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THE MAPLIN MAGAZINE

ELECTRONICS and Beyond

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Published by Maplin Electronics plc., P.O. Box 777, Rayleigh, Essex, SS6 8LU. Tel: (01702) 554155. Fax: (01702) 554001.
Lithographic Reproduction by Planographic Studios, 18 Sinclair Road, Brook Road Ind. Estate, Rayleigh, Essex SS6 7UX.
Printed by St Ives (Gillingham) Ltd., Grant Close, Gillingham, Kent, ME8 0QB.

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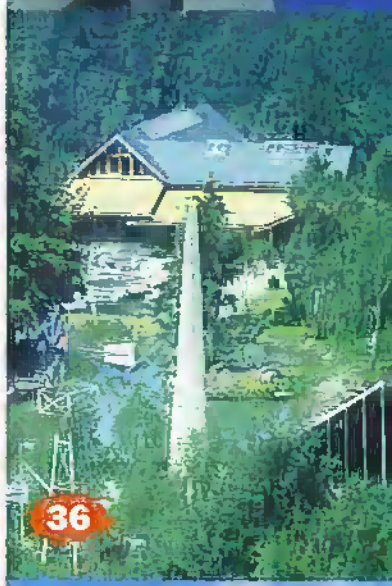
Maplin Electronics plc., P.O. Box 777, Rayleigh, Essex, SS6 8LU. Tel: (01702) 554155. Fax: (01702) 554001.

UK Newstrade Distribution
Maplin Electronics PLC.

Export Distribution
Comag Magazine Marketing
Tavistock Road, West Drayton, Middx, UB7 7QE



ELECTRONICS and Beyond

This month we are giving away the new Maplin Catalogue on CD-ROM. Do have a look at the new products we have on offer. You will also find a special supplement in the centre pages listing lots of special offers. Next month's issue will include the second CD-ROM with 1160 data sheets and lots of free software.

Towards the end of last year, Alan Simpson tragically died. Alan had been associated with Maplin Electronics, and in particular the Magazine, for many years contributing many articles on a diverse range of related topics. His style was always interesting and easy to follow, and he will be missed. His last article for Electronics and Beyond on the British Library is featured in this issue, and includes one of Alan's 'distinctive' competitions.

This month sees the first part of Mike Bedford's world of 3-D images and how to view them. Included in the article is an address where you can obtain a free pair of glasses to view the images, so do have a go!

And in a slightly different vein, George Pickworth recalls how light, using a heliograph, was used in the earlier part of this century to send messages.

Britain's Best Magazine for the Electronics Enthusiast

NEWS REPORT

Robotic Cat Set to Become Reality

A computerised robot with the intelligence of a domestic cat could become reality before 2001 according to researchers at the Brain Builder Group Evolutionary Systems Department, Human Information Processing Laboratories, Kyoto, Japan.

The main aim of the CAM-Brain Project is to evolve an artificial brain with a billion artificial neurons. As an intermediate step, an artificial brain with 32,000 evolved neural network modules will be built before 2000.

Called Robokoneko, which means robot child cat in Japanese, the robot is initially being simulated in software, using physical reality simulation tools.

For further information, check: <www.hip.atr.co.jp/~degaris/papers/icannga99/icannga99.html>.

Contact: Brain Builder Group, Tel: +81 774 95 1079.

Honeywell in Space

Honeywell Space Systems is using ISI's real time operating system MATRIXx as the foundation of its MDM Application Test Environment (MATE) for the International Space Station (ISS).

MATRIXx is the key component of The MATE test and verification systems, which are used to develop and execute simulations that verify and debug flight software for Honeywell's MDM Flight processor.

For further details, check: <www.isi.com>.

Contact: ISI, Tel: (01438) 751651.

Multi-colour iMac

Colour is much more important than the megahertz, gigabytes and other gibberish associated with buying a typical PC according to Apple boss Steve Jobs. Jobs was speaking at the launch of a new line-up of iMacs for 1999 featuring five stunning new colours - Strawberry, Lime, Blueberry, Tangerine and Grape.

For those readers that put the performance of a computer before its colour will be reassured to know that the new iMacs also feature a 266 MHz PowerPC G3 processor and a 6GB hard drive.

For further details, check: <www.apple.com/uk>.

Contact: Apple, Tel: (0870) 600 6010.

Watch GPS on Your Wrist

Here's a gadget that every would be James Bond should never be without. Casio demonstrated the first wristwatch with a built-in Global Positioning System (GPS) at the US Consumer Electronics Show in January.

The Casio Global Positioning System watch that will be available on the high street from June this year, picks up transmissions from 27 GPS satellites. Data from these satellites can be used to determine any location on the globe.

The watch, which incorporates an 8-channel receiver, can pick up signals from up to eight GPS satellites at anyone time. Data is received from at least three GPS satellites to determine your current location. As quickly as four seconds after you trigger a GPS operation, your current latitude (degrees, minutes, seconds north or south) and longitude (degrees, minutes, seconds east or west) appear on the display.

After specifying your destination, the watch graphically indicates the direction and the distance to your destination from your current location. This data can be updated along the way, which means you always have an idea of remaining distance and the correct direction. If you are taking continuous readings, you can also produce a reading of your current bearing and speed, and even calculate your estimated time of arrival.

For further details, check: <www.casio.co.uk>.

Contact: Casio, Tel: (0181) 452 7253.

NEWS BYTES

£10,000 Up for Grabs for Young Designers

Prize money totalling over £10,000 is available to entrants of the 1999 Young Electronics Designer of the Year Awards (YEDA). The competition challenges young people between the ages of 12 and 25 at schools and universities, to design and build an electronic device that answers an everyday need.

For further details, check: <www.yeda.org.uk>.

Contact: Young Electronic Designers Awards, Tel: (01798) 874767.

Business as Usual at Hayes

Hayes Europe is continuing to trade profitably and to honour its commitments to its business partners, despite the announcement from the company's US headquarters that Hayes has ceased operation in the US.

For further details, check: <www.hayes.com>.

Contact: Hayes, Tel: (01276) 704400.

Tuner on a Chip

US start-up Microtune based in Texas, US, has developed a TV tuner on a chip, an achievement long sought by giant electronics manufacturers. A TV tuner is made of a few dozen components, so reducing that function to a single computer chip eventually could significantly simplify TV manufacturing.

For further details, check: <www.microtune.com>.

Contact: Microtune, Tel: +1 972 673 1600.

Berkshire Counterfeiters Cracked

Microsoft officials have recovered 55,000 counterfeit Microsoft Office 97 CD-ROMs in a raid on locked premises in Berkshire, England. Had the software been genuine, it would have had a total street value of almost £20,000,000. During the past four months, Microsoft claims that it has recovered £70,000,000 in counterfeit software in the UK.

For further details, check: <www.microsoft.com>.

Contact: Microsoft, Tel: (0345) 002000.

Intel Invests In Samsung

As part of a strategy to ensure an adequate supply of next-generation memory chips, Intel is investing almost £70 million in Samsung Electronics, the world's largest dynamic access memory (DRAM) manufacturer. Intel made a similar investment in October when it put £350 million into Micron Technology.

For further information, check: <www.intel.com>.

Contact: Intel, Tel: (01793) 403000.

NEWS BYTES

Start-up Launches Postcard Speakers

Authentic, backed by NEC, has launched a new range of postcard-size flat panel speakers. With internal amplifiers, translucent plastic frames and special adhesive to allow pictures to be placed over the front panels, the new MusiCanvas MC-16AL speakers can also double as a pair of photo frames without any detriment to sound quality.

For further details, check: <www.nec.co.uk>.

Contact: NEC, Tel: (0181) 993 8111.

Customised PC with Maplin Build to Order Service

Maplin customers can now purchase PCs built to their own specification, thanks to a build-to-order service. Machines ordered from Maplin are built by Compusys, a specialist PC builder. All systems include a 12-month onsite warranty.

For further details, check: <www.maplin.co.uk>.

Contact: Maplin Electronics, Tel: (01702) 554155.

Electronics Leads Employment Stakes

Employment prospects in the manufacturing sector are headed by the electronics industry which registers a balance significantly above the sector average according to the latest Manpower Survey of Employment Prospects.

For the first quarter of 1999, 26% of employers in the industry are forecasting increased job prospects, while 9% anticipate a decrease, registering a balance of 17%. Although positive and 17 points above the national average, this represents a downswing of 21 points on the comparable period for 1998.

For further details, check: <www.manpower.co.uk>.

Contact: Manpower, Tel: (0171) 253 3300.

Frequency Changes for Radio Amateurs

The Radiocommunications Agency has changed the allocation of the 10GHz band from the 1st February. The government agency claims that while part of the band will be withdrawn, there is to be an overall increase in the allocation of spectrum to radio amateurs.

The new allocation is from 10.00 to 10.125GHz and from 10.225 to 10.475GHz for the terrestrial service. The amateur satellite allocation will remain unchanged.

For further details, check: <www.gtnet.gov.uk/radiocoo>.

Contact: Radiocommunications Agency , Tel: (0171) 211 0211.

Handheld Device Is Optimised For Mobile Email

Research In Motion, a US based start-up, has added a new product concept to the exploding mobile computing sector. Its BlackBerry palm device is based on an Intel 386 and includes a 2 MB Intel Flash memory, integrated wireless modem, full keyboard, email and personal organiser software. It creators say it is designed to be wearable, operate 24 hours per day and run on a single AA alkaline battery.

For further details, check: <www.blackberry.net>.

Contact: Research In Motion, Tel: +1 877 255 2377.

Photosuite Is Consumers' Choice

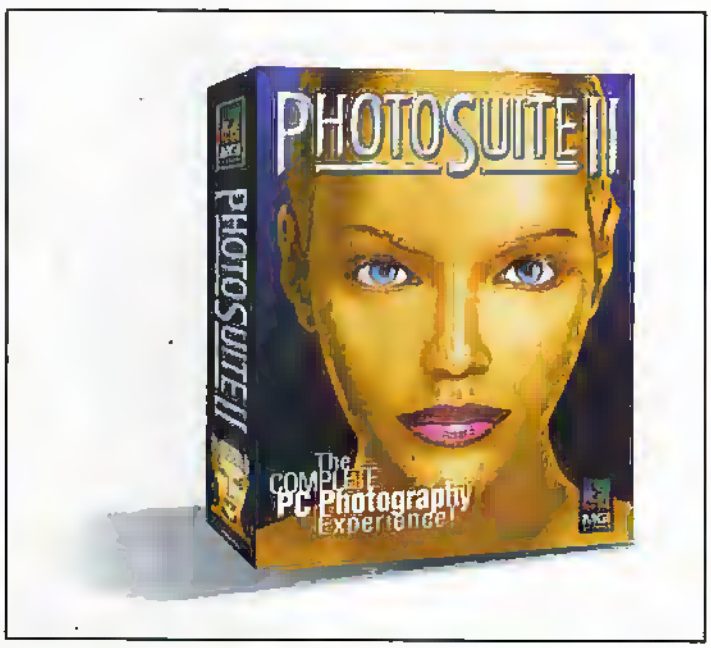
MGI PhotoSuite II has become the leading PC photography software in the UK, according to retail research specialist, ChartTrack.

Over four months, MGI Software has gained over 33% market share. Furthermore, combined with its predecessor, PhotoSuite the company has achieved 47% of the entire photo software market.

At £50, MGI PhotoSuite II provides a complete suite of PC Photography tools for beginners and advanced users alike, and includes sophisticated photo correction, manipulation, cataloguing and slide show presentation features in one integrated package.

For further details, check: <www.mgisoft.com>.

Contact MGI, Tel: (0171) 365 0034.



Acorn Launches Element 14

From little acorns do mighty oaks grow – well not quite. Acorn has changed its name in a bid to reflect its current business activities. From here on after Acorn will be known as Element 14.

Here's why. Acorn has increasingly become targeted on the creation of next generation silicon and software Intellectual Property (IP) for multimedia devices, initially focused in the digital TV market.

The new name was selected because it represents the core values of the company. Silicon is the 14th element on the periodic table. And as any student of science will tell you, elements are the basic building blocks of matter, and Silicon is the building block of digital technology.

So Acorn, sorry Element 14, is re-positioning itself as a set top boxer designer. Upsetting news if you are an Acorn computer user or are a third party developer. As yet Element 14 has said that Acorn PCs will continue to carry the Acorn brand, and will be manufactured in line with market demands.

For further details, check: <www.e-14.com>.

Contact: Element 14, Tel: (01223) 725000.

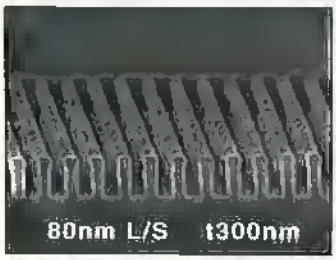
Computer Safety Check Curbs Legal Threat

The Continuous Compliance Programme, launched by the Initiative for Software Compliance (iSC), and welcomed by DTI Minister Michael Wills, is claimed to help Britain's smaller businesses to stay on the right side of the law by complying with an industry standard for the use and management of IT systems.

Targeted at the country's near 1,200,000 small and medium enterprises (SMEs), the programme is fronted by a comprehensive standard for the management of IT within the law. It serves to reassure all SMEs that once they have signed up to the programme, they will be using their IT systems with minimal legal or financial risk.

For further details, check: <www.isc.org.uk>.
Contact: iSC, Tel: (01283) 585585.

Nikon's Reduction-Projection Electron Beam Exposure System



Nikon said this month that it intends to develop and commercialise a reduction-projection electron beam lithography exposure system which is designed to permit semiconductor companies to achieve high productivity manufacturing of integrated circuits with sub-100nm minimum pattern linewidths..

Consistent with a sub-100nm design rule that is predicted to be in full-scale production in 2006, the system would be capable of printing future high performance microprocessors and 16G DRAMs. Such systems will hold the equivalent amount of information that will appear in every edition of a typical daily newspaper for the next 4 years.

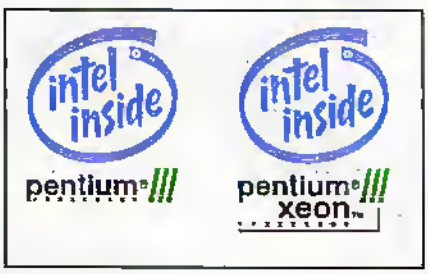
Electron beam lithography is one of the leading candidates to replace today's optical lithography technology for leading edge semiconductor production. Optical systems have a natural limitation due to the wavelength of the light used. Electron beams are capable of achieving dimensions much smaller than those achievable by optical means.

For further details, check: <www.nikon.com>.
Contact: Nikon, Tel: (0181) 541 4440.

Only the Name Stays the Same for New Intel Chip

Intel has retained the brand name of its most famous chip for its next-generation microprocessor when it becomes available in March. The Pentium III, currently code-named Katmai, initially will run at speeds of 450 and 500 MHz, and is designed for fast multimedia processing thanks to 70 new instructions specifically aimed at speeding up graphics, communications, audio and video.

For further information, check: <www.intel.com>.
Contact: Intel, Tel: (01793) 403000.



Lucent Technologies and Ascend to Merge

In its boldest move yet to address high-growth opportunities in data networking, Lucent Technologies is set to merge with Ascend Communications is a deal valued at $20 billion. The merger will position Lucent as a clear leader in communications networking and at the forefront of the merging areas of voice and data technology.

Lucent is no stranger to merger and acquisitions. In the last two years the industry powerhouse has acquired 11 companies in different areas of data networking.

For further details, check: <www.lucent.co.uk>.
Contact: Lucent, Tel: +1 317 322 6848.

IBM Demos Wearable PC

IBM's 300 gram prototype Wearable PC fits in your pocket and is completely portable. With 340MB of storage and 64MB of EDO RAM, the 233MHz hands-free computer lets you watch videos on an eye-level display and incorporate voice recognition for command and text entry.

For further details, check: <www.ibm.com>.
Contact: IBM, Tel: (0990) 426426.

Write to:
Electronics and Beyond,
P.O. Box 777,
Rayleigh, Essex SS6 8LU

E-mail your views and comments to:
AYV@maplin.demon.co.uk

Quality Articles

Dear Sir

Just a short note to congratulate you and all your staff on an excellent magazine. I am continually impressed with the high quality articles on subjects like DAB, DVD and Digital TV.

They appear to cover the subjects to a depth not found in other more commercial orientated magazines. The latest on in colour on DVD (March, issue 135) was absolutely first class.

Because of the speed at which technology is progressing such in-depth information is just not available in the book shops. Have you considered the possibility of producing compiled publications (supplements) of similar subject articles?

A Fletcher
Wetherby

I am glad you found the DVD article so good, for we firmly believe this will be the year that DVD takes off in a big way. But allied technology is also developing at a breath-taking rate - LEP displays and 'digital' loudspeakers. We have mentioned these British products before in these pages and will hopefully soon have an article on digital loudspeakers from 1...Limited.

PK - Not Again!

Dear Sir

You comment at the end of the weird letter in the March issue that "we have not heard the last of this topic," well I sincerely hope that we have! I suspect that I speak for the majority of your subscribers who pay money for your magazine because of its excellent electronics content. Surely we have suffered enough from all this Aldous-Geller nonsense. The arrival of the Maplin magazine is getting as bad as having Jehovah's Witnesses standing on your doorstep.

There are already magazines that cater for those who cannot think logically and believe things for no other reason than that they wish to believe them. Surely it would be better to let them publish such letters.

Rodney Hannis
Reading

Dear Sir

First let me say how disappointed I was to read that there was little response to this subject. I was expecting quite a lively debate. Mr Marett seems to sit firmly in the anti-psychic camp, regarding it as nothing but a waste of time and money. I, as you do, "sit on the fence".

Not even 'serious science' knows all the forces of nature. Indeed, there seems to be a possible new force or phenomenon currently being investigated, one that appears to effect gravity over large distances, affecting the course of some of the space probes launched many years ago. I bring this up merely to illustrate that the universe still has many surprises in store.

Psychic phenomena has never really been given a chance to be properly investigated. People like Mr. Marett simply disregard the field entirely without even thinking about it. There have been many attempts to investigate the field, but always with little funding, except by the military who keep the results secret. If the military keep these results secret, there's probably a reason why!

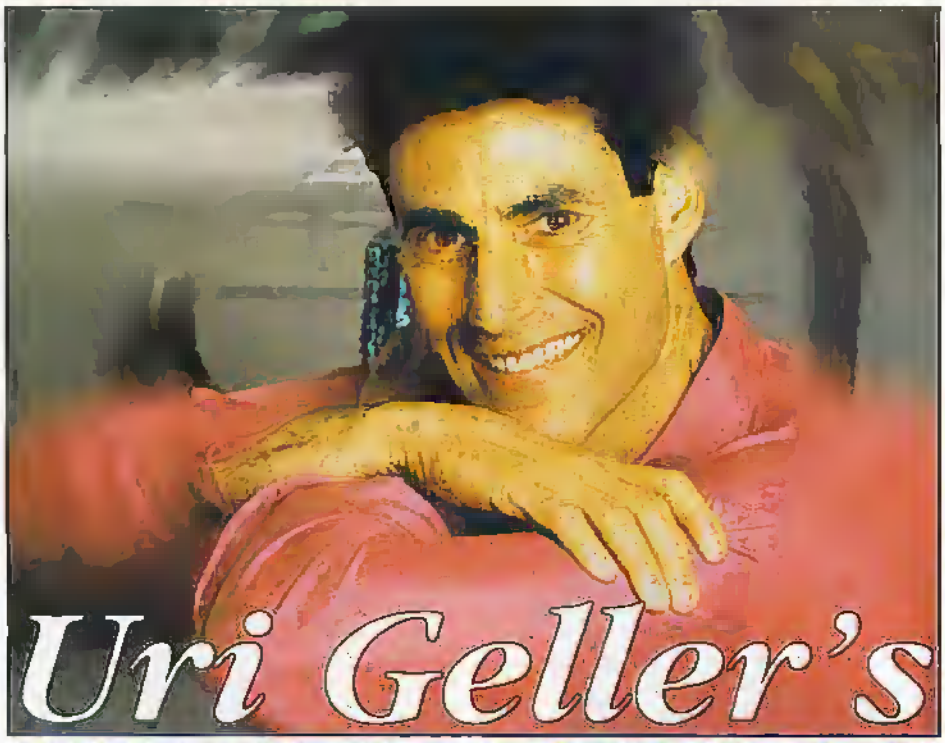
What is needed is substantial funding to be made available in order that psychic phenomena be investigated scientifically and as thoroughly as possible. Mr. Marett will no doubt say that this funding should be used for a more orthodox branch. However, all over the world psychic research is still being carried out, with little funding or resources, by government, commercial (that says a lot in itself) and private sources. The funds from all these small research efforts add up to a lot more than is probably needed to fund one big effort, although I would like to see this effort politics-free.

I say to Mr. Marett have a sceptical view if you wish, but please don't simply pooh-pooh it and throw it out the window as nonsense without even thinking about it. Don't let your prejudice get the better of you. Give it a chance to be researched properly, by respected scientists in respected research labs. It may just surprise you.

I am not usually one to respond to letters in magazines (I've never actually responded to one before, or even written a letter myself), but in this case I felt the need to air my two pence worth.

Stephen Bassett
by E-mail

Two quite different views on this thorny topic, but when Rodney Hannis says ".. who cannot think logically" I would refer him and other sceptical readers to Uri Geller's page in this issue for a another point-of-view. As we have said in the past, we are prepared to keep an open mind about such topics.



Uri Geller's EXTENDED REALITY

Nothing Changes!

My reaction to the letter from a reader who objected to 'parascience' finding its way into this magazine (January 1999) was that nothing seems to have changed over the past century as far as this kind of attitude is concerned. Let's go back a hundred years or so and see what's going on in what he calls 'real science'.

Lord Kelvin was one of the most distinguished scientists of the 19th century, who among other things invented the temperature scale named after him. Yet when Röentgen announced his discovery of X-rays, Kelvin denounced it as "an elaborate hoax". He told his students to look for careers in something other than physics, because there wasn't anything left to discover about the nature of matter, and he told one of them, Ernest Rutherford, not to waste time on 'radio' because it had no practical applications.

Rutherford went on to do important work on the structure of atoms, yet right up to his death in 1932 he was making fun of the possibility of 'atomic energy'. That was just five years before the first chain reaction and thirteen years before Hiroshima.

One man who can't have been listening to Kelvin was a young fellow named Albert Einstein. Instead, he was getting some strange ideas as he rumbled along the streets of Zurich in the tram taking him to work in the patent office. Then, in 1905, he came out with the first of his relativity theories, and physics was never to be the same again. He went on to become as famous in his century as Kelvin was in his, yet even he had his off days. A few years before the first atomic bomb went off, he was telling President Roosevelt that it could never be used because it would be too heavy for any aeroplane to take off with one on board.

I could give dozens more examples of this kind of thing. My favourite one is the reactions of American scientists when the Wright brothers were hopping around in their field at Kitty Hawk - in full view, incidentally, of a busy highway and a railway line. Within weeks of their first flight, the eminent professor Simon Newcomb announced that it had been scientifically proved that powered flight was "utterly impossible". And we all remember the Astronomer Royal's description of space travel as 'utter bilge' a few months before Yuri Gagarin (who can't have been listening) made the first manned space orbit.

Today, we have fundamentalist vigilante outfits like the Committee for the Public Understanding of Science (COPUS) - or should that be Committee for the Proclamation of Unassailable Truth (COPOUT)? - telling us what is possible and what isn't, and what we should do with awkward people like Uri Geller who just don't fit into their view of proper scientific research. "The paranormal is bunk", yelled Professor Richard Dawkins of COPOUT in a 1998 tabloid newspaper article. Sure it is, just as X-rays, powered flight, space travel and nuclear fission were.

According to my dictionary, paranormal simply means beyond the range of normal experience or scientific explanation. So what the thought police at COPOUT are saying is that if something can't be explained (yet) or doesn't happen every day, then it doesn't exist and shouldn't be studied.

It's clear by now that professors, however distinguished they may be in their own fields, are not the right people to decide what should exist and what shouldn't. Nature is what it is, and the scientist's job is to study it – all of it. Some of the paranormal probably is utter bilge and bunk, but some of it isn't, and the only way to find out which is which is to do some proper research - not make sarcastic comments from the sidelines.

I have been rounding up all the reports I can find by scientists (real ones) who have been looking at subjects Professor Dawkins probably considers to be bunk and showing that they aren't. In earlier columns, I described the work of Rupert Sheldrake, Robert Jahn and Dean Radin, and I'll be describing the work of many others in future columns. Some of you may be surprised to learn how many of them there are and just how good their work has been.

Doing research into anything paranormal is not easy. It doesn't do anything for a scientist's street credibility, and has led to labs being closed down and jobs lost. It isn't much fun for the laboratory guinea-pig either, as I know because I was one in the 1970s for about two years, shuttling from one lab to another and having electrodes stuck all over me. I did what I was asked to do, usually successfully, and some of the results filled a whole book (The Geller Papers, edited by Charles Panati) in 1976. By then, I reckoned I had done my share, and had the right to get on with earning my living in my own way, as I have done.

In any case, parapsychologists today prefer to look for signs of what they call psi (telepathy, psychokinesis, clairvoyance and precognition) among ordinary members of the public rather than in individuals, and they are right. I have always told people that they can do what I do if they really put their minds to it, and a good many have. They are helping us to learn more about how the mind works, which is surely what real scientists are supposed to do?

I have no problem with sceptics, genuine ones who know that the word comes from the Greek word for 'examine' - not deny, debunk or dismiss without examination. If COPOUT and its predecessors, such as the medieval church, the Inquisition and the witch-finders had always been in charge of science, we might not have had the atomic bomb. We would also not have had space flight, aeroplanes or X- rays.

And of course the sun would go around the earth and the earth would still be flat.

Uri Geller's novel Ella is published by Headline Feature at £5.99, and his Little Book Of MindPower by Robson Books at £2.50, and Jonathon Margolis' Uri Geller Magician or Mystic? by Orion Books at £17.99.
Visit his live website camera at **urigeller.com** and e-mail him at **urigeller@compuserve.com**

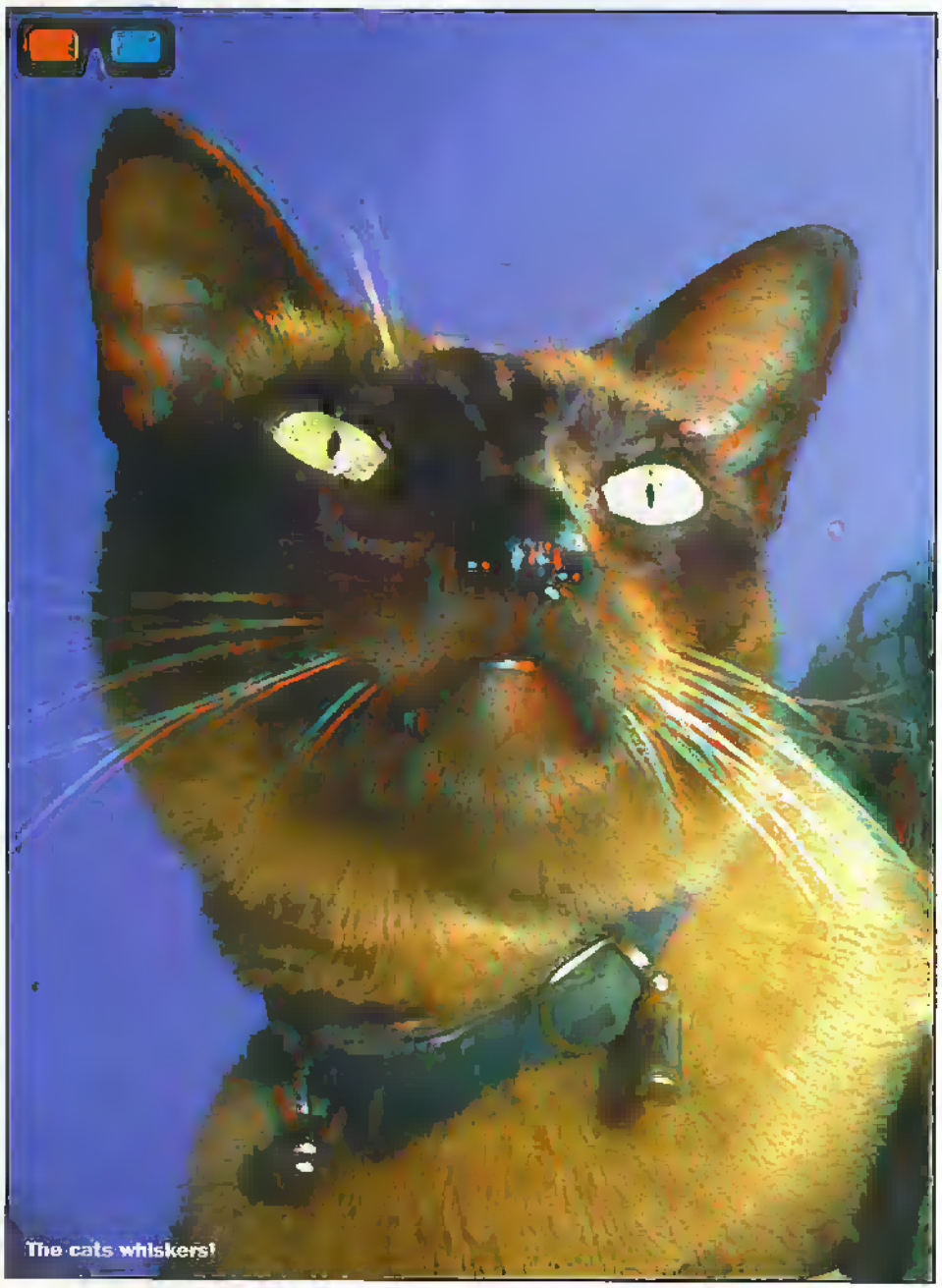
THE WORLD OF 3D

PART 1

Mike Bedford investigates the world of 3D.

In an age in which everything seems to be possible, there are now few technological achievements which elicit the 'wow factor'. With few exceptions, the public at large seem totally blasé about Digital TV, DVD players, supercomputers which can beat the world chess champions and even space probes which can explore the further reaches of the Solar System. It's rather surprising, therefore, that three dimensional images do still attract more than the odd glance. This is especially intriguing when we remember that the technology of 3D imaging is by no means new. Stereoscopic viewers graced many a Victorian drawing room, three dimensional horror movies were produced in large numbers during the 50s, and the View-Master 3D viewer has been popular for many years. Despite their impressive heritage, though, three dimensional photographs, 3D movies or TV programme, and 3D computer displays still aren't encountered on a regular basis. Remember that many things which claim to offer 3D – the current generation of PC video cards, for example – don't provide the full three dimensional experience. So on the rare occasions that people do encounter a genuine 3D image, the reaction is often one of considerable amazement.

This short series of articles is an investigation of the world of 3D. To start off, we'll look at the ways in which the human visual system perceives depth and, in so doing, get a clearer idea of exactly what we mean by that phrase 'three dimensional'. We'll then go on to look at some of the traditional methods of recording and reproducing a three dimensional image. Most of these methods pre-date computers or even television but, in most cases, can be adapted to electronic displays, nevertheless. We'll conclude by investigating some of the newer hardware for displaying 3D images, hardware which has been designed specifically for use as a computer display.



The cats whiskers!

What is 3D?

The world in which we live is described in terms of three spatial dimensions which we could refer to as width, height and depth. By way of contrast, drawings, photographs, cinema screens, TV screens and computer displays are flat or, in other words, they're only two dimensional so the depth dimension is missing. If we are to give the impression of a three dimensional world on a flat surface, therefore, we somehow need to give some clues from which our eyes can deduce information about depth. To start to see how this might be done, let's take a look at the various so-called depth cues, the types information which we use to perceive depth when we look at the world around us. Many of these depth clues are perfectly obvious, once they're pointed out, but it will be helpful to run through the list nonetheless.

Perspective

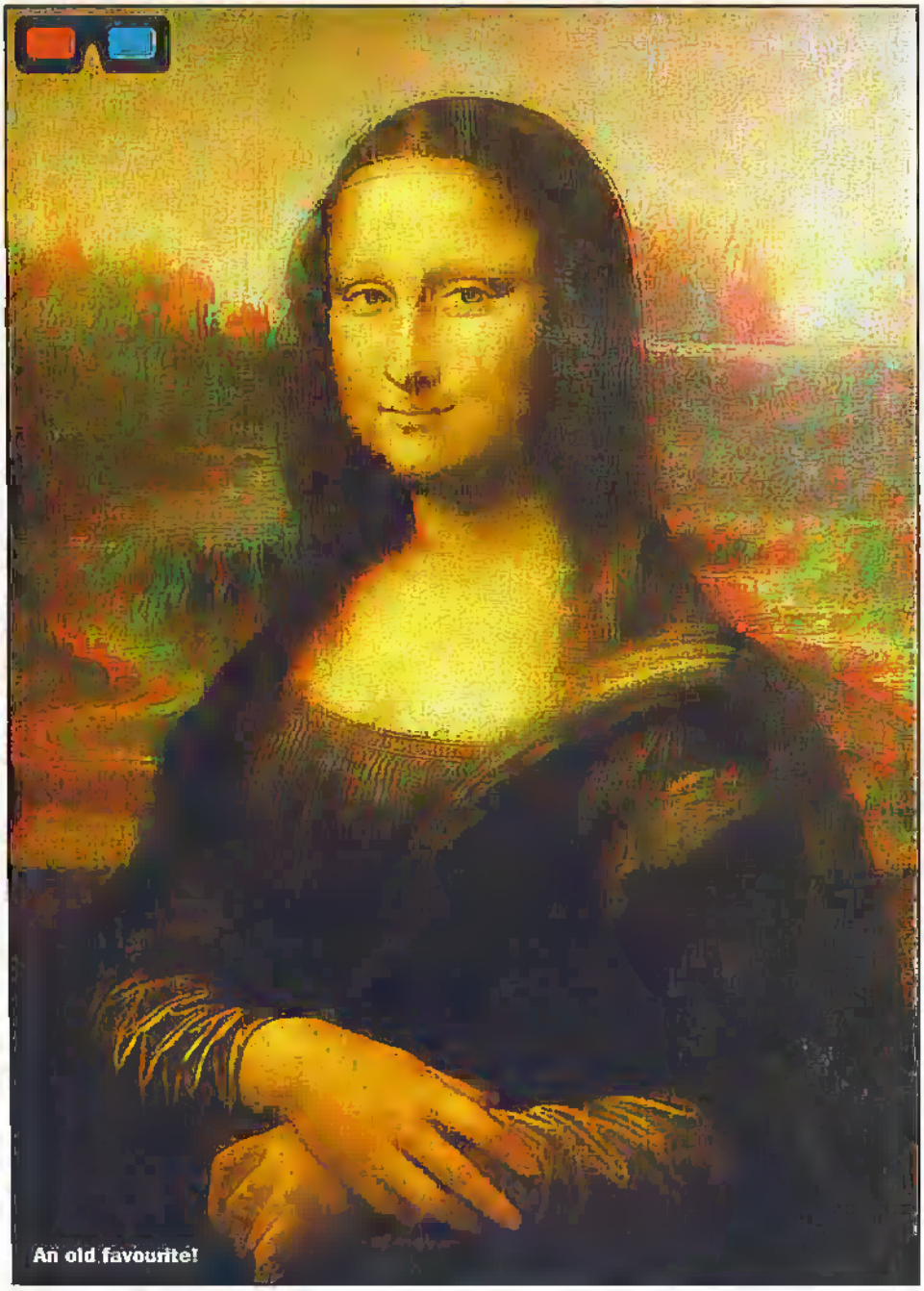
I guess we all learned about perspective in art classes at school and this is probably the single most important depth cue. Distant objects look smaller than closer objects of the same size and one implication of this is that parallel lines going away from the viewer seem to converge at a so-called vanishing point which lies on the horizon.

Interposition

So long as they aren't transparent, objects close to the viewer will obscure objects which are further away – this is called interposition. In other words, if two objects intersect, the one with the more complete outline is closer than the one with the less complete outline.

Shading

Lighting normally falls on a scene from a single direction so different faces of objects will be lit to different degrees. This causes differential shading and helps to give the viewer a sense of depth.



An old favourite!

Shadowing

Closely related to shading is shadowing. Opaque objects can prevent light from illuminating more distant objects and in so doing cause shadows. Since objects can only cast shadows on other objects which are further away from the light source, this is another important depth cue.

Texture Gradient

The amount of detail which we can see in the surface texture is greater for close objects than for distant ones. In other words, a close object looks well textured whereas a distant object looks smoother and more devoid of surface detail.

Colour Gradient

Since light is absorbed and scattered in the atmosphere, those objects which are close appear to have more vibrant colours than more distant objects. Some colours of light are also scattered to a greater degree than other colours and this results in more distant objects have an overall bluish cast.

Binocular Disparity

Human beings have two eyes, each of which looks forward, so we see the world from two slightly different positions. The brain merges these two views to generate a single image with an important depth cue called binocular disparity. This is the hardest depth cue to describe since if refers to subconscious processing within our brains but it is, nevertheless, one of the more powerful cues so long as the field of view includes some reasonably close objects.

Ocular Accommodation

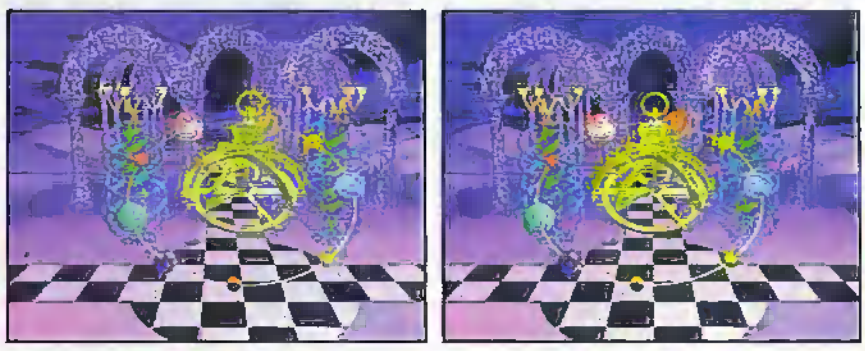
Ocular accommodation is the technical terms for our ability to selectively focus our eyes on objects at differing distances. If we're viewing a scene with no nearby objects this cue is virtually non-existent since our eyes have sufficient depth of field to ensure that all medium to far distance objects will be in focus at the same time. If the scene contains comparatively close objects in addition to more distant ones, however, this is an important depth cue.

Motion Parallax

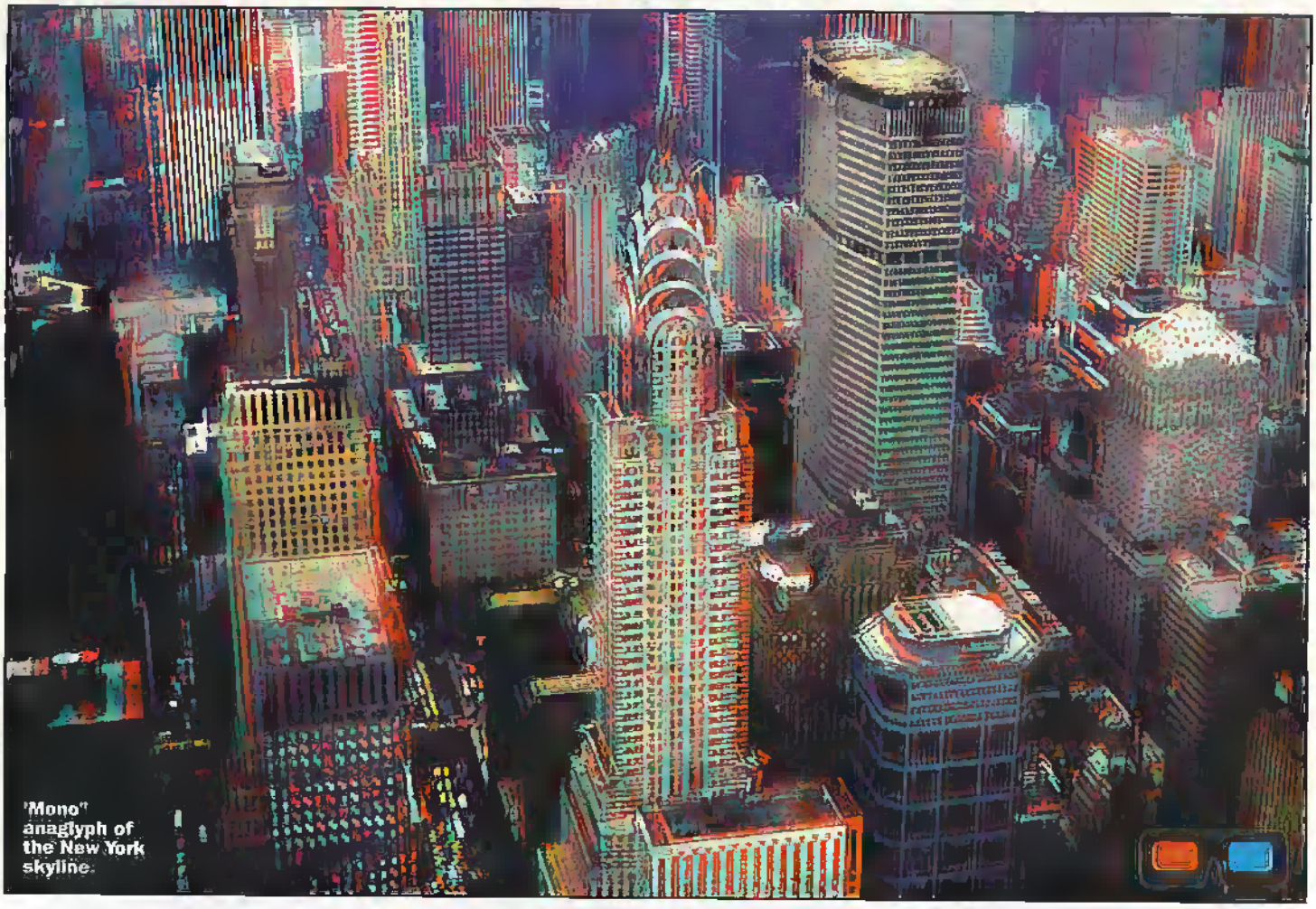
Motion parallax is one stage on from interposition. We've already seen that close objects can obscure portions of more distant ones but as we move our head from side to side, the amount of the overlapping changes. This, in turn, means that portions of previously obscured objects are revealed. Another consequence of motion parallax is that closer objects appear to change their position relative to the field of view more rapidly than distant objects.

Photography & Computer Images

In conventional photography you don't need to do anything special at all in order to reproduce many of the depth clues we've looked at. Simply using an ordinary camera and either printing on ordinary photographic paper or projecting on an ordinary screen using an ordinary projector will give you perspective, interposition, shading, shadowing, texture gradient and colour gradient. This, of course, is why standard photographs and TV pictures look natural enough, even though they might not shout '3D' at us. And exactly the same applies to a computer generated image. In the early days, the amount of processing power available was severely limited so images weren't photo-realistic. The implication of this, of course, was that many of the depth cues available in photography weren't available on the computer screen so the results were much less 3D than ordinary photographs. Today, much of the heavy number crunching is off-loaded onto a 3D graphics cards and the end result is a huge improvement on the wire-frame graphics of the 80s or even the crudely rendered



Computer generated image supplied by David Todman.



