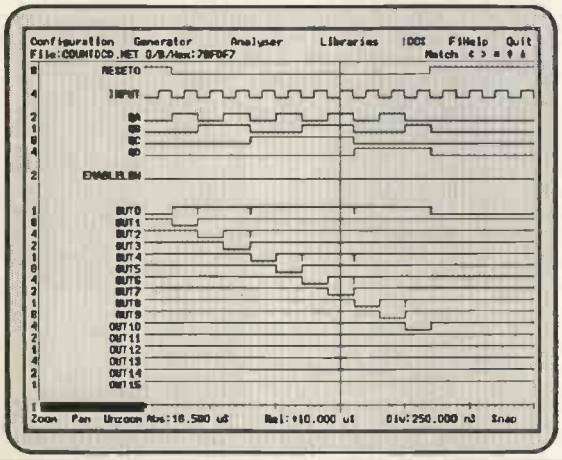
Still Only £98.00!
Plus P&P+VAT

BRITISH DESIGN AWARD 1989



Options:
1000 piece Symbol Library £38, Gerber Import facility £98

DIGITAL SIMULATION
PULSAR £195



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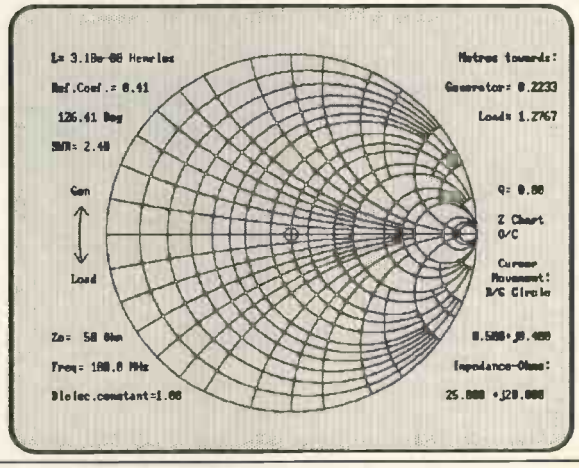

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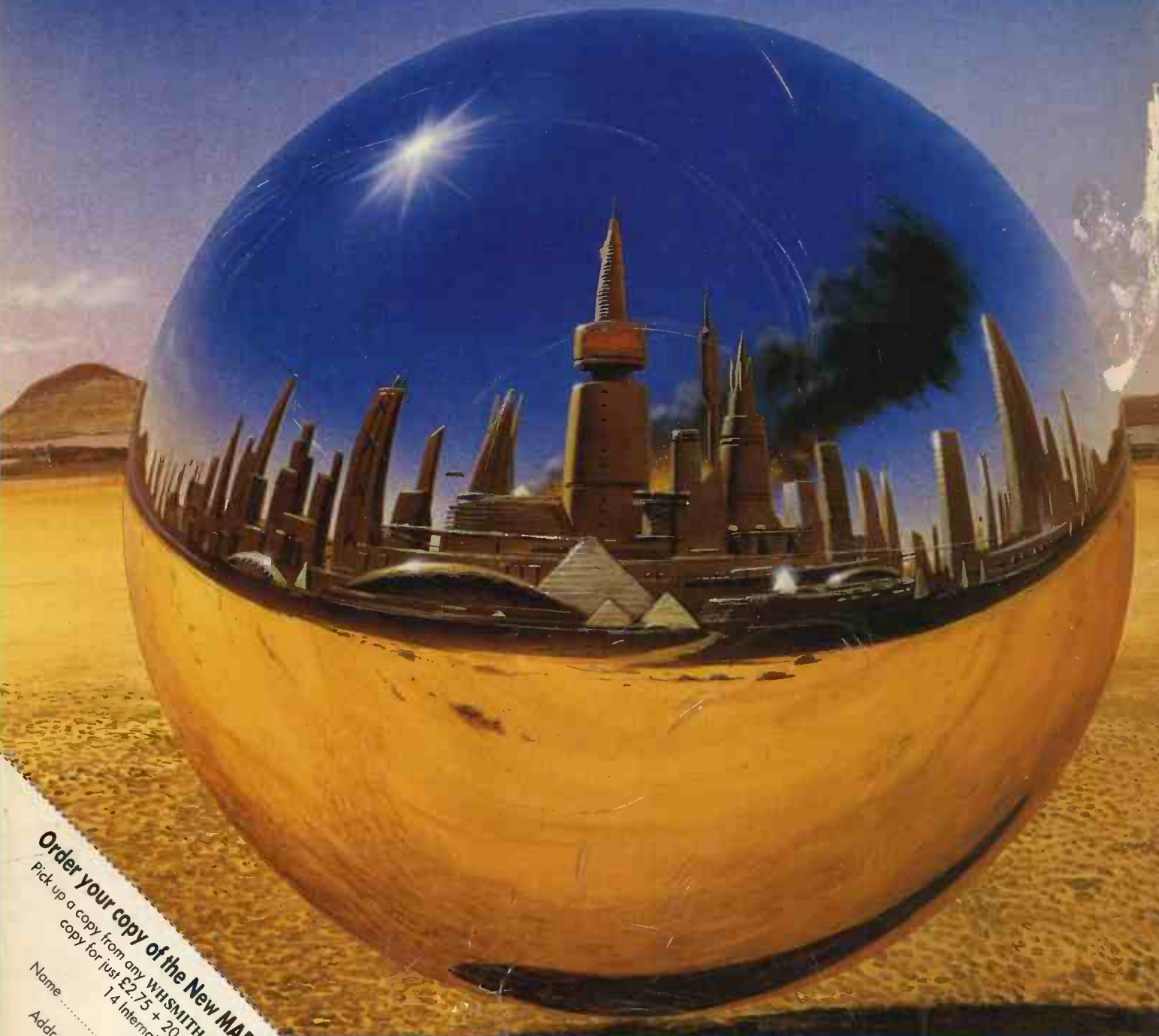

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