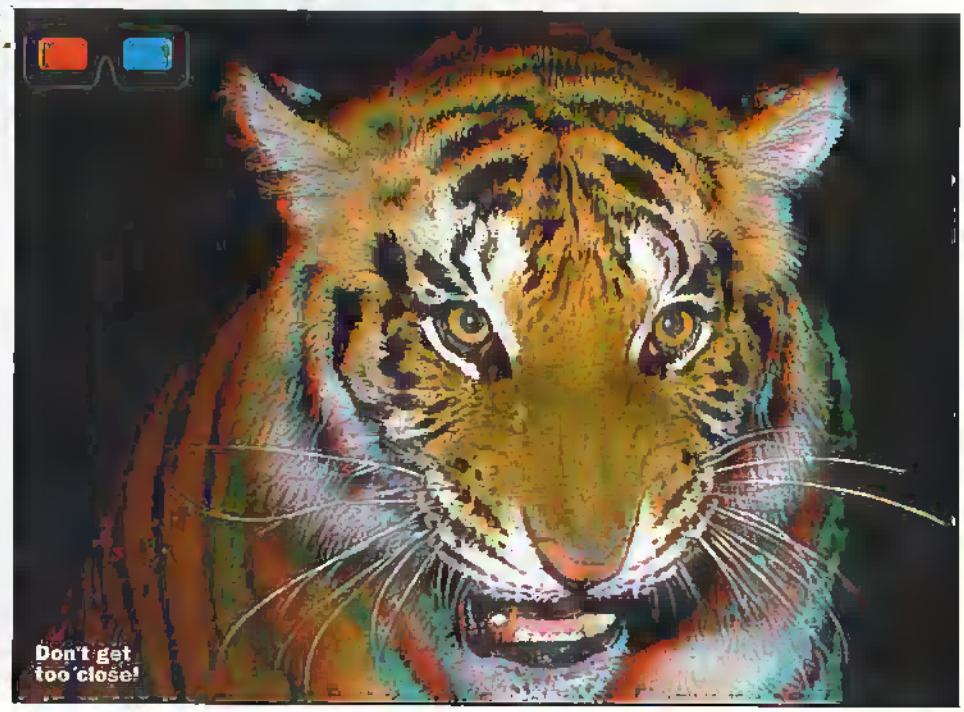
"Mono" anaglyph of the New York skyline.

images of not many years ago. Nevertheless, we shouldn't loose sight of the fact that a so-called 3D graphics card only allows the computer display to catch up with conventional photography. It certainly doesn't provide results which a photographer, a cinematographer or a TV engineer would refer to as three dimensional.

Of the depth cues we've looked at, the three which can't be provided by conventional photographic techniques or on a television or a conventional PC screen – even with a 3D video card – are binocular disparity, ocular accommodation and motion parallax. And the one which people most commonly think of as the crucial element in true 3D is binocular disparity. This doesn't mean that the others are unimportant though – what it does mean is that ocular accommodation and motion parallax are far harder to produce. So, to set the ball rolling, let's take a look at how binocular disparity can be provided.

Stereoscopic Imaging

To provide binocular disparity I guess it must be fairly obvious that we need to photograph or generate a pair of images, one representing the left eye's view and the other the right eye's view. Such a pair of images is usually referred to as a stereo pair and it really isn't particularly difficult to produce. If you're photographing a still scene, for example, you can simply take one photograph then move the camera by 65mm – the average distance between the eyes – and take another photograph. For a moving image, you'd either have to use a pair of cameras attached to each other at the appropriate distance apart and simultaneously triggered using a special cable release or you'd use a special 3D camera with two lenses. The effect can also be exaggerated by increasing the distance between the two viewpoints – this is referred to as hyper-stereoscopy. This is often used, for example, in aerial reconnaissance photography. If you view the ground from an aircraft, you don't normally get a good idea of the surface topology because binocular disparity is a fairly weak depth cue at distance. Similarly, normal stereoscopic photography would provide no benefit over a single photograph. However, by using time lapse photography, a stereo pair with a much increased separation (the distance the aeroplane had moved between the two exposures) can be produced. When subsequently viewed, the exaggerated 3D effect which results is of great value in interpreting the landscape. So far, we've looked purely at photography but similar principles can be applied to computer generation. Rather than just generate a



Don't get too close!

single photo-realistic image, it's comparatively simple for a software package to generate a scene from two different viewpoints and thereby create a stereo pair.

Free Viewing

But if generating a stereo pair is relatively easy, providing a means of correctly viewing the 3D image requires a bit more imagination. The aim, of course, is to provide some viewing method by which the left image enters the left eye only and the right image enters the right eye only. Something which permits this is referred to as a stereogram and there are quite a few variations on the theme. And surprisingly, you don't need any special apparatus to view the first type of stereogram we'll investigate although this free viewing method does require the viewer to engage in a bit of visual gymnastics. A stereogram intended for free viewing is sometimes referred to as a left-right stereogram for obvious reasons. The two images are displayed side by side on the page or the screen, with the left image on the left and the right image on the right. But there is one important restriction – the separation between identical distant points in the two images should be no greater than 65mm. Obviously this means that photographs can only be displayed at quite a modest size using this method. A couple of stereo pairs presented in this way is reproduced with this article and, unless you've already attempted free viewing, you're probably going to need some instruction. Hold the page at a comfortable viewing distance from your eyes—for most people this will be about 300mm. Now, try to focus your eyes on a point well beyond the page or, if you prefer, go cross-eyed. The images will go out of focus and they'll also start to overlap. If you persevere, adjusting your eyes accordingly, you should end up with three images instead of two. Now, forget about the outer ones and concentrate on the middle image. Try – without loosing those three images – to bring that centre one into

A 3-D digital camera.

focus. If you succeed, you'll find that it will appear to be in full 3D. It's not easy at first, admittedly, but with a bit of practice most people are able to free view stereo pairs in this way. The Victorian stereogram allowed people to view images mounted this way but the provision of some simple optics meant that viewing the stereo photographs was a lot easier. Similarly, stereo 35mm slides can be viewed using a special viewer or even a pair of ordinary hand-held slide viewers taped together at that magic distance of 65mm. Traditionally, you needed a darkroom to create side-be-side stereograms since the photographs had to be accurately printed at a non-standard size. As with many forms of 3D photography, however, it's now much easier to do this on a PC – all you need is a film scanner (or have your photographs professionally scanned onto a Kodak PhotoCD), just about any word processor or DTP package and a photographic quality printer such as an inkjet.

An original '3D View Master'.

Anaglyphs

Viewing stereo pairs using free viewing or an optical viewer has a number of serious drawbacks, perhaps most fundamentally that it doesn't really lend itself to projection and not everyone can achieve free viewing. The anaglyph addresses both these problems and is applicable to the printed page, the cinema or TV screen and the computer monitor. Even if you don't recognise the name, you've almost certainly come across anaglyphs – this is the technique which was used during the 50s 3D movie craze, it has been used on TV and it's sometimes used in magazines. It's the method which requires the viewer to wear those red-blue (or red-green) funny glasses.

Traditional anaglyphs only work with monochrome images. To create a monochrome anaglyph you take the right image and render it in shades or red, take the left image and render it in shades of blue, and then superimpose the two tinted images. The end result looks rather like and out of focus black and white photograph with red and blue fringes around objects, especially the closer ones. However, if you view it through a pair or red-blue glasses, it appears remarkably different. Since the left eye views the anaglyph through a red filter, only the blue-tinted image will be visible and similarly, the right eye, looking through the blue filter

What can you see?

Courtesy David Burder 3D Images

will only see the red-tinted image. You'll notice that each eye will, therefore, only receive the image intended for it and the end result is a 3D representation. As with stereo pairs, it's now far easier to generate anaglyphs in the 'digital darkroom' than by conventional chemical methods. A PC with a photo-retouching package now makes the creation of photographic anaglyphs a viable proposition for any photographer. Similarly, computer-generated stereo pairs can also be turned into anaglyphs.

Although anaglyphs were originally restricted to monochrome images, some degree of success can also be achieved in producing colour anaglyphs and, once again, this is much simpler using digital techniques. Instead of colouring monochrome images, colour anaglyphs are produced by extracting just the red content of the left image and the green and blue content of the right image and merging the two. All the colour information is still present, therefore, in the anaglyph as a whole, and when it's viewed through red-blue glasses (which, strictly speaking, are red-cyan) a colour 3D image results. In practice things are not always as simple as this – a problem arises with images which contain areas of fully saturated colours. A fully saturated red object, for example, will only appear in one of the two images and will, therefore, only be seen by one eye. These objects are often referred to as ghosts since they're effectively 2D objects within a 3D scene. Needless to say, such an image doesn't look at all natural so some means has to be found to eliminate these ghosts. The normal solution is to de-saturate these areas but a by-product, of course, is that colours tend to look a bit washed out. Software packages have been produced to do all this automatically.

A similar technique which is appropriate for colour images and doesn't have the problem of ghosts is to use the polarisation of the light rather than its colour to direct each image into the appropriate eye. This is a technique which doesn't work with the printed page though – it's only applicable to projection and, with some special additions, to the computer display screen. Instead of a single projector, a pair of projectors is used – one for the left image and the other for the right. Both projectors have polarising filters attached, one aligned vertically, the other aligned horizontally. The viewers now wear polarising glasses but, unlike Polaroid sunglasses, the filters are crossed such that one eye only sees vertically-polarised light and the other only sees horizontally-polarised light. A special silver projection screen is needed since ordinary white screens scatter the light thereby destroying the polarisation.

Lenticular Stereograms

With one notable exception which we'll come onto later, people don't want to have to work hard to see in 3D, nor do they want to have to wear glasses or some other viewing aid. And since all the stereograms we've seen so far require you either to go cross-eyed or to wear glasses, there would appear to be some scope for improvement. The next type of stereogram we'll look at is a so-called auto-stereogram, that is, one which can be viewed without a viewing aid. Strictly speaking, of course, the left-right stereogram is also an auto-stereogram but the one we're about to look at avoids the requirement to perfect a special viewing technique. It's called a lenticular stereogram and you've probably seen examples even though, like the anaglyph, you might not have been familiar with the terminology.

To create a lenticular stereogram each image of the stereo pair is cut into thin vertical strips. Next the strips are re-assembled to generate a composite image with alternate left image and right image strips. In fact, although this is conceptually how you'd start to create a lenticular stereogram, in practice this would all be done in software. Finally, to complete the stereogram, a lenticular sheet is attached to the front of the composite image. This is a sheet of plastic moulded into thin vertical lenses which alternately direct the light reflecting off the strips to the left and the right. So long as the stereogram is viewed from a suitable distance, therefore, a 3D image is seen. In fact, the technique can be extended to include more than two images so that as you move your head to the left or the right, different images are seen. This allows a degree of motion parallax to be achieved in addition to binocular disparity.

Random Dot Stereograms

So far, we've seen three methods of preparing a pair of stereo photographs or computer generated images such that they can be viewed in 3D. The next method we're going to investigate doesn't lend itself to photographs or photo-realistic computer images but it is an interesting alternative with very simple computer generated objects.

First of all, a model of the three dimensional object is created in computer memory. Now, a single point on that object is picked and calculations are performed to determine where, on the screen, a viewer's left eye would see that point. In all the other forms of stereoscopy we've seen so far, that point would then be plotted in some way such that it will only be seen by the left eye. In this method, however, this isn't a concern so that point is simply drawn to the screen as a black dot. At first sight this would seem to be a problem since it will also be seen by the right eye whereas it is, of course, a left eye point. Certainly it is the left eye point for the initially selected point on the 3D object but it is also the right eye point for a different point on the 3D object. The next stage, therefore, is to determine which point on the 3D object, the previously plotted point is the right eye projection of. We now have another point on the 3D surface so the process starts again, determining and plotting the left eye projection for this point. If this process is repeated too many times the screen will end

up all black and if the operation is performed too few times the end result will have too few points. There is a middle point, however, where we have sufficient points for the objet to be seen in 3D – so long as you view it in the correct way, that is. The name of this type of stereogram is a single image random dot stereogram or SIRDS.

Closely related to single image random dot stereograms are stereograms which most people will think of as Magic Eye images after the name of the company which commercialised this form of stereoscopy. The basic principle of a Magic Eye image is similar to that of a SIRDS but instead of seeing just an apparently random arrangement of dots, the 3D image is hidden in some rather more decorative wallpaper. Obviously generating this sort of image requires more sophisticated software than that needed for the basic dot variant. As with the SIRDS, viewing Magic Eye images requires some practice and we'll describe exactly how to do it a bit later. It's interesting, however, that left-right stereograms have only been popular among stereo-photography enthusiasts whereas Magic Eye books, posters, calendars and the like have been hugely popular. Not only this but the left-right stereogram is applicable to full colour photographic images whereas a Magic Eye stereogram is capable only of representing a very simple image and no colour information is recorded except for the colour of the wallpaper. The answer must surely lie in the fact that seeing a Magic Eye image is something of a puzzle or a challenge. If you look at a left-right stereogram, it's immediately obvious what you should see even if you don't manage to see it in 3D. With a Magic Eye image, on the other hand, the initial appearance is one of an almost random repeating pattern. The 3D object is totally hidden and only when you view it in the correct way will that hidden object suddenly reveal itself. As such, these images have attracted something of a cult following and are regularly used in promotional material and advertising campaigns.

But if you're not one of the millions who have bought a Magic Eye book, you might be interested to know what all the fuss is about and how you do view this sort of image. There are close similarities between the method used for viewing this type of stereogram and the method used for left-right stereograms. The following description was provided by Magic Eye Inc.

Hold the image right up to your nose (it should be blurry), very very slowly move it away until the two dots at the top of the image turn into three! Once you have three dots, hold the image still. Stare at the middle dot, try not to blink, and the hidden image will slowly appear! Once you see depth, you can look directly at the entire 3D image! The longer you look, the clearer it will become!

This method assumes that a pair of dots or registration marks is printed at the top of the stereogram. Many SIRDS and Magic Eye images do include these 'cheat marks' but not all. However, once you've managed to resolve a stereogram which does include these registration marks you'll find that it's comparatively simple to manage with stereograms which don't.

Sources

You'll need red-blue glasses to view the anaglyphs reproduced with this article and on the front cover. 3D Images Ltd. will supply two free pairs of glasses (red-green, red-blue or one of each). To take advantage of this offer, send a stamped self-addressed envelope to 3D Images Ltd. at 31 The Chine, Grange Park, London, N21 2EA.

Most of the 3D images reproduced with this article were supplied by David Burder 3D Images Ltd. one of the UK's leading suppliers of 3D products and services. The company can be contacted on 0181 364 0022 or you may prefer to point your Web browser at `http://www.3dimages.co.uk` The company specialises in most 3D technologies including anaglyphs, lenticular stereograms, side-by-side stereo pairs, Magic Eye type stereograms and holograms. They can also provide stereo cameras (including digital), stereo projection systems and LCD shutter displays (which will be discussed next month).

Chester - A NEW STORE AND A MILESTONE

Store Manager Mark Smith recalls the opening.

On the 21st November 1998 a new Maplin Store opened in the city of Chester, this new store takes the total number of stores to 50 and was opened 24 years after the first store opened at Westcliff-on-Sea, near Southend, in 1974. The first day we opened, the store had a customer flow of over 300 people, who traveled from near and far to celebrate our grand opening, along with many of the local store managers who were there to lend their help and support to the new staff.

The new staff comprises of six members.

Staff at the Chester Store including Maplin Retail Director Graham Caldwell.

They are Mark Smith, Branch Manager; Jonathan Flynn, Assistant Manager; Neil Chandwick, Technical Sales Assistant; Anthony Matthias, Technical Sales Assistant; Rachael Robbers, Sales Assistant and Lee Chadwick, Part-time Sales Assistant.

Mark Smith has worked for Maplin for the last five years. He started as a part time technical sales assistant and worked his way up the ranks to Branch Manager at the Preston Store. The rest of the team come from very differing backgrounds but they were all selected for their ability to offer

customers the very best service possible.

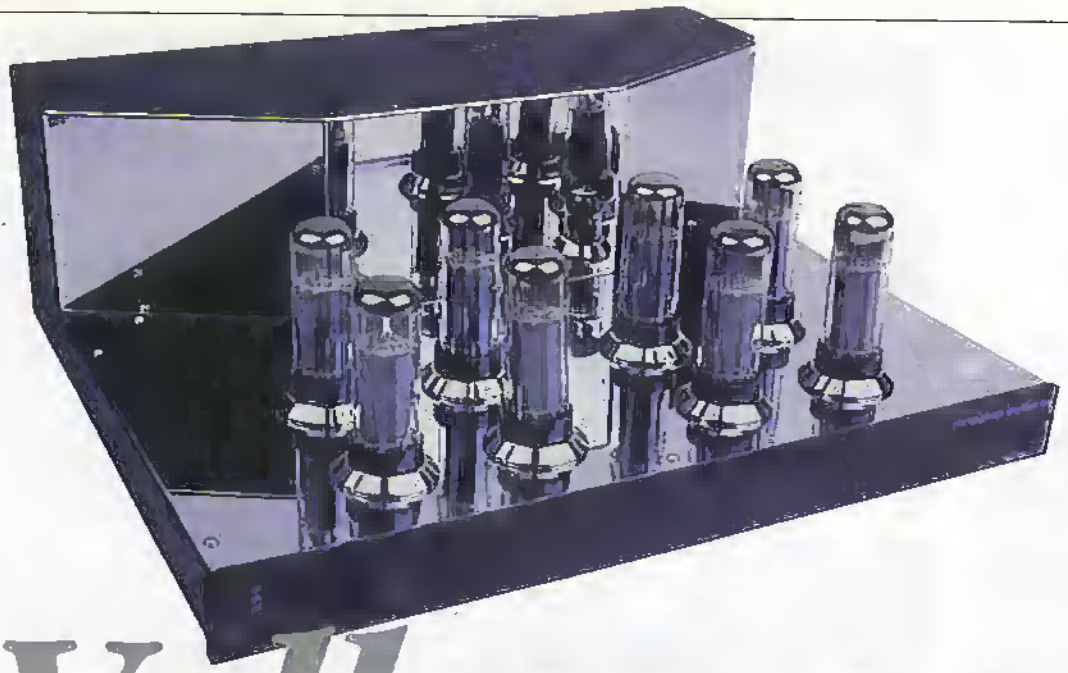
The Chester Store can boast of having one of the largest sales floors amongst the Maplin Stores. It has many extra product sections that are not always found in other stores. The main section is the computer centre which includes four of our most popular specified computers to help aid in sales demonstrations. With the use of Maplin's very unique 'Build-to-Order' service we can provide our customers with the latest technology and would be configured to their exact requirements. We also stock a large range of computer accessories from mouse mats to motherboards. We also have a special offer computer bundle which is only available at the Chester store - but hurry as it is only available while stocks last. The system is based around the Maplin Jupiter, and features a K6 2/300, 32Mb SDRAM, 3.2 Gb Hard Drive, 32x CD ROM and a host of highly specified components including a free 56k internal Voice/Fax Modem for a low price of £599.99 inc VAT.

The store has a large Music and Disco section with an impressive range of disco lighting effects that are on constant demonstration, plus a headphone stand to allow customers to try models from our range of headphones. The In-Car Entertainment display gives various examples of how to complete a typical installation, with help from our knowledgeable staff.

Many product ranges have a dedicated floor area such as Radio Control Modeling, Sound and Vision, Home and Office, Communications and Books. The staff on the component counter are available to help and assist customers to select the smaller but often desperately needed spares - whether it is a part for the hobbyist or for the service engineer.

As with all Maplin Stores, shoppers can choose from an impressive 37000- strong product range, and although not everything is kept in stock at the store, any product can be obtained from the warehouse within two working days, or dispatched by the warehouse to the customer's address.

The Chester store can be found at Unit 1A, The Boughton Centre, Boughton, Chester, CH3 5AF. Tel: 01244 315484, Fax: 01244 315468.



Velleman VALVE AMPLIFIER

John Mosely constructs this revised valve amplifier and tries it with the Velleman digital Pre-amplifier.

Introduction

A friend back in the Sixties introduced me to electronics, and my first project was a 12W valve amplifier that was featured in Practical Wireless. Being at school and short of cash, I suppose to some extent part of the pleasure (if you can call it that!) was in acquiring the necessary bits. I have to admit to it being not very elegant, but after a problem with the power supply (I was badly advised as to a suitable alternative to the recommended selenium bridge rectifier), it worked extremely well. I later constructed a second one for stereo and a valve pre-amplifier to match. This set-up lasted for several years and performed very well. I then moved in to the transistor era.

It was early in the nineties that I acquired some old Leak TL25s which I refurbished and which brought back memories of how well valve amplifiers sounded. Later, Mike Holmes (he was responsible for the Maplin Millenium) and I constructed a pair of valve amplifiers based on the early designs of Williamson using a pair of KT88s in triode output mode. Although they sounded superb, unfortunately, they could not quite manage 10W and so were confined to the cupboard until I can get round to rebuilding them into an ultra linear output.

It was with a certain amount of pleasure that it was decided to look at the Velleman Valve amplifier again (the original article appeared back in March 1992, issue 51) and use it with the digital preamplifier - also from Velleman. The valve amplifier has had two important modifications made to aid construction and setting-up - the output stage biasing and setting-up is now easier, and the use of one large PCB for the vast majority of all the components.

The amplifier design is quite straight forward using a common ECC82 for pre-amplification, ECC83s for voltage gain and phase splitting, and two parallel pairs of EL34s in an ultra linear, push-pull output configuration. The one distinguishing feature is the use of toroidal transformers for the main HT and heater transformer and the output transformers.

Construction

This is not a cheap kit to buy, so it is not surprising that the first thing you notice is the quality of the components used and the chassis construction. It is also very heavy!

Construction starts with the octal valve bases which are mounted using spacers. One spacer is mounted between the valve base and the top of the

SPECIFICATION

Output per channel:	90W rms into 4 or 8Ω up to 15W rms in Class A
Bandwidth:	8Hz to 80kHz (-3dB/1W)
Harmonic distortion:	0.1% @ 1W/1kHz
S/N ratio:	>105dB (A weighted)
Input sensitivity:	1V rms

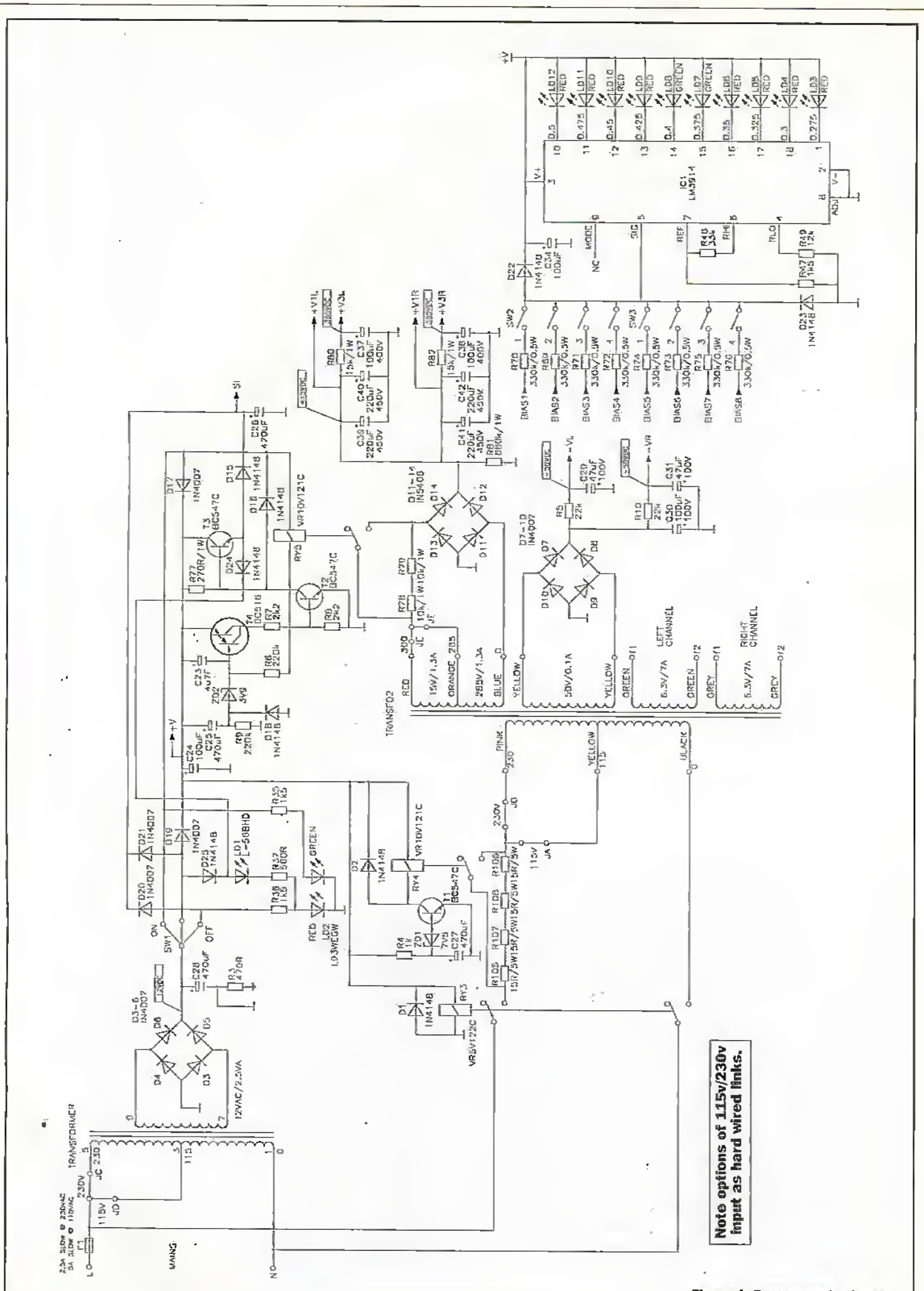


Figure 1. Power supply circuitry.

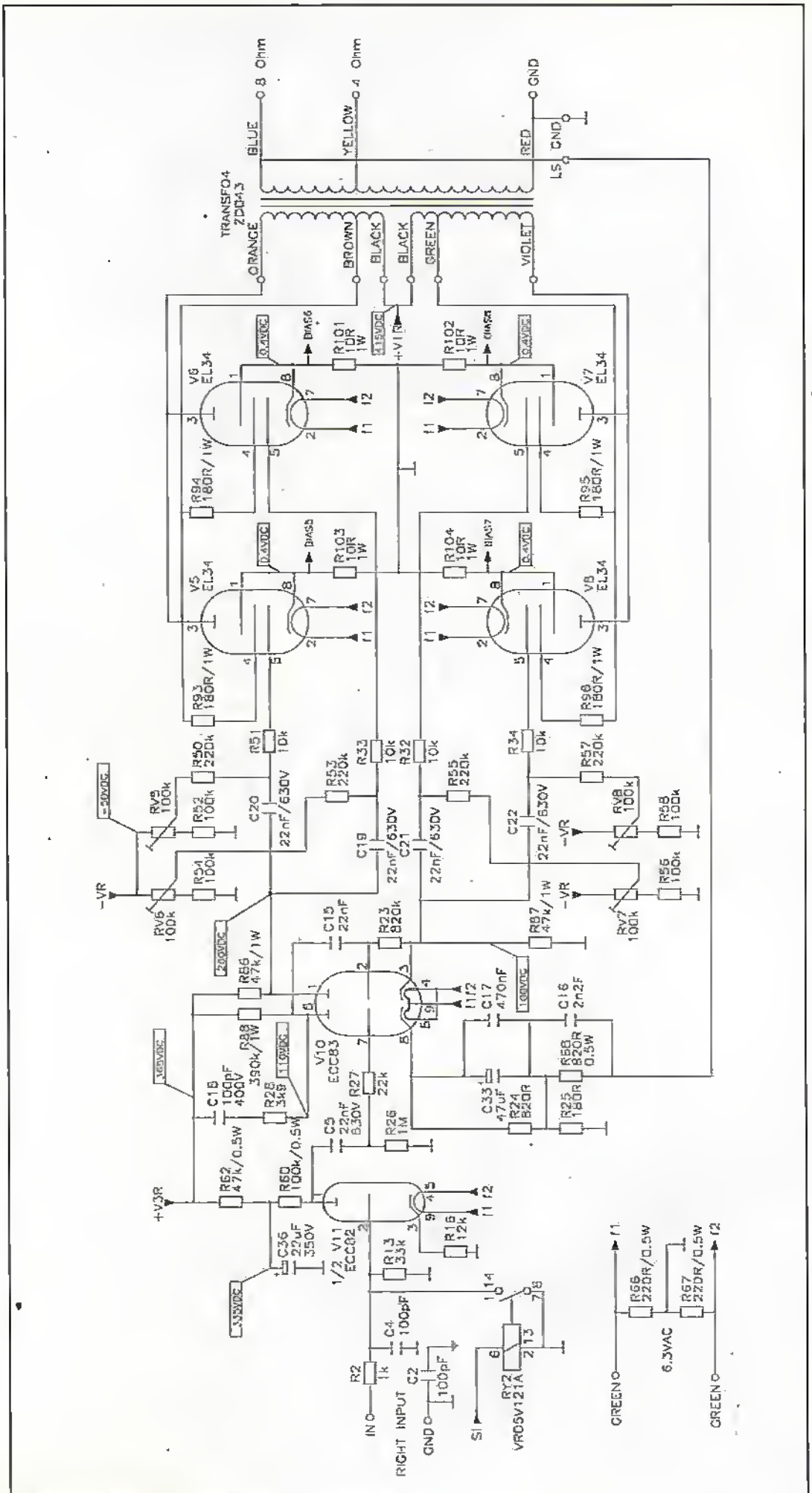


Figure 2. Valve power amplifier for one channel.

PCB, and another (threaded type) is mounted below the board. This one is used to secure the PCB to the chassis. Connections are made to the board from the valve bases by short links of wire, and it is important that the links do not protrude above the height of the spacer as they will short to the metal base cover. These links should be as short as possible.

Next are the wire links, and there are many of them, so make sure you check that you find them all. Next comes the diodes and low wattage resistors, followed by LEDs, the IC socket, reed relays, trimmers, transistors, high power resistors, capacitors, screw connectors, valve sockets and other sundry items. Lastly the octal valve base heater wiring needs to be soldered into place. Velleman supply the necessary wire, and again it is important to keep the wiring runs below the height of the spacers. The wires need to be twisted and anchored at one end to the PCB, and the other ends to the respective valve bases. Connections to the mains transformer are made using screw connectors. When this wiring is complete, check with a multimeter, set to a suitable resistance range, that there are no shorts. Remember that there is a 220Ω resistor to ground from each heater wiring leg, so you will not measure a high resistance across the two wires.

The PCB board is now complete, so a thorough check of the board should now be made. There are nearly 700 solder joints, so do check very carefully as time spent now may well prevent problems later.

There are three small PCBs that need to be mounted to the back of the case. One carries the input phono sockets and the other two are used to mount the left/right loudspeaker terminals. Again, Velleman have used gold plated components of the highest quality. A small length of screened audio lead is supplied and this is soldered to the input sockets. Also, lengths of cable are attached to the 4Ω output terminal and ground terminal. The 4Ω connection provides feedback to the first stage of the ECC83. Note the circuit diagram shows this as being taken from the 8Ω terminal. You may need to use a higher power soldering iron to make these joints, as the loudspeaker terminals are quite

substantial. The mains input socket is also mounted at this stage.

Protective self-adhesive foil is provide to stick on the mains input socket and to the top of the case above the three transformers. Similarly self-adhesive feet are stuck to the bottom of the case below the three transformers. The two output transformers are now mounted to the case. The output connections can now be made to the loudspeaker terminals, remembering to slip the supplied heat shrink sleeving over the wires prior to making the solder joint. The mains transformer is now mounted. Note that Velleman supply the correct mounting bolts for all the transformers, and it is important to ensure that the transformers do not touch any metal parts such as loudspeaker terminals.

The main PCB is now mounted, and care needs to be taken in sliding the board into place. There are many screw mountings to hold the board in place, and Velleman thoughtfully supply the two Allens keys for the job.

There may be a good argument for soldering all the transformer connections to the board, but Velleman have chosen to use screw terminals for all these off-board connections, except for the audio input, which is soldered. This method is certainly simpler, and makes servicing (if necessary) easier, however, the mains transformer connections are a little bit tricky due to the close proximity of the transformer to the PCB, where there screw connector is mounted. Finally, one last check.

Testing

With the front mounted mains switch fully down i.e. OFF, connect the mains lead to the mains input socket and with mains voltage applied to the amplifier, the red LED next to the mains switch should light. Now, holding your breath, the mains switch is switched on (fully up), and the bi-coloured LED next to the switch should alternately flash red/green. After approximately one minute the relay will energise and the LED should go to continuous green illumination. Now with your multimeter set to a suitable AC voltage range, measure the 6.3V heater voltages around the octal valve bases. Remember that there are several points on the board sitting at over 400V, so exercise due care. If you are happy so far then switch off and wait several minutes for the high voltage on the smoothing capacitors to dissipate.

SPECIFICATION

INPUT SENSITIVITY	
phono:	5.5mV/50k
CD:	500mV/32k
tuner:	360mV/22k
tape 1/2:	360mV/22k
RATED OUTPUT	
line:	1V
tape:	360mV
equaliser:	180mV
TONE CONTROL	
bass:	±15dB (100Hz) in 2.5dB steps
treble:	±15dB (10kHz) in 2.5dB steps
S/N RATIO	
phono:	75dB (A weighted/rated output)
tape/CD/tuner:	100dB (A weighted/rated output)
THD:	0.01%
Response:	8Hz to 150kHz (-3dB)
Channel separation:	90dB
Crosstalk:	98dB (between inputs)
RIAA deviation:	±0.5dB (20Hz to 20kHz)

WARNING

This amplifier contains high DC and AC voltages and can kill – beware!

The small B9A valves can now be inserted - ECC82 and ECC83s - and again power up the amplifier. When the green LED is on, the various voltage points indicated on the board can be measured, except the 0.4V bias voltages. If all voltages are about right switch off and again wait several minutes, and insert the eight EL34s.

Valve amps must always be connected to a suitable load, so Velleman supply two 8.2Ω, 5W resistors to complete the set-up of the amplifier. With these resistors connected, and no signal applied, the output valve biasing can be set. All eight trimmers at the front of the board are set anti-clock wise, and the eight DIP switches all set to the OFF position i.e. up.

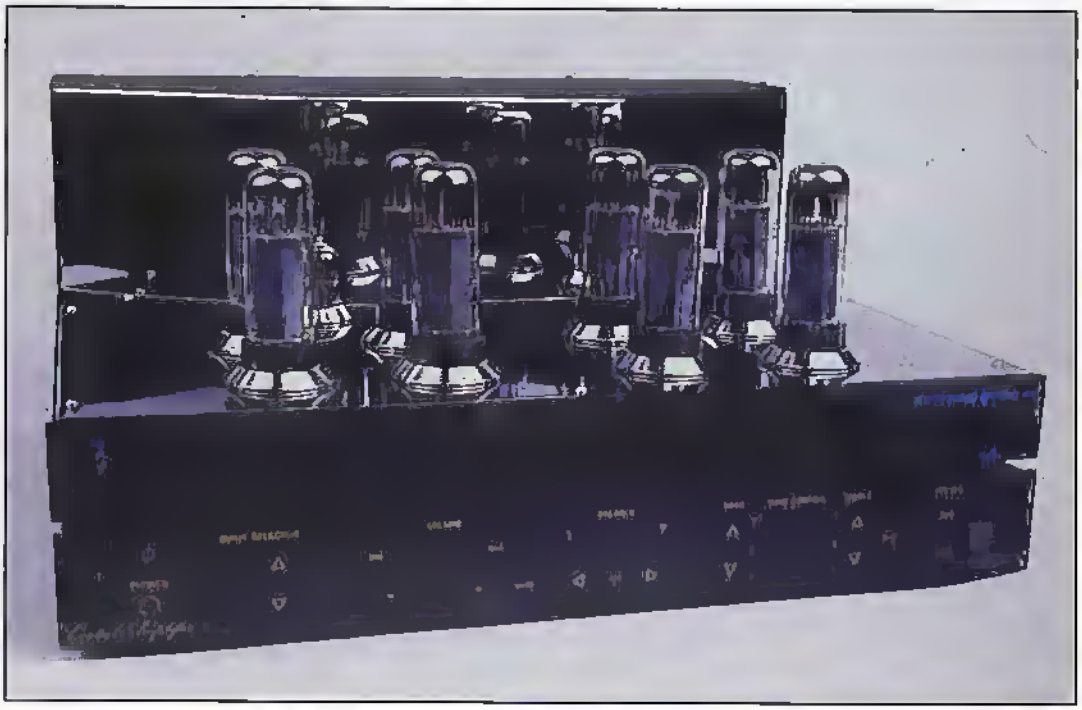
Velleman has designed a very simple, visual and elegant method of setting up the bias. With the amplifier on and the green LED on, the first switch of the left hand DIP is switched on i.e. down, RV1 is adjusted until the second or third red LED (LD4 or LD5) lights-up. The DIP switch is then switched up and the next one is switched on. RV2 is now adjusted until again the second or third LED lights-up. This is repeated for all eight valves.

The amplifier is now allowed to warm up for a further 10 minutes and the above alignment is repeated, but instead of red LEDs lighting up, adjustment is made until one of the green LEDs light up. This is again repeated for all eight valves. The 0.4V bias voltages as indicated on the PCB can now be checked. All eight readings were very close.

Before the panels are fitted to the case, the final test needs to be made!

The Ultimate Test

After you have connected the amplifier to suitable speakers, and before you apply an audio signal, check that there is not an excessive amount of hum present. Hum can be reduced to a minimum by carefully rotating the relevant output transformer either clockwise or anticlockwise until the hum is at a minimum. This is particularly tricky for the right channel as the ECC82 sits in front of it. I certainly had to put my ear very close to my



loudspeakers to hear a very small amount from my right loudspeaker.

You have probably spent well over 20 hours in time and £700 from your pocket to get this far. So just what have you got? Simple - a very fine amplifier. I fed the output from my CD player into the amplifier via a shielded volume control pot, and the result was excellent.

We have no doubt all read in Hi-Fi magazines those wonderful descriptive phrases that reviewers tend to use. Well, I can now understand what they are getting at! Phrases such as pace, dynamic, involving etc. all take on a true meaning. If you enjoy listening to music - any music - then this amplifier certainly lets you hear it. Pop, jazz, classical, blues, it takes them all on and reveals all. If there is bass there, you will hear it, with clarity and depth. Voices are clear and well defined. I normally listen to a Musical Fidelity amplifier with Heybrook loudspeakers - but this amplifier is several steps up from my Musical Fidelity. Valve amplifier sound is often described as warm, and I have always noticed that valve amplifiers do produce a distinctive sound that I believe is preferable to transistor amplifiers.

Velleman Digital Pre-Amplifier

The digital controlled preamplifier is an ideal partner for the valve amp offering a range of functions and an excellent specification. Control can either be via front panel push buttons or a separately available remote control unit. LEDs are used to display input selected, volume, bass and treble level. In and out sockets are provided for a remote equaliser, but if one is not used, then these sockets need to be shorted together. A push button is provided to give a flat response, plus there is a convenient switched mains output. The floor area dimensions match the valve amp, so that the amplifier can comfortably sit on top of the preamp.

In use, the preamp performed remarkably well, and I was impressed with the lack of break through from one input to another. Functions performed as expected, and with the tone controls in the flat position, the preamp did not appear to degrade the signal at all.

Conclusion

The valve amplifier needs to be partnered with loudspeakers and sound sources that will do justice to its ability. So if you are aiming for a realistically priced top-end system then this amplifier is a worthy contender, and if you do need a preamp, then the K4100 is an excellent match.

Not only does the system sound impressive, but it looks impressive too - my family and friends remarks backed this up. There is a lot of satisfaction in knowing that you have built a quality hi-fi system, and one you can repair!

If you buy the amp, preamp and remote control then you are looking at nearly £1000 outlay, and if you add the matching cover for the valve amp then it is over a £1000. Is it worth it? Personally - yes.

Velleman Kit	Maplin Code	Price inc. VAT
K4040 valve amp	VF83E	£699.99
K4100 preamp	VE46A	£224.99
K4101 remote control	VE47B	£45.99
Amp cover	VX82D	£49.99

PROJECT PARTS LIST

RESISTORS

R1,2,4	1k
R3	470R
R5,10,21,27	22k 0.25W
R6,9,39,41,43,45,50,53,55,57	220k 0.25W
R7,8	2k2 0.25W
R11,16,49	12k 0.25W
R12,13,48	33k 0.25W R17,23 820k 0.25W
R18,24,65,68	820R 0.25W
R19,25	180R 0.25W
R20,26	1M 0.25W
R22,28	3k9 0.25W
R29,30,31,32,33,34,38,51	10k 0.25W
R35,36,47	1k5 0.25W
R37	560R 0.25W
R40,42,44,46,52,54,56,58	100k 0.25W
R59,60	100k 0.5W
R61,62	47k 0.5W
R63,64,66,67	220R 0.5W
R69,70,71,72,73,74,75,76,77	330k 0.5W
R77	270R 1W
R78,79	10K 1W
R80,82	15k 1W
R81	680k 1W
R83,84,86,87,	47k 1W
R85,88	390k 1W
R89,90,91,92,93,94,95,96	180R 1W
R97,98,99,100,101,102,103,104	10R 1W
R105,106,107,108	15R 5W
RV1,2,3,4,5,6,7,8	100k Vertical Trimmer
8.2R 5W	2 off (dummy load)

CAPACITORS

C1	47nF
C2	
C3,4,10,18	100pF 400V
C5,6,9,11,12,13,14,15,19, 20,21,22	22nF 630V
C7,17	470nF
C8,16	2n2nF
C23	4µF Electrolytic
C24	100µF Electrolytic
C25,26,27,28	470µF Electrolytic
C29,31	47µF 100V Electrolytic
C30	100µF 100V Electrolytic
C32,33	47µF Electrolytic
C34	100µF Electrolytic
C35,36	22µF 350V Electrolytic
C37,38	100µF 400V Electrolytic
C39,40,41,42	220µF 450V Electrolytic

SEMICONDUCTORS

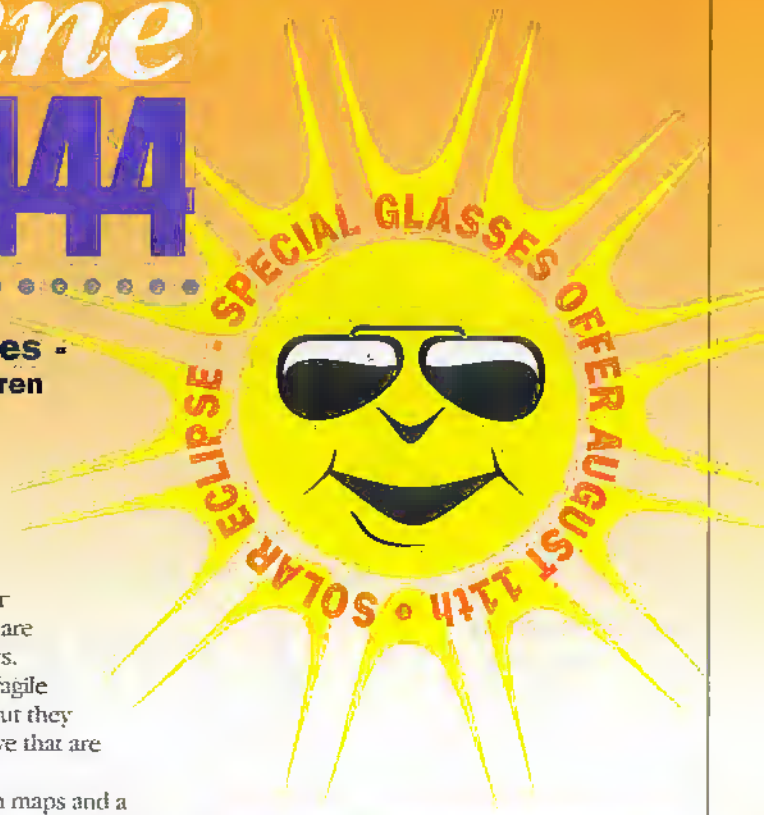
D1,2,15,16,18,22,23, 25	1N4148
D3,4,5,6,7,8,9,10,17, 19,20,21,26	1N4007
D11,12,13,14,	1N5408
ZD1,2	Zener 3.9V
LD1	5mm Red Blinking
LD2	3mm Bicolour
LD3,4,5,6,9,10,11,12	3mm Red
LD7,8	3mm Green
T1,2,3	BC547C
T4	BC516
IC1	LM3914

MISCELLANEOUS

RY1,2	Reed Relays VR05R121	2
SW1	3P On-On-On	
SW2,3	DIP Switch DS-4P	2
	IC Skt 18W DIL	1
SK3,4	2P Screw Connector	2
SK5	3P Screw Connector	1
SK6,7,8	8P Screw Connector	3
	Octal Valve Base	8
	B9A Valve Base	3
RY3	Power Relay VR5V122C	1
RY4,5	Power Relay VR10V121C	2
TR1	12V Transformer	1
TR2	HT Transformer	1
	Output Transformer	2
	Mains Input Socket	1
	Gold-plated Phono socket	2
	Gold-plated Speaker Socket	6
	Wire	Assorted

Science Line

0345 600 444



A total eclipse happens when the Moon passes in front of the Sun, blocking its light. It's a remarkable sight and usually a once in a lifetime experience. The eclipse on August 11, 1999 is the first total solar eclipse visible from the UK since 1927.

To view the Sun safely you need to make a pin-hole camera to project the Sun's image or use CE certified glasses. Science Line can offer two types of eclipse glasses to readers.

Solar Viewer - not suitable for children

The Solar Viewer is a hand-held viewer which makes it unsuitable for children. It is a robust unit of special plastic without cardboard around it. This means it offers a wider field of view than the conventional glasses and we would recommend them to anyone with more than a passing interest in the eclipse.

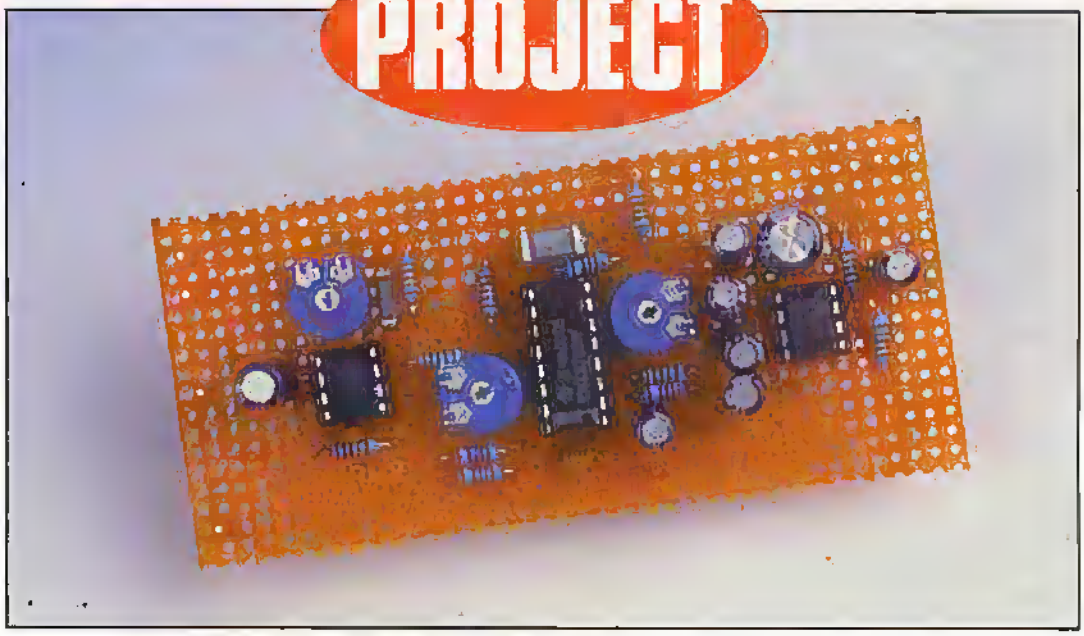
Eclipse Glasses - suitable for children

The Eclipse Glasses are more traditionally styled, a bit like 3D glasses, with cardboard frames and elasticated straps making them suitable for children. However, they are also designed to fit adults. They are slightly more fragile than the solar viewers, but they offer a cheaper alternative that are suitable for children.

Both are available with maps and a leaflet. Prices start from £5 for the Solar Viewer and £3.50 for the Eclipse Glasses. Please order by the above telephone number only. Lines open between 1pm-7pm daily. For bulk orders (over 50), please call Nicole for further details.

N.B. Viewing the Sun is dangerous Those doing so do it at their own risk Maplin, BSS and its employees do not accept any liability for any injury which may arise.

PROJECT



Low Cost COMPRESSOR

Gavin Cheeseman describes a signal processor for communications, and musical effects.

Introduction

When amplifying and processing audio frequency signals problems are often encountered due to wide amplitude variations. If an amplifier is set up with a high gain to amplify signals of a few mV then larger signals may well result in overload and distortion. If the amplifier is being used for hi-fi reproduction then probably the only way to deal with this is to use a circuit with a very wide dynamic range as it is important that the dynamic characteristics are preserved. This often means using circuits with high slew rates and relatively high voltage supply rails. However, for other applications such as communications, musical effects, and the like, an alternative is to process the signal so that small and large signals both end up at a similar level.

The maximum level of a signal can be limited using clipping techniques as illustrated in Figure 1. However, for many applications this method is unsuitable as high levels of distortion are introduced resulting in an unwanted 'fuzz' effect. Therefore, where intelligible audio reproduction is required (with the exception of certain specialised applications in communications) this method is best avoided.

A much more suitable method is compression. The term 'compression' is often used to describe a variety of different processes in electronics. In the context of this article it is a method of reducing the dynamic range of a signal by controlling the gain of an amplifier, without introducing high levels of unwanted distortion.

Most compression circuits are based around the use of voltage or current controlled amplifiers and automatic gain control. Typically, the input signal is applied to an amplifier and part of the output signal is rectified to produce a voltage corresponding to the average amplitude. This voltage is then used to control the gain of the amplifier. At low signal levels the gain is high but as the amplitude of the input signal increases the gain of the amplifier is reduced to compensate. As a result the average amplitude at the output of the amplifier remains relatively constant within a given range even though the level of the input signal is varying drastically. The circuit must be set up to respond only to the average level of the signal and not to individual peaks. The optimum time required for the circuit to respond to a change in level varies depending on the application. It is also necessary to set a threshold which the signal must reach before compression starts to take place.

There are various ways to implement automatic gain control in a circuit. Indeed a variety of different off-the-shelf ICs are available designed specifically for the purpose. The circuit described in this article makes use of the LM13700 dual transconductance operational amplifier IC. This is an excellent general purpose device that is easy to use and is capable of good results. The circuit is designed as a general purpose building block that can be adapted for use in a variety of different applications. The block diagram of the unit is shown in Figure 2 for reference. The circuit uses two stages of compression to maintain a stable output level over a wide range of input voltages.

Circuit Description

Figure 3 shows the circuit diagram of the compressor unit, which is relatively simple using just three IC's. The unit is designed to operate from a single rail power supply connected to terminals P1 (+V) and P2 (0V). Capacitor C2 acts as bulk de-coupling for the main supply rails. Additional high frequency de-coupling is also provided close to IC2 and IC3 in the form of C9 and C10. Operational amplifier IC1 together with R1 and R2 provides a low impedance half supply reference for the other ICs effectively functioning as an artificial 0V within the circuit. The use of IC1 as a unity gain buffer allows relatively high values to be selected for R1 and R2. The input to IC1 is filtered by capacitor C1. Additional de-coupling of the half supply reference is provided by C3 and C4. IC2 is a dual transconductance operational amplifier and forms the heart of the compressor circuit. There are two amplifier

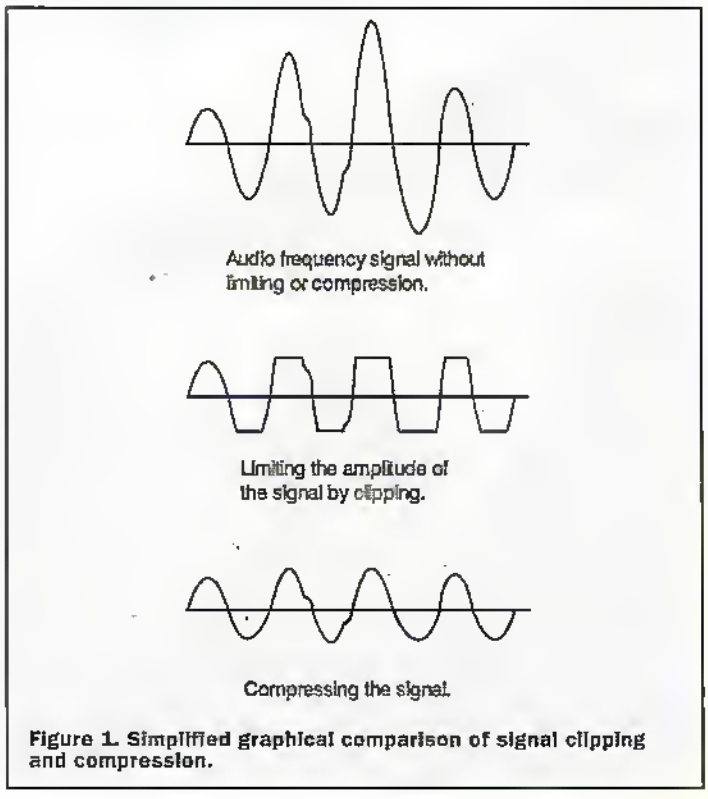


Figure 1. Simplified graphical comparison of signal clipping and compression.

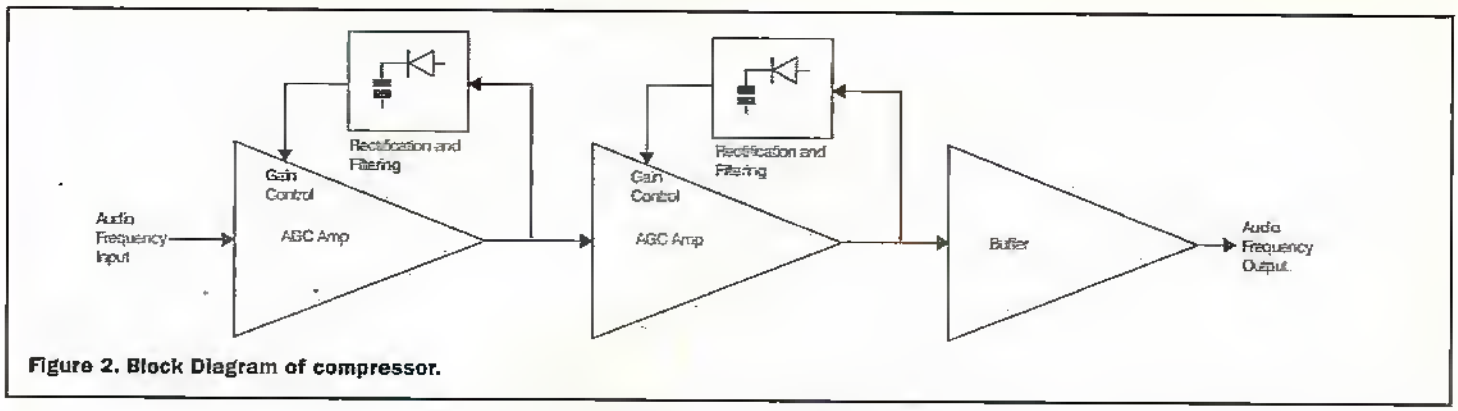


Figure 2. Block Diagram of compressor.

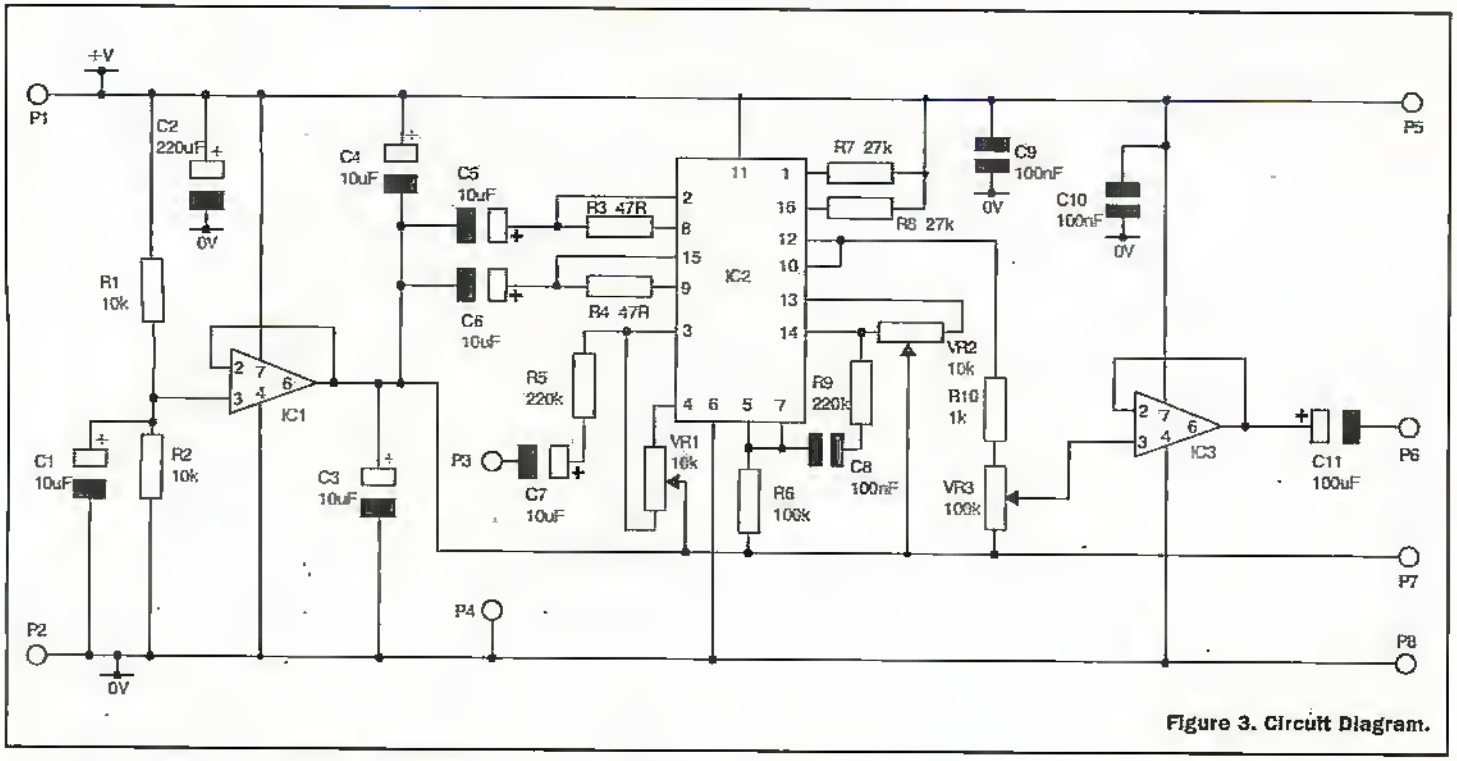


Figure 3. Circuit Diagram.

sections to the IC as can be seen from the IC pinout. Input signals are coupled to the input of IC2 on pin 3 via C7 and R5. Variable resistor VR1 acts as a balance control affecting the symmetry of the signal. R7 and R8 are biasing components. The current output of the first amplifier is on IC2 pin 5. The output current develops a voltage across load resistor R6 and is connected to the base of an internal buffer transistor on pin 7. The output of the buffer on IC2 pin 8 is used to charge capacitor C5 producing an effectively rectified and filtered DC level directly related to the amplitude of the input signal. This is fed to the diode bias input of the IC on pin 2 effectively controlling the gain of the amplifier stage. The base-emitter voltage of the internal buffer transistors determines the threshold at which the compressor starts to operate. The audio frequency output from pin 5 is coupled to the next amplifier stage on IC2 pin 14 via C8 and R9. Once again VR2 acts as a balance control. As with the first stage, the output on pin 12 is fed to the input of the buffer (in this case on IC2 pin 10). The output of the buffer on pin 9 is filtered by C6 to produce a DC level which is used to control the gain of the amplifier via the diode bias

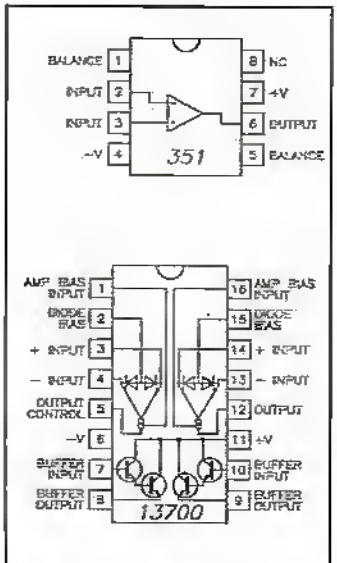


Figure 4. IC Pinouts.

input on pin 15. In addition, the audio frequency output of the second amplifier stage is fed to the input of IC3 which acts as an output buffer. In addition to acting as a load for the output at pin 12, R10 and VR3 act as a variable attenuator allowing the user to set the relative output level. The Output on IC3 pin 6 is coupled to output terminal P6 via capacitor C11.

Building the Compressor Circuit

The compressor circuit may be built on printed circuit board or matrix board. As with most amplifier circuits some attention must be paid to the correct component layout if optimum performance is to be achieved. It is sensible to layout the components in logical order as shown on the circuit diagram. Try to keep connections between components as short as possible to avoid stray coupling. It is usually advantageous to run separate supply rails to each of the ICs joining only at the power supply terminals. Also take care with positioning of de-coupling capacitors. C2 should be positioned close to power supply terminals P1 and P2. High frequency de-coupling capacitors should be kept close to the relevant IC. Hence C9 should be connected as close as possible to IC2 and C10 should be adjacent to IC3. This helps to prevent high frequency noise on the supply rails adversely affecting the operation of the circuit.

It is usually best to start constructing the circuit by fitting the low profile components such as resistors first. As always use of DIL sockets is to be recommended IC's can sometimes be damaged if overheated during soldering. It also makes life considerably easier if it is necessary to replace one of the ICs. It is worth noting that if the DIL sockets are fitted before any of the larger components, this makes the job simpler, as the socket can be held in position during soldering by placing the board upside down on a flat surface. Otherwise, once the capacitors are in place holding the socket

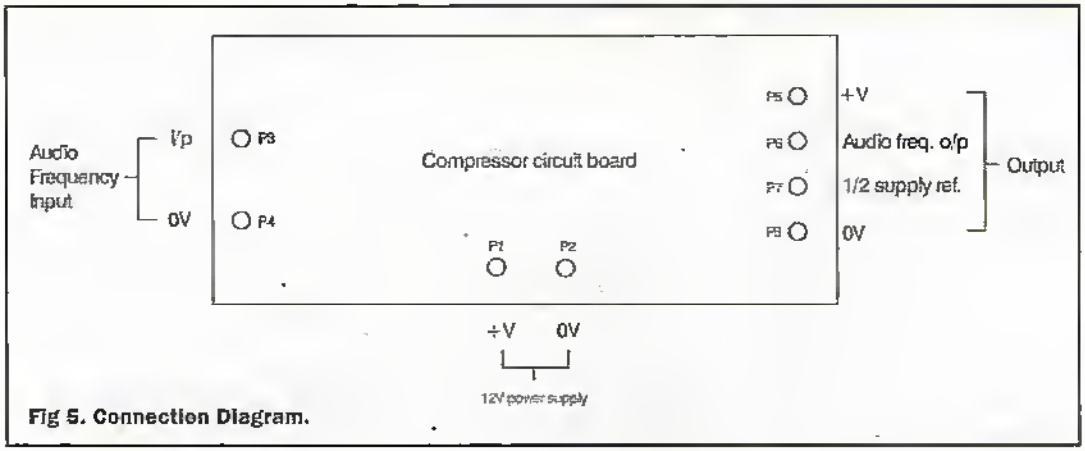


Fig 5. Connection Diagram.

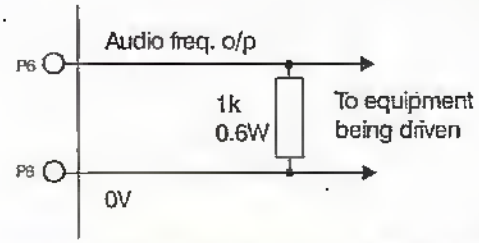


Figure 6. Connecting a load to the output of the circuit.

in place can be quite awkward.

Pay close attention to component polarities where applicable. I may be in danger of appearing a little repetitive on this point but incorrectly connected electrolytic capacitors and semiconductors can explode very violently indeed not to mention the damage in terms of functionality. Just for those who may not be aware, the polarity of the electrolytic capacitors is indicated by a minus (-) symbol on the component case close to the negative lead. The negative lead is also usually the shortest of the two. The IC pinouts are shown in Figure 4. Please ensure that all pins are connected correctly before applying power to the circuit. It is best to wait until the rest of the circuit is constructed before inserting the ICs into the DIL sockets.

Once construction is complete, take a second look over your work, just to check that everything is connected correctly. Pay particular attention to the solder joints. Poor soldering is often an initial cause of failure when first testing a circuit either due to high resistance joints (which cannot always be easily seen) or inadvertent short circuits. Holding the board up to a bright light can sometimes show up problem areas. Also double check the component connections against the circuit diagram. This may all appear to be unnecessary extra work but a few minutes spent checking the board can save a lot of time later.

Testing the Circuit

In order to test the Compressor circuit you will need an AF signal source such as a signal generator and a method of monitoring the output of the unit. An oscilloscope is preferable but if this is not available, a suitable audio amplifier may be used. You will also need a regulated 12V DC power supply. A bench supply is ideal. The current consumption of the circuit is in the region of a few mA maximum. Figure 5 shows the connection diagram.

Connect the power supply to the circuit. The positive connection (+V) is made to terminal P1 and the negative (0V) connection is via P2. If you are using a power supply with a current limit control set this for around 100mA just in case there is an error or fault on the circuit board. Similarly if you are using a high current supply it should be suitably fused to protect the circuit and prevent any hazard due to a short circuit.

If available it may be useful to connect a multimeter set to the current range in series with the +V supply rail to monitor the power supply current. Drastically increased current consumption can be an early indicator of a fault. If possible, check the voltage level at terminal P6. This should be approximately half of the supply voltage (6V).

Connect an audio frequency signal source to the input of the circuit between terminals P3 (i/p) and P4 (0V). If you are using a signal generator, adjust the frequency to approximately 1kHz (sine wave) for the initial test. Set the level control of the signal source to minimum to start with, so that no signal is present. Connect an oscilloscope or test amplifier to the output of the Compressor circuit between P6 (o/p) and P8 (0V). If the compressor circuit is driving into a high impedance input, it is advisable to connect a small load resistor between P6 and P8 as shown in Figure 6 to allow C11 to charge otherwise there may appear to be a standing DC offset. A suitable value is 1k. Initially, variable resistors VR1 and VR2 should be set to central position. VR3 should be set to maximum.

Increase the level of the input signal until an output is detected. At first this may be quite distorted. A level of not more than a few mV should be required. If no output appears to be present, disconnect the input signal and monitor the DC level at IC2 pin 5. Adjust variable resistor VR1 for a DC level of approximately half the supply voltage. Next monitor the level at IC3 pin 6 and adjust VR2 for a level of approximately half supply. Re-connect the input signal and try the test again. Adjust VR1 and VR2 until minimum distortion is achieved. If you are using an oscilloscope to monitor the output, adjust VR1 and VR2 until the most sinusoidal output waveform is produced. Reset the level of the input signal to minimum.

Once again, slowly increase the level of the signal source. As the amplitude is increased, a corresponding increase at the output should be noted. If the input signal is increased further, a point should be reached where changes at the compressor input no longer affect the level at the output. The output signal should remain at approximately the same level over a wide range of input voltages. It may be necessary to re-adjust VR1 and VR2 to provide optimum symmetry at the output and to minimise distortion. Finally check that VR3 adjusts the output level.

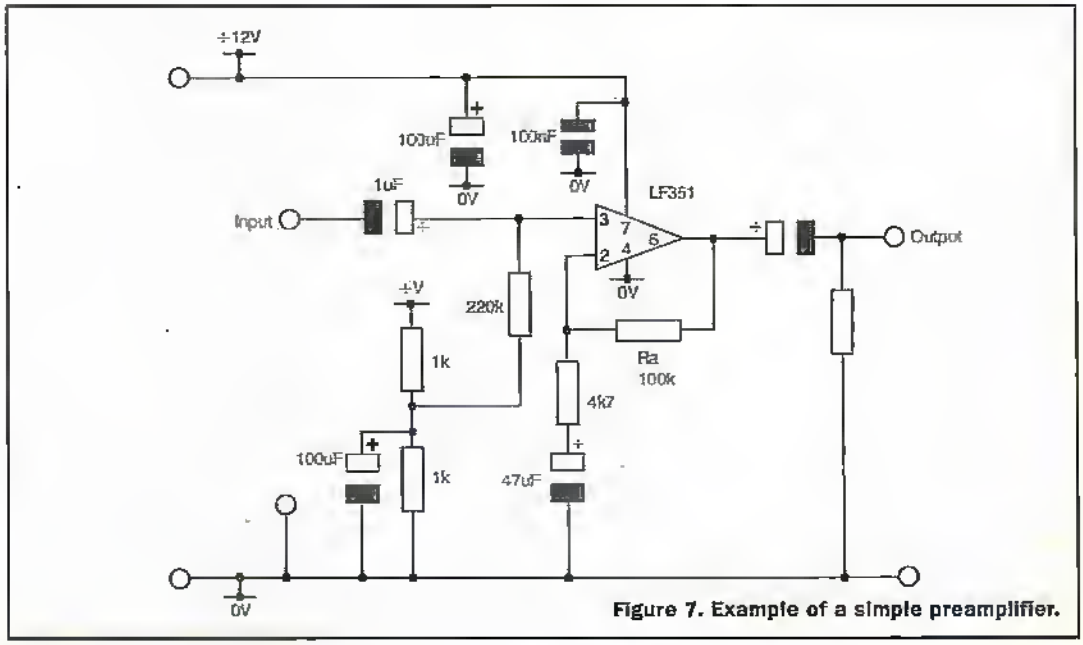


Figure 7. Example of a simple preamplifier.

Using the Compressor

The compressor unit lends itself to use in a wide range of applications. It should be noted that the unit is not optimised for any specific purpose and therefore it may be necessary to adapt the circuit or change component values to suit different applications.

Before connecting the compressor circuit to other equipment check that the output and input requirements are compatible. Variable resistor VR3 determines the final output level. The control should be adjusted to suit the drive requirements of the equipment connected to the output of the compressor.

In some applications where the maximum input level is relatively small, a simple op-amp preamplifier stage may be added to the input of the circuit to improve sensitivity. A typical example of this type of circuit is shown in Figure 7 for reference. The value of resistor Ra may be modified in order to change the gain of the preamplifier. It is best to avoid the use of very high values of resistance as this may result in unwanted noise or instability. Although useful for amplifying small signals, it should be noted that high level signals will tend to be clipped and this results in distortion. Therefore the gain must be set at an appropriate level, otherwise distortion in the preamplifier will tend to diminish the usefulness of the compressor. Similarly a resistive attenuator network may be fited to the input of the device if signal levels are very high.

Applications

To cover all applications of the circuit in detail is outside the scope of this article. The following suggestions are intended to provide an example of possible uses for the unit. They are not all fully tried and tested as specific requirements vary considerably and may require some experimentation to obtain usable results.

Microphone Preamplifier

A typical application for the compressor circuit is as a microphone preamplifier for communications use. It may be necessary to use an additional preamplifier stage as described earlier to lift the level of the input signal to a point where limiting takes place. This will depend on the sensitivity of the microphone. When set up correctly, the compressor may improve the effectiveness of a communication link especially under weak signal conditions.

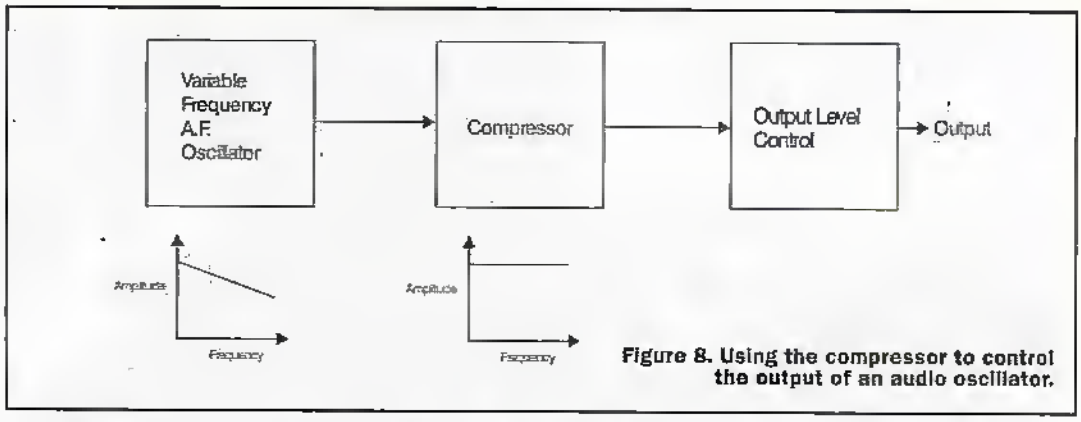


Figure 8. Using the compressor to control the output of an audio oscillator.

Electromusic Applications

It may be possible to use the compressor circuit to produce sustain effects for use with electric guitars and other instruments. For this application, it is necessary to set up the unit such that limiting starts at a very low level. Then when you strike a note the circuit will attempt to maintain the same volume level as the note decays. You may wish to reduce the value of C5 and C6 to provide a more instantaneous effect or increase the value to delay the effect. However, use of very low values may produce undesirable effects if there is insufficient filtering of the control voltage. The compressor could also be used ahead of effects units to maintain a relatively constant input level independent of the loudness of the instrument.

Use with Radio Receivers

Another possible use for the circuit is to provide audio frequency automatic gain control for radio receivers. This could be useful with simple AM communications receivers where the audio output level can vary over a wide range due to variations in signal strength. It should be possible to maintain the audio output of the receiver at a relatively constant volume avoiding the need to continuously adjust the AF gain control. The output of the compressor could be used to drive a small audio power amplifier and loudspeaker. If you are building your own radio receiver, it may be worth installing the unit inside the receiver. A bypass switch could be provided.

Use with Oscillators

Often simple A.F. variable frequency oscillators or signal generators produce an output which varies in amplitude as the frequency is adjusted. This can be a problem when using the oscillator for test purposes as it is often necessary to adjust the level control every time the frequency is changed significantly. The compressor circuit can be used at the output of an audio frequency oscillator to ensure that the output level remains consistent over the entire frequency range (See Figure 8). Set the oscillator to the frequency where the output level is minimum. Adjust the amplitude so that the compressor is driven enough for it to limit. Adjust the frequency and check that the output from the compressor remains constant. VR3 may be used to adjust the output level. A 100k panel mounting potentiometer may be used in place of the preset resistor if it is more appropriate. The unit may introduce some distortion but for many applications this is not a problem.

Audio Processing Applications

Many devices used in audio processing such as active filters and analogue to digital converters have relatively tight input level requirements. High level signals may overload the device and small signals may suffer from serious degradation due to noise. Compressors may be used to try to ensure that the signal remains at the most optimum level as much as possible.

Limitations

The compressor unit described is relatively basic and as with most simple circuits suffers from some shortfalls. There may be a degree of distortion at some input levels and initial alignment may take some patience if the best performance is to be achieved. However, the circuit costs relatively little to build and can provide a good introduction to automatic gain control and compression techniques with a whole host of practical uses.

PROJECT PARTS LIST

RESISTORS			
R1, 2	10k	2	M10K
R3, 4	47R	2	M47R
R5, 9	220k	2	M220K
R6	100k	1	M100K
R7, 8	27k	1	M27K
R10	1k	1	M1K
VR1, 2	Hor Encl Preset 10k	2	UH03D
VR3	Hor Encl Preset 100k	1	UH06G
CAPACITORS			
C1, 3-7	GenElect 10µF 63V	6	AT77J
C2	GenElect 220µF 16V	1	AT41U
C8	Poly Layer 100nF	1	WW41U
C9, 10	Minidisc 0.1µF 16V	2	YR75S
C11	GenElect 100µF 16V	1	AT40T
SEMICONDUCTORS			
IC1, 3	LF351N	2	WQ30H
IC2	LM13700N	1	YH64U
MISCELLANEOUS			
	DIL Socket 8 pin	2	BL17T
	DIL Socket 16 pin	1	BL19V
P1-8	Pin 2145	8 pins	FL24B

Figure 1. What types of processors are used in cars? Quite a few as a look at the Volvo S80 will show - 80% of on-board silicon comes from Motorola.

Electronics in the MOTOR INDUSTRY

PART 5

In this last part Mike Bedford looks at types of processor used in cars and a new voltage standard.

This month, for the final article of our in-depth look at electronics and computing in the motor industry, we're going to have a change of direction. The first three parts of the series were concerned with the exciting new facilities which are now starting to appear in production motor vehicles thanks to advances in electronics. And the fourth part was an investigation into the use of electronics in Formula One and the quest for the land speed record. All these articles concentrated on what marketeers would refer to as "features and benefits". This article, on the other hand, is more technical in nature so we'll be looking at what goes on behind the scenes. So, if you've ever wondered, for example, what sorts of processors are used in cars and how they communicate with each other, this article is just what you've been waiting for.

Processors

We introduced this series with BMW's claim that their 750iL had more processing power on-board than the Apollo spacecraft which took Neil Armstrong to the moon. But whereas this may be an impressive sounding claim to the layman, those who are *au fait* with computers will know that the phenomenal rate of change could mean that this still isn't a vast amount of processing muscle in today's terms. After all, that historic Apollo 11 landing took place almost thirty years ago and it's probably true to say that you don't need many desktop PCs to equal the total amount of processing power in Silicon Valley back in 1969. This isn't to underestimate the worth of the innovative systems on BMW's top-end motors but to point out that many people – even the electronically minded ones – have little idea of how many processors and of what type are used in vehicle. An answer to the first of those questions would be pretty meaningless because there's so much variation. The BMW saloon we talked about earlier has around forty processors but a basic compact car probably has just the one – in the engine management system. What would be more useful to investigate is what types of processors are used for various tasks. Are we talking powerful processors like those which are used in PCs or are we talking of tiny 8-bit devices like the well-known PIC micro-controllers? You may be surprised to learn that the answer to both these questions is "yes". Cars with systems using Intel Pentium MMX processors have already been demonstrated, many of the more basic functions in cars are controlled using low-cost 8-bit micro-controllers and between these extremes is a whole range of processors. To start off, therefore, let's see what types of processors are used for what jobs.

First of all, what about those in-car systems which use the Pentium MMX processor? At first sight this seems a rather unlikely scenario since this family of processors is designed with desktop multimedia applications in mind, not control functions. But the use to which these processors have been put isn't a run-off-the-mill automotive application, instead it's an entertainment and communication system which has been incorporated into a car. And as such, this is far more the sort of application the top-end Intel processors are optimised for. Not yet available on production motors, the system in question is a technology demonstrator which was put on show by Intel at last year's Consumer Electronics Show in Las Vegas. Called the Connected Car PC, the system is designed to bring PC functionality to car drivers and passengers. The demonstration vehicle, a Ford Expedition 4X4, integrated satellite navigation, cellular phone, Web browsing, e-mail, games playing and DVD movies. The system may also be extended to provide a user friendly front-end to other on-board systems. So, for example, by communicating with the various vehicle management systems, the Connected Car PC could determine when the car was due for service. This information – plus information on local service centres obtained from the Web – would be relayed to the driver. The interface for the rear seat passengers would include a flat panel display mounted on the ceiling. For safety reasons, the driver would obtain navigational information or receive e-mails via voice recognition and voice synthesis.

For a number of years, some of the executive saloons have provided driver preference features. One example is seat positioning. When a driver gets into the car and presses the button for, say, driver number one, electric motors move the seat

Figure 2 Intel's Ford Explorer 4X4 was used to demonstrate the Connected Car PC concept at last year's Consumer Electronics Show in Las Vegas.

forward or backward, up or down, and select the angle which that driver prefers. Clearly it doesn't take any very sophisticated electronics to do this, in fact it could easily be done with a handful of logic chips. However, you can't buy many logic chips for the price of a bottom end microcontroller so these systems tend to be driven by slow 8-bit processors with an absolute minimum of memory. PIC processors from Microchip are commonly used for this sort of applications since they can be bought in bulk for about 30p each. Also at the bottom end, 8-bit processors are used for detonating air bags, controlling the instrumentation on the dashboard, and lots of other non-demanding applications. So we've seen both the top end and the bottom end of the processor spectrum but between these extremes, we have 16-bit processors or controllers for ABS brakes, fuel injection, transmission and engine management and the trend is ever upwards. In the near future, many of these 16-bit applications are going to become the domain of 32-bit processors and DSPs will also become increasingly common. Without a doubt, we're going to see some pretty powerful processors used in automotive electronics in the non-too-distant future. And we're not just talking of their use in periphery systems like Intel's Connected Car PC. Motorola, for example, are shipping microcontrollers with a PowerPC core for use with in-vehicle systems. The most likely applications for this device will be in the power-train. Clearly the consumer will see consequential benefits from this rapid growth in the number and power of the on-board processors.

The onset of digital signal processing in automotive electronics is intriguing. Perhaps it would come as no surprise that some of the more esoteric applications such as noise cancelling and Lotus' noise synthesis (which can make a Citroen 2CV sound like a Ferrari) use DSPs but their potential use in cars goes far beyond this The move to "drive by wire" systems is one key development which will make use of the DSP's processing capability. In the drive by wire approach, all mechanical linkages from the driver controls are replaced by electronic ones. So, for example, rather than have a hydraulic power steering system to augment the mechanical linkage between the steering wheels and the drive wheels, the steering wheel is attached to a potentiometer or similar, and the steering of the wheels is achieved using an electric motor. This is a classic example of a servo control system requiring a three term controller, something which can be readily implemented using a DSP. Another example of a DSP application is the implementation of digital filters for extracting a particular type of information from a complicated signal. For example, by monitoring the engine sound and performing the appropriate signal processing, it is possible to detect the onset of knocking and adjust the ignition timing accordingly.

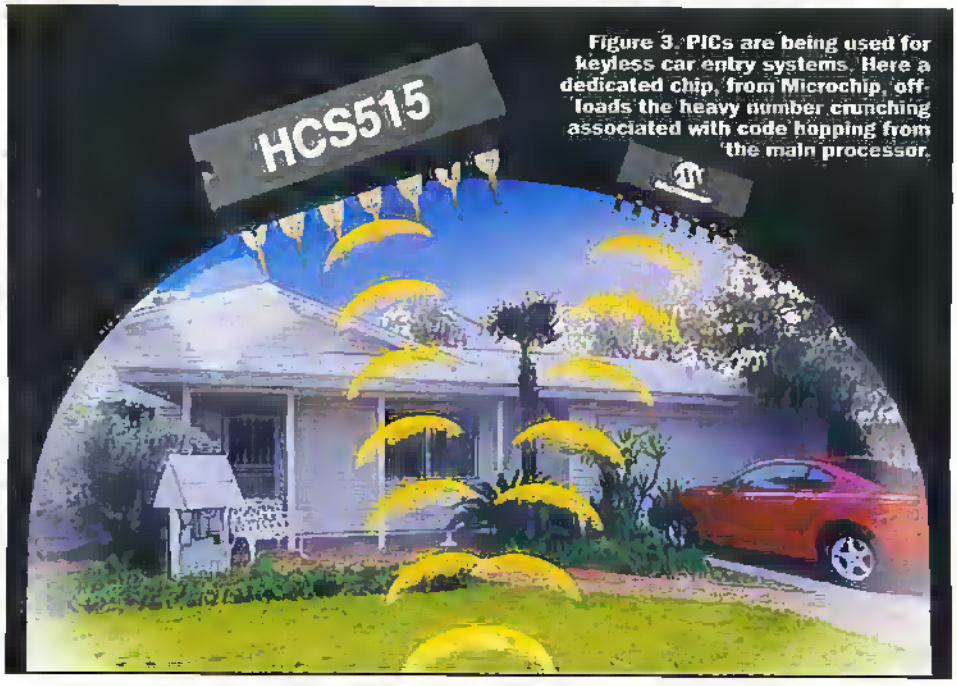


Figure 3 PICs are being used for keyless car entry systems. Here a dedicated chip, from Microchip, off-loads the heavy number crunching associated with code hopping from the main processor.

The CAN Bus

If you've ever spent much time poking around the insides of an average family saloon you'll have discovered that some of the wiring looms carry a phenomenal number of wires. But if fairly run-of-the-mill motors, which are comparatively light on electronics, contain a lot of wiring, what about some of the executive saloons we've looked at in this series. To provide the sophisticated control functions and in-car entertainment systems, these cars are packed full of sensors, motors, controllers, warning lights and the like so the wiring looms will, presumably, be even more bulky. In fact, it's been reported that some of the more prestigious cars have had over 300 miles of wire weighing in at 200 pounds — that's the weight of an extra passenger. But it's not just the added weight that's a problem with conventional wiring. The vast number of connectors associated with conventional wiring looms can be a reliability nightmare too.

In the realm of computer networking, the answer to many of these problems is to use a bus-based network rather than point-to-point wiring. This is the basis of the conventional coax-based Ethernet LAN and of the Universal Serial Bus which is fast becoming the new standard for attaching external peripherals to PCs. In a bus, all devices attach to the same conductor (or perhaps a pair of conductors, one for transmit and one for receive) and some sort of protocol is used to ensure that only one device transmits at once. The same sort of principle is now being applied in the motor industry. In the early days of bus wiring in vehicles, proprietary serial busses were used. Today, although manufacturer-specific busses haven't been totally ousted, the

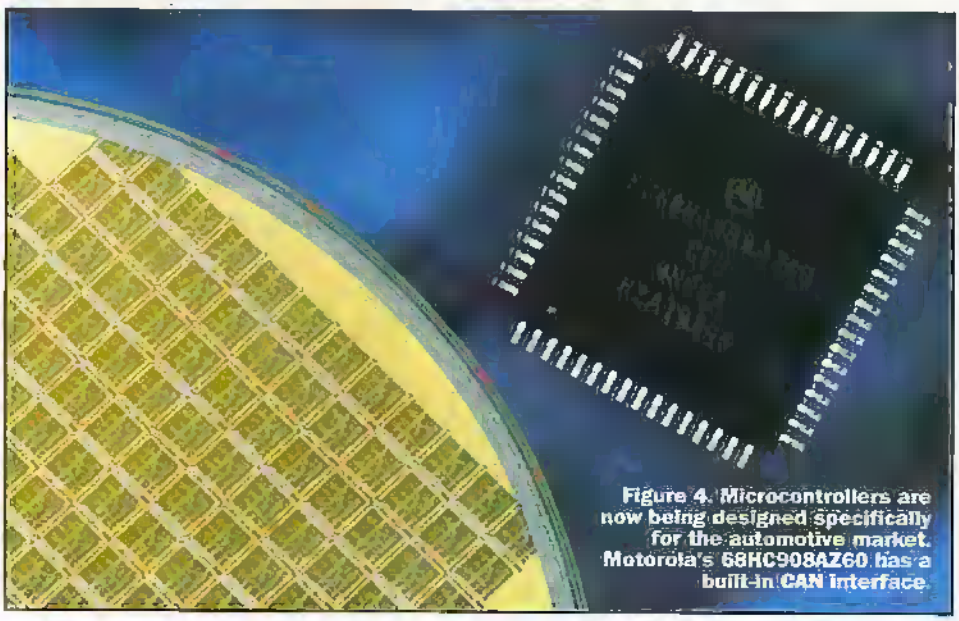


Figure 4. Microcontrollers are now being designed specifically for the automotive market. Motorola's 68HC908AZ60 has a built-in CAN interface.

trend is toward the use of open standards and this clearly has an advantage in terms of the availability of off-the-shelf components. Two competing standards were introduced in the late 80s – J1850 which gained popularity in the USA and Japan, and CAN (Controller Area Network) which was the choice of European motor manufacturers. CAN now appears to be the network of choice on both sides of the Atlantic and with prices continuing to fall, semiconductor manufacturers are suggesting that networks – and CAN in particular – will soon be found in all cars, not only in luxury and performance motors.

CAN has now gained the status of an international standard; being defined by ISO 11898 and ISO 11519-1. It conforms to the OSI 7-layer networking model and defines the lowest two layers: the physical layer and the data link layer. The highest rate of data exchange for which CAN is specified is 1Mbit/s but it's common to use lower speed networks for less critical systems as a cost cutting exercise. For example, a car may contain one high speed network for essential and safety critical systems like engine management, braking and air bag control but a lower speed network for the lights and the electric windows. A bridge would allow data to be passed between the two busses. In terms of components, CAN controllers are available off-the-shelf from various semiconductor manufacturers and some microcontrollers – those primarily intended for the automotive market – have embedded CAN controllers.

We've already seen some of the advantages of using a bus for wiring a car as opposed to taking the more conventional approach but yet more benefits are available to those car manufacturers who have standardised on networks like CAN. For a start, the need for multiple sensors is eliminated. For example, a number of systems may need access to the wheel speed – ABS braking, speedometer, and traction control all come to mind as possible candidates. With the standard approach of point-to-point wiring, there's a good chance that a separate wheel speed sensor would be required for each of these systems, each wired back to each of the appropriate controllers. With a CAN bus things are quite different – if a single wheel speed sensor broadcasts data onto the bus then any system can pick up that information as and when it's required. An interesting example of how this can lead to exciting new features is illustrated by a new car radio developed for Mercedes Benz. By using information on the speed of the car, the volume is adjusted automatically to compensate for road noise. Had a separate sensor been required, this particular function might not have been added due to cost considerations. Another advantage is the ease with which new features can be designed into a car. Very often, new facilities can be provided by nothing more than a software change – with the possible exception of simply connecting a new sensor or some other device onto the bus – wiring changes become a thing of the past.

High Performance Networks

Despite the undoubted advantage of a bus technology compared to point-to-point wiring, and despite the apparent superiority of CAN over the J1850 standard, some manufacturers are suggesting that CAN will not be suitable for all applications. In particular, alternatives are being proposed for systems in which failure cannot be tolerated. If the car radio stops working, then it's little more than an inconvenience and for many systems, the use of CAN will continue to grow. However, the move to "-by wire" systems such as steer-by-wire and brake-by-wire are far more demanding. Since these systems are safety critical yet will have no mechanical or hydraulic backup, network integrity is essential. One problem with CAN is that it uses the CSMA/CD network access mechanism which is used in Ethernet LANs. This stands for Carrier Sense Multiple Access with Collision Detection. If a device wants to use the bus, it listens for a carrier. If it senses a carrier, this means that another device is already using the bus so it waits until the bus is free before jumping in. Unfortunately, however, if two devices were both waiting for the bus to become

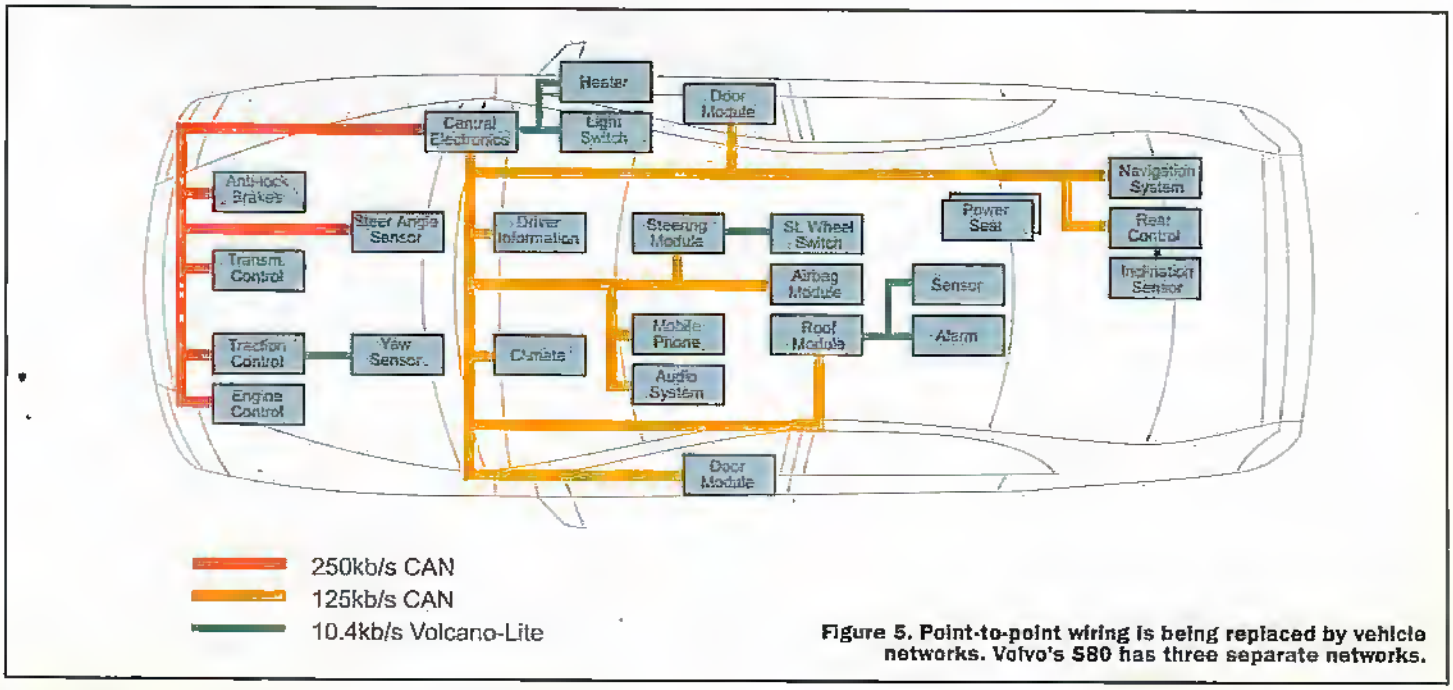


Figure 5. Point-to-point wiring is being replaced by vehicle networks. Volvo's S80 has three separate networks.

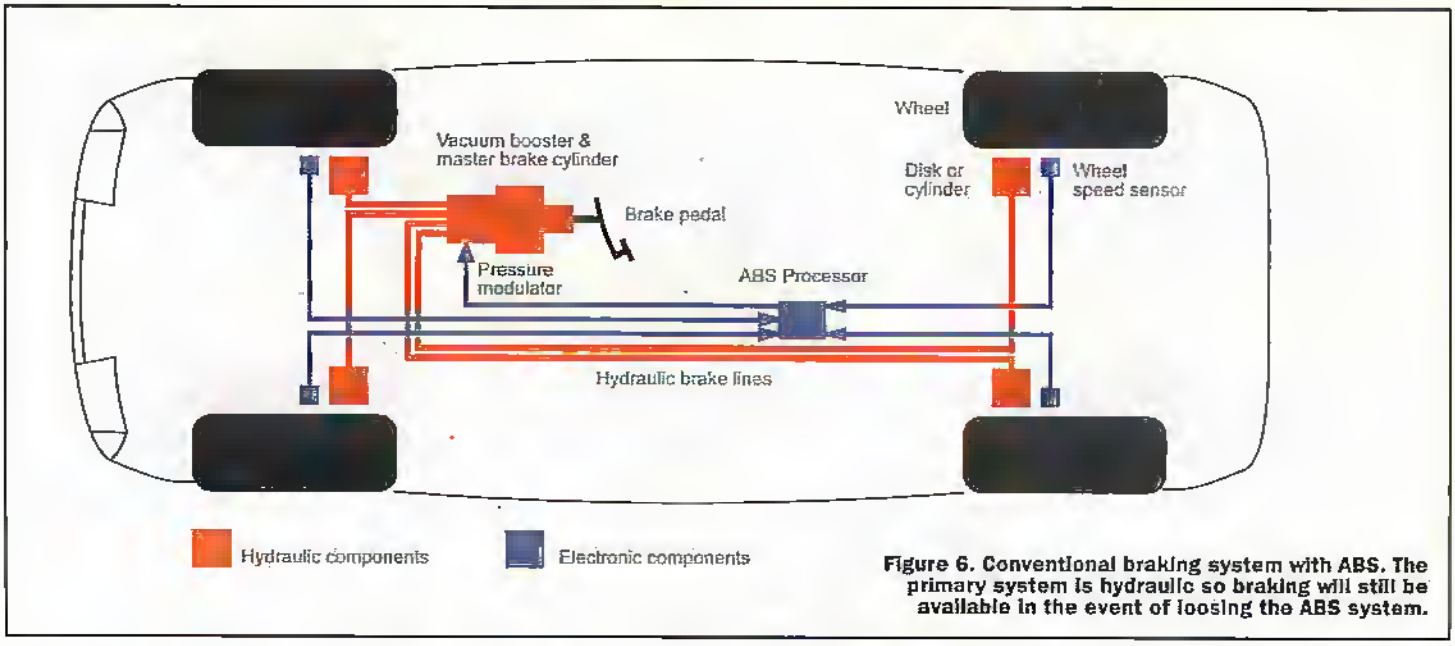


Figure 6. Conventional braking system with ABS. The primary system is hydraulic so braking will still be available in the event of loosing the ABS system.

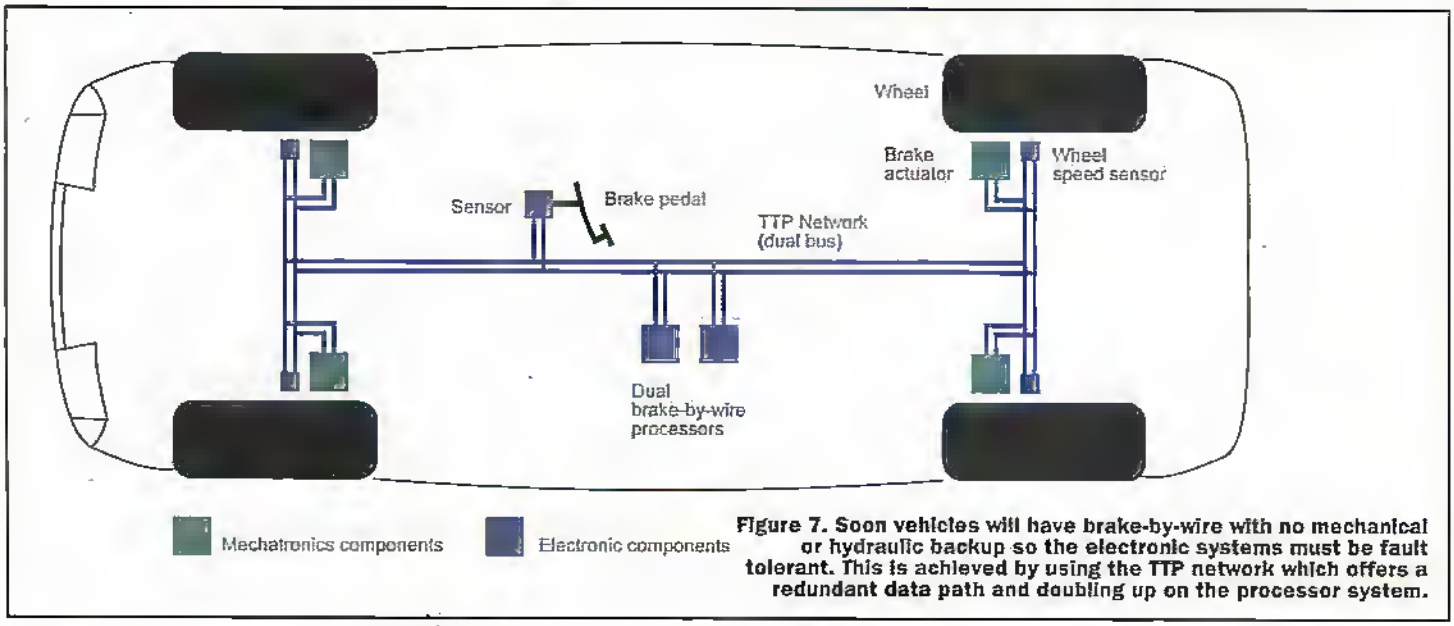


Figure 7. Soon vehicles will have brake-by-wire with no mechanical or hydraulic backup so the electronic systems must be fault tolerant. This is achieved by using the TTP network which offers a redundant data path and doubling up on the processor system.

available, both would access it at the same time. This is called a collision and devices detected it by listening on the bus as they transmit. If the received data is different from the data transmitted this means that it has been corrupted by a collision. When a device recognises a collision, it transmits random data for a while to ensure that the other device also recognises the collision, it then stops transmitting and waits a random time before trying again. CAN is, therefore, a first come first served system so it doesn't guarantee any device a particular response time. Eventually a device will get access to the bus but it may take a few milliseconds if some other device was already using it. With some systems this may be too long and some network access method which guarantees a given response is essential. The second drawback with CAN networks is that they aren't tolerant of a cable break. If, for example, a car is involved in a collision (a crash, that is, not a network collision) and the CAN cable is damaged, communication will be lost.

The Time-triggered Protocol (TTP), developed by TTTech of Austria in conjunction with Motorola, is designed to overcome these drawbacks of CAN for safety-critical systems. The network has already been accepted by Daimler-Benz. First of all, rather than CSMA/CD, access to the bus is controlled by time division multiple access. In this scheme, devices are given time slots in rotation and are therefore guaranteed a specified percentage of the overall bandwidth of the bus. Fault tolerance is provided by doubling up the cabling. So long as the two cables are routed such that they are physically separated, damage to the vehicle which might break one of the cables would leave the other cable unaffected. But TTP isn't the only network architecture designed for safety critical automotive applications. Another contender is PLANET – Philips Lite Automotive NETwork which is designed for systems such as airbags and active seatbelt pre-tensioners. Here, a different topology is used to provide resilience in the event of a cable break. PLANET is a ring network which means that any two devices can communicate with each other so long as there are no more than a single break in the cabling. The network has also been designed to cope with shorts between the conductors in the bus or between any conductor and ground.

Mechatronics

If your exposure to digital electronics has been restricted to consumer electronics equipment or PCs and their associated peripherals, then automotive electronics will be something of an eye-opener in some respects. Although electronics is becoming increasingly important in automotive engineering, a motor vehicle is, nevertheless, still primarily a mechanical device. So much of the electronics in the vehicle will end up driving electro-mechanical devices such as electric motors and solenoids.

Figure 8. By combining mechanics and electronics in a single component, sensors and actuators can be connected directly to the vehicle network.

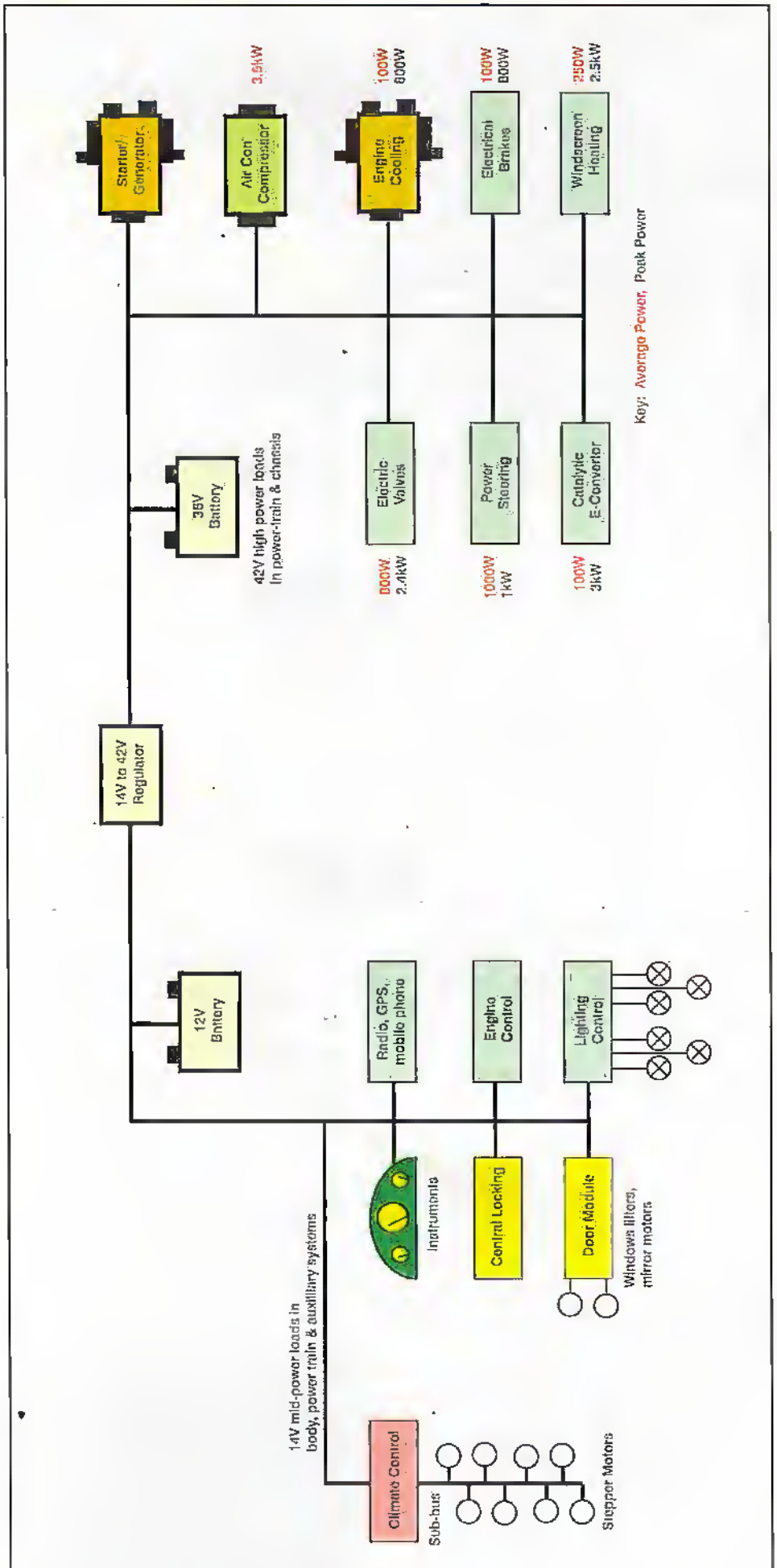


Figure 9. Vehicles will soon have a dual 14V/42V power bus in order to cope with higher electrical loads.

The buzz word for this grey area which encompasses mechanical, electrical and electronics systems is mechatronics. Mechatronics departments are starting to appear at many of the world's academic institutions and, in addition to automotive engineering, applications include robotics and industrial control. Let's see how the adoption of mechatronics principles simplifies the design and manufacture of an electric window control system. Conventionally, an electric motor controls the raising and lowering of each window, a sensor monitors the windows' movement and checks for obstructions, and a centralised microcontroller and associated interface electronics attaches to the various motors, sensors and switches around the car. An electric window system is not especially complicated yet, as we can see, even this system can involve a reasonable amount of wiring. And the electric motors can't even be connected to the other components using the vehicle bus since they're dumb electrical components. In the mechatronics approach, a motor, sensor, interface circuitry and microcontroller are assembled as a single component which can interface to a CAN bus. Now, the only wiring requirement is for each of the distributed mechatronics window components to be connected to the bus and for the windows switches also to be connected to the bus. Motorola has partnered with electrical connector company Amp to develop mechatronics components for the automotive industry. Products are expected to start rolling off the assembly lines in 2002.

One important implication of the fact that cars contain electric motors and solenoids is that the control electronics will have to drive high currents. Furthermore, this requirement to drive high loads is one which will increase. Even if we forget about the possibility of the fully electric vehicle or the hybrid vehicle which will require huge currents, moves to steer-by-wire and brake-by-wire plus the increase in comfort features such as car seat positioning will all result in a greater need of high current electronics. Traditionally, high power components such as the starter motor have been switched using relays but the move now is to the use of more reliable solid state switching elements. But with the 12V supply currently used in cars, this can result in some very high currents. For example, an electric brake will average 100W and peak 500W so will draw an average of 8A and a peak of 40W from a 12V supply. With an on resistance of just 40mΩ – typical for today's solid state relays – this will result in an average power dissipation of 2.5W and a peak of 64W. And for equipment such as an air conditioning compressor, which consumes about 3.5kW, it just isn't feasible to use today's generation of solid state switches. Certainly we can expect to see the on resistance of solid state switches decrease, in fact a reduction by a factor of two every three years is predicted. However, another initiative is aimed at reducing the power dissipation of solid state switching devices. A consortium headed up by the Massachusetts Institute of Technology and including major American and European motor manufacturers plus key automotive

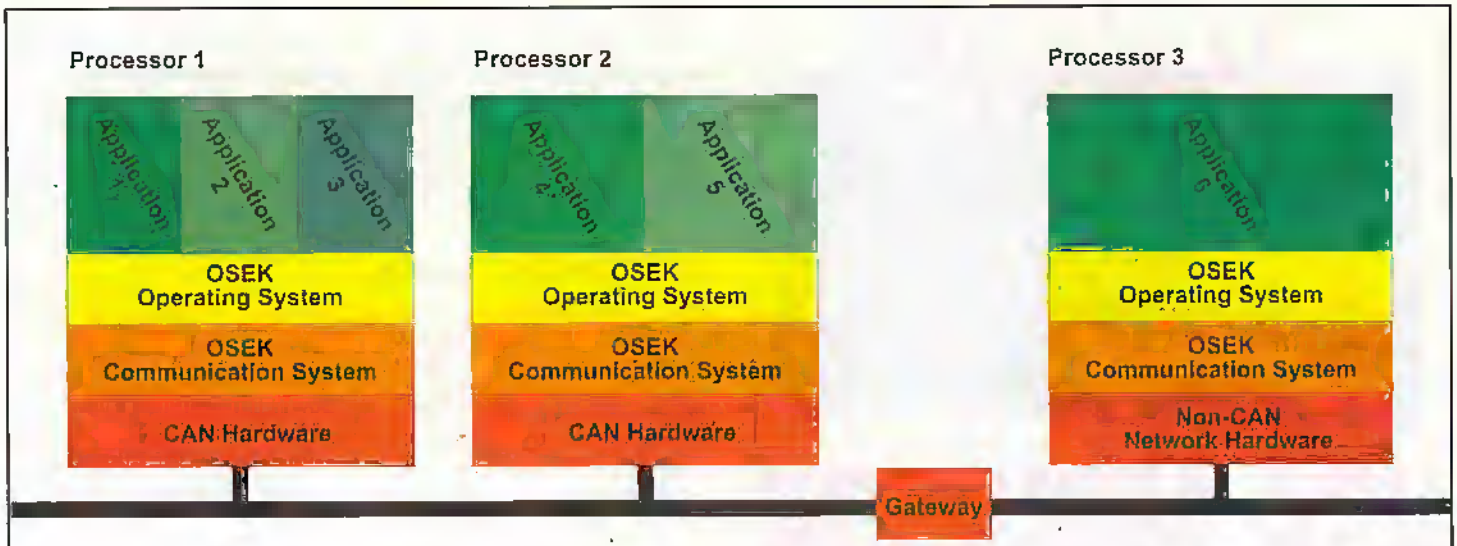


Figure 10. OSEK, the operating system for automotive engineering allows software engineers to write software without having to take details of the underlying hardware into account.

electronics suppliers has proposed 42V power bus in addition to the current 12V supply. The system is called PowerNet and has already been agreed by BMW, Daimler-Benz, Ford, General Motors, Peugeot-Citroen, Renault and Volvo.

Software Standards

From what we've seen so far, it will come as no surprise that the amount and complexity of the software residing in motor vehicles is growing at a significant rate. Estimates put the growth on the size of code in the engine management unit at 26% per year and software engineers generally assume that the complexity of code increases exponentially with its size. These figures relate to just a single system but we can reasonably expect that other systems are growing at a similar rate and, furthermore, the number of on-board systems is also continuing to grow. When we further bear in mind that product lifecycles are reducing it's clear that many of the software engineering difficulties are the same as those which apply to the PC software industry. Not surprisingly, therefore, a number of software development techniques which were adopted in the realm of mainstream computing are now migrating to automotive electronics. Perhaps the most fundamental of these is the onset of operating systems.

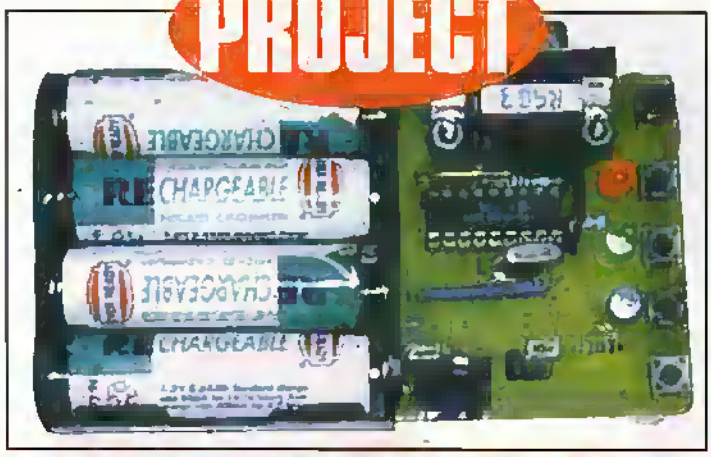
In the realm of PCs or workstations, either we're well familiar with the advantages of standard operating systems such as Windows 95/98, Windows NT or UNIX or we just take them for granted. To recap, however, an operating system removes from the application programmer the need to write low-level routines to access each part of the hardware and if that operating system is a standard (open) one available on a number of platforms it makes it easier to transfer applications from one system to another and to use third-party routines. In other words, it makes the programmer more productive and it increases flexibility. These are exactly the same advantages which have led car manufacturers to adopt OSEK/VDX – Offene Systeme und deren Schnittstellen für die Elektronik im Kraftfahrzeug (Open System and the Corresponding Interfaces for Automotive Electronics) / Vehicle Distributed eXecutive. The goals of the OSEK/VDK consortium – of which Mercedes-Benz and Bosch were two of the founding members – are to support the portability and re-usability of application software. Anticipated advantages include savings in cost and development time, and an improvement in software quality. This latter point is particularly important when we consider that so much of the software in motor vehicles is safety critical. And with software becoming ever more complex, manufacturers can no longer rely on simply testing the software prior to going into production as the sole means of eliminating software bugs. Instead, the whole of the specification and design of the software must take place within a quality-conscious environment. Writing software which adheres to an open operating system promotes this sort of approach to software engineering.

Suppliers of microcontrollers intended for the automotive market are now in the process of launching OSEK/VDX for their silicon (Motorola, for example, offers the operating system on their 68HC08, 68HC12, MPC5xx PowerPC and m.core families) and a version is available for Windows NT workstations to ease program development and testing. Development under OSEK/VDK is already underway with the first cars designed for this operating system expected on the market in the year 2000.

The 21st Century?

Over the last few months, we've seen a picture of a rapid rate of increase both in the amount of electronic hardware in vehicles and the benefits this is bringing to the driver, the passenger and society at large. Had this been an article on just about any other area of technology, we'd have been inclined to close with the sentiment "you ain't seen nothing yet" with hints at an ever increasing rate of change. But things are somewhat different here. As we're all well aware, not everyone is a fan of the private motor vehicle. And without a doubt things can't go on as they have done or our roads will grind to a halt, our cities will disappear under a sea of exhaust fumes, and our countryside will be systematically eaten away. The government has already announced plans to continue to raise the price of petrol above inflationary increases, to introduce tolls for driving on some roads and in town centres and to put a tax on parking spaces. And even when an element of "carrot" is proposed to supplement the more common "stick" approach, that carrot still involves attracting people away from their cars to public transport. If public transport ran to every home in the UK every five minutes then this would be an acceptable carrot to most people but, as we're well aware, even an improved public transport system will fall far short of this. Perhaps there's a better way. As we saw in the second part of our series, advances in automotive electronics have already improved engine efficiencies, reduced emissions and made a significant contribution to road safety. Further advances in all these areas seem assured and techniques which are still at the experimental stage promise less congestion while, at the same time, providing increased road capacity. Instead of penalising car users, therefore, an alternative approach would be to actively encourage developments which would eliminate today's problems with motor vehicles. But, of course, there's a vociferous lobby which would refute all such suggestions. This is the lobby which would argue that the whole concept of personal transport is flawed so, by definition, a car will never be socially acceptable whatever improvements are brought about. So will electronics bring us super-efficient, super-clean, super-safe cars which are able to transport anyone anywhere without covering more of the countryside with tarmac or will the 21st century see the death of the car? The former is almost certainly possible but whether this scenario comes to fruition depends on whether ideology or technology gains the upper hand.

PROJECT



VGA MONITOR TESTER

Richard Grodzik describes a simple, compact monitor tester based on a PIC.

Introduction

As a repair engineer I am armed with an arsenal of test equipment to help me diagnose faulty computer peripherals. Computer monitors are prone to failure because they operate at high voltages and high temperatures, and their analogue components e.g. inductors, capacitors and resistors etc. are not as resilient as their silicon digital counter-parts.

A computer system may fail for a variety of reasons. You switch on your PC and nothing appears on the screen - so what is the fault?. Let us consider the possibilities:

- The screen saver has come on.
- The mains supply is not connected.
- The mains on/off switch is defective.
- The internal PSU is defective.
- The VGA cable between the monitor and the PC is disconnected or faulty.
- The video card inside the PC has failed.
- The BIOS has failed.
- The monitor is faulty.

The RGB monitor tester described here is a quick and simple way to verify if your monitor is working. The circuit diagram is shown in Figure 1. It works on all monitors as it sends out a standard colour signal which all modern monitors are capable of displaying. No mains is involved since it is battery operated and therefore safe to use. Now let's see how a computer monitor actually works.

VGA Monitor Theory

PC colour display monitors come in all shapes and sizes but all work in one of three modes - VGA,SVA or XVGA. The mode determines the resolution of the display i.e. the number of individual pixels (dots) that can be displayed in a horizontal and vertical plane. The greater the number of dots, the finer the detail and the better the picture quality. The mode/resolution (dots per inch) is as follows:

Mode	Resolution (dots/inch)
VGA	640 X 480
SVGA	800 X 600
XVGA	1024 X 768

To produce a raster of lines covering the entire screen, two sync signals are required by the monitor which are generated by the PC's video card. The line sync signal occurs at a high rate since in the VGA mode it takes approximately 30µs for the CRT beam to traverse the screen i.e. from left to right. A line sync pulse of approximately 4µs duration causes the electron beam to switch off and to repeat the line scan - concurrently, a much lower frequency frame (FIELD) sync pulse occurs every 17ms which controls the rate at which the monitors vertical deflection circuits cause the beam to move down the screen. See Figure 2. In this way a raster of lines is painted across the entire screen. The raster does not contain any video information and serves as a carrier for the color video dots which make up the picture. For a correctly setup monitor, using the brightness control, the screen should appear black with no visible raster.

The video information for the monitor is generated on three different channels - red,green and blue - by the video card inside the PC. These three signals modulate three electron beams in the monitors CRT producing red, green and blue beams which converge into a single dot on the screen. Each color drive signal is in turn

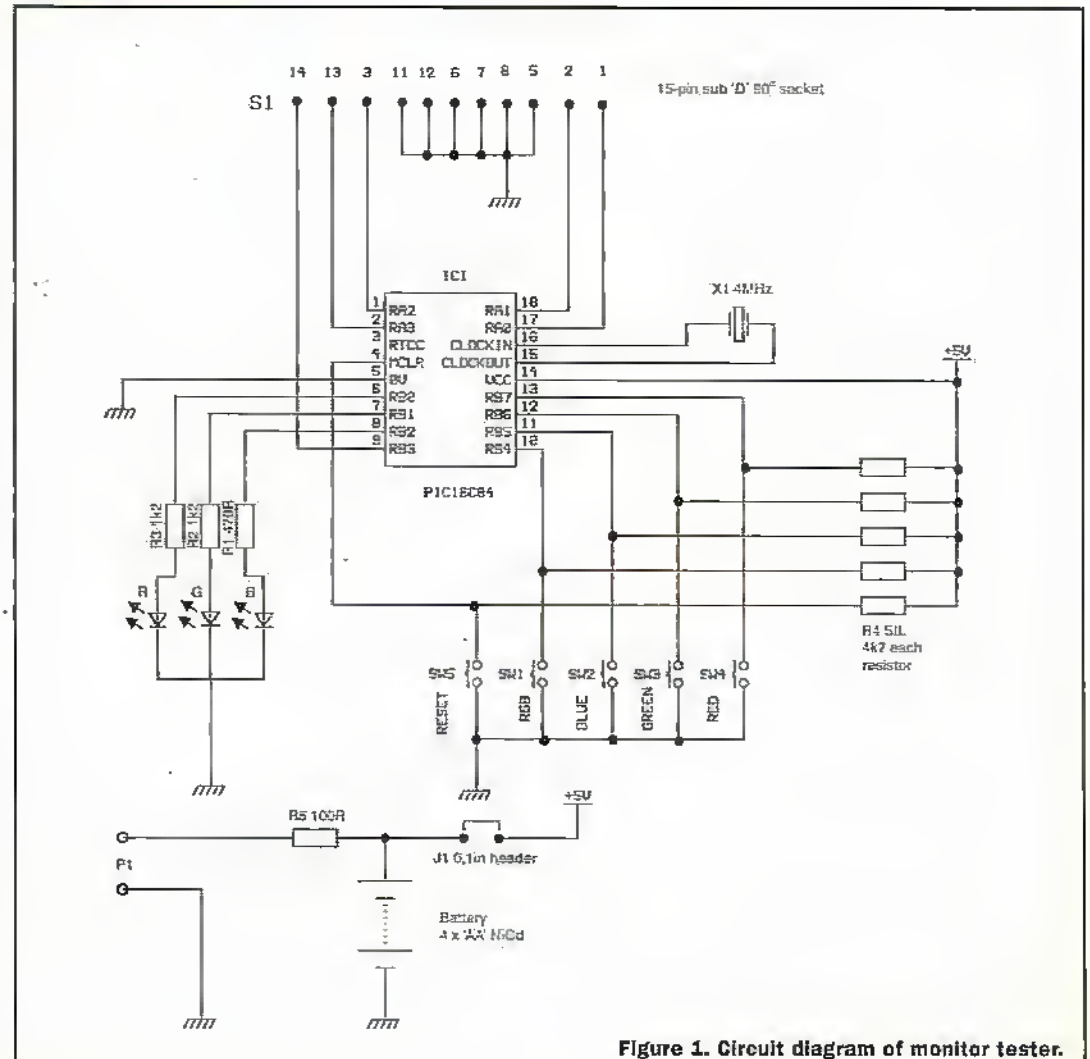
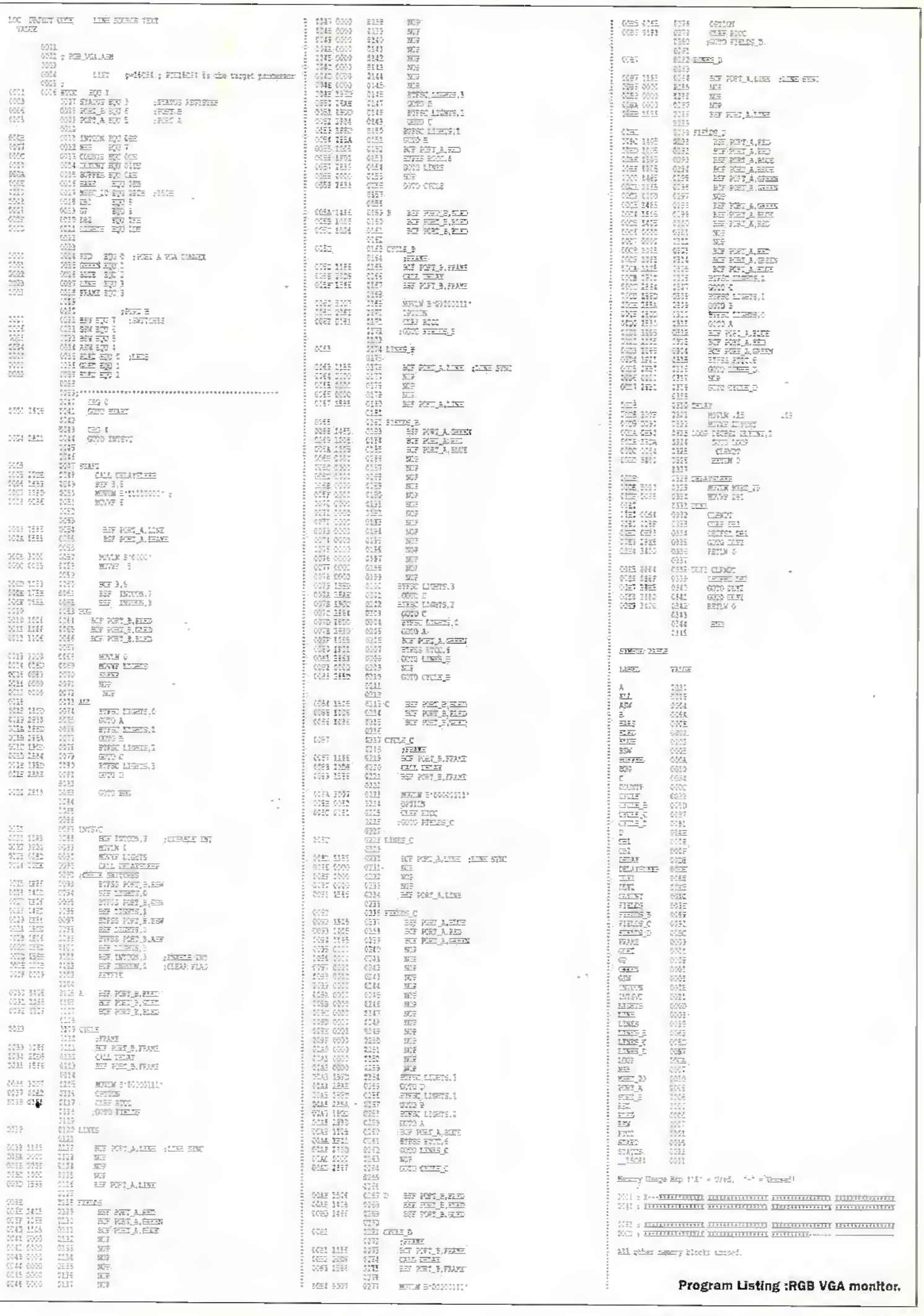


Figure 1. Circuit diagram of monitor tester.



Program Listing :RGB VGA monitor.

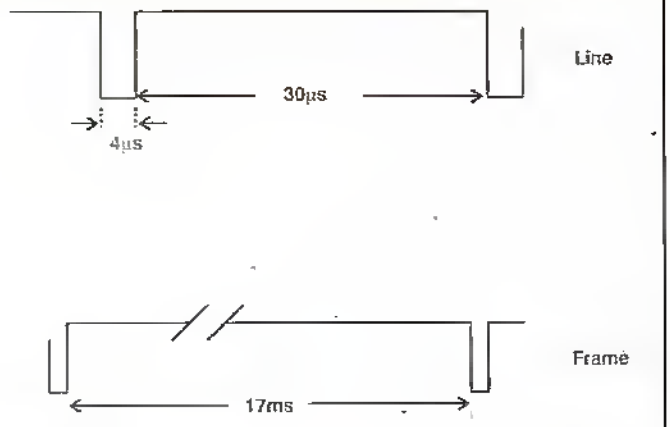


Figure 2.

level, a white dot is produced, conversely all the beams cutoff will produce a black dot (no video information).

Due to the nature of the electronics associated with monitors and the fact that very high voltages are necessary for the CRT, heat is produced which degrades components - especially electrolytic capacitors - and thereby reduces the working life of a monitor. Although a typical tube has a life of 15000 hours, a monitor may fail well before that due to component failure. However, if a monitor fails to produce a picture the cause could just as

the wrong colours. Connect in the RGB tester and a red green or blue screen is easily produced.

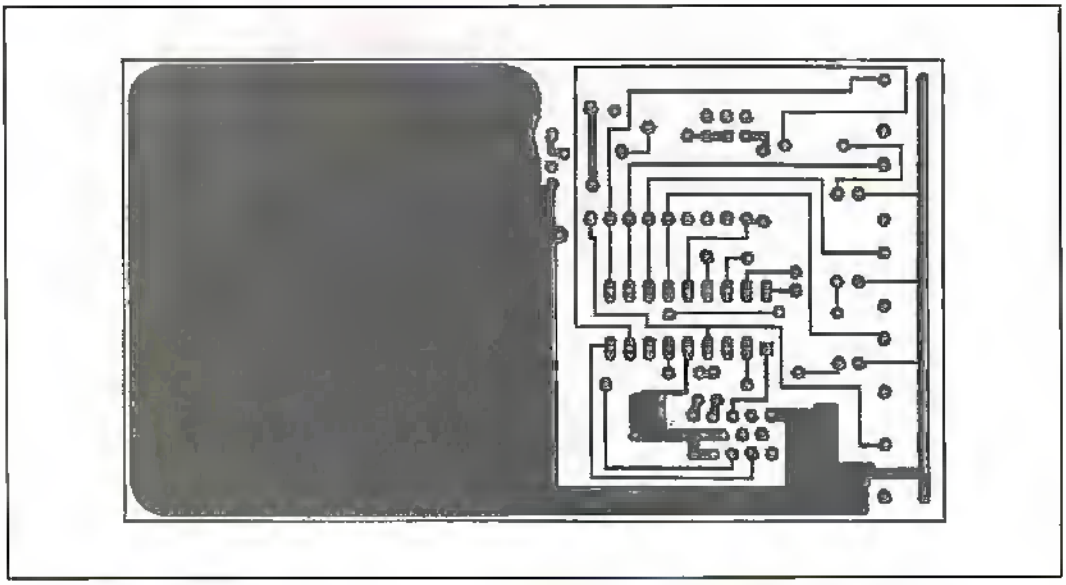
Description

The table below shows a typical PC colour monitor's factory preset display modes and their associated vertical and horizontal frequencies. The RGB tester was measured with a high accuracy digital storage 'scope.

Mode	Frequency	
	Vertical	Horizontal
VGA	70Hz	31.47Khz
VGA	60Hz	31.47Khz
VGA	72Hz	37.86Khz
SVGA	60Hz	37.88Khz
SVGA	75Hz	46.88Khz
XVGA	60Hz	48.37Khz
RGB tester	61Hz	31.00Khz

The monitor tester utilises a PIC16C84 in the SLEEP mode so that no ON/OFF switch is required. When SW1 is pressed, red, green, blue and white bars are displayed on the monitors screen. Pressing buttons SW2 SW3 SW4 will cause the screen to display a single colour i.e. red green or blue. SW5 is the reset switch and will blank the display and cause the PIC to enter the SLEEP mode. Pressing any other switch will wake it up to produce the separate line and frame sync pulses and the color information. Associated with each switch is an LED of appropriate colour to signal which colour is being generated. Pressing the RGB button will light all the LEDs and produce bars of different colours as well as a white bar. Note that the series limiting resistor for the blue LED is of a lower value (470R) to compensate for the reduced luminosity of blue. A bank of 4 x 'AA' size rechargeable NiCd cells provide the power with a simple charging circuit consisting of a single 100R resistor. A DC mains adaptor with an output from 9V to 12V will recharge the battery pack in a couple of hours.

Construction is straightforward with a few wire links as depicted in the component overlay diagram, Figure 3. Note wire links from points B-B, C-C and D-D.



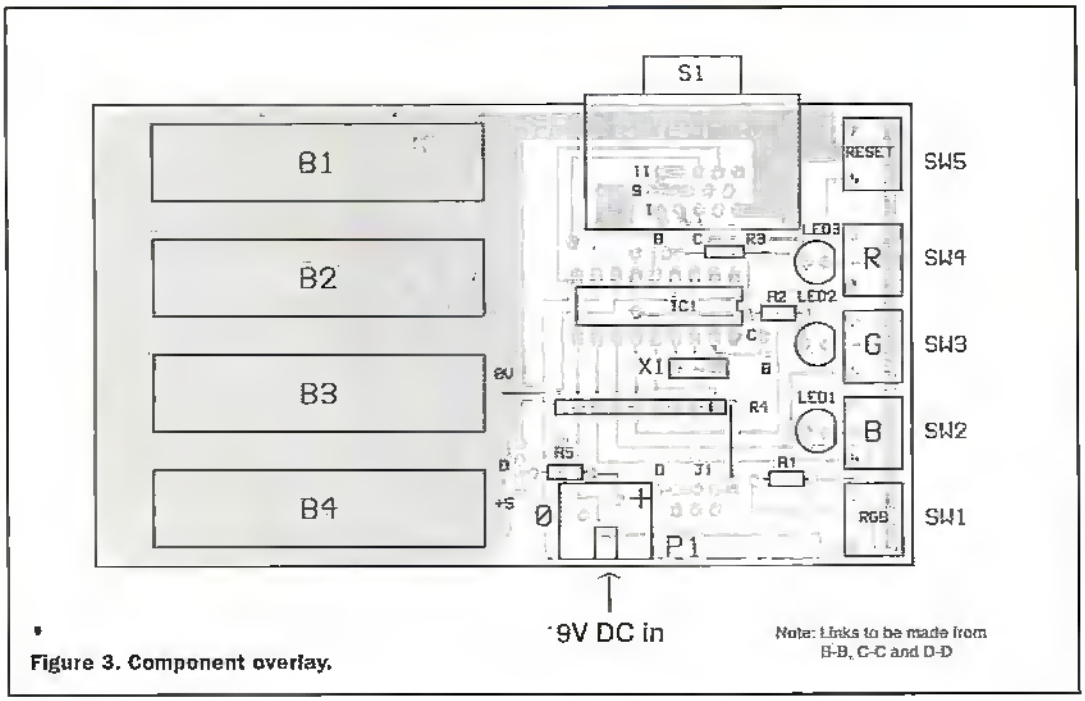


Figure 3. Component overlay.

generated by an 8-bit D/A converter producing 255 discrete voltage levels for each colour. The amplitude of the color signal determines the saturation (i.e. light/dark) of the colour and the combination of the RGB signals determine the hue (colour) of the dot on the screen. As the raster draws each individual dot across the screen, it's luminance and chrominance (brightness and colour) varies in sympathy with the incoming video information. If all three drive signals are at maximum easily be a failure in the video card or PC CMOS setups. This monitor tester will soon determine what is at fault. It could be that one of the primary colours (red, green or blue) is missing which will produce a picture but with all

Description of Firmware

PIC port lines RA0, RA1 and RA2 control the switching of the RGB drives to the monitor. On power-up the routine at START configures port A and B lines for inputs (switches SW1-SW4) and for outputs (RGB, line sync

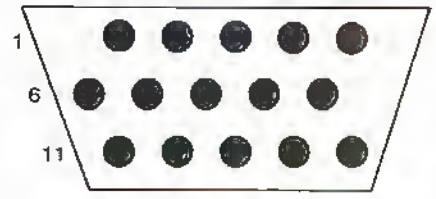
and frame sync).The interrupt mechanism of the PIC is enabled by instructions:

```
BSF INTCON,7
BSF INTCON,3
```

All LEDs are extinguished and the PIC is sent to sleep. If any logic level on port B pins RB4-RB7 changes state by pressing any switch, an interrupt is issued and program execution vectors to address 04H at which subroutine INTSVC is executed. This routine polls each switch in turn and sets a flag in variable LIGHTS - the bit set dependent on switch pressed. Subroutines A B C and D are identical in structure and generate red, green, blue or RGB signals.

- A frame sync pulse is issued.
- The RTCC is loaded with 00000111 which determines the frame rate.
- A line sync pulse is issued.
- Instructions at label FIELDS switch on or off the R G B outputs along one line scan period.
- Successive video lines are then repeated until bit 6 of the RTCC is set, at which point a frame sync pulse is issued and the entire frame raster is repeated.
- Pressing the Reset switch (SW5) at any time will disable all outputs and put the PIC back into SLEEP mode.

15-pin mini D-type male connector
(on monitor video cable)



1	Red Video
2	Green Video
3	Blue Video
13	Horizontal Sync
14	Vertical Sync
5,6,7	
8,11,12	Ground

Figure 4. D-type connections.

PROJECT PARTS LIST

RESISTORS:

R1	470R Min Res	M470R
R2,R3	1K2 Min Res	M1K2
R4	4K7 SIL	RA31J
R5	100R Min Res	M100R

SEMICONDUCTORS

IC1	Pre-programmed PIC (See Note)	
LED1	LED Red	QZ28F
LED2	LED Green	QZ30H
LED3	LED Blue	JA28F
X1	4MHz Quartz Crystal	FY82D

MISCELLANEOUS

P1	2.5mm PCB Skt		FK06G
S1	15-pin Sub 'D' 900 VGA Skt		JW85G
B1-B4	4 x 'AA' NiCd Batteries 4 pack		FM22Y
	Battery Holder		CL19V
J1	0.1in DIL Header/Jumper	as reqd.	JW59P
		as reqd.	UL71N
SW1-SW5	Push-to-Make Sw		KR92A

Note: A pre-programmed PIC is available from the author at £14.50 inc. p&p.

R.Grodzik, 53 Chelmsford Road, Bradford, West Yorkshire, BD3 8QN

RESEARCH NEWS

Dr. Chris Lavers looks at an innovative solar power roofing system at the Welsh Centre for Alternative Technology.

Brian Wharmby, Technical Director of the UK's electricity regulation board OFFER, opened Britain's largest fully integrated solar roof at the Centre for Alternative Technology (CAT) in North Wales during the summer of 1998. The roof is constructed using an innovative 'building integrated' mounting system developed by CAT and the University of Wales, and funded by the Department of Trade and Industry. Normally solar electric panels are mounted on top of an existing roof, or use expensive custom designed solar roof tiles. However, CAT's new system enables any standard production panel to be used as the waterproof roof covering itself. This results in significant installation cost savings by not using the normal roofing materials. The CAT's system can also be used in the form of wall cladding, such as that used on 'high-tech' look commercial buildings. "Solar technology is now on the threshold of a performance to cost capability which will enable it to make significant advances in many new market areas. The new mounting techniques will reduce the costs of the overall system, increasing the range of economic applications," said CAT's solar design consultant Paul Trimby.

The roof will generate over 3kW of power into the independent electricity grid powering the centre's visitor complex, with any surplus being exported to the UK's National Grid. The completed on-site CAT solar roof covers an area of over 100 square metres, and should generate 9MW-hours of electricity each year, using pollution free solar energy (Figure 1).

Mr Trimby went on to say "Although it is not yet a fully economically mature technology, the costs are falling every year. Solar generators operate with no moving parts, noise or pollution, making them the most appropriate renewable energy source for use in urban areas-reducing greenhouse gas emissions. As the costs become comparable with conventional building cladding and roofing materials, solar power will allow buildings to generate their own electricity - selling it to the National Grid when they have a surplus, and buying electricity back when they have a deficit." The roof will be monitored using equipment supplied by Dulas Ltd of Machynlleth and the Energy Equipment Testing Service from Cardiff. CAT's solar roof project will provide performance data vital to the design of future large scale solar power projects throughout Europe.

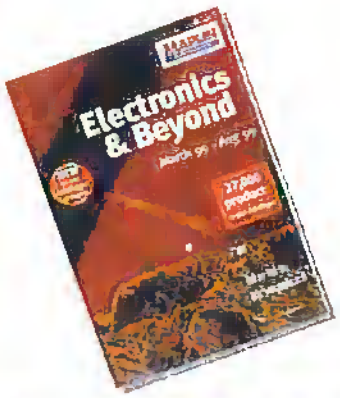
The Centre for Alternative Technology has also launched its campaign for a so called Autonomous Environmental Information Centre (AtEIC) to be built using rammed earth and sheep's wool, which will provide the site with essential facilities for the presentation and communication of viable and sustainable technology energy solutions into the next Millennium. AtEIC Campaign President, Lord Elis-Thomas, said "The Centre for Alternative Technology has operated as a model environment centre for over 20 years and has been a source of inspiration for the ecological movement all over the world. The new Information Centre will extend the scope of the Centre immensely and help to ensure that our children and subsequent generations live a sustainable, happier, healthier life."

The new Information Centre will be constructed using a range of innovative low impact materials, exploring modern versions of traditional technologies and will serve as a test bed for ecological building techniques. Building techniques will include structural walls of rammed earth, columns held together with earth blocks, insulation provided by low grade sheep's wool, local timber, and traditional lime rendering.

The use of rammed earth aims to highlight the environmental advantages of an abundant and locally available building material. Project co-ordinator Rachel Banks explains, "rammed earth will hold the building up- it is an excellent alternative to concrete and cement, it has a high thermal mass, is non-toxic and abundandly available in most areas. Although there is a growing interest in using more 'natural' building materials, there are as yet few modern examples of rammed earth technology. As far as we know, AtEIC will be the first ever large scale public building to employ structural rammed earth in the UK." Featuring the latest in energy conservation, heating waste and water management, the AtEIC building will also be operated as a model for future commercial buildings. It aims to produce zero carbon dioxide emissions, and will include roof mounted solar collectors, rain water harvesting; and compost public toilets.

Figure 1. Wind power generator, Visitor Centre and innovative solar powered roofing. (Courtesy The Centre for Alternative Technology)

new products on the horizon



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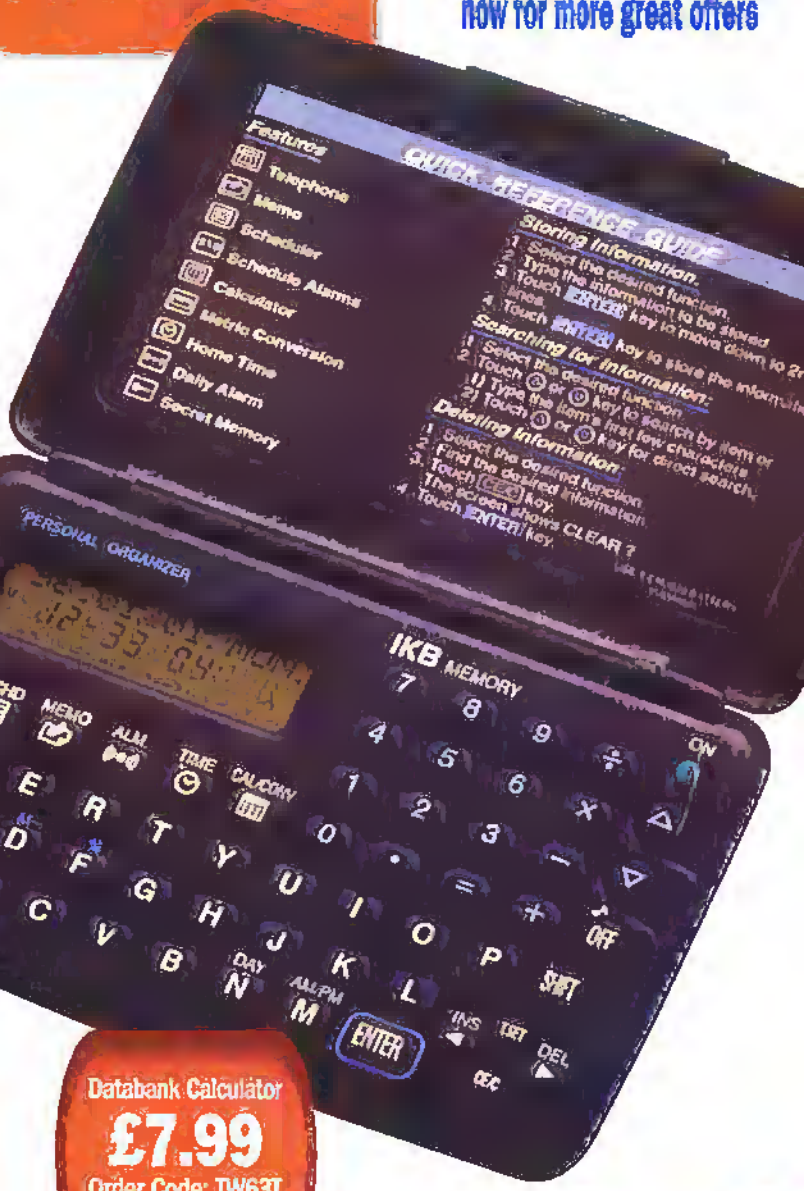

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new products on the horizon

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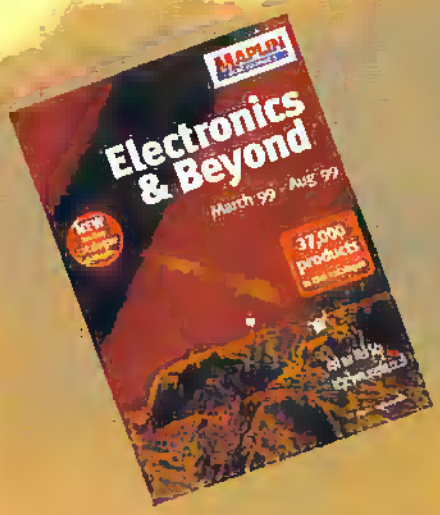

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Bell Wire

Solid cored low voltage bell wire. The conductors are laid side by side in a flat 'figure of 8' configuration. The solid, plain annealed copper cores are 1/0.50mm.

Sold per metre and on 100m reels.

Order Code	Type	Price each inc VAT New Catalogue Price
XB25A	Bell Wire	£0.60
PJ95D	Bell Wire 100m	£14.99

Clearsound 750

Geemarc

- ★ *New frequency*
- ★ *13 memories*
- ★ *8 channel autoscan*
- ★ *Last number redial*
- ★ *Paging facility*
- ★ *Wall mountable*
- ★ *Extended standby*

Slim and elegant cordless phone, featuring highly advanced cordless technology. This phone benefits from all the advantages of clarity and range of the new cordless frequencies.

Order Code	Type	Price each inc VAT New Catalogue Price
SA83B	Clearsound 750	£99.99

RJ11 In-line Coupler

In-line connector for joining two American style RJ11 (6P4C) modular plugs.

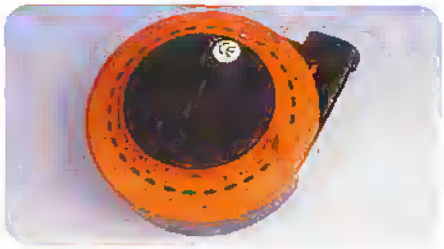
Order Code	Type	Price each inc VAT New Catalogue Price	Offer Price
UN43Y	RJ11 Coupler	£1.99	£1.25

IEC 'Hot' IEC Connector Lead

Moulded, high quality, 10A, hot condition IEC320 (BS4491) socket to moulded, non-rewirable cable assembly 1m long with standard moulded BS1363 UK mains plug. This is the standard power lead as used by hot appliances such as kettles, toasters, etc. Available in black or white.

Order Code	Type	Price each inc VAT New Catalogue Price	Offer Price
PJ51F	Hot IEC Lead Blk	£5.99	£4.99
PJ52G	Hot IEC Lead Wht	£5.99	£4.99

Mains Extension Reels



A range of sturdy mains extension reels with integral moulded hand grip and double mains socket. The reel also has a special storage slot for the mains plug for safety whilst transporting the reel.

Available with cable rated at 6A (when fully unwound) in 6m and 10m lengths and at 13A (when fully unwound) in 5m and 12m lengths.

Code	Length	Current
TZ56L	6m	6A
TZ57M	10m	6A
TZ58N	5m	13A
TZ59P	12m	13A

Order Code	Type	Price each inc VAT New Catalogue Price	Offer Price
TZ56L	6m 6A Reel	£12.99	
TZ57M	10m 6A Reel	£17.99	
TZ58N	5m 13A Reel	£17.99	£14.99
TZ59P	12m 13A Reel	£19.99	

Security Flashing LED

A flashing LED in a mounting bezel designed to be mounted in the dashboard to indicate that an alarm is installed (even if no alarm is installed!) Fitted with 1.5m lead. Operates on 12Vdc and draws 10mA.

Order Code	Type	Price each inc VAT New Catalogue Price	Offer Price
UN42V	Flashing Alarm LED	£1.99	£1.69

Schuko to UK Mains Adaptor

A simple plug-in adaptor that will allow you to plug equipment with the continental Schuko style plug in to UK mains outlets. Fused with a standard 1inch plug-top fuse to 13A. To BS1363/3

Supplied singly.

Order Code	Type	Price each inc VAT New Catalogue Price	Offer Price
YZ35K	Schuko to UK Adaptor	£2.99	£1.99

Marbella

Geemarc

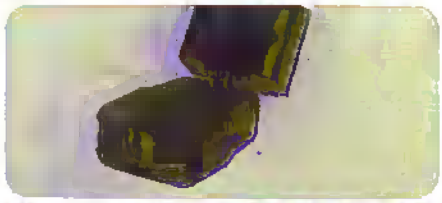
- ★ *Last number redial*
- ★ *Time break recall*
- ★ *Mute button*
- ★ *Ringer on/off*
- ★ *Desk or wall mountable*

Sleek modern desk or wall telephone with solid big buttons. Designed in two-tone metallic colouring, this phone is functional enough for the office - smart enough for the home. Available in the following colours: steel blue, petrol green and metallic plum.

Order Code	Type	Price each inc VAT New Catalogue Price
SM85T	Marbella Steel Blue	£12.99
SM87U	Marbella Petrol Grn	£12.99
SM86V	Marbella Plum	£12.99

Commando Mono CCTV Kit

Brace



The Commando camera kit consists of a tough, polycarbonate, weatherproof external camera housing and installation kit. The installation kit contains a 20m pre-wired cable, with SCART and phono connections and a mains plug-in power supply. This facilitates quick and easy connection to a TV or VCR.

Specifications:

Weatherproof:	IP65
Sensor element:	1/3" CMOS
Resolution:	240 TV lines
Sensitivity:	1 Lux
Video output:	1Vp-p, 75
Power requirements:	9 to 12Vdc @ >100mA
Lens:	3.6mm, 92° viewing angle

Order Code	Type	Price each inc VAT New Catalogue Price
YZ12H	Commando Mono Kit	£99.99

Ranger Timer Modules

- ★ *Suitable for switches or sockets*
- ★ *98 switching operations per week*
- ★ *Random facility*
- ★ *Summertime setting*

Convert any normal mains socket or light switch to a timer controlled one. Suitable for both single and double sockets. The Ranger 1 (UN07H) is easy to install and wire in to an existing switch or socket. An LCD makes it easy to program with up to 98 switching operations per week. The random facility switches on and off randomly and is ideal for security as a deterrent. The summertime setting allows you to simply add and remove the extra hour.

The Ranger 3 (UN08J) has all the features of the Ranger 1 with the added benefit of a countdown timer. This makes it ideal for immersion heaters, simply set the countdown timer for, say, an hour and it will switch off after that time saving energy and money.

Specifications:

Voltage: 230 to 250Vac
Max Load: 13A

Conforms to **BS60730-2-1 Jan97, EN60730-1-1995, EN60669**

Order Code	Type	Price each inc VAT New Catalogue Price	Offer Price
UN07H	Ranger 1	£29.99	£24.95

Super Sabre Lite

Peli Products

★ *Submersible to 2000 feet (400m)*
★ *Made in the USA*
★ *Tough ABS body*

'Laser Spot' Xenon lamp module produces a tightly focused collimated white light beam. Includes belt spring clip, stainless steel split ring and lanyard. Requires 3 alkaline C cells (not included). Length 19.1cm, diameter 4.8cm. Spare bulbs available.

Order Code	Type	Price each inc VAT New Catalogue Price	Offer Price *
T206F	Sabre Lite	£27.99	£26.99
PZ06G	Sabre Lite Bulb	£9.99	£9.49

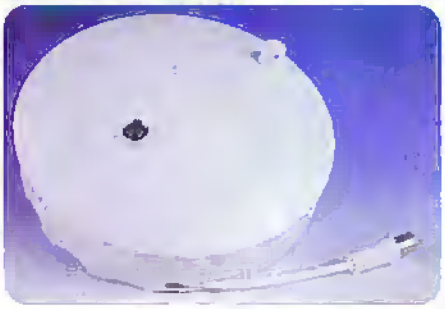
BT to RJ45 Adaptors

A range of three adaptors for connecting equipment with standard 631A BT style plugs, such as telephones, faxes and modems, in to RJ45 (8P8C) modular sockets as typically used in office data networking schemes.

Code	Description
UN27E	Full Master Socket with line protection
UN28F	PABX Master Socket w/o line protection
UN29G	PABX Slave Socket only

Order Code	Type	Price each inc VAT New Catalogue Price	Offer Price
UN27E	LA01 Line Adaptor	£6.99	£5.99
UN28F	LA02 Line Adaptor	£5.99	£4.99
UN29G	LA03 Line Adaptor	£4.99	£4.49

Extension Leads



A 10m TV/FM coaxial extension reel that allows easy re-positioning of TV and Hi-Fi equipment. It features a unique design with contoured grip for comfort and ease of use. Compact casing makes the reel unobtrusive when being used and allows for easy storage. Ideal for use in bedrooms, kitchens and utility rooms.

Order Code	Type	Price each inc VAT New Catalogue Price
PW98S	10m TV/FM Coaxial Ext Reel	£9.99

Digital TV Aerial

Maxview

An attractive set-top indoor wideband TV aerial, that comes complete with coaxial cable. It features a unique design that allows the aerial to simply swing up into position, eliminating the need for screws or any assembly and making it easy to install in seconds. Fully illustrated instructions included. The unit is fully compatible with the Digital terrestrial transmissions.

Order Code	Type	Price each inc VAT New Catalogue Price
PW11U	Digital Indoor Aerial	£7.99

Clock Radio

Features
★ *Ideal Gift*
★ *Large LCD display*
★ *Time/year date display*
★ *Calendar and temperature display*
★ *FM/AM radio*
★ *Natural sounds alarm featuring*
Frogs in water
Amazon rainforest
Waves on shore
Birds singing
★ *Requires 2 AA batteries and 4 C types (not supplied)*

This highly innovative product has a number of features not normally found on a single unit. A fully functional clock radio with FM and AM bands the unit has a large LCD display with a calendar normally displayed. In addition to this the unit displays the temperature. A further feature is that as well as waking to the radio it is possible to have one of four pre-programmed sounds to wake up to. These sounds are amazon rainforest, frogs in water, waves on shore and birds.

Order Code	Type	Price each inc VAT New Catalogue Price
PW63P	Natural Sounds Radio	£34.99

CD Storage

This CD storage wallet will hold up to a massive 128 CD's. Made from PVC it has the look and feel of genuine leather. A zip fastener ensures secure storage on the move.

Order Code	Type	Price each inc VAT New Catalogue Price
PW57L	128 Disc CD Wallet	£14.99

Radio

An ingenious, new device that combines the functions of a radio alarm clock with an alarm activated message playback. This allows messages of your choice to be recorded and played back as an alarm. The unit comprises a 2-band radio receiver and display with date, month, year and day of the week. The unit that is compact, portable and stylishly designed comes in white with complimenting grey buttons. Operates with 4 single alkaline AA cell batteries and 1 button cell battery.

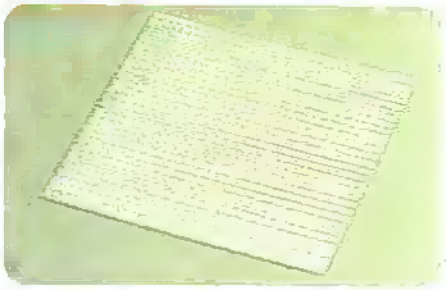
Order Code	Type	Price each inc VAT New Catalogue Price
PW65F	Home Message Centre	£29.99

Lighting Systems

Easy to install, simply connect up to 12 Volts and this bright neon light will transform your car. Waterproof, it can be installed anywhere in the car. The product comes complete with fixings and installation instructions. Compared with a bulb, this lamp saves more than 50% of energy. Available in blue.

Order Code	Type	Price each inc VAT New Catalogue Price
PW36N	Mini Neon	£6.99

Mirror Mats



This unique product can be used in many applications were a mirrorred tiling effect is desired. Available on easy to cut sheets the product is easy to use. Each facet size is 7 x 7mm and they are available in several sizes.

PW82 Mirror Mat 200 x 200mm
PW83 Mirror Mat 400 x 200mm
PW84 Mirror Mat 400 x 400mm

Order Code	Type	Price each inc VAT New Catalogue Price
PW82D	200x200mm Mirror Mat	£5.99
PW83E	200x400mm Mirror Mat	£5.99
PW84F	400x400mm Mirror Mat	£7.49

CDStorage

This product which is designed to fit behind your car visor, it will hold up to 6 CD's and also has capacity for sunglasses or change and 2 pens/ pencils. It has elastic straps for universal fitting.

Order Code	Type	Price each inc VAT New Catalogue Price
LW993	Car Visor Storage	£3.99

Portable systems

Roadstar

Features

TV Section

- ★ *Screen size 5 inch (12cm)*
- ★ *Black and white picture (low power consumption)*
- ★ *CCIR, UHF/VHF*
- ★ *External antenna socket*
- ★ *Sunscreen*

Radio Section

- ★ *AM/FM/FM Stereo tuner*
- ★ *FM stereo indicator*

Tape recorder

- ★ *Built in microphone*

General

- ★ *Power supply Battery/Mains/12v (car adaptor included)*
- ★ *Tone control*
- ★ *Headphone socket*
- ★ *Platinum finish*

This unusally styled radio/TV/cassette player features everything you need for entertainment on the move. Designed for portability the sound production gives a high quality performance.

Order Code	Type	Price each inc VAT New Catalogue Price
PW51F	5" B&W TV Stereo Cass	£99.99

Remote Controls

Let Genii grant you 3 wishes. This stylish products has been designed with ease of use and handling in mind. Operating up to 3 different infra-red devices it is pre-programmed form almost all popular brands.

Features:

- ★ *Pre-programmed and auto code search.*
- ★ *Covers 1000's of bands*
- ★ *operates TV/VCR and Satellite systems*
- ★ *Customer helpline*
- ★ *Illuminated keys*

Order Code	Type	Price each inc VAT New Catalogue Price
PW97C	Gen3 Remote Controls Silver	£14.99

Remote Controls

Features

- ★ *Operates most brands of TV, Video,AUX and Satellite/Cable*
- ★ *Preprogrammed for easy set-up*
- ★ *Scan, Teletext, Fastext, Safe Record Key, Menu Control*
- ★ *Eliminate the need for 4 controls*
- ★ *Control Island" for frequently used keys*
- ★ *Mode Indicator Lights show device operating*

This 4 way remote control is similar to the 3 way remote control, but with the added ability to operate Satellite and Cable as well as TV and Video. The remote features the unique volume/channel "Control Island" that puts the user in control of all the most frequently used keys. It features volume +/-, power on/off and will change channels and is preprogrammed for easy set-up. Includes special features Scan ,Colour/Brightness Control, Teletext, Fastext, Safe Record Key and Menu Control. Remote incorporates Mode Indicator lights to show which device is being controlled. Operates any infrared TV and is compatible with all brands of TV. A consumer help-line is available. Ideal for replacing lost or damaged remote controls.

Order Code	Type	Price each inc VAT New Catalogue Price
PW95Q	Remote Control 4	£19.99

Headphones

ROSS

These elegant stylish headphones from Ross provide a good quality headphone ideally suited to CD / radio listening.

Order Code	Type	Price each inc VAT New Catalogue Price
PT61E	DS Headphones	£99.99

Dynamic Microphones - e8155

SENNHEISER

A powerful microphone from Sennheiser suitable for vocal applications. The e815S offers you Sennheiser quality at an affordable price. Fully equipped an XLR connector and a noisless on/off switch, of particular note is the high feedback rejection pattern

Specifications:

Frequency Response:	80 - 15KHz
Pick up pattern:	Cardoid
Weight:	330g

Order Code	Type	Price each inc VAT New Catalogue Price
PT15P	E815S Microphone	£99.99

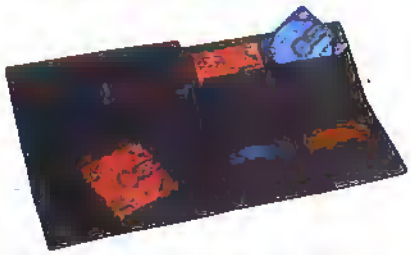
Wireless Headphones

ROSS

Utilising the lates 863 MHz technology. Purchase one transmitter and one belt clip and convert any headphones into wireless a type. The transmitter comes complete with phono leads and mains adaptor. The beltcip receiver may then be worn and a normal pair of headphones simply plugged into the unit which has volume, off/on and tuning controls. Ideal for listeneing to music in the garden, around the house etc.

Order Code	Type	Price each inc VAT New Catalogue Price
PT62P	Wireless Transmitter	£29.99
PT63S	Wireless Belt Clip	£22.99

Mini Disc Wallet



A black simulated leather wallet with individual cotton lined pockets to hold up to 12 mini discs. Velcro fastener.
Dimensions: 185 x 110 x 35mm
Weight: 123g

Order Code	Type	Price each Inc VAT New Catalogue Price
FT62Y	Mini Disc Wallet	£14.99

Walkman/Cassette Carry Bag

Stylish padded, black nylon bag with separate compartments for a personal cassette player, cassettes and a pair of earphones. Comes complete with adjustable waist belt.
Dimensions: 180 x 120 x 75mm
Weight: 85g

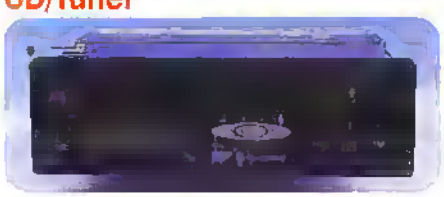
Order Code	Type	Price each Inc VAT New Catalogue Price
FT62W	Walkman Carry Bag	£5.99

Mini Disc Personal Bag

A blue weatherproof, foam lined fabric bag to house your MD personal stereo and earphones. The product comes with a convertible shoulder strap/waist belt. Zip fastener.
Dimensions: 135 x 107 x 58mm

Order Code	Type	Price each Inc VAT New Catalogue Price
FT72U	Mini Disc Stereo Bag	£7.99

CD/Tuner



Features
- ★ AM/FM radio
- ★ PLL synthesised tuner
- ★ 30 preset stations
- ★ Random/repeat play on CD
- ★ 4x25W per channel output
- ★ 2 channel line output
- ★ Electronic audio controls
- ★ Bal/fader/bass/treble/loudness controls
- ★ Clock function
- ★ Illuminated display

This stylish radio/CD player from Roadstar is an ideal headunit for a car hi-fi system. Featuring a 2-band PLL tuner and detachable front panel, the unit will drive 25W into 4 seperate channels.

Order Code	Type	Price each Inc VAT New Catalogue Price
FM52G	In Car CD Tuner	£149.99

DJ Keyboard

Yamaha

Features
- ★ 32 note polyphony
- ★ 284 AWM and sampled voices
- ★ 61 Keys
- ★ Reverb 8 types
- ★ Chorus 4 types
- ★ DSP 33 types
- ★ 6 track user recording
- ★ Multi fingering music accompaniment
- ★ Midi compatible
- ★ 100 patterns

Just "PLUG AND GO". This innovative keyboard from Yamaha features state of the art electronics, a host of features and reviews to match. The keyboard includes a built in sampler, 32 note polyphony and an array or special effects and rythms. Perfect for DJ's to produce backing and music tracks from one easy to use machine.

Order Code	Type	Price each Inc VAT New Catalogue Price
NE61Y	DJ Keyboard	£269.99

High Gain TV Aerials

Maxview

Available in grouped A,B,C/D and Wideband models. these 48 element high gain TV aerials give improved signal reception in weak signal areas.
An ingenious design allows the permanently attached elements to 'lock' into place in seconds - no screwing required. the product comes with fully illustrated easy to follow instructions

Specifications:

Stock Code	Group	Channel Number
PT15	A	21 - 37
PT16	B	35 - 53
PT17	CD	48 - 68
PT18	W	21 - 68

Order Code	Type	Price each Inc VAT New Catalogue Price
FT13J	High Gain Grp W/B TV Aerial	£29.99

Multi Effects Processor

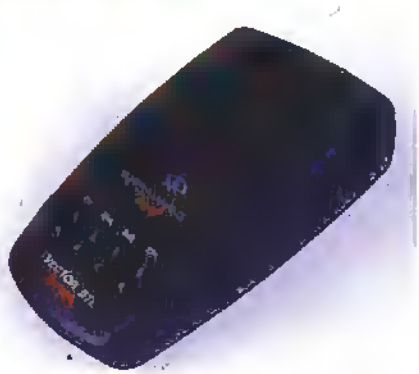
Soundlab

Features
- ★ Input impedance line 47K ohm
  Mic 1K ohm
  CD/Tape 10K ohm
- ★ Nominal input level Line -10dBV
  Mic -50dBV
  CD/Tape -10dBV
- ★ Output impedance 330 ohm
- ★ Nominal output level 10dBV
- ★ Power 9.5VAC(via mains adaptor supplied)
- ★ Dims 483x175x44 mm
- ★ Weight 2.4kg

The ultimate effects processer. In addition to the 256 pre-set digital effects, the unit boasts a built in 3 channel mic/line mixer. With 5 quick pre-set programs and 256 user programs effects include reverb, delay, chorus, flanger, phaser and karaoke. The 3 microphone inputs have a common 3 band EQ. Also includes a seperate stereo RCA input on the rear. Can be used in conjunction with a power amp.

Order Code	Type	Price each Inc VAT New Catalogue Price
FM66A	Multi-Effects Processor	£249.99

Radar Detector



Designed specifically for the European market with Fundemental Mixer Technology(FMT) to achieve excellent detection range and minimal false alarms. The product detects all forms of police radar, Laser, speed camera and Mini Gatso.

Features
- ★ Each frequency band(e.g. X band not used by police in UK) can be switched on/off to minimise falsing.
- ★ Seperate audio/visual alerts.
- ★ Full 360 degree protection.
- ★ Mute,Dark and City modes.
- ★ Dot matrix high contrast text message display showing radar band/laser and signal strength / distance to trap.
- ★ comes complete with visor and windscreen bracket, 2 power cords, spare fuse, hook and loop fastenere and full instructions.

Order Code	Type	Price each Inc VAT New Catalogue Price	Offer Price
FW07S	Radar / Laser Detector	£299.99	£279.99

CD Storage

This handy wallet will store up to 48 discs. Manufactured from PVC they have the look and feel of genuine leather. The wallet has a zipper for secure storage

Order Code	Type	Price each Inc VAT New Catalogue Price
FW52X	48 Disc CD Wallet	£5.99

CD Storage

Made from a blend of PVC and and a non woven lining this wallet will store up to 24 CD'S in a handy sized wallet.

Order Code	Type	Price each inc VAT New Catalogue Price
PA57U	24 Disc CD Wallet	£4.99

MIDI

You can't combine MIDI signals just by joining the wires together. Merging MIDI data is a job for a microprocessor, like the state of the art enhanced RISC CPU in the Little 2M merge box. The Little 2M has intelligent prioritisation and interlocks for Pitch Bend and MIDI Clocks. It properly merges all types of MIDI data including MIDI Time Code and System Exclusive. Thanks to state-of-the -art low power technology, the unit is powered via one of it's MIDI IN lines. Thus, it requires neither batteries or an external adaptor. An indicator lamp lights when correct power is being received. The same lamp dips to indicate transmit data flow. The lamp flashes during dense data. It flashes rapidly when only synchronisation messages being sent.

Order Code	Type	Price each inc VAT New Catalogue Price
PT25G	Little 2M Midi Merge Unit	£39.99

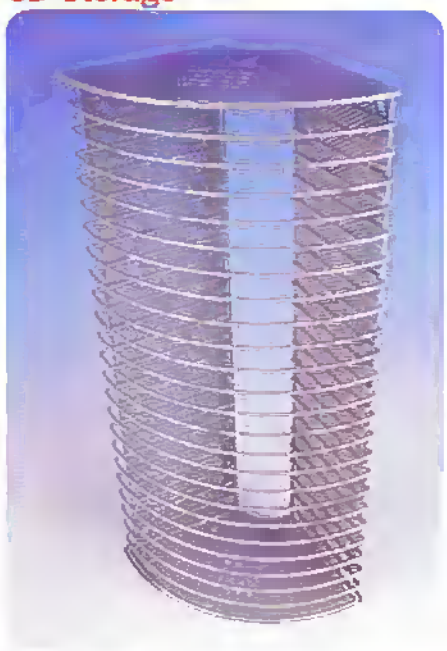
15W Lectern PA System

A complete, self-contained voice and music amplification system that packs into a single flight case. Features metal speaker/amplifier casing, additional microphone input, microphone shock mount, high sound quality. No technical knowledge is required to assemble, the 7 parts fit together in minutes.The controls are on the sound column and allow the mixing of a second microphone and an 'auxiliary' (tape, external mixer etc) if required.

Power Output:	15 Watts RMS
Microphone 1:	5 mV @ 2kΩ
Microphone 2:	5mV @ 20kΩ
Auxiliary:	50 mV @ 10kΩ
Freq. response:	150Hz-20kHz
THD:	Better than 2% at rated output
S/N Ratio:	all Inputs better than 60dB
Power Req:	12 V dc nominal either from mains adaptor (supplied) or from 8 x D type batteries (not supplier)

Order Code	Type	Price each inc VAT New Catalogue Price	Offer Price
[illegible]	15W Lectern PA	£299.99	£249.99

CD Storage



A stylish brushed aluminium Cd storage rack that will hold up to 24CD's whilst still looking good in the living room.

Order Code	Type	Price each inc VAT New Catalogue Price
PT62C	Tenor CD24	£9.99

Cleaning kits

A useful kit for camcorders featuring a mini-five piece vacuum cleaner, wet or dry head cleaner tape and cleaning fluids and tissue papers for cleaning coated lenses. These neatly packaged tools will help keep your camcorder heads and lenses clean, ensuring optimum performance and reducing the risk of damage.

Order Code	Type	Price each inc VAT New Catalogue Price
PT47D	Camcorder cleaning kit	£9.99

Handheld PA System

The Mini-Vox is the modern alternative to the traditional megaphone. It is a featherweight 2.5kg and will run for up to 35 hours on a set of dry cell batteries. Re-chargeable battery kits are available. It is supplied with a detachable microphone and shoulder-strap, and can handle crowds of up to 200 making the system ideal for tour guides, school teachers and the security and emergency services the evacuation or crowd control. Available with a signal alert button for getting attention.

Order Code	Type	Price each inc VAT New Catalogue Price
PT52S	Handheld PA	£99.95

Video Tapes

★ *Six Videos at a great price*
★ *Maxell for quality*

Order Code	Type	Price each inc VAT New Catalogue Price
PW06S	6 pack E180	£5.99

Minidiscs

3 pack of recordable mini discs, 74 minutes in length. These discs provide exceptional sound reproduction, with a long life expectancy. Suitable for use with an Mini Disc recorder or player. Free storage is given with this item

Order Code	Type	Price each inc VAT New Catalogue Price
PW32R	Recordable Minidisk	£9.99

Clock Radio

Features
- ★ *World time with 16 zones*
- ★ *Choice of 12 or 24 hour clock*
- ★ *Clear FM radio with auto scan*
- ★ *Alarm function music or alarm*
- ★ *8 digit calculator*
- ★ *Displays date, month, year and day of week*
- ★ *Requires 1 x 2032 battery (supplied)*
- ★ *3xAAA Batteries (not supplied)*

This uniquely designed Computer Style radio alarm clock incorporates all the features you would usually expect in a radio alarm clock including an LCD display that shows date, month, year, day of the week, time and the calender and an FM radio with auto scan, together with other more unique functions like a 8 digit calculator with memory and % functions make this a multiple use and very useful device. The unusual novelty design is particularly appealing to children making it an ideal gift for younger relatives or friends.

Order Code	Type	Price each Inc VAT New Catalogue Price	Offer Price
FW29G	PC Clock Radio	£19.99	£15.99

Single Video Tapes

Maxell

Super High Quality Grade Video Cassette best suited for long play recording.
Available in 180, 240 and 300 minute lengths.

Order Code	Type	Price each Inc VAT New Catalogue Price
FT53P	300 Min VHS Tape	£9.99

Dynamic Microphones

This professional dynamic PA microphone comes complete with a long gooseneck terminating in a 3-pin XLR connector. Suitable for DJ's public address, churches etc. Matt black finish with on/off switch on base connector.

Order Code	Type	Price each Inc VAT New Catalogue Price
FM72P	Dynamic Microphone	£7.99

USB Zip Drive

Iomega

The portable USB Zip drive utilizes USB advantages.
- **Easy to connect.** Plug it in, connect the USB cable to the computer, and install theIomegaWare software. Done!
- **Hot swappable.** Once the IomegaWare software has been loaded, remove and swap the Zip drive with other USB devices without rebooting your computer. When you need to reconnect your USB Zip drive, just plug the USB cable back into the computer and it's ready to go.
- **Simple, lightweight cable.** The USB Zip drive's translucent blue cable is thin, light weight and connects easily to your computer.
- **Connect Multiple USB devices.** Using USB hubs, you can daisy chain up to 127 devices, including the USB Zip drive, on a single USB port.
- **Fast, unlimited capacity.** Add 100MB of storage with each Iomega Zip disk the easiest way to extend the life and capabilities of your computer.
- **Familiar and reliable.** Using Zip is familiar and easy since it feels and handles like your hard drive. Enjoy the peace of mind brought by saving your files to rugged, reliable Zip disks.
- **Compatibility.** Compatible with over 100 million Zip disks and 16 million Zip drives already sold.

Order Code	Type	Price each Inc VAT New Catalogue Price
FS12R	Iomega Zip USB Drive	£119.99

USB Adapters

A range of USB adapters to convert from Type A to Type B to allow users to mix and match cable types and genders as required.

Order Code	Type	Price each Inc VAT New Catalogue Price
UC67H	USB Adapter AF-AM	£4.99
UC26J	USB Adapter AF-BF	£4.99
UC25K	USB Adapter AM-BF	£4.99

Compact Flash Adaptor

A Compact Flash adapter card to allow users of Compact Flash to transfer data to a PCMCIA port. No drivers are required and a standard PCMCIA port can be used.

Order Code	Type	Price each Inc VAT New Catalogue Price
LW17	Compact Flash Card	£49.99

Smart Media and PCMCIA Reader

A SmartMedia and PCMCIA card reader and writer that simply plugs into a parallel port on the PC. Install the drivers and the inserted card is displayed as an extra drive on your Windows system.
A keyboard cable adapter is provided to supply power to the unit.

Order Code	Type	Price each Inc VAT New Catalogue Price
LY13J	Smart PCMCIA Reader	£29.99

Compact Flash Reader

A Compact Flash and PCMCIA card reader and writer that simply plugs into a parallel port on the PC. Install the drivers and the inserted card is displayed as an extra drive on your Windows system. A keyboard cable adapter is provided to supply power to the unit.

Order Code	Type	Price each inc VAT New Catalogue Price
LY197	Compact Flash Reader	£79.99

Playstation SCART Lead

Performance

- ★ *Playstation compatible SCART Cable*
- ★ *Provides Audio and Composite Video outputs*
- ★ *SCART Adapter Included*

SCART adapter cable for use with Playstation consoles, compatible with standard SCART sockets fitted to most domestic televisions.

Cable Length 1.7m approx.

Order Code	Type	Price each inc VAT New Catalogue Price
LY30H	PSX Scart A/V Vid	£7.99

Canon BJC-5000

Canon

Features

- ★ *Innovative Dual Cartridge System - enabling five different cartridge combinations for different printing applications*
- ★ *Vivid 7 Colour photo printing*
- ★ *A3 manual paper feed*
- ★ *Heavy media capability up to 550gsm*
- ★ *Up to 7.5 pages per minute mono, 3 pages per minute colour*
- ★ *Print resolution of up to 1440 x 720 dpi*
- ★ *New pigmented black ink cartridge for crisp sharp contrast*
- ★ *Drop Modulation TechnologyTM*

The Canon BJC-5000 Personal Printer is a new addition to the already successful range of Bubble Jet printers. It is innovative in both design and concept, setting new standards in terms of user flexibility

The BJC-500 features a paper path that is able to feed extremely thick media, up to 550 gsm. This feature makes it possible to print on card stock. A wide range of print media is supported including transparencies, back print film, and glossy paper.

The BJC-5000 also supports A4+ (full bleed) media enabling a full page of A4 to be printed. Additionally the BJC-5000 can print onto media up to A3 in size via the manual feed for the occasional printing of wide-format documents.

Order Code	Type	Price each inc VAT New Catalogue Price
LY33.	Canon BJC 5000	£249.99

Hot-Swap IDE Drive Caddy

- ★ *Hot-Swap IDE Interface*
- ★ *Suitable for hard drives up to 5,400RPM*
- ★ *Compatible with RH32 and RH57 IDE caddies*
- ★ *Automatic door on outer frame*
- ★ *No need to shut down computer to swap caddies*

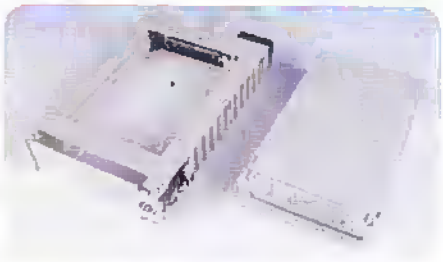
The RH-37 rack system offers a new level of convenience to the PC user. It is now possible to hot-swap IDE devices, using a software driver, removing the need to reboot.

The RH-32 and RH-57 IDE caddies are compatible with the RH-37 frame allowing users to install hard drives with spindle speeds up to 10,000RPM (RH-32).

Supplied with fitting kit and software drivers for Windows 95 and 98.

Order Code	Type	Price each inc VAT New Catalogue Price
LY32C	Hot Swap IDE Caddy	£45.99

RH-32 IDE and SCSI Caddies



- ★ *Automatic door on outer frame*
- ★ *High efficiency ball bearing fan*
- ★ *Tested to 5,000 insertions*
- ★ *Suitable for hard drives to 10,000rpm*
- ★ *Aluminium inner caddy*

A pair of high quality hard drive caddies with either 40 pin IDE interface or 50 pin SCSI interface. Compatible with RH-57 and RH-37 frames and caddies, correct interface type must be used. High quality aluminium bodied caddy, with good heat dissipation qualities, and auto-eject handle system for easy removal. Suitable for use with 1in high 3.5in drives.

Order Code	Type	Price each inc VAT New Catalogue Price
LY32V	SCSI HD Caddy HP	£29.99

Window CE Companion

TechROM

Windows CE is the latest operating system for hand held computers. This CD-Rom contains tools and utilities to help you work more efficiently, connect to other computers and it also contains lots of leisure & games software for all Windows CE based computers.

All the programs are categorised with complete descriptions and with the unique search engine you can easily find the utility or program that you want.

Order Code	Type	Price each inc VAT New Catalogue Price
TW50E	Windows CE Companion	£14.95

14 Digit Tax Calculator

Texet

- ★ *Giant 14 Digit Display*
- ★ *Can calculate those awkward Tax calculations*
- ★ *Angled Display*
- ★ *Full Function Memory*
- ★ *Simple Percent Key*
- ★ *Dual Powered*

Order Code	Type	Price each inc VAT New Catalogue Price
TW51R	14 Dig Dual TAX Calc	£12.99

Databank Calculator

Texet

- ★ *Dual Line Display*
- ★ *IKb Memory 1.3Kb*
- ★ *Flip Top Case*
- ★ *Telephone/Memory*
- ★ *Separate 10 digit Calculator Keypad*
- ★ *Security Password Feature*
- ★ *Time/Day/Date Facility*
- ★ *Alarm Clock with Scheduler*
- ★ *Metric conversions*
- ★ *Auto Shut-Off*

Order Code	Type	Price each inc VAT New Catalogue Price
TW51T	Databank Calculator	£7.99

Flexi Keyboard 2

Inpace

Probably the most high-tech keyboard you have ever seen.

Totally flexible Keyboard which can be rolled up for easy storage and transportation.

IP65 rated - resistant against liquid spills, grease, dust and grime.

Slim-line ergonomic design allows the user to operate the keyboard with minimal effort, the touch sentive keys allow silent operation, with a adjustable sensitivity feature.

Both AT and PS2 (with connector included) compatible.

Order Code	Type	Price each inc VAT New Catalogue Price
TW51Y	Flexi-Keyboard	£65.99

Made to Measure Keyboard Gloves

Inpace

A specially "Made to Measure" Keyboard Glove.

These gloves protects against liquid spills, dust, grime and dirt, they resist oil, grease and most aggressive agents.

Ideal for use in factories, laboratories, hospitals, classrooms.

Invest in a Keyboard Maker and choose from hundreds of Keyboard Types or if it is an unusual type it can be made specially for you.

Order Code	Type	Price each Inc VAT
		New Catalogue Price
TW92A	Key Glove Maker	£19.99

2940UW SCSI Card

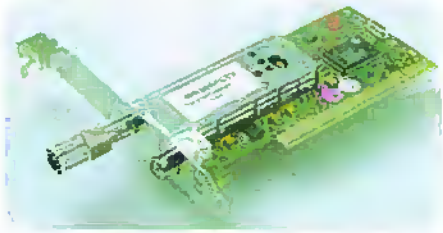
Adaptec

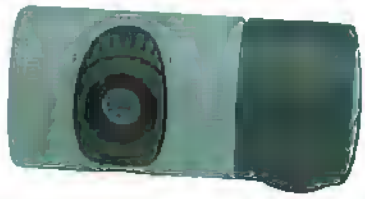
Maximize the performance and flexibility of your system with the ability to connect up to 15 SCSI devices at data transfer rates of up to 40 MBps with the Adaptec® AHA-2940UW host adapter. SCSI's multithreaded I/O interface optimizes multitasking operating systems like Windows® NT or Windows 95. Ideal for servers or workstations, the AHA-2940UW set the industry standard for compatibility.

Order Code	Type	Price each Inc VAT
		New Catalogue Price
YU04E	Adaptec 2940 UW	£229.99

TV Card and Camera Kit

Modular Technology





- ★ *Nicam Stereo Sound*
- ★ *Still Image and Video Capture*
- ★ *QuartzSight Colour Video Camera*
- ★ *Unlimited Simultaneous Teletext Pages*

Full featured TV with Nicam stereo and Teletext on your PC plus the ability to record and capture local video or stills and then send them to any e-mail address. The TV tuner has automatic channel tuning and can present the picture as any size from icon to full screen. Additional TV features include Channel Preview, Wide Screen, Instant Teletext Scrolling, Multiple Live Teletext Screens, DDE Links between Teletext and PC spreadsheets, Always on Top and Replay. The Always on Top mode allows you to monitor what's on TV while working on other windows before blowing the TV picture up to full screen for the interesting bits.

QuartzSight Video Camera is optimised for use with PCs. It delivers 24-bit full colour video and is small enough to rest on top of most PC monitors. Also suitable for live video conferencing over the Internet, Lan or Point to Point. Still images and video sequences can be sent over the Internet to any recipient with an e-mail address.

Plug and Play installation, compatible with Windows 95 and 98.

Television Receiver: 21-59 channel range for UHF
Connectors: 75Ω coax aerial, phono for composite video
PC Interface: Requires PCI 2.1 slot with support for Bus Mastering
Camera: Dimensions 75x37x58mm. Lens Aperture F1.9, Focal Length 4.8mm, 45° Horizontal Field of View, Depth of Field 20cm to Infinity.

Order Code	Type	Price each Inc VAT
		New Catalogue Price
TW99P	ModTec TV Card Card	£129.99

ISDN Terminal Adapters

Virtual Access

- ★ *MSN - Multi Subscriber Numbering*
- ★ *Multilink PPP Channel Bonding 128Kbps*
- ★ *Supports ISDN Worldwide*
- ★ *2 Telephone Ports*
- ★ *Flash Upgradeable*
- ★ *UK Caller Line Identification*

The Virtual Access ISDN TA is an easy to use ISDN modem designed to provide high performance access to Internet, Intranet, Retail Point of Sale (POS) and Alarm Monitoring services. Dual analogue phone ports enable users to make phone calls or send faxes whilst also connecting to data services such as the Internet.

Using both of the two 64K channels provided by ISDN, the Virtual Access ISDN TA transmits at rates up to 128Kbps. Data compression even makes it possible to achieve throughputs of up to 230Kbps over a single B-Channel.

Advanced features include Multi Subscriber Numbering, allowing 10 numbers to be allocated to one ISDN line so that fax, phone and modems can all have separate direct dial numbers.

All Virtual Access models are D-Channel ready and are able to take advantage of future D-Channel data services such as AO/DI.

Available in two versions with and without Analogue Ports

Rate Adaption:

Protocols supported include V120, PPP, multilink PPP, and Bandwidth Allocation Control Protocol (BACP)

X.25:

Support over both B and D Channels (X.3, X.28, X.29) TPAD

Security Protocols:

PAP, CHAP, Shiva-PAP, MS-CHAP

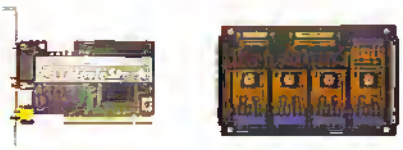
Interface:

ISDN on RJ-45, DTE Interface to PC - RS232 presented on DB9. Analogue on two RJ11.

Order Code	Type	Price each Inc VAT
		New Catalogue Price
TW9C	ISDN TA Data	£149.99

MovieStar Security Patch Panel

ATM



- ★ *PC based CCTV*
- ★ *Un-attended event driven video recorder*
- ★ *4 Camera inputs*
- ★ *4 Trigger inputs for sensors*
- ★ *Twin double throw output relay*
- ★ *LookC security software and manual included*
- ★ *Internal MovieStar PCI capture card and external security patch panel*
- ★ *Wiring guide includes Maplin part codes for sensors & wire etc*

The MovieStar Security Patch Panel system allows you to use a PC to capture video clips from up to four cameras. Recording is triggered by inputs from standard alarm sensors such as PIR's, pressure mats, door and window contacts. Each camera input has it's own trigger input. The video clips are stored to the PC's hard disc in the AVI movie format and the time and date are used as the file names. The LookC software opens a new directory for each new day and keeps all of the event video clips for the day in that folder.

The LookC software allows you to use the computer normally by working in the back-ground and you can configure it to 'pop-up' into the foreground when an event is triggered. The system can be used via modem in a remote site to verify alarm call-outs and to provide the essential visual confirmation of a break-in to enable the police to respond immediately.

The captured image quality is determined in the LookC set-up menus, you can choose the resolution up to a maximum of 768 x 576 (broadcast PAL), frame rates of between 1 and 25 frames per second and a recording time limit. The AVI movies are just like any other piece of computer data and they can be e-mailed, backed-up or sent across local networks.

The MovieStar Security Pack includes the PCI card, patch panel, LookC software and all leads. If you have the MovieStar PCI video editing package already you can order the Security Upgrade in order to give it the full security specification as well.

Order Code	Type	Price each Inc VAT
		New Catalogue Price
TY52E	ATM Security Panel	£119.99

Waterproof GPS Cases

Aquapac

Waterproof protection for your GPS system, available in two sizes for different GPS systems. Keep your GPS dry, dust and dirt free without compromising performance or usability. Waterproof to 10m (33ft) thanks to the easy to use, quick action Aquaclip seal.

Medium Case: 220 x 95 x 185mm internal length x width x circumference

Small Case: 165 x 90 x 175mm internal length x width x circumference

Order Code	Type	Price each inc VAT
		New Catalogue Price
TW26	Medium GPS Case	£11.99

CAT5 UTP Patch Cables

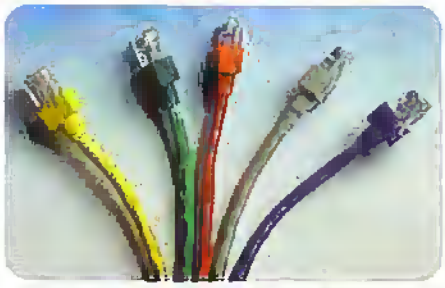
Net 5

A range of high quality Category 5 unshielded twisted pair patch cables assembled in the UK using Draka Cardinal stranded UTP cable with AMP RJ45 connectors and boots. These cables are approved by BASEC to EIA/TIA 568 and are available in a range of colours and lengths. Grey patch cables are available in extended lengths.

Order Code	Type	Price each inc VAT
		New Catalogue Price
TW28V	Grey UTP Patch 10m	£9.99

Crossover Patch Cables

Net 5



A range of UTP cross-over patch cables suitable for connecting two network cards directly to create a simple network, also suitable for connecting two hubs together when uplink ports are not available.

Order Code	Type	Price each inc VAT
		New Catalogue Price
TW29V	Grey UTP Xover 0.5m	£5.99

ISP4 Surge Protectior

ASC Bowthorpe

- ★ *Protection Clamps below 900 Volts*
- ★ *Noise Free Operation with Automatic Reset*
- ★ *Surges Dissipated within the Unit*

Ideal for equipment with figure '8' IEC power sockets this product plugs between the IEC socket and the IEC plug and lead supplied with your equipment. This device dissipates incoming and outgoing surges to and from domestic and professional equipment. Power consumption is minimal and reset is automatic.

The internal surge supressors are tested against worst case conditions as defined in International Standards IEEE C62.41-1991 Bat.B3 and comply with the recommendations of BS6651:1992 Appendix C.

Suitable for use with laptop computers, computer peripherals, audio equipment, video recorders and other equipment fitted with IEC figure '8' connectors.

Order Code	Type	Price each inc VAT
		New Catalogue Price
TW06	ISP4 Surge Protector	£9.99

USB Colour Camera

Pace

- ★ *Digital colour camera for direct connection to a USB ready PC*
- ★ *Combines visual & audio communications*
- ★ *Designed for use over phone lines, ISDN & the internet*
- ★ *Ideal solution to video mail, video conferencing, still image capture & video clips*
- ★ *Plug & play for straight forward installation*

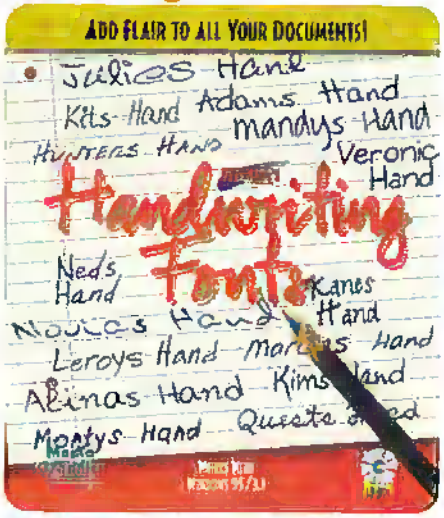
Pace colour video cameras are the perfect way to take your communications into another dimension. The Camera is designed for direct connection to a USB ready PC. This compact digital camera sits neatly on top of your PC monitor and sends pictures via the PC's USB port. It's also very quick and easy to install. You simply plug the camera into your USB port and allow Windows' plug and play to install the camera for you. Running the applications supplied with the camera will get you up and running in a couple of minutes.

Specifications:

Enhanced resolutions of up to:
704 x 576 pixels (still images)
352 x 288 pixels (live video)
24 bit colour images for smooth colour gradients
Adjustable focus colour digital CMOS sensor
Depth of field: 5cm to infinity (variable focus)
Field of view: 52 degrees (horizontal)
Frame rate: 30 frames per second
Video format: 4:2:2 YUV; 4:2:0 YUV;YUV9;24bit RGB, 16 bit RGB; 8 bit palletised RGB
Proprietary hardware compression of up to 5:1

Order Code	Type	Price each inc VAT
		New Catalogue Price
TW01	Pace USB Camera	£99.99

Handwriting Fonts



Give all your documents the personal touch with this unique collection of fonts that look like real handwriting. Choose sophisticated printing, or you may find a "chicken scratch" that looks almost like your own! You're sure to find the perfect style to compliment your message. Add individual flair to all your letters, invitations and more. All your documents will get noticed when you use fonts from this comprehensive collection.

Order Code	Type	Price each inc VAT
		New Catalogue Price
TW05	Handwriting Fonts	£4.99

PII BX Motherboard

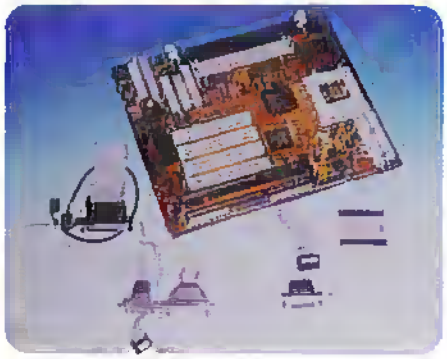
Commate

- ★ *Intel 82440BX Chipset*
- ★ *ATX Form Factor*
- ★ *Supports Intel Pentium II up to 450MHz*
- ★ *100MHz System Memory Bus with Intel Pentium II from 350MHz up*
- ★ *Up to 768MB SDRAM using 3 x 168-pin 3.3V DIMM Sockets*
- ★ *AGP Slot Functions in 1x and 2x mode (66/133MHz)*
- ★ *4 x PCI Slots & 3 x ISA Slots*
- ★ *2 x Serial & 1 x Parallel Port*
- ★ *2 x USB Ports*
- ★ *2 x Bus Master UDMA/33 EIDE Channels Support 4 x Devices including ATAPI CD-ROM*
- ★ *ACPI & APM Power Management*
- ★ *Award BIOS*

Order Code	Type	Price each inc VAT
		New Catalogue Price
TW07	Commate PII BX Board	£99.99

Socket 7 Motherboard

Commate



- *ALI Aladdin V Chipset*
- *Baby AT Form Factor*
- *Supports all Socket 7 Processors (at time of writing)*
- *Up to 100MHz System Memory Bus (with compatible CPU)*
- *Up to 128MB EDO/FP DRAM using 2 x 72-pin SIMM Sockets*
- *Up to 512MB SDRAM using 2 x 168-pin 3.3V DIMM Sockets*
- *AGP Slot Functions in 1x and 2x mode (66/133MHz)*
- *4 x PCI Slots & 2 x ISA Slots*
- *2 x Serial & 1 x Parallel Port*
- *2 x USB Ports*
- *2 x Bus Master UDMA/33 EIDE Channels Support 4 x Devices Including ATAPI CD-ROM*
- *ACPI Power Management*
- *Award BIOS*

Order Code	Type	Price each inc VAT New Catalogue Price
[illegible]	Commate Socket 7 Mot	£49.99

MXPRO 200 Processor Upgrade

Evergreen

- *Microsoft Windows certified processor with 64k write-back cache*
- *Universal voltage support*
- *Upgrade selected 75MHz and higher Pentium systems*
- *Includes a high performance BIOS upgrade*
- *Plugs into standard Pentium CPU socket (socket 5 and 7 compatible)*

The Evergreen MXPRO processor upgrade boosts 75MHz and higher Pentium systems to MMX performance levels. The Evergreen MXPRO supports top brand name system models such as IBM, Compaq, Dell, Packard Bell and more. It comes with universal voltage support for 75MHz and higher Pentium systems, and BIOS upgrade for selected systems.

Order Code	Type	Price each inc VAT New Catalogue Price
UA1CA	Evergreen Pent Upgrade	£39.99

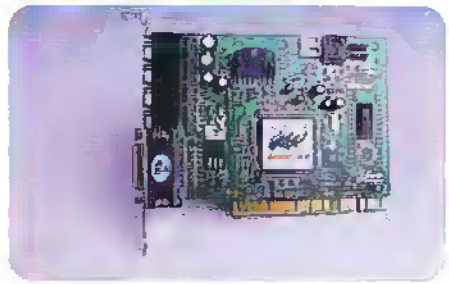
Analogue to USB Gameport Converter

- *A convenient way to add more than one joystick to your PC*
- *Use your favourite analogue joystick on a USB port*
- *Compatible with conventional analogue joysticks*
- *Eliminates the need for re-booting when changing joysticks*
- *6 foot extension cable*

An ideal soulution to the problem most gamers have when wanting to use multiple joysticks. Instead of unpluging one joystick to add another just add this device to your USB port and you can have two joysticks running on your PC.

Order Code	Type	Price each inc VAT New Catalogue Price
UA2ZY	USB Joy Converter	£9.99

16bit PCI Soundcard



- *16bit soundcard with PCI interface*
- *SoundBlaster Compatible*
- *Windows 3.1, 95/98 and NT support*
- *Full Duplex CODEC Support*

A 16bit PCI sound card with built in wavetable and 3D sound. It comes with support for MIDI aplications. Included on the card are ports for Joysticks, Line In, Line Out, Speakers Out and Microphone In.

Order Code	Type	Price each inc VAT New Catalogue Price
UA2SC	PCI Sound Card	£19.99

Voodoo 2 3DFX 12Mb Card

- *Voodoo 2 3DFX 12Mb card*
- *Fully compatable with almost all modern software*
- *Direct-X and Open GL compatible*
- *Speed up your 3D games experience*

Join the new revolution in gaming with this top of the range Voodoo 2 12Mb card. The Voodoo 2 is compatible with all 2D cards and uses a link to connect to your existing graphics card.

Please note you must use this in conjunction with a standard 2D graphics card.

Order Code	Type	Price each inc VAT New Catalogue Price
UA2SF	Voodoo 2 3D 12Mb	£99.99

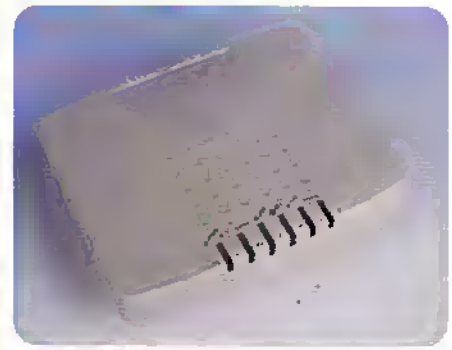
Glidepad Keyboard

- *Standard 105 Key Windows 95/98 Keyboard*
- *Built in glide pad mouse with 2 buttons*
- *Connects using both a PS/2 and 9 way serial adaptor*
- *Comes with a PS/2 to DIN convertor*

A Windows 95/98 keyboard with built in glide pad mouse. Ideal soultion for people with minimal space in which to move a standard mouse. Plugs into your standard keyboard and mouse ports and comes complete with all drivers required.

Order Code	Type	Price each inc VAT New Catalogue Price
UA2SG	SITC 514 Keyboard	£29.99

SOHO Network Hub



- *5 port Ethernet hub for connecting up to 5 PCs*
- *Compatible with 10BASE-T specification*
- *Wall mountable and hub cascading options*
- *6 LED indicators for easy network troubleshooting*

A pocket size network hub ideal for home or small office use. It is compatible with the industry standard 10BASE-T and can be extended by cascading the hubs. You have the option of power either from an AC power adaptor (not supplied) or using the power from the keyboard port using the adaptor supplied.

Order Code	Type	Price each inc VAT New Catalogue Price
UA3BK	5 Port 10BASE-T HUB	£29.99

USB Card

- *A PCI adaptor that allows you to add two USB ports to your PC*
- *Compatible with all USB devices*
- *Fully Supported by Microsoft drivers*
- *Upto 12Mbps Data Transfer speed*

A low cost addition to your PC that allows you to connect USB devices. The Card simply fits into any free PCI slot allowing for trouble free installation of USB equipment such as Joysticks, Mice, Speakers etc. Compliant with PCI 2.1. Requires Windows 95 V2.5x or Windows 98.

Order Code	Type	Price each inc VAT New Catalogue Price
UA33L	USB Host Adapt PCI	£29.99

System Temperature Monitor

★ *Check the temperature of your system*
★ *Switchable between Centigrade and Farenheight*
★ *Built in clock*
★ *User set Upper Temperature Warning*

Check that your PC is not getting too hot with this computer thermometer. It fit's neatly into any free 5.25 inch bay (possibly even if there is a hard disk behind it) with the display built into the blanking panel. Ideal for high specification PCs where internal temperature is generally higher than normal.

Order Code	Type	Price each inc VAT New Catalogue Price
UA34U	Thermal Sensor	£19.99

10Mbps Network Starter Kit

Bay Networks

The EB104 network kit contains the following parts:
★ *One 4 port ethernet hub (EN104TP)*
★ *Two 10BaseT ISA ethernet cards (EA201)*
★ *Two 25ft twisted pair cables*
★ *A full instruction book*

This network kit contains all the parts required to set up a Windows 95, 98 or NT network. All components are plug and play for ease of installation. Perfect for use at home or in a small office or workgroup.

Order Code	Type	Price each inc VAT New Catalogue Price
UA66W	Bay EB104 Net Kit	£54.99

RIO MPEG Player

Diamond

★ *Palm size for easy portability*
★ *Supports MP3 compression*
★ *32MB built-in flash memory*
★ *Expandable playback time with removable flash cards*
★ *Skip free - no moving parts*
★ *MusicMatch Jukebox Limited Edition software for converting CD's to an MP3 format*
★ *CD Music Sampler*
★ *Goodnoise: The premier source on the net for high-quality, downloadable musicMP3.com: Over 100 songs from new artists MP3 songs from MusicMatch and Audio Explosion, also included*

Internet Music in the Palm of Your Hand!
Diamond's Rio PMP300 is the first portable MP3 music player for under £180 that stores up to 60 minutes of digital-quality sound. It's smaller than an audio cassette and has no moving parts, so it never skips. Powered by a single AA battery, Rio provides up to 12 hours of continuous music playback.

Order Code	Type	Price each inc VAT New Catalogue Price
UA73K	Da Rio	£179.99

Banshee PCI

Creative

★ *Single-slot 2D, 3D graphics and video accelerator*
★ *3Dfx Interactive3/4 Voodoo Banshee® chipset*
★ *Integrated 250MHz Palette-DAC supporting up to 1920x1200 at 75Hz*
★ *16MB of 100MHz SDRAM*
★ *MPEG-1/MPEG-2 and full-motion video playback acceleration*
★ *PCI bus version 2.1*
★ *Multi-display support under Windows3/4 98*
★ *VESA DDC 2B + DPMS*
★ *Full Plug-and-Play compliant*

A complete 2D/3D graphics solution based on the new Voodoo Banshee® chipset from 3Dfx Interactive3/4.

Features a full 128-bit graphics core and the same 3D rendering technology used in the award-winning Voodoo2.

16MB of high-speed SDRAM and a 250MHz DAC deliver awe-inspiring resolutions, rock-solid refresh rates, and stunning visual quality.

Order Code	Type	Price each inc VAT New Catalogue Price
UA81C	CL Banshee PCI	£79.99

Marble Mouse

Logitech

★ *Feels like a mouse, works like a trackball*
★ *Superior precision and smooth motion*
★ *Reduces movement; saves desk space*
★ *Works with Windows® 3.1x, 95, 98 and NT® 4.0*

Logitech® Marble® Mouse fits right or left hand like a mouse and works with the convenience of a trackball. Patented Marble optical technology provides superior precision, reduced wear and smooth motion, and eliminates the need for regular cleaning. Just move the trackball instead of moving the whole mouse around. It saves desk space, reduces hand and wrist movement, and plugs conveniently into your system's serial or PS/2 port. There's no need to bother with software. Use it with Windows® 3.1x, 95, 98, and NT® 4.0 applications. Includes a three-year guarantee.

Order Code	Type	Price each inc VAT New Catalogue Price
UA82K	Marble Mouse	£39.99

USB Cable Type B

A Type B USB cable which features male Type B connectors at both ends.
Connectors: Type B male to Type B male
Lengths: 2m, 3m, 5m

Order Code	Type	Price each inc VAT New Catalogue Price
UB16S	USB Type B-B 2m	£4.99

USB Adapter Cable

A Type A to Type B USB adapter cable for connecting equipment with different USB connector types.
Connectors: Type A male to Type B male
Length: 2m, 3m, 5m

Order Code	Type	Price each inc VAT New Catalogue Price
UC03D	USB Type A-B 3m	£5.99

USB Mouse

★ *USB Connection*
★ *Ergonomic Design*
★ *Easy Installation*

A standard USB mouse for use with computers that have USB ports, suitable for home or office as an upgrade or replacement.

Order Code	Type	Price each inc VAT New Catalogue Price
UC10L	USB ICE Mouse	£9.99

Electronic Circuits & Components

Matrix

- ★ *Virtual Laboratories*
- ★ *Electronic Workbench & Crocodile Clips Compatible*
- ★ *Full Audio Commentary*
- ★ *Supervisers' notes*
- ★ *Editable Worksheets*

Electronic Circuits & Components provides a sound introduction to the principles and application of the most common types of electronic components and how they are used to form complete circuits. Sections on the disc include: fundamental electronic theory, active components, passive components, analogue circuits and digital circuits. A full set of support materials is included.

Note This version is the Full Licence Single User/Institution version

Order Code	Type	Price each inc VAT New Catalogue Price
PF30	Electronic Circuit	£24.99

Digital Electronics

Matrix

- ★ *Virtual Laboratories*
- ★ *Over 20 links to predesigned Electronics Workbench circuits and Crocodile Clips*
- ★ *Full Audio commentary*
- ★ *Supervisors' notes*
- ★ *Editable Worksheets*

Digital Electronics provides a broad introduction to the principles and practice of digital electronics, including logic gates, combinational and sequential logic circuits, clocks, counters, shift registers and displays. The CD ROM also provides an introduction to microprocessor based systems

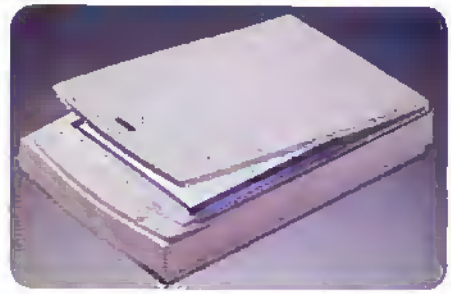
Note:-

OA24 Student Version (Home Use Only)

Order Code	Type	Price each inc VAT New Catalogue Price
OA24S	Digital Elect Student	£45.99

Colorado Direct 9600

Primax



- ★ *36bit Colour Scanner*
- ★ *300 x 600 Optical Resolution, up to 19200 dpi with software enhancement*
- ★ *Parallel Port Interface*
- ★ *2 Year Warranty*
- ★ *Comes with OCR Software*

A full colour scanner from Primax boasting an optical resolution of 300x600 dpi which can be taken as high as 9600 dpi with software enhancement. This powerful scanner plugs directly into your parallel port making it very simple to install. The Colorado 9600 scans, faxes or copies with one single action. 9600 dpi resolution and 36bit colour give bright clean results. A full version of PrimaPage 98 home edition - an excellent OCR program based on the award winning FineReader - is included.

Order Code	Type	Price each inc VAT New Catalogue Price
UC43T	Colorado Direct 9600	£49.99

EZ-2 and EZ-4 Label Printers

C.ITOH

The C.ITOH EZ-2 and EZ-4 direct thermal label printers have many versatile features and are extremely easy-to-use. Neat, dynamic and compact - these two particular products (with remakably small footprints) are ideally suited to home office or small company use, as well as a range of commercial and industrial applications. They are not only easy-to-load and operate but are extremely robust and reliable.

C.ITOH EZ-2 (just 215mm high x 144mm wide x127mm deep)is one of the smallest printers available, yet, it is capable of providing exceptional print quality at speeds of up to 2 inches per second and has a facility to take 2 inch wide label rolls upto 260 meters long. This neat little printer makes light work of address labels, tickets and receipts.

C.ITOH EZ-4 on the other hand offers the same print quality and speeds, but being a little larger in size, is designed to take 4 inch wide labels that make it ideal for larger labeling applications.

Free Windows software and drivers are supplied. This includes a full set of Windows drives (versions 3.1/95/98 &NT) as well as the exclusive C.ITOH 'Q Labels' which is a fully featured easy to use Windows label design software package for printing Graphics, fonts and bar codes.

Order Code	Type	Price each inc VAT New Catalogue Price
UC43D	C.ITOH EZ-2 Printer	£299.99

Prima Navigator Pro

Primax

- ★ *3 Button Mouse*
- ★ *Middle button is a scroll wheel*
- ★ *Micro Switch Buttons*
- ★ *400dpi resolution*
- ★ *USB version*

The unique finger controlled PRIMAX Prima Navigator Pro mouse lets you scroll smoothly and easily through text and columns. Ideal for surfing the Internet, it works with any Microsoft Windows application and includes Mousesuite 98 software for personalizing button and scroll control.

Order Code	Type	Price each inc VAT New Catalogue Price
UC56L	Navigator Pro USB	£19.99

BackUPS Systems

APC

- ★ *Full time noise, surge, spike and black-out protection*
- ★ *Dedicated surge protection socket*
- ★ *2 Year warranty*
- ★ *Instantaneous battery backup*

APC's Multipath Power Protection offers complete system protection. There is no need to purchase a separate UPS or Surge protector for your printer and other peripheral devices. User replaceable batteries give you a renewable UPS that keeps protecting your equipment year after year without factory service. A push-button resettable circuit breaker allows quick and easy recovery if you accidentally overload the UPS. Suitable for use on workstations or servers at home on in the office.

Order Code	Type	Price each inc VAT New Catalogue Price
UC60Q	BackUPS 300M	£79.99

Intelligent LCD Modules

Lascar

Available configured as a counter, timer or frequency counter, these microcontroller-based meters are designed around a 6+3 character alphanumeric starburst LCD, and are housed in a snap-in DIN sized enclosure for easy assembly. The meter features 10mm digit height, password protection of configuration settings, choice of annunciators, leading zero blanking, on-board buzzer and power-up with "last saved settings". Navigation through the menu is straightforward and allows the the user to configure the meter. Besides

displaying the measured input, the meter can be made to control events via its two open collector outputs. The meter can communicate with other intelligent systems via its built-in RS232 and RS485 communications ports. Several meters can be networked and each individually addressable.

Specifications:

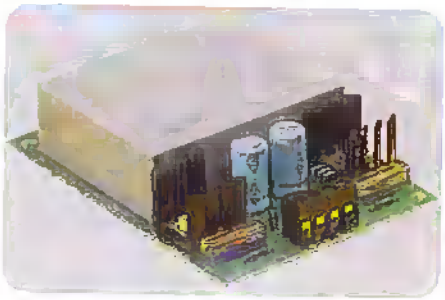
Operating Temperature	0 - 50°C
Temp Stability (freq & timer)	20ppm
Supply Voltage	4.5 - 5.5V
Supply Current	35mA
Supply Current (light off)	15mA
Input Voltage	15V
Display range (freq & count)	-99999 to +999999
Max I/P Freq (counter only)	15KHz
I/P Freq (freq counter only)	0.1-1M(Hz)
Min I/P Pulse (freq counter)	0.5 µS
Display Area (mm)	57.5 x 15.0
Bezel Dimensions (mm)	72 x 36
Panel Cut-out	68 x 33

This product is supplied with detailed instructions

Order Code	Type	Price each inc VAT New Catalogue Price
TY81C	Prog Counter	£117.44
TY82D	Prog Freq Counter	£117.44
TY83E	Prog Timer	£117.44

Dual Rail 5V PSU

Lascar



- ★ *Adjustable voltage twin rail PSU*
- ★ *Simple screw terminal connection*
- ★ *Encapsulated mains transformer*
- ★ *Positive and negative adjustable rails*
- ★ *20 turn trim pots for accurate setting*

A low cost adjustable twin rail power supply, meeting the requirements of the European CE Directive. A quality British product, the PSU 203 is a low profile easy to use linear supply suitable for a wide range of applications

Technical Specifications

Load Regulation:		1%
Line Regulation:		1%
Ripple:		0.5mV
Temperature Range:		0 - 70 °C
Output - DC @ 20°C		
Positive:	V:	5 - 15V
	I:	150mA (max)
Negative:	V:	-5 - -15V
	I:	-150mA
Input 50-60Hz (link selectable)		110 - 125 Vac 220 - 250 Vac

Order Code	Type	Price each inc VAT New Catalogue Price
TY83T	PSU203	£37.15

High Grade Audio Capacitors

Samwha

- ★ *For high grade audio equipment*
- ★ *High resonant frequency*
- ★ *Low ESR*
- ★ *Low Impedance*
- ★ *Snap-in terminals*
- ★ *Manufactured to ISO9001 standard*

A range of very high quality audio grade capacitors with both 2 pin and 4 pin variants

Specifications:

Tolerance	±20%
Temp range	-40 to +85°C
Load life	2000Hrs @ 85°C
Leakage current (max)	=3√(CV) (µA)
Dimensions - dia x length (mm)	
TY98G	30x60
TX83E	35x60
TX84F	40x60
TX85G	40x80

Order Code	Type	Price each inc VAT New Catalogue Price
TY98G	AS 10000uF 63V 4 Pin	£31.72
TX83E	AS 1000uF 63V 4 Pin	£15.12
TX84F	AS 4700uF 63V 2 Pin	£4.67
TX85G	AS 6800uF 63V 2 Pin	£5.72

Component Analyser

Peak

- ★ *Automatic component identification*
  - *Bipolar transistor*
  - *MOSFETs*
  - *Diodes*
  - *Diode networks*
- ★ *Automatic pinout identification for all the above components*
- ★ *Gain measurement for transistors*
- ★ *LED illumination regardless of connected polarity*
- ★ *2 line supertwist LCD for clear analysis results*
- ★ *Colour coded, gold plate test clips*
- ★ *Single button control*
- ★ *Automatic power-on and power-off*
- ★ *Long life battery supplied*
- ★ *Low battery warning*

This component analyser is a highly advanced instrument that provides a wealth of functionality and features in one extremely easy to use unit. You will no longer need to search through lengthy data books in order to identify component identification and pinouts, this instrument does it all. In addition to all this the instrument also measures component functionality and even measures transistor gain. Using the latest manufacturing techniques together with advanced microprocessor software, this instrument is a true innovation for the engineer, technician, hobbyist and student.

Dimensions 131 x 65 x 30 (mm)

Order Code	Type	Price each inc VAT New Catalogue Price	Offer Price
UE94C	Component Analyser	£69.95	£60.00

Diode Tester

Peak

- ★ *High quality diode tester*
- ★ *Instant test of all diodes*
- ★ *Displays polarity*
- ★ *Auto power-off*
- ★ *Test leads terminated by crocodile clips*
- ★ *Battery and instructions included*

This useful and ingenious device allows the user to detect faults and polarity of all diodes in usually less than six seconds. The unit will also check LEDs and illuminate them whilst under test to show it is working.

Specifications:

Detectable Junction	< 2.5V
Battery Life	1500 tests (approx)
Dimensions	80 x 56 x 25 (mm)

Order Code	Type	Price each inc VAT New Catalogue Price
UE81Y	Diode Tester	£29.99

MOSFET Analyser

Peak

- ★ *Pocket size MOSFET analyser*
- ★ *Colour coded leads terminated in crocodile clips*
- ★ *Suitable for both N and P channel devices*
- ★ *Identifies gate, drain and source*
- ★ *Complete with battery and instructions*

This high quality piece of test equipment is an advanced microcontrolled instrument that will quickly and easily analyse almost any enhancement mode MOSFET. With the touch of a button, the analyser will verify the MOSFET under test is working, identify Gate, Source and Drain and determine an N-channel or P-channel type.

Specifications:

MOSFET Type	N/P Channel
MOSFET Technology	Enhancement
Gain Range (@ Ids=3mA)	25mA/V (typ)
Peak Test Voltage	5.5V
Peak Test Current	4mA
Analysis Duration	<1 S
Display Duration (pass)	20 S (typ)
(fail)	5 S (typ)
Temperature Range	+10 to 45 °C
Dimensions (mm)	80 x 56 x 25

Order Code	Type	Price each inc VAT New Catalogue Price
UE95A	Mosfet Analyser	£29.99

Transistor Analyser

Peak

An advanced Microcontrolled instrument that will quickly and easily analyse almost any type of Bipolar transistor. With a press of a button, the analyser will verify the transistor under test is working, identify Base, Emmitter and Collector and determine whether the transistor is NPN or PNP type.

Specifications:

Transistor type		NPN/PNP
Transistor technology		S/Ge
HFE Range @ Ic=3mA		>20 (typ)
Peak test voltage		5.5 V
Peak test current		4mA
Analysis duration		< 1 S
Display duration	pass	20 S (typ)
Display duration	fail	5 S (typ)
Temperature range		+10 to 45°C
Dimensions (mm)		80 x 56 x 25

Order Code	Type	Price each inc VAT New Catalogue Price
UE96B	Transistor Analyser	£29.99

Master Faders

Alps

★ *Very high quality*
★ *Very high precision*
★ *Single or dual logarithmic tracks*
★ *Super smooth actuator travel*

A pair of master fader slider potentiometers available as both single and dual track variants

Specifications:

Power Rating	0.25W
Resistance Tolerance	±20%
Temperature Range	-25 to +70 °C
Resistance Scale	Logarithmic
Resistance	10kΩ
Actuator Travel	100mm

Order Code	Type	Price each inc VAT New Catalogue Price
UE89W	Master Fader Sngl	£9.02
UE90X	Master Faders Dbl	£9.54

Slim Line Slide Potentiometers

Alps

★ *Metal construction including tapered lever*
★ *Linear and logarithmic tracks available*

A range of standard, low profile slide potentiometers suitable for many applications including audio and light fading. They are available in two series, a 50kΩ linear track and a 10kΩ logarithmic track. Each series has devices with 30,45 and 60 mm travel.

Specifications:

Operating Temperature	-25 to +70 °C
Sliding Life (approx)	10,000 cycles
Tolerance	±20%
Body Width	8mm
Max Operating Voltage	Log - 150V Lin - 200V Power (W)

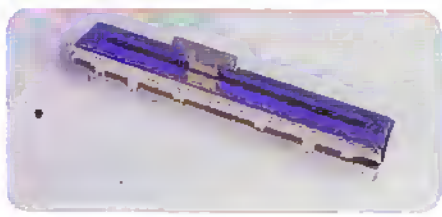
Variant (mm)	30	45	60
Log	0.1	0.125	0.1
Lin	0.2	0.25	0.2

Note: For knobs for these devices see Fixings & Hardware section

Order Code	Type	Price each inc VAT New Catalogue Price	Offer Price
UE91C	30mm Slider 10K	£5.29	£4.99
UE92D	45mm Slider 10K	£5.34	£4.99
UE93E	60mm Slider 10K	£10.38	£9.53
UE94F	30mm Slider 50K	£14.47	£13.99
UE95G	45mm Slider 50K	£1.73	£1.62
UE96T	60mm Slider 50K	£9.02	£8.62

Low Profile Master Faders

Alps



★ *Low profile*
★ *Smooth operation*
★ *Manufactured to the highest quality*
★ *Logarithmic tracks*
★ *Available in single and dual slide format*

A pair of very high quality master faders in a low profile format. The slider is available in two variants, the first being a single throw slider with the second being dual.

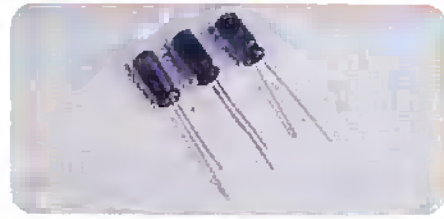
Specifications:

Slider Travel	60mm
Power Rating	0.2W
Resistance Tolerance	±20%
Operating Temperature	-25 to +70 °C

Order Code	Type	Price each inc VAT New Catalogue Price
UE97U	Fader Sngl	£2.84
UE98V	Fader Dble	£3.73

Low Impedance Electrolytics

Samwha



★ *Extremely low impedance at high frequency*
★ *Ideally suited for use in switching power supplies*
★ *Manufactured to ISO9001 standards*
★ *Solvent proof*
★ *High reliability*
★ *Max leakage current 0.01CV or 3μA whichever is greater after 2 mins*

A range of 105°C rated electrolytic capacitors with an extremely low impedance at high frequency.

Specifications:

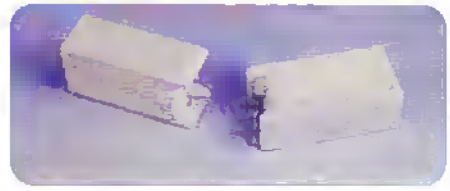
Operating temperature range	-55 to +105 °C
Capacitance tolerance	±20% 0.5" Pitch

Stock Code	D x L (mm)	Impedance @100kHz	Ripple Current (mA rms)
TX86T	5x11	4.0	1E
TX87U	5x11	3.5	27
TX88V	5x11	2.2	49
TX89W	5x11	1.8	45
TX90X	5x11	1.05	67
TX91Y	6.3x11	0.52	110
TX92A	6.3x11	0.43	135
TX93B	6x11.5	0.3	264
TX94C	8x11.5	0.16	395
TX95D	10x16	0.09	560
TX96E	12x20	0.045	1112
TX97F	13x25	0.036	1430
TX98G	16x25	0.028	1645
TX99H	16x25	0.027	1688
UE50E	16x35.5	0.020	2410
UE51F	18x35.5	0.018	2510

Order Code	Type	Price each inc VAT New Catalogue Price
TX86T	Low Prof 1μF 50V	£0.15
TX87U	Low Prof 2.2μF 50V	£0.16
TX88V	Low Prof 4.7μF 50V	£0.16
TX89W	Low Prof 6.8μF 50V	£0.16
TX90X	Low Prof 10μF 50V	£0.20
TX91Y	Low Prof 22μF 50V	£0.23
TX92A	Low Prof 33μF 50V	£0.23
TX93B	Low Prof 47μF 50V	£0.34
TX94C	Low Prof 100μF 50V	£0.34
TX95D	Low Prof 220μF 50V	£0.65
TX96E	Low Prof 470μF 50V	£1.22
TX97F	Low Prof 1000μF 25V	£3.65
TX98G	Low Prof 2200μF 25V	£5.50
TX99H	Low Prof 3300μF 16V	£2.16
UE50E	Low Prof 4700μF 16V	£2.55
UE51F	Low Prof 6800μF 16V	£4.44

5 Watt Resistors

Meggitt



An innovative high power to size 5 watt power resistor consuming minimum board space with cool operation at board level even at full power. Wide range of ohmic values.

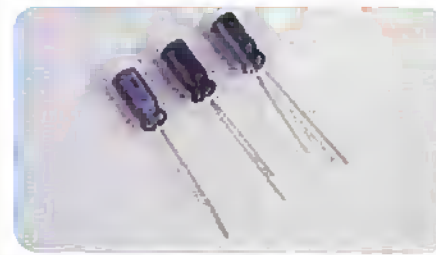
Specifications:

Power Rating	5W
Resistance Tolerance	±5%
Temperature Co-eff	300ppm / °C (max)
Max Working Voltage	350V
Operating Temperature	-55 to 275 °C

Order Code	Type	Price each inc VAT New Catalogue Price
FK00J	5CM5 3R3	£0.5
FK00K	5CM5 4R7	£0.5
FK00L	5CM5 10R	£0.5
FK01M	5CM5 22R	£0.5
FK02N	5CM5 33R	£0.5
FK03P	5CM5 47R	£0.5
FK04Q	5CM5 100R	£0.5
FK05R	5CM5 220R	£0.5
FK06S	5CM5 330R	£0.5
FK07T	5CM5 470R	£0.5
FK08U	5CM5 1K	£0.5
FK09V	5CM5 2K2	£0.5
FK20W	5CM5 3K3	£0.5
FK21X	5CM5 4K7	£0.5
FK22Y	5CM5 10K	£0.5

Wide Temperature Range Electrolytics

Samwha



★ *Wide operating temperature range*
★ *Cleaning and solvent proof below 200V*
★ *Manufacured to ISO9001 standard*
★ *General purpose*

A range of general purpose, wide temperature range miniature aluminium electrolytic capacitors

Specifications:

Operating temperature	-55 to 105°C @<100V -40 to 105°C @<250V -25 to 105°C @<450V
Leakage I @<100V	0.01CV or 4μA (greater)
Leakage I @>100V	0.02CV+15μA (>5 mins)
Capacitance tolerance	±20% 0.5" Pitch

Order Code	Type	Price each inc VAT New Catalogue Price
UE52G	105C Rad 1μF 100V	£0.13
UE53H	Rad 2.2μF 100V	£0.13
UE54J	Rad 3.3μF 100V	£0.13
UE55K	Rad 4.7μF 100V	£0.13
UE56L	Rad 6.8μF 100V	£0.13
UE57M	Rad 10μF 100V	£0.13
UE58N	Rad 22μF 100V	£0.3
UE59P	Rad 33μF 63V	£0.15
UE60Q	Rad 47μF 63V	£0.25
UE61R	Rad 100μF 63V	£0.42
UE62S	Rad 220μF 50V	£0.69
UE63T	Rad 470μF 63V	£1.14
UE64U	Rad 1000μF 25V	£1.08
UE65V	Rad 2200μF 25V	£2.05
UE66W	Rad 3300μF 16V	£1.65
UE67X	Rad 4700μF 16V	£2.5
UE68Y	Rad 6800μF 16V	£4.01
UE69A	Rad 10000μF 10V	£3.76

Low Cost Multimeter

★ *Volts (AC & DC), Current and Resistance ranges*
★ *Battery test*
★ *9 testing ranges*
★ *5 functions*
★ *Complete with battery, instructions and test leads*

This product gives exceptional value for money. A multimeter offering features you would

expect on one at three times the price. This instrument is a compact yet reliable meter that is ideal for hobbyists and students or the occasional DIY hobbyist who wants a digital multimeter in their toolbox for peace of mind.

Specifications:

AC Volts	20/200 (V)
DC Volts	500V
AC/DC Current	200mA/10A
Resistance	2kΩ/2MΩ
Battery Test (10mA load current)	1.5V/9V
Power	9V (PP3)
Weight (excluding battery)	170g

Order Code	Type	Price each inc.VAT New Catalogue Price	Offer Price
VQ61R	Budget Multimeter	£7.99	£5.99

Tantalum

AVX

A range of high quality tantalum capacitors in a 5mm pitch package. Capacitors in the range are available in values from 1µF to 100µF and in working voltages from 6.3V to 35V

Specifications:

Capacitance Tolerance	±20%
Pitch	5mm

Order Code	Type	Price each inc.VAT New Catalogue Price
FY11N	Tant 0.1µF 63V	£0.25
FY12F	Tant 1.0µF 6.3V	£0.30
FY13Q	Tant 1.0µF 6.3V	£0.62
FY15R	Tant 100µF 6.3V	£1.43
FY25S	Tant 1.5µF 10V	£0.41
FY26H	Tant 100µF 10V	£2.43
FY27J	Tant 2.2µF 10V	£0.25
FY27K	Tant 4.7µF 10V	£0.30
FY27L	Tant 6.8µF 10V	£0.54
FY28B	Tant 10µF 10V	£0.43
FY61C	Tant 22µF 10V	£0.62
FY62D	Tant 33µF 10V	£0.62
FY63E	Tant 47µF 10V	£1.72
FY64F	Tant 68µF 10V	£2.81
FY65G	Tant 2.2µF 25V	£0.23
FY26T	Tant 3.3µF 25V	£0.30
FY67U	Tant 4.7µF 25V	£0.34
FY68V	Tant 6.8µF 25V	£0.41
FY69W	Tant 10µF 25V	£0.43
FY70X	Tant 15µF 25V	£0.62
FY71Y	Tant 22µF 25V	£1.43
FY72A	Tant 33µF 25V	£1.72
FY73B	Tant 1µF 35V	£0.23
FY74C	Tant 1.5µF 35V	£0.23
FY75D	Tant 2.2µF 35V	£0.30
FY76E	Tant 3.3µF 35V	£0.34
FY77F	Tant 4.7µF 35V	£0.45
FY78G	Tant 10µF 35V	£0.62

SMD Tantalum

Kemet

- ★ *Industrial grade*
- ★ *Surface mount tantalum*
- ★ *For automatic insertion*
- ★ *Meets or exceeds EIA*
- ★ *Standard 535BAAC*
- ★ *Operating Temperature -55 to 85 °C and up to 125°C at reduced voltage*
- ★ *Ideal for telecommunications equipment, computer and portable equipment*

A range of surface mount tantalum capacitors available in capacitance values from 0.47µF to 33µF and in voltage ratings from 16V to 35V

Specifications:

Tolerance	±20%
Case Size (L,W,H):	
UE70M,UE74R	3.2 x 1.6 x 1.6 (mm)
UE76H,UE78K,UE80B	6.0 x 3.2 x 2.5 (mm)
UE77J,UE79L	7.3 x 4.3 x 2.8 (mm)
All others	3.5 x 2.8 x 1.9 (mm)

Order Code	Type	Price each inc.VAT New Catalogue Price
UE70M	SMD Tant 1µF 16V	£0.42
UE74R	SMD Tant 4.7µF 16V	£0.56
UE77J	SMD Tant 33µF 16V	£0.56
UE73Q	SMD Tant 2.2µF 16V	£0.56
UE74R	SMD Tant 4.7µF 25V	£0.51
UE70S	SMD Tant 1µF 35V	£0.56
UE76H	SMD Tant 10µF 16V	£0.62
UE77J	SMD Tant 33µF 16V	£1.25
UE78K	SMD Tant 47µF 25V	£0.22
UE79L	SMD Tant 10µF 25V	£1.29
UE80B	SMD Tant 22µF 25V	£0.89

0.4W Metal Film Resistors

Phillips

The popular MRS16T, 0.4W metal film resistor series from Phillips.

Specifications:

Tolerance	1%
Power Rating	0.4W
Voltage Rating	200V
Operating Temperature	-55 - +155 °C
Temperature Coefficient	±50ppm / °C
Dimensions	L 3.7mm
	Dia 1.9mm

Order Code	Type	Price each inc.VAT New Catalogue Price
TX00A	MRS16T-10R	£0.07
TX01B	MRS16T-15R	£0.07
TX02C	MRS16T-22R	£0.07
TX03D	MRS16T-33R	£0.07
TX04E	MRS16T-47R	£0.07
TX05F	MRS16T-68R	£0.07
TX06G	MRS16T-82R	£0.07
TX07H	MRS16T-82R	£0.07
TX08J	MRS16T-100R	£0.07
TX09K	MRS16T-120R	£0.07
TX0L	MRS16T-150R	£0.07
TX11M	MRS16T-180R	£0.07
TX12N	MRS16T-220R	£0.07
TX13P	MRS16T-270R	£0.07
TX14Q	MRS16T-330R	£0.07
TX15R	MRS16T-390R	£0.07
TX16S	MRS16T-470R	£0.07
TX17T	MRS16T-560R	£0.07
TX18U	MRS16T-680R	£0.07
TX19V	MRS16T-820R	£0.07
TX20W	MRS16T-1K	£0.07
TX21X	MRS16T-1K2	£0.07
TX22Y	MRS16T-1K5	£0.07
TX23A	MRS16T-1K8	£0.07
TX24B	MRS16T-2K2	£0.07
TX25C	MRS16T-2K7	£0.07
TX26D	MRS16T-3K3	£0.07
TX27E	MRS16T-3K9	£0.07
TX28F	MRS16T-4K7	£0.07
TX29G	MRS16T-5K6	£0.07
TX30H	MRS16T-6K8	£0.07
TX31J	MRS16T-8K2	£0.07
TX32K	MRS16T-10K	£0.07
TX33L	MRS16T-12K	£0.07
TX34M	MRS16T-15K	£0.07
TX35N	MRS16T-18K	£0.07
TX36P	MRS16T-22K	£0.07
TX37S	MRS16T-27K	£0.07
TX38R	MRS16T-33K	£0.07
TX39N	MRS16T-39K	£0.07
TX40T	MRS16T-47K	£0.07
TX41U	MRS16T-56K	£0.07
TX42V	MRS16T-68K	£0.07
TX43W	MRS16T-82K	£0.07
TX44X	MRS16T-100K	£0.07
TX45Y	MRS16T-120K	£0.07
TX46A	MRS16T-150K	£0.07
TX47B	MRS16T-180K	£0.07
TX48C	MRS16T-220K	£0.07
TX49D	MRS16T-270K	£0.07
TX50E	MRS16T-330K	£0.07
TX51F	MRS16T-390K	£0.07
TX52G	MRS16T-470K	£0.07
TX53H	MRS16T-560K	£0.07
TX54J	MRS16T-680K	£0.07
TX55K	MRS16T-820K	£0.07
TX56L	MRS16T-1M	£0.07

0.6W Metal Film Resistors

Phillips

The popular MRS25, 0.6W metal film resistor series from Phillips.

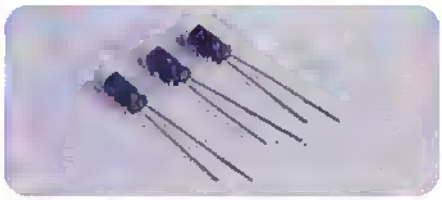
Specifications:

Power Rating	0.6W
Voltage Rating	200V
Operating Temperature	-55 - +155 °C
Temperature Coefficient	±50ppm / °C
Dimensions	L 7mm
	Dia 2.5mm

Order Code	Type	Price each inc.VAT New Catalogue Price
TY00A	MRS25-10R	£0.06
TY01B	MRS25-15R	£0.06
TY02C	MRS25-22R	£0.06
TY03D	MRS25-33R	£0.06
TY04E	MRS25-47R	£0.06
TY05F	MRS25-56R	£0.06
TY06G	MRS25-68R	£0.06
TY07H	MRS25-82R	£0.06
TY08J	MRS25-100R	£0.06
TY09K	MRS25-120R	£0.06
TY10L	MRS25-150R	£0.06
TY11M	MRS25-180R	£0.06
TY12N	MRS25-220R	£0.06
TY13P	MRS25-270R	£0.06
TY14Q	MRS25-330R	£0.06
TY15R	MRS25-390R	£0.06
TY16S	MRS25-470R	£0.06
TY17T	MRS25-560R	£0.06
TY18U	MRS25-680R	£0.06
TY19V	MRS25-820R	£0.06
TY20W	MRS25-1K	£0.06
TY21X	MRS25-1K2	£0.06
TY22Y	MRS25-1K5	£0.06
TY23A	MRS25-1K8	£0.06
TY24B	MRS25-2K2	£0.06
TY25C	MRS25-2K7	£0.06
TY26D	MRS25-3K3	£0.06
TY27E	MRS25-3K9	£0.06
TY28F	MRS25-4K7	£0.06
TY29G	MRS25-5K6	£0.06
TY30H	MRS25-6K8	£0.06
TY31J	MRS25-8K2	£0.06
TY32K	MRS25-10K	£0.06
TY33L	MRS25-12K	£0.06
TY34M	MRS25-15K	£0.06
TY35N	MRS25-18K	£0.06
TY36P	MRS25-22K	£0.06
TY37S	MRS25-27K	£0.06
TY38R	MRS25-33K	£0.06
TY39N	MRS25-39K	£0.06
TY40T	MRS25-47K	£0.06
TY41U	MRS25-56K	£0.06
TY42V	MRS25-68K	£0.06
TY43W	MRS25-82K	£0.06
TY44X	MRS25-100K	£0.06
TY45Y	MRS25-120K	£0.06
TY46A	MRS25-150K	£0.06
TY47B	MRS25-180K	£0.06
TY48C	MRS25-220K	£0.06
TY49D	MRS25-270K	£0.06
TY50E	MRS25-330K	£0.06
TY51F	MRS25-390K	£0.06
TY52G	MRS25-470K	£0.06
TY53H	MRS25-560K	£0.06
TY54J	MRS25-680K	£0.06
TY55K	MRS25-820K	£0.06
TY56L	MRS25-1M	£0.06

Miniature Aluminium Electrolytic Capacitors

Samwha



★ *Super miniature series with 7mm height*
★ *Suited for use in compact audio equipment*

A range of very high quality, 85°C rated, miniature aluminium electrolytic capacitors

Specifications:

Operating temp	-40 to +85°C
Leakage I (max)	0.01CV or 4μA (the greater)
Tolerance	±20%

Maplin Part Numbers	Dimensions (dia x length)
TY84F - TY89W, TY91Y, TY95D, TY96E	4 x 7 mm
TY90X, TY92A, TY97F	5 x 7 mm
All others	6.3 x 7 mm

Order Code	Type	Price each inc VAT New Catalogue Price
TY84F	7mm Rad 1μF 50V	£0.17
TY85G	7mm Rad 4.7μF 50V	£0.17
TY86T	7mm Rad 10μF 50V	£0.17
TY87U	7mm Rad 22μF 50V	£0.17
TY88V	7mm Rad 47μF 25V	£0.17
TY89W	7mm Rad 10μF 35V	£0.17
TY90X	7mm Rad 100μF 50V	£0.19
TY91Y	7mm Rad 22μF 16V	£0.17
TY92A	7mm Rad 47μF 16V	£0.19
TY93B	7mm Rad 100μF 16V	£0.20
TY94C	7mm Rad 220μF 10V	£0.21
TY95D	7mm Rad 22μF 63V	£0.20
TY96E	7mm Rad 22μF 63V	£0.20
TY97F	7mm Rad 47μF 25V	£0.20

Universal 2 Hour Fast Charger

Unross

★ *LED charging indicators*
★ *Reverse polarity protection*
★ *Rapid two hour charge time*

This Nickel Cadmium (NiCd) battery charger, designed for use with PP3, AAA, AA, C and D cells, makes use of a two stage charge cycle. When used with higher capacity batteries, using the red push switch enables the very fast two hour charge cycle which bulk charges for two hours before switching to a low current charge state.

Cell Type	Charging Time Standard Capacity	High Capacity
PP3	14-16Hrs	14-16Hrs
AAA	4-5Hrs	5-7Hrs
AA	10-12Hrs	2 or 14Hrs
C	10-12Hrs	2 or 14Hrs
D	10-12Hrs	2 or 14Hrs

Order Code	Type	Price each inc VAT New Catalogue Price	Offer Price
PL45A	2/4 NiCd Charger	£14.99	£9.99

In-Line Connector

A metal barrel adaptor for connecting two phono plugs together. Also available in a gold plated version.

Order Code	Type	Price each inc VAT New Catalogue Price
PL45M	Gold Phono Coupler	£1.99

Plug Top SMPS AC/DC Adaptors

★ *High power in a plug-top box!*
★ *High quality construction*
★ *Low cost compared to linear alternative*
★ *Level B EMI filter*

These high quality switched mode power supplies are available in 6 variants. Each is suitable for a wide range of input voltages and features a short circuit protection system with auto recovery. Conforms to UL1950, CSA22.2 No.950 and EN60950.

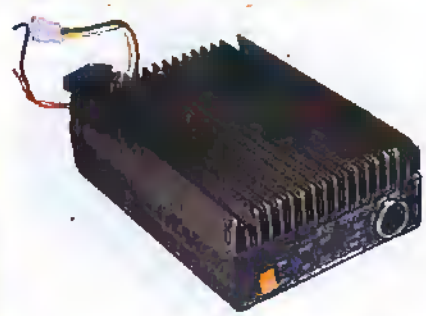
Specifications:

Output Voltage Tolerance	5%
Input Voltage:	90-264VAC
Operating temperature:	0°C to +40°C ambient
Ripple/noise(Vp-p)	1% (20MHz bandwidth)

Order Code	Manufacturers Part No.	Output Voltage	Output Current	Max. Output Voltage
PL61R	BPA-201S-5	5V	2.0A	6.5V
PL62S	BPA-201S-7	7.5V	2.0A	9V
PL63T	BPA-201S-12	12V	1.5A	15-17V
PL64U	BPA-201S-15	15V	1.2A	17-19V
PL65V	BPA-201S-18	18V	1.1A	20-22V
PL66W	BPA-201S-24	24V	0.8A	26-28V

Order Code	Type	Price each inc VAT New Catalogue Price
PL61R	Plug Top SMPS 5V 2.5A	£14.99
PL62S	Plug top SMPS 7V 1.67A	£14.99
PL63T	Plug top SMPS 12V 1.25A	£14.99
PL64U	Plug top SMPS 15V 1.2A	£14.99
PL65V	Plug top SMPS 12V/18V 0.83A	£14.99
PL66W	Plug top SMPS 24V 0.63A	£14.99

24V to 13.8V Convertor



★ *Use your 12V equipment in a truck, boat or other 24V system!*
★ *A hefty 15A current rating*

This sturdy 13.8V convertor makes use of switched mode technology to reduce 18 to 36VDC to 13.8VDC. This method of conversion avoids the need for large heatsinks commonly associated with voltage 'droppers'.

Specifications:

Input Voltage:	18 to 36VDC
Output:	13.8VDC, 15A (50% duty cycle)
Ripple/noise:	≤.05%RMS Continuous load
Operating temp.	0°C to +50°C
Dimensions:	140 x 65 x 200mm

Order Code	Type	Price each inc VAT New Catalogue Price
PL27K	24V to 13.8V Convertor	£49.99

True Sine Wave Inverter

★ *Ideal for use with difficult loads!*
★ *International style power outlet*

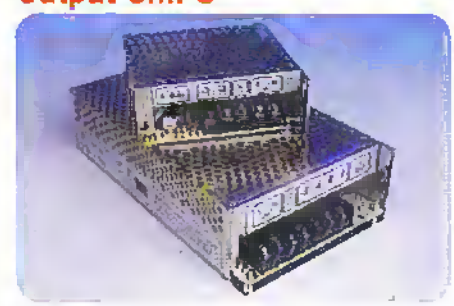
This range of true sine inverters are ideal for use on equipment where the modified sine just doesn't cut the mustard. Ideal for use with televisions, control electronics and other sensitive equipment.

Specifications:

THD	<4%
Protection systems	Low battery Over temperature
Operating temp.	-15° to +50°C
No load power consumption	<4W

Order Code	Type	Price each inc VAT New Catalogue Price
PL25K	Sine Inv. 150W	£149.99
PL26L	Sine Inv. 300W	£199.99
PL28B	Sine Inv. 300W 24V	£199.99

Universal Input, Single Output SMPS



★ *Wide range of power outputs available*
★ *International AC input range*
★ *Built in EMI filter, low ripple noise*
★ *Short circuit, overload and over voltage protected*

This range of switched mode power supplies offers exceptional value for money coupled with excellent reliability. Please consult the full data sheets included on the data CD-ROM for full details of these power supplies.

General Specifications:

Input voltage	85 to 264VAC
Operating temp.	-10°C to +60°C

25W Versions:

DC Output voltage:	5V	12V	24V
Output current:	5A	2.1A	1.1A
Ripple/noise(mVp-p)	50	100	100
Dimensions(mm):		99x97x35	
Weight:		0.37Kg	

40W Versions:

DC Output voltage:	5V	12V	24V
Output current:	8A	3.5A	1.8A
Ripple/noise(mVp-p)	75	100	100
Dimensions(mm):		129x98x38	
Weight:		0.45Kg	

60W Versions:

DC Output voltage:	5V	12V	24V
Output current:	12A	5A	2.5A
Ripple/noise(mVp-p)	50	100	100
Dimensions(mm):		159x97x38	
Weight:		0.55Kg	

100W Versions:

DC Output voltage:	5V	12V	24V
Output current:	20A	8.5A	4.5A
Ripple/noise(mVp-p)	100	125	150
Dimensions(mm):		199x98x38	
Weight:		0.65Kg	

150W Versions:

DC Output voltage:	5V	12V	24V
Output current:	30A	12.5A	6.5A
Ripple/noise(mVp-p)	100	120	150
Dimensions(mm):		199x110x50	
Weight:		0.8Kg	

240W Versions:

DC Output voltage:	5V	12V	24V
Output current:	40A	18A	10A
Ripple/noise(mVp-p)	100	120	180
Fan control	<40°C Fan ON >70°C Shut down		
Dimensions(mm):		190x93x65	
Weight:		1.1Kg	

Order Code	Type	Price each inc VAT New Catalogue Price
PM25A	Ind. 25Watt PSU 5V	£44.99
PM25B	Ind. 25Watt PSU 12V	£44.99
PM25C	Ind. 25Watt PSU 24V	£44.99
PM40D	Ind. 40Watt PSU 5V	£54.99
PM40E	Ind. 40Watt PSU 12V	£54.99
PM40F	Ind. 40Watt PSU 24V	£54.99
PM60G	Ind. 60Watt PSU 5V	£69.99
PM60H	Ind. 60Watt PSU 12V	£69.99
PM60J	Ind. 60Watt PSU 24V	£69.99
PM80K	Ind. 100Watt PSU 5V	£74.99
PM80L	Ind. 100Watt PSU 12V	£74.99
PM80M	Ind. 100Watt PSU 24V	£74.99
PM85Q	Ind. 150Watt PSU 5V	£99.99
PM85P	Ind. 150Watt PSU 12V	£99.99
PM85S	Ind. 150Watt PSU 24V	£99.99
PM85R	Ind. 240Watt PSU 5V	£154.99
PM85N	Ind. 240Watt PSU 12V	£154.99
PM85T	Ind. 240Watt PSU 24V	£154.99

Striped PSU Boxes with Plug

- ***Attractively styled***
- ***Large box features ventilation slots***
- ***Brass Earth pin***

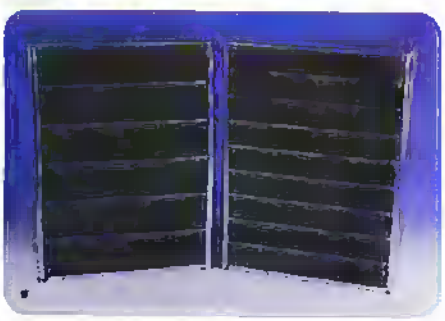
These attractively styled boxes are shown in more detail on the data CD-ROM.

	Large	Small
Order Code	PN60B	PN79L
Dimensions (excl. pins)	47.7x104x61	47.7x104x61

Order Code	Type	Price each inc VAT New Catalogue Price
PN79L	Sm Striped PSU Case	£2.49
PN60B	Lrg Striped PSU Case	£2.99

Anti Static Drawer Cabinets

Raaco



- ***Safe storage of sensitive components!***

These 18 and 36 drawer cabinets are ideal for the safe storage of static sensitive devices. Supplied complete with grounding leads, these cabinets feature steel construction and conductive drawers. Static safe dividers for these drawers are also available.

	18 Drawer	36 Drawer
Order code	PM03D	PM02C
Dimensions Overall	420 x 307 x 150	420 x 307 x 150
Each drawer	57 x 87 x 135	35 x 64 x 135
Dividers	PM05F (24pack)	PM04E (48 pack)

Order Code	Type	Price each inc VAT New Catalogue Price
PM02C	36 Drawer ESD Safe Cabinet	£78.75
PM03D	18 Drawer ESD Safe Cabinet	£78.75
PM04E	Dividers Type A x 48	£2.49
PM05F	Dividers Type C x 24	£2.49

Speakon Connector - 2 Pole

Neutrik

- ***2 Pole version of popular Neutrik Speakon connector***
- ***Positive keying and latching***
- ***Cable connector (NL2FC) mates with 4 pole male connector (NL4MP)***

A rugged 2 pole connector ideal for portable applications, audio or otherwise.

Maplin Code	Neutrik Part. Number	Gender	Mounting Method
PM16S	NL2MP	Male	Chassis
PM17T	NL2FC	Female	Cable

Specifications:

Rated current	20A (continuous) 40A (1 minute)
Rated voltage	250Vac
Max wire size	4mm²

Order Code	Type	Price each inc VAT New Catalogue Price
PM16S	Speakon 2pole Male	£2.79
PM17T	Speakon 2pole Fem	£3.99

Tappet Plug-in Timeswitch

Timeguard

- ***Simple to program***
- ***6 on & 6 off tappets supplied***
- ***Compact design***
- ***Manual overide facility***
- ***Controls electrical appliances up to 3kW (13A)***

These easy to program plug-in timeswitches, in either 24 hour or 7 day variants, are easily set via the use of simple plug in tappets. Three red and three blue tappets are supplied fitted and three of each colour supplied separately.

Specifications:

	24 hour	7 day
Min switching interval	15 mins	2hours
Operating voltage	230Vac	
Contact rating	13A (resistive) 4A (inductive)	
Operating temperature	0°C to 40°C	

Order Code	Type	Price each inc VAT New Catalogue Price
PM48C	24hr Tappet T Switch	£9.99
PM49T	7day Tappet T Switch	£11.99

Space Saving Coin Cell Holders

- ***PCB space saving design***
- ***UL94V-0 rated***

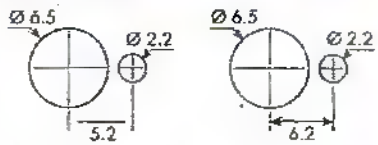
Save valuable PCB space with these 20mm diameter coin cell holders. Available in vertical and 'top loading' versions these holders will accept the popular CR2025 and CR2032 cells.

Order Code	Type	Price each inc VAT New Catalogue Price
PM54J	Coin Cell Hldr 20mm Vertical	£1.49
PM55K	Coin Cell Hldr 20mm Compact	£1.99

5600 Series Toggle Switches

Apem

Panel Cut - Out



Standard locking Ring — Special Locking Ring

A range of high quality toggle switches available with either round or flat levers. A special locking ring is available in bags of 10 to provide an alternative hole mounting combination.

Specifications:

Body dims.(mm)		h	w	d
	SPDT	12.0	7.0	13.2
	DPDT	12.0	12.0	13.2
	3PDT	13.0	16.5	13.2
	4PDT	13.0	21.2	13.2

Bush length(mm):	8.0
Lever(mm):	10.5 (round type) 11.6 (flat type)
Contact resistance:	<10mΩ
Contact material:	Silver
Contact Rating:	3A@250VAC, 6A@125VAC, 4A@30VDC
Contact bounce:	2mS Max.
Mechanical life:	100,000 operations
Electrical life:	50,000 single and double pole 40,000 3 pole 30,000 4 pole

Order Code	Type	Price each inc VAT New Catalogue Price
PM62S	Std Tog SPDT	£1.45
PM63T	Std Tog SPDT CENTRE OFF	£1.69
PM64U	Std Tog DPDT	£2.19
PM65V	Std Tog DPDT CENTRE OFF	£2.19
PM66W	Std Tog 3PDT	£4.29
PM67X	Std Tog 4PDT	£5.69
PM68Y	SPECIAL LOCKING RING (10 pack)	£1.69
PM69E	Flt Tog SP ON MOM	£2.99
PM69F	Flt Tog SP ON ON	£2.19
PM69G	Flt Tog SP ON OFF MOM	£2.69
PM69T	Flt Tog SP ON OFF ON	£2.69
PM70U	Flt Tog DP ON MOM	£3.69
PM70V	Flt Tog DP ON ON	£2.79
PM70W	Flt Tog DP ON OFF MOM	£3.99
PM70X	Flt Tog DP ON OFF ON	£3.29
PM70Y	Flt Tog 3P ON ON	£4.79
PM70A	Flt Tog 3P ON OFF ON	£5.39
PM55S	Flt Tog 4P ON ON	£5.29
PM54C	Flt Tog 4P ON OFF ON	£6.29

IP67 Sealed Toggle Switch

Apem

This high quality range of toggle switches are sealed to IP67 to withstand all but the harshest environments.

Specifications:

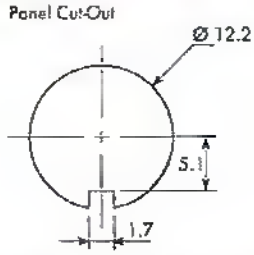
Contact rating	12A@28VDC, 6A@250VAC
Contact material	Silver
Electrical life	10,000 cycles@full load
Operating temp.	-40°C to +85°C
Body dims.	24.6(H) x 21.5(W) x 35(L)
Bush dims.	10.5(L)
Lever dims.	17.5(L)

Order Code	Type	Price each inc VAT New Catalogue Price
FM65D	IP67 Tog SPST	£8.52
FM65E	IP67 Tog SPDT	£9.99
FM67F	IP67 Tog DPST	£11.99
FM68G	IP67 Tog DPDT	£12.15

15A Toggle Switches

Apem

Panel Cut-Out



These high quality, heavy duty switches are available in plastic and metal lever versions. Approvals include UL and CSA.

Specifications:

Contact rating	15A@250VAC(latching types) 10A@250VAC(momentary types)
Body dims.	SP: 15.0(H)x14.0(W)x29.5(L) DP: 21.4(H)x21.5(W)x29.7(L)
Bush dims.	Metal: 10.5(L)x12.0(dia) Plastic: 11.5(l)x12.9(dia)
Lever dims.	Metal: 17.5(L) Plastic: 13.5(L)

Order Code	Type	Price each inc VAT New Catalogue Price
FM69H	15A Tog Plas SPST	£2.39
FM69A	15A Tog Plas SPDT	£2.99
FM61B	15A Tog Plas SPDT CENTRE OFF	£2.95
FM62C	15A Tog Plas DPST	£4.25
FM63D	15A Tog Plas DPDT	£5.15
FM64E	15A Tog Plas DPDT CENTRE OFF	£5.15
FM65F	15A Tog Mtl SPST	£2.15
FM66G	15A Tog Mtl SPDT ON/MOM	£3.95
FM67H	15A Tog Mtl SPDT	£2.55
FM68J	15A Tog Mtl SPDT CENTRE OFF	£2.79
FM69K	15A Tog Mtl DPST	£3.95
FM70L	15A Tog Mtl DPDT	£4.49
FM71M	15A Tog Mtl DPDT CENTRE OFF	£4.99

Vandal Resistant 16mm Switches

Apem

- ★ *Standard 16.2mm fixing hole*
- ★ *Sealed to IP65*
- ★ *Screw terminals*
- ★ *Stainles steel construction*

These hardy vandal resistant switches are sealed to IP65 for internal and sheltered external applications.

Specifications:

Contact rating	48VDC 200mA
Operating temp.	-20°C to +55°C

Order Code	Type	Price each inc VAT New Catalogue Price
FM65F	16mm A Vandal Ord	£5.99
FM65G	16mm A Vandal Pr	£5.99
FM65H	16mm A Vandal Ord Recessed	£5.99

Labelling Machine - PT300SP

Brother

- ★ *Low cost Label Printer using laminated tape*
- ★ *Desk Top Design*
- ★ *300 character memory*
- ★ *Underline & box printing*
- ★ *4 Character LCD*
- ★ *Accepts 6, 9, 12 and 18mm laminated tape*

This label printer offers the advantages of printing on laminated tape at a competitive price. Labels can be printed in six different font sizes on four different tape sizes.

For replacement/additional tapes in varying sizes and colours SEE ACCOMPANYING LIST.

Specifications:

Dimensions	174mm (W) x 200mm (D) x 50mm (H)
Weight	0.65Kg

Order Code	Type	Price each inc VAT New Catalogue Price
FM45Y	PT300SP Labelling Machine	£99.99

Label Printer for PC use - PT-9200PC

Brother

- ★ *Plug and Print technology*
- ★ *Windows 95 and NT4.0 compatible*
- ★ *Icon based graphic user interface gives WYSIWYG view of labels*
- ★ *Processes and prints scanned originals; logos, picures & graphics.*
- ★ *Prints up to 11 lines of text*
- ★ *Built in Bar Code facility*
- ★ *Accepts 6,9,12,18,24 &36mm laminated tapes*
- ★ *Supplied with CD-ROM, Power Cable, Interface Cable, User Guide, One Tape Cassette*

This compact label printer is easily attached to your PC to allow printing of labels utilizing easy to install software.

The software allows label creation using text, graphics and pictures, which can be taken from scanned orininals. Re-creation of company logos, pictures and diagrams is therefore easy to incorporate in to your labels.

PC System Requirements

PC:	IBM compatibe CD-ROM drive operating Windows 95/98 or NT4.0. Approx 20Mb of hard disc space
Monitor:	VGA or higher graphics card

Specifications:

Built if fonts	Helsinki, Brussels & Bermuda
Bar Code Fonts	CODE39, CODE128, EAN8, EAN13, EAN128, CODABAR, I2/5, UPC-A & UPC-E
Dimensions	110mm (W) x 250mm (L) x140mm (H)

Order Code	Type	Price each inc VAT New Catalogue Price
FM65A	Label Mch - PT9200PC	£299.99

Label Printer - Full QWERTY Keyboard

Brother

- ★ *Full size QWERTY keyboard*
- ★ *WYSIWYG display*
- ★ *Prints up to 10 lines of text*
- ★ *Integrated graphics function allows easy layout creation*
- ★ *Horizontal & vertical printing*
- ★ *10 Built in fonts, freely combinable*
- ★ *16 font styles, freely combinable*
- ★ *PC connectivity for Windows 95 & NT4.0*
- ★ *Integrated graphics function allows incorporation of logos, graphics & pictures into labels*
- ★ *Accepts 6,9,12,18,24 & 36mm laminated tapes*

This label printer with full size QWERTY keyboard can be used in conjunction with a PC (software included) or as a stand alone unit. The full size keyboard and LCD make label design simple and quick.

Advanced features include:

Automatic currency calculation
Up to 99 multiple print outs.
Mirror image printing for labels on glass
Automatic numbering function

PC System requirement:

PC	IBM compatible CD-ROM drive Windows 95/98 or NT4.0 Approx 20Mb free hard disk space
Monitor	VGA or higher graphics card

Specifications:

Built if fonts	Helsinki, Brussels & Bermuda
Bar Code Fonts	CODE39, CODE128, EAN8, EAN13, EAN128, CODABAR, I2/5, UPC-A & UPC-E.

Order Code	Type	Price each inc VAT New Catalogue Price
FM75	Label Mch - PT9400	£299.99

Security Tape for Brother Labelling Machines

Brother

- ★ *Ideal for marking high value or sensitive equipment*
- ★ *Tape leaves checkered pattern if removed from surface*
- ★ *Available in 18mm wide tape*
- ★ *For use with the following labelling machines:*
  PT305 (PN45), PT200 (MG92), PT220 (MG93), PT350 (MG94), PT550 (PJ65), PT9200-PC (PN46) and PT9400 (PN47)

Maplin Code	Brother Part Number
PN75	TZ-SE4

Order Code	Type	Price each inc VAT New Catalogue Price
FM75S	18mm Security Tape	£21.49

Tapes for Brother Labelling Machines

Brother

These laminated tapes are specifically designed for use with the Brother PT305 (PN45), PT200 (MG92), PT220 (MG93), PT350 (MG94), PT550 (PJ65), PT9200-PC (PN46) and PT9400 (PN47) labelling machines.

Brother's unique laminated labels are weatherproof, scratchproof and can endure temperatures from -50°C up to 300°C. They will even withstand sunlight, solvents and abrasives making them ideal for many industrial applications.

The following sizes and colours are available:

Maplin Code	Brother Code	Size	Colour
MJ11	TZ111	6mm	Black on Clear
MJ12	TZ121	9mm	Black on Clear
MJ14	TZ131	12mm	Black on Clear
MJ56	TZ141	18mm	Black on Clear
MK03	TZ151	24mm	Black on Clear
PJ79	TZ161	36mm	Black on Clear
MK04	TZ211	6mm	Black on White
MK05	TZ221	9mm	Black on White
MK06	TZ231	12mm	Black on White
PJ76	TZ-241	18mm	Black on White
PJ77	TZ251	24mm	Black on White
PJ80	TZ261	36mm	Black on White
PN61	TZ611	6mm	Black on Yellow
PN62	TZ621	9mm	Black on Yellow
MK09	TZ631	12mm	Black on Yellow
MK10	TZ641	18mm	Black on Yellow
PJ78	TZ651	24mm	Black on Yellow
PJ81	TZ661	36mm	Black on Yellow
PN63	TZ222	9mm	Red on White
MK07	TZ232	12mm	Red on White
PN64	TZ242	18mm	Red on White
PN65	TZ252	24mm	Red on White
PJ82	TZ262	36mm	Red on White
PN66	TZ223	9mm	Blue on White
MK08	TZ233	12mm	Blue on White
PN67	TZ243	18mm	Blue on White
PN68	TZ253	24mm	Blue on White
PJ83	TZ263	36mm	Blue on White
PN69	TZ123	9mm	Blue on Clear
MJ15	TZ133	12mm	Blue on Clear
PN70	TZ421	9mm	Black on Red
PN71	TZ431	12mm	Black on Red
PN72	TZ441	18mm	Black on Red
PN73	TZ721	9mm	Black on Green
PN74	TZ731	12mm	Black on Green
PN77	TZ-C31	12mm	Fluorescent Black on Yellow
PN78	TZ-C51	24mm	Fluorescent Black on Yellow

Order Code	Type	Price each Inc VAT New Catalogue Price
MJ11M	6mm Black on Clear	£13.99
MJ12N	9mm Black on Clear	£11.99
MJ14Q	12mm Black on Clear	£12.99
MJ56L	18mm Black on Clear	£15.49
MK03D	24mm Black on Clear	£19.99
PJ79L	36mm Black on Clear	£20.99
MK04E	6mm Black on White	£11.49
MK05F	9mm Black on White	£12.99
MK06G	12mm Black on White	£13.99
PJ76H	18mm Black on White	£17.99
PJ77J	24mm Black on White	£19.99
PJ80E	36mm Black on White	£22.49
PN61R	6mm Black on Yellow	£11.99
PN62S	9mm Black on Yellow	£12.99
MK09W	12mm Black on Yellow	£13.99
MK10L	18mm Black on Yellow	£17.99
PJ78X	24mm Black on Yellow	£19.99
PJ81D	36mm Black on Yellow	£22.49
PN63T	9mm Red on White	£12.99
MK07H	12mm Red on White	£13.99
PN64U	18mm Red on White	£17.99
PN65V	24mm Red on White	£19.99
PJ82G	36mm Red on White	£22.49
PN66W	9mm Blue on White	£11.99
MK08J	12mm Blue on White	£13.99
PN67Y	18mm Blue on White	£17.99
PN68Y	24mm Blue on White	£19.99
PJ83E	36mm Blue on White	£22.49
PN69S	9mm Blue on Clear	£11.99
MJ15R	12mm Blue on Clear	£12.99
PN70M	9mm Black on Red	£12.99
PN71K	12mm Black on Red	£13.99
PN72P	18mm Black on Red	£17.99
PN73Q	9mm Black on Green	£12.99
PN74R	12mm Black on Green	£13.99
PN77J	12mm Fluorescent 5Y	£15.49
PN78X	24mm Fluorescent 5Y	£22.49

Centre Conductor Cutter

Ideal

★ *Trims coax center conductor to 4.8mm length*
★ *Consistent, repeatable, results every time!*

Trims coax centre conductor to 4.8mm (3/16in.) length for proper installation into a dual crimp coax connector.

Order Code	Type	Price each Inc VAT New Catalogue Price
PZ140	Centre Cond Cutter	£10.45

USB Plugs

★ *Types A and B available*
★ *Nickel plated outer shield*
★ *UL94V-0 rated thermoplastic housing*

These solder type USB plugs feature gold plated contacts and strain relief fold-over clamp.

Order Code	Type	Price each Inc VAT New Catalogue Price
PN66T	USB A Plg	£0.69
PN67U	USB B Plg	£0.75

Alkaline Back up Battery

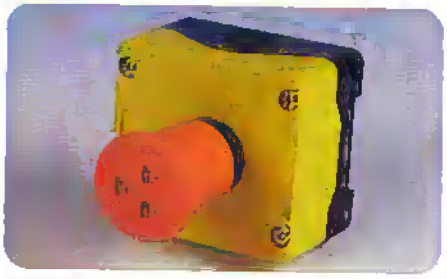
A non-rechargeable 4.5V alkaline battery for use in computers and other electronic equipment. Supplied with a self adhesive velcro pad and a 2 wire connector. Suitable for use with a wide range of Apple Macintosh, Performa and Quadra computers.

Dimensions: 31L x 26W x 20D

Order Code	Type	Price each Inc VAT New Catalogue Price
UD12N	Alkaline CMOS Battery	£9.99

Safety Twist to Release Emergency Stop Station

Camden



Two IP65 rated stop stations available with or without a visual status indicator. The positive break normally closed contact block is joined directly to the operator. Conforms to EN418, IEC947, VDE0660, UL and CSA approvals. Additionally the indicator version conforms to EN81.

Specifications:

Contact rating	6A 230VAC
Dimensions(mm)	80x73x102

Order Code	Type	Price each Inc VAT New Catalogue Price
UD11L	EM16E Stop	£15.49
UD11M	EM16E Stop + Ind	£16.75

Temperature Controlled Iron

Weller

★ *High power mains irons for heavy duty soldering!*
★ *Well balanced and lightweight handle*
★ *Supplied with long life tips*

A range of low-cost, portable, general-purpose soldering irons with automatic control of output and temperature. These well-balanced soldering irons feature lightweight thermoplastic handles, fully earthed, and comes with a long-life tip. Fitted with 1.3m of PVC mains lead (conforms to BS6500).. Spare tips and elements are available separately.

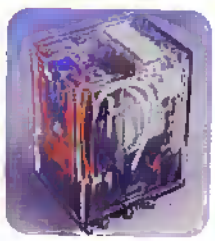
Order Code	Power Output	Weller Part No.	Supplied Tip
DF47B	60W	W60D	CT5DC7
UD31	100W	W100D	CT5E7
UD32	200W	W200D	CT2F7

Order Code	Type	Price each Inc VAT New Catalogue Price
DF47B	W60D	£49.99
UD31	Iron W100D	£61.99
UD32	Iron W200D	£74.49

5A 4PDT Relays with Idicators & Test Buttons

Omron

★ *Built in LED status indicator, test button and name plate!*



This range of general purpose plug in four pole relays, which feature contacts rated at 5A. With its Gold flashed silver contacts it is suitable for switching anything from 1mA to 5A which opens up a host of switching applications.

Specifications:

Rated load	5A, 30VDC 5A, 250VAC
Min Load	1mA, 5VDC
Max Switched Voltage	250VAC, 125VAC
Contact Resistance	≥50mΩ
Electrical life	200,000 ops (min)
Mechanical life	50,00,000 ops (min)
Max. Coil Voltage	110% Rated Voltage
Nominal Coil Power	0.9W/1.2VA
Operate time	20mS

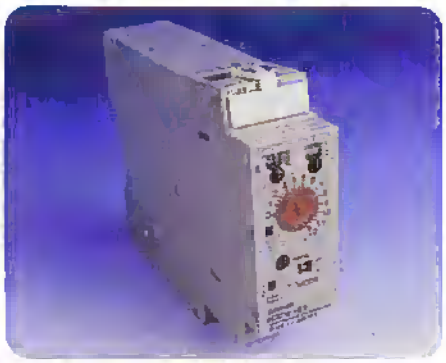
A sockets for these relays are also available.

Order Code	Omron Part Number	Description
UD53	PY11 PYF14AE	14 Pin Socket Standard
UD54	PY12 PYF14AN	14 Pin Socket Euro type
UD55	PY5 PYC-A1PAIR	Relay Sockets Clips

Order Code	Type	Price each Inc VAT New Catalogue Price
UD47B	4PCO 5A Rly 12VDC	£5.52
UD48C	4PCO 5A Rly 24VAC	£5.52
UD49D	4PCO 5A Rly 110VAC	£5.52
UD50E	4PCO 5A Rly 230VAC	£5.99
UD51F	4PCO 5A Rly 12VAC	£5.52
UD52G	4PCO 5A Rly 24VDC	£5.52
UD53H	14 Pin Soc Std	£4.55
UD54J	14 Pin Soc Euro	£4.55
UD55K	Rly Soc Clips	£0.49

DIN Rail Mounting Timers

Omron



★ *Timing controls and status LED on front of unit*
★ *Wide selection of operating modes available*
★ *Compact design - just 22.5mm wide!*

These versatile timers are available in four and eight mode variations in both single and double pole contact arrangements.

Operating modes

4 mode	A: On delay, B2: Recycling ON start, E: Interval, J: One shot.
8 mode	A: On delay, B Recycling OFF start, B2 Recycling ON start, C: Single ON/OFF delay, D: Single OFF delay, E: Interval, G: Signal ON/OFF delay, J: One shot delay.

Specifications:

Time range	0.12s-1.2S to 12Hr-120Hr
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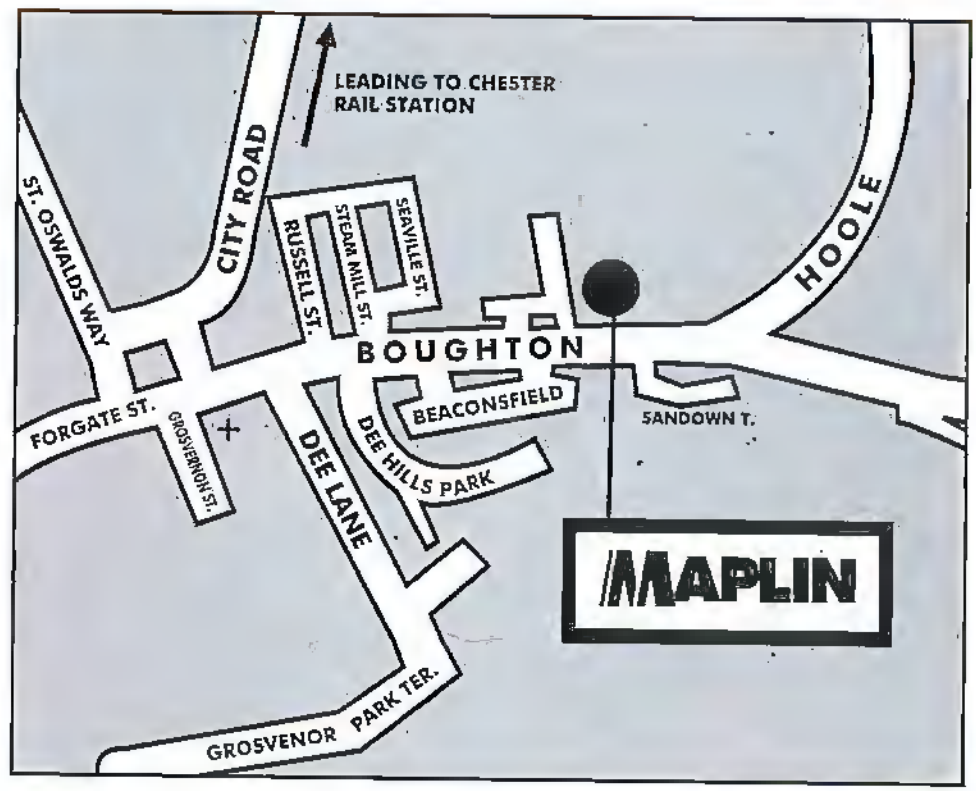

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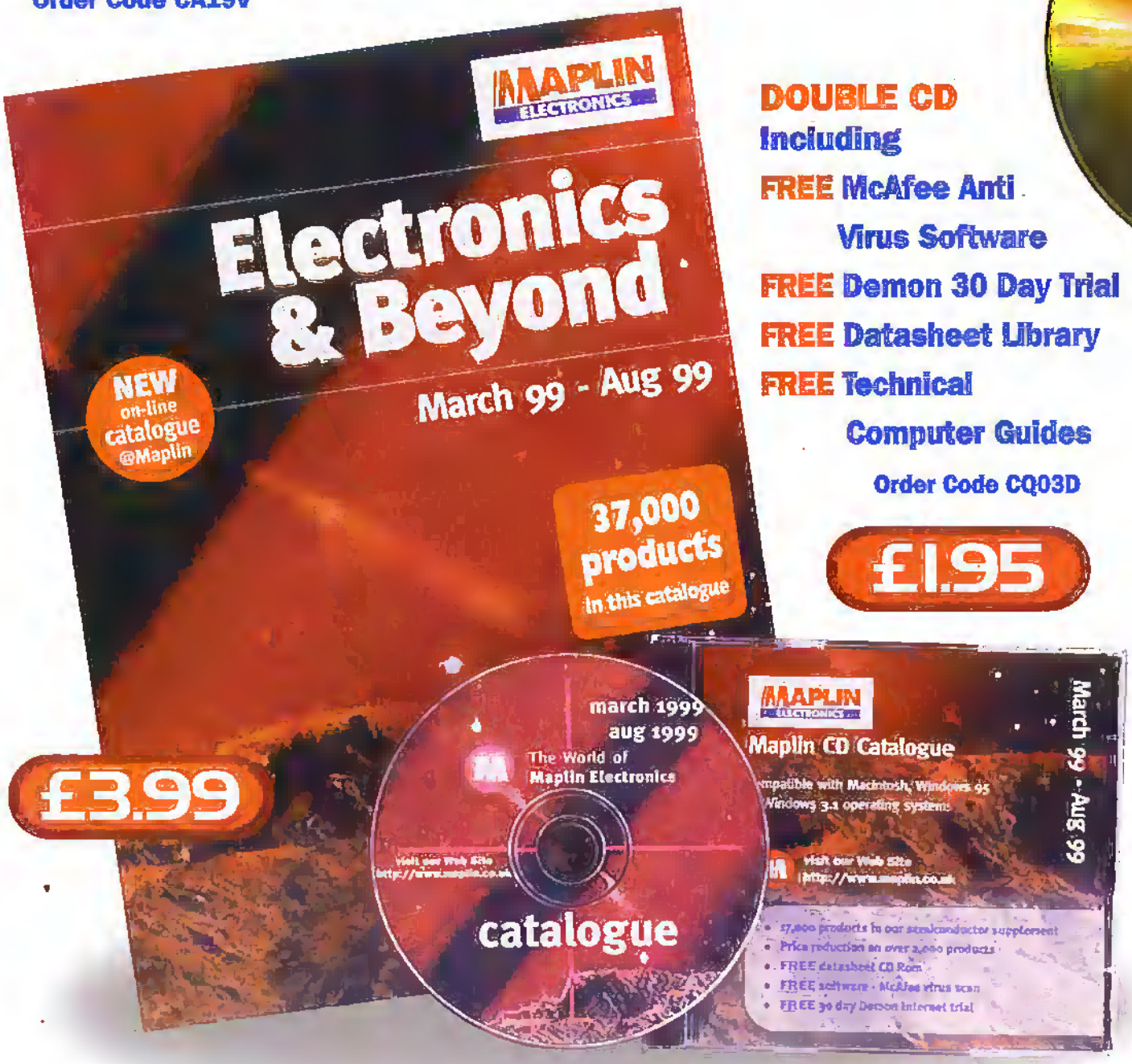

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Figure 2. Cliff Railway and Visitor Centre. (Courtesy The Centre for Alternative Technology)

The total project cost is about £544,000 of which over half has already been raised from corporate donations. The House of Lords launch on October 28th 1998 aims to develop the project profile and find further partners to raise the remaining capital figure. The AtEIC concept has been designed by Architect Pat Borer and Building Project Manager Cindy Harris.

CAT's development office Paul Allen outlines their current aims. "The Rio Summit, Agenda 21, the Kyoto conference and many other events around the world have alerted governments and local communities everywhere to the need for sustainable development. Now, the importance of showing the solutions as well as the problems is fully recognised. We all know our society will need to make important decisions on which technologies we shall use in the future. We have a crucial role this, seeking them out, proving which ones work- by actually living with them, then inspiring, informing and enabling people to set a new pattern by making the changes which will help us all move towards a more sustainable future."

The Centre for Alternative Technology, amongst others, has inspired hundreds and thousands of people to live a more environmental, sustainable lifestyle and has tested varied ecological building techniques. CAT opened to the public in 1975, and rapidly assumed the role as a unique pioneering demonstration centre illustrating practical solutions to many of the world's environmental problems. Now 20 years later, it is recognised as Europe's leading Eco-centre and has a highly qualified staff of around thirty environmentalists and over 100,000 visitors a year, including respected academic and governmental institutions. Many of the Centre's employees live on the site and depend to a large degree on the technologies displayed. The site has its own independent renewable electricity mainly from a combination of wind, water and solar power, as well as its own water supply. CAT treats its own sewage, returning nutrients to the soil as compost. Located in Mid Wales on the southern edge of the Snowdonia National Park CAT's unique visitor centre offers practical ideas and information on sustainable technologies and lifestyles. Visitors to CAT are welcomed with a breath-taking ride on its water-powered cliff railway (Figure 2), discover its wind pavilion and the UK's largest fully integrated photovoltaic roof (Figure 1) offering spectacular examples of renewable technologies in use.

The Centre also successfully treats its visitors' 'wastes' with a novel reed bed sewage system. Operating from Easter to the end of October the railway uses water to carry over a thousand visitors a day up a 180 foot slope to the heart of CAT's environmental complex. The complex contains an exciting educational range of interactive displays which are continually up dated to reflect the ways in which our society is adopting sustainable technologies and lifestyles. The wind pavilion, self built house, adventure playground, and power displays are popular with holiday makers, students and serious decision-makers in industry. The 'Mole-hole' offers visitors a chance to 'shrink the kids' and lets them explore the complex beauty of life within the soil. CAT provides residential courses, a free information service and a range of alternative technology books published by the centre. The Centre for Alternative Technology is open seven days a week from 10am to 7.00pm with a railway which closes at 5.30pm. Discounts are available for families, senior citizen's, students and claimants. Visitors arriving by bicycle receive a 50% discount!

For details of the Centre for Alternative Technology contact:
The Centre for Alternative Technology Machynlleth, Powys, SY20 9AZ
Tel: 01654 702400
Fax: 01654 702782
e-mail:aleic@calmlo.demon.co.uk
Web http://www.cat.org.uk

EEC Sensor Linking Network

A new five nation EEC Network to link research and development in instrumentation and sensors has been established. Technology Exchange Ltd of Bedfordshire, in co-operation with German engineering institutions, French nuclear power laboratories, Danish Technology Transfer and Eurosportello in Northern Italy have agreed to participate in a two year project to assist small and medium sized enterprises manufacturing instrumentation and sensors. There are no costs involved for the enterprises who are willing to participate by describing their technology needs, nor for the universities and research organisations willing to state their research output in the instrumentation, transducers and sensors fields. Similarly, universities, research organisations and individual researchers developing instrumentation and sensors who seek outlets for their research and development are invited to send a description of their work to the Technology Exchange Ltd. The partners in all five European countries will undertake similar surveys, with the objective of identifying opportunities for linking together complementary groups.

The Technology Exchange Ltd, Wrest Park, Silsoe, Bedford MK45 4HS Tel 01525 8603 E-mail: tech-ex@dial.pipex.com

Forthcoming Electronics and Electronics related conferences

Creating the Future
The Institute of Physics 1999 125th Anniversary Congress will be held at the University of Salford between 12-15th April 1999. Topics to be covered include: vacuum applications for industry, research and development, technology seminars, and a talk given on Thrust SSC with Squadron Leader Andy Green! Contact: The Institute of Physics, 76, Portland Place, London W1N 3DH. Tel 0171 470 4800.

The 7th International Conference on Image Processing and its applications will be held between 12-15 July 1999 in Manchester, UK. Contact: A Robinson, Institution of Electrical Engineers, Savoy Place, London WCR OBL.

INTERKAMA the largest recognised world measurement, control and automation exhibition and ISA the International society for measurement and control will jointly organise the INTERKAMA-ISA TECH Conference between 18-20th October 1999 in Dusseldorf, Germany. The conference will emphasise practical solutions to manufacturing and automation problems, and the transfer of ideas and technology. For further information contact: ISA, 67, Alexander Drive, Research Triangle Park, NC 27709 USA.

READ ALL ABOUT IT!

Alan Simpson recently visited the long awaited, and newly opened British Library.

We presented this article as a tribute to Alan Simpson who sadly passed away late last year. Alan had a long and happy association with Maplin Electronics, and will be greatly missed.

Reading Room.

Entrance Hall.

It may have taken a long, long time in arriving, but the new British Library at St Pancras, London, is well worth the wait. The British Library is the national library of the United Kingdom and one of the world's greatest libraries. Certainly, the related facts and figures are impressive by any standards. There are more than half a million reading room visits each year: Over 4 million documents are supplied to remote users each year: Some 3 million separate items are added to the collection each year (on each working day some 8000 items are added to the collection): The Library which at present operates over several sites in London and Yorkshire, has over 2,400 staff but by 1999 most of the Library activities will be based at St Pancras.

The Library's collection has developed over 250 years and exceeds 150,000,000 separate items. It includes: books, journals, manuscripts, maps, stamps, music, patents, newspapers and sound recordings in all written and spoken languages. But what makes the Library of special interest to Electronics readers is the commitment to using whenever possible new technologies. Certainly there is plenty of scope for the introduction of hi-tech. Reading Rooms apart, there are three exhibition galleries, conference facilities, restaurant and coffee shop plus the British Library bookshop.

The Building – A Brief History

When it comes to statistics, there are a whole clutch that the British Library authorities would prefer to shelve. The building which took 20 years of planning, opened several years late at a cost of £511,000,000 against an original budget (in the 1970s) of £116,000,000. It also had The Prince of Wales commenting that 'it is a costly eyesore – an assembly hall for an academy of secret police.' Perhaps a more favourable comment would be that it is a most impressive building of angles within a graceful City space alongside the grandeur of St Pancras station.

Costly eyesore or not, the building is certainly impressive. There are eleven reading areas proving seats for 1206 readers with 23 linear kilometres of open access shelving. At the heart of the building is the King's Library, the 65,000 volume collection of George III given to the nation by George IV. This is housed in a six storey, 17 metre glass-walled tower fully accessible to staff and visible to all visitors. The four basement levels descend nearly 23 metres and contain 300 linear km of various types of shelving. Carefully controlled environmental conditions in the basements, promise a fourfold increase in life expectancy for the volumes stored there.

Reading Rooms are at the centre of all the British Library's activities. In its time, these have hosted such literary luminaries as Wilde, Carlyle, Ruskin, Orwell and perhaps the most famous 'reader' Karl Marx. Reading Rooms can be used by those holding a reader's pass, but there is much more to do and see in the building. For the electronic enthusiast, there is much in the way of buttons to press and screens to touch. Not to mention priceless books and documents to marvel over.

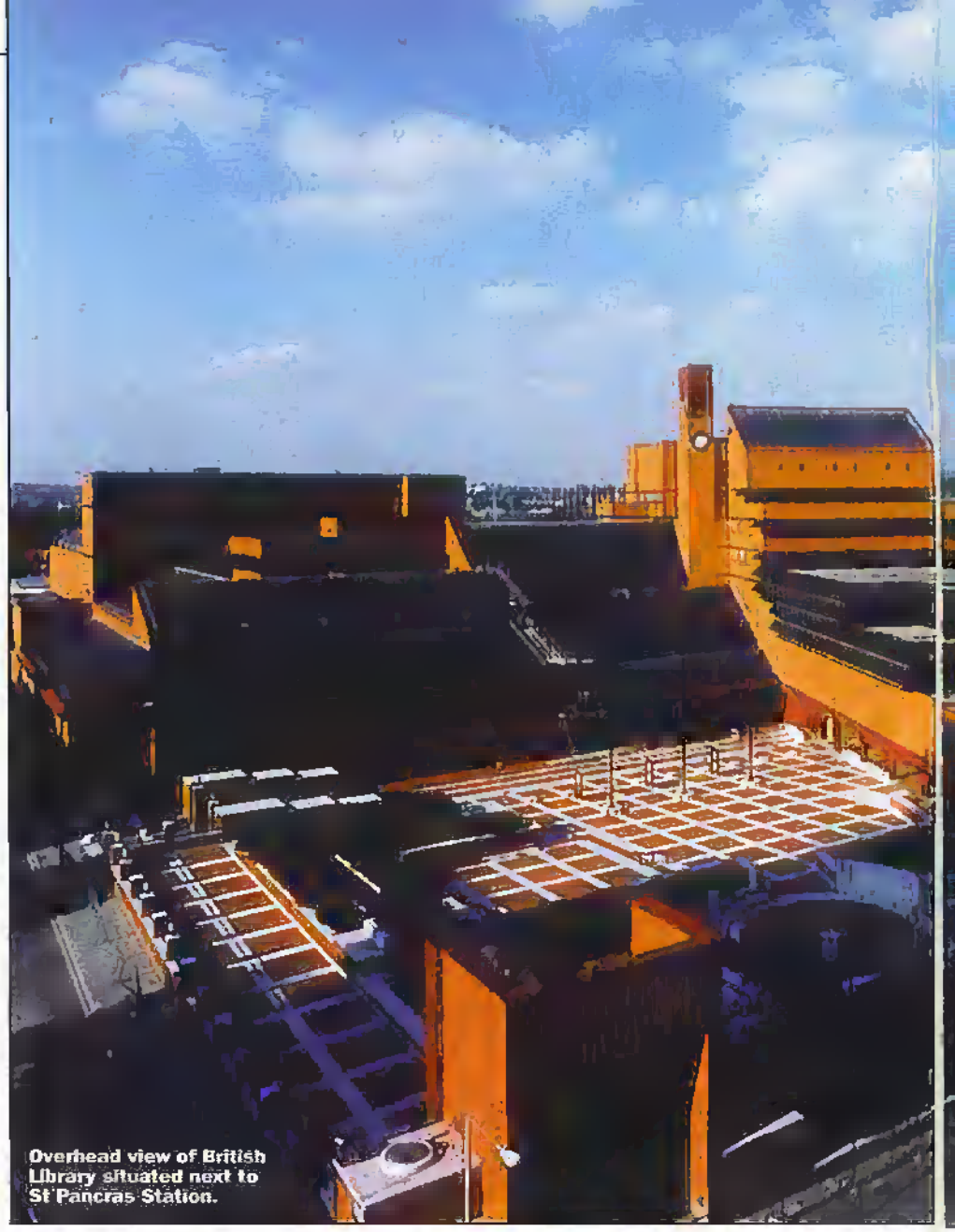
There are three main galleries (open to everyone, free of charge seven days a week) where hundreds of items from the world's greatest collection of books and manuscripts are on display, some for the first time. The galleries are just off the magnificent lobby and reveal how the latest advances in museum design and technology have been employed to provide what can best be described as interactive space.

Without doubt the gallery to see – and be seen in – is the John Ritblat Gallery. Here the Library's world famous treasures: Magna Carta (1215), Lindisfarne Gospels, the Beatles Manuscripts, Shakespeare's First Folio of 1623, The Gutenberg Bible (c 1455) – the first western book printed using movable type, and many, many more historic treasures.

Turning The PC Pages

Without doubt, the highlight of the Ritblat Gallery is 'Turning the Pages'. Developed by the Library and recent winner of the British Interactive Multimedia Award for the best display of the year, the system uses animation and high quality digitisation to simulate the actual turning of pages. Images included are from The Sforza Hours, the Lindisfarne Gospels, the Diamond Sutra – the world's earliest dated printed book and a Leonardo da Vinci notebook. Certainly, Turning the Pages technology is a project which revolutionises the way in which people can look at fragile and static items without any risk of damage.

Turning the Pages uses computer animation, high quality digitised images and touch screen technology to simulate the action of turning the pages of a book. It meets the challenge of displaying books and manuscripts and explaining the significance or beauty of each when only a single opening can be displayed. The system develops the very simple concept of allowing the visitor to turn a surrogate but



Overhead view of British Library situated next to St Pancras Station.

facsimile page. Digital technology combined with animation and televisual techniques provide the perfect medium since neither the original nor the facsimile is damaged or degraded by the process. Each of the six screens is driven by an Apple McIntosh specially adapted 9600 computer. The pioneering system allows the user to touch the Mitsubishi screen, drag a hand across it and the pages hovers or turns. Quality is excellent, certainly better than examining the original page under a glass frame. The system is accompanied by an audio commentary, musical and zoom effects. The system has even resolved the mystery of Da Vinci's famous mirror-writing. Other galleries and museums are apparently lining-up to develop similar systems.

Meanwhile, the Pearson Gallery of Living Words reflects the amazing range and diversity of the Library's collection through five themes, each brought alive by a stimulating mix of books, manuscripts, maps, interactives and other media. Here, you can enjoy the Story of Writing, looking at the technology used and directions taken, particularly in Western culture. Then within the Pearson Gallery of Living Words, there is a Children's Books section with original material on such well enjoyed stories as Winnie the Pooh and Peter Rabbit plus the popular creation Babe. The Scientific Record section is illustrated by first editions of the works of Charles Darwin and Sir Isaac Newton.

Next comes the Workshop of Words, Sound and Images. This is a dynamic, hands-on gallery which traces the story of book production from the earliest written documents through medieval manuscripts and printing to modern industrial processing and the present digital revolution. In reality it is a hands-on display in the art of book creation from an 18th century print shop to the latest in desk-top publishing. Here you can handle compositor tools and materials assisted with a mass range of video displays. The Digital Age section shows, by means of an ISDN link, how new technology can combine printing and publishing using digital data.

The Digital Library

The term 'digital library' says a special digital report by the British Library. Essentially, digital is seen as being integral with the growth and progress of the Library. The digital collection may be created and produced in a variety of different places, but will be accessible as if it were a single entity. In particular, the Library

is producing a variety of electronic publications in a number of media, particularly published over networks and on CD-ROM, which will exploit the potential of imaging and other technologies to better access items in the collection.

Already integral to the Library's work is its World Wide Web site, which has been expanded from an experimental online information server to a comprehensive guide to collection and services. The system allows web users to search the Library's online catalogues free of charge and how to order from the Document Supply Centre. Containing well over a thousand Web pages, it currently attracts three million transactions a year. Extensive hypertext links connect the system to related Internet sites around the world. (Main public Web site: http://portico.bl.uk)and http://www.bl.uk).

Three separate but linked automated system are at the heart of the reader service. The Online Public Access Catalogue (OPAC) holds over 12,000,000 records: The Automated Book Request System verifies availability, prints the request in the storage area, tracks and communicates its progress: The Mechanical Bookhandling System routes the container to the correct collection point. The Library expects that when all systems are fully operational, the majority of material held on site will be delivered to readers within 30 to 45 minutes.

The power behind the Library's data telecommunications is an ATM network supplied by Siemen Network Systems Ltd. The network's role is to support new and existing services and to deliver access to people offsite and remotely in as little as two seconds. The network is the highway over which the Library services are carried. Perhaps the most innovative service, is that of the delivery of digital images into reading rooms around the building, and ultimately to anyone's PC wherever they are in the world. In-house, this means 800 PC-using staff and another 400 to 500 terminals for the public. The network is based around Cisco's Catalyst and Lightstream switches, ATM with Ethernet switching to the desktop, giving the library full scale multimedia performance. A fully resilient backbone was included to ensure maximum availability at all times. The network also connects to the Internet via the Super Janet academic service.

Sorry. No Mobiles – Use The Payphones

No Mobile phones may be the rule for the British Library, but users and visitors will be able to keep in touch thanks to a battery of some 40 Interphone payphone kiosks located around the building. The payphones have been designed to blend in with the stylish interior of the new library. Stephen Moran, IT Services Manager at the Library, states that we chose IPM Communications to supply their payphones for several reasons. Principally they provided us with a very satisfactory revenue stream for the period of the contract. They also offer a managed service which means that they take full responsibility for running the payphones – collecting the money, cleaning and repairing should any problems occur. Another advantage for users is that Interphone payphones take 5p pieces, allowing users to make cheaper calls. Users also enjoy the 'best coin return' system which returns the largest denomination coin where a credit is due.

Quote - Unquote

The success or otherwise of any public exhibition can be best judges by visitors comments. "More than anyone could have expected or hoped for"; "A very unusual exhibition – amazing to have so many treasures together"; "I have never been so awed by any other exhibition": "A joy to be at": "worthy of the greatest national library in the world".

So what next? The overall aim says Brian Lang, chief executive is to create an electronic document store – one that can keep pace with digital change and developments. For many of us, the challenge will be to keep pace with documenting the changes at the British Library. Yes, perhaps books will become obsolescent in the future, but the advent of the microchip and multimedia technologies, will keep books in one form or another around for the foreseeable future.

Further Information

British Library, 96 Euston Rd, London NW1 2DB. Tel: 0171-412 7000

Opening time for the galleries, restaurant, cafe, coffee shop and bookshop: Monday, Wednesday – Friday: 0930 – 1800. Tuesday: 0930-2000 Saturday: 0930-1700. Sundays: 1100 – 1700)

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- ☐ 1850
- ☐ 1950
- ☐ 1960

2. Spot the odd one out:

- ☐ A4
- ☐ Foolscap
- ☐ Tadpole

3. What is the 'English Patient'?

- ☐ a long-term hospital inmate
- ☐ a best selling book
- ☐ the first person in the bus queue

4. Which book wins most plaudits world-wide?

- ☐ The Lord of the Rings
- ☐ Just William
- ☐ The Tales of Peter Rabbit

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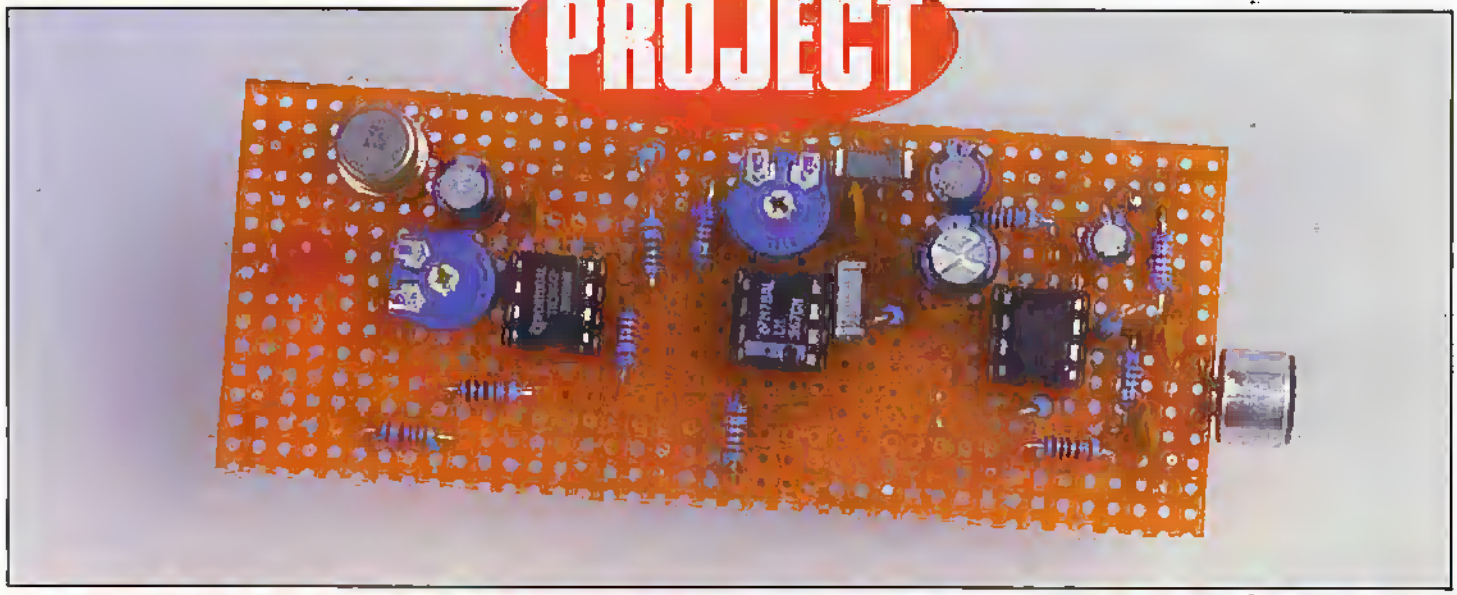


SOUND OPERATED SWITCH

Gavin Cheeseman looks at a slightly more unusual remotely operated switch and suggests some applications.

Electronically operated switches of different types are relatively common, particularly in control, sensing and security applications. Examples are light operated switches sometimes used to control street lamps, and PIR sensors used in intruder alarm systems. There are many different ways to trigger a switch each with advantages and disadvantages depending on the application. In this article we look at a circuit that provides a switched output triggered by sound. Although not new, use of this method of triggering is perhaps less common than light and infrared but as will be seen, the circuit has a wide range of applications.

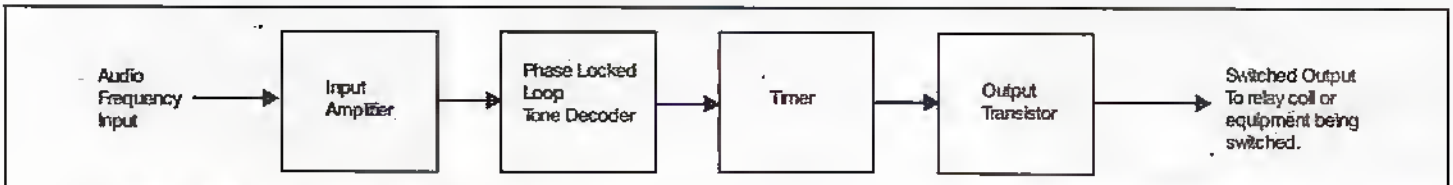


Figure 1. Block Diagram of Sound Operated Switch.

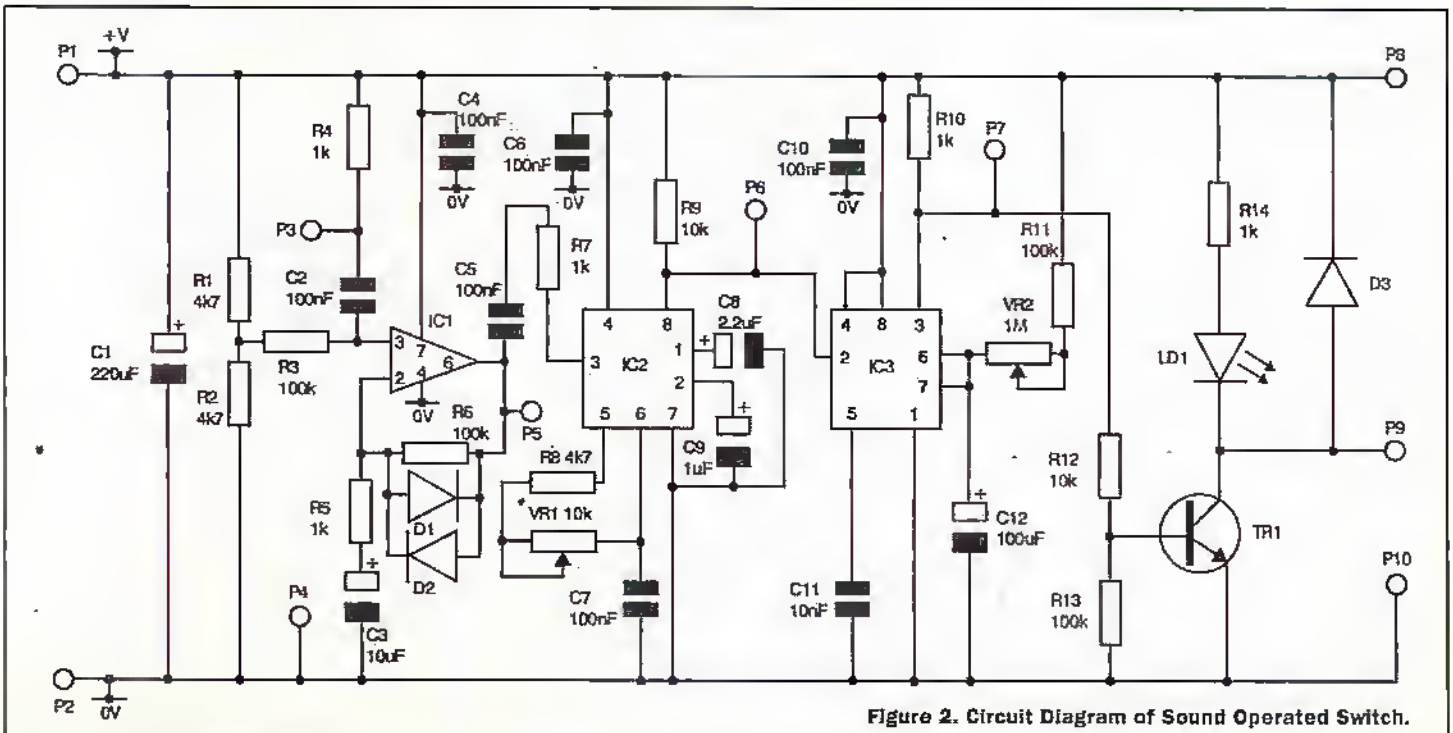


Figure 2. Circuit Diagram of Sound Operated Switch.

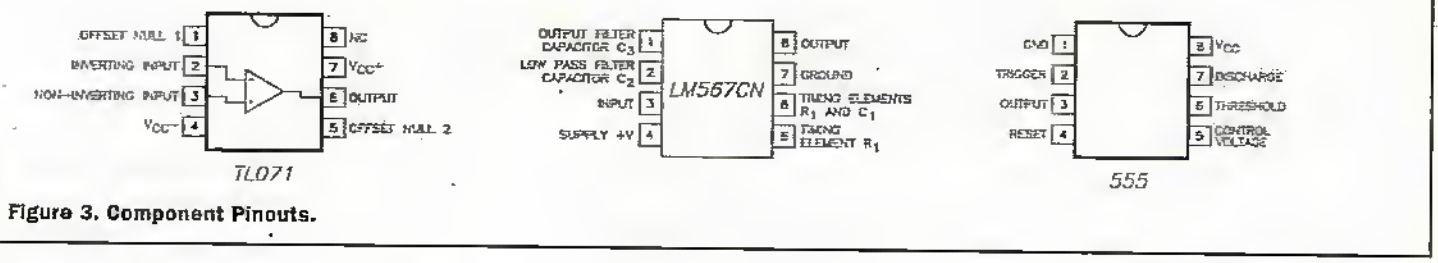


Figure 3. Component Pinouts.

Overview

In order for the circuit to operate satisfactorily it is necessary to be able to discriminate between different types of sound. There are several different ways to achieve this. For example, it can be arranged for the switch to operate when a tone of specific frequency is present or when the sound exceeds a predetermined level. Some devices even use software to look at specific wave shapes; for example the waveform produced by breaking glass may be used to trigger an intruder alarm.

The circuit described here is relatively simple in operation and is intended to provide a starting point for those who may wish to take the idea further. The basic unit is designed to be triggered when sounds within a specific frequency range are detected. The circuit makes use of a Phase Locked Loop (PLL) tone decoder, the popular LM567 IC. This device provides an output that switches to a logic low condition when signals within a predetermined range of frequencies are present at the IC input. Figure 1 shows the block diagram of the Sound Operated Switch.

It is also possible to modify the circuit so that it is triggered by changes in sound level. More of this later.

Circuit Description

Figure 2 shows the circuit diagram for the Sound Operated Switch. The power supply is connected between terminals P1 (+V) and P2 (0V). Capacitor C1 functions as bulk de-coupling for the power supply rails with C4, C6 and C10 providing high frequency filtering close to the individual ICs. Input signals are applied between terminals P3 (i/p) and P4 (0V). Resistor R4 is included to power an electret microphone. Operational amplifier IC1 together with associated components provides amplification of the incoming audio signal. The signal is coupled to the non-inverting input of the op-amp via C2 with R1 - R3 providing a half supply reference voltage.

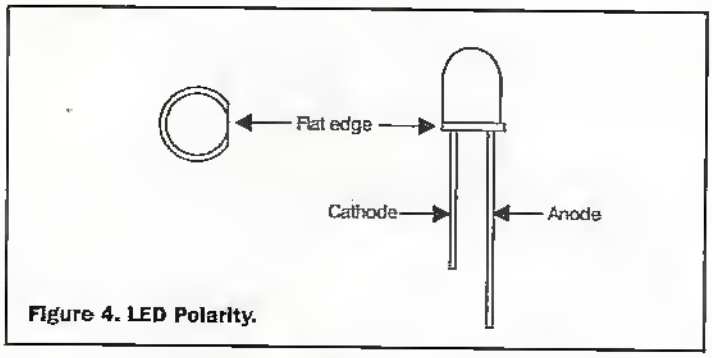


Figure 4. LED Polarity.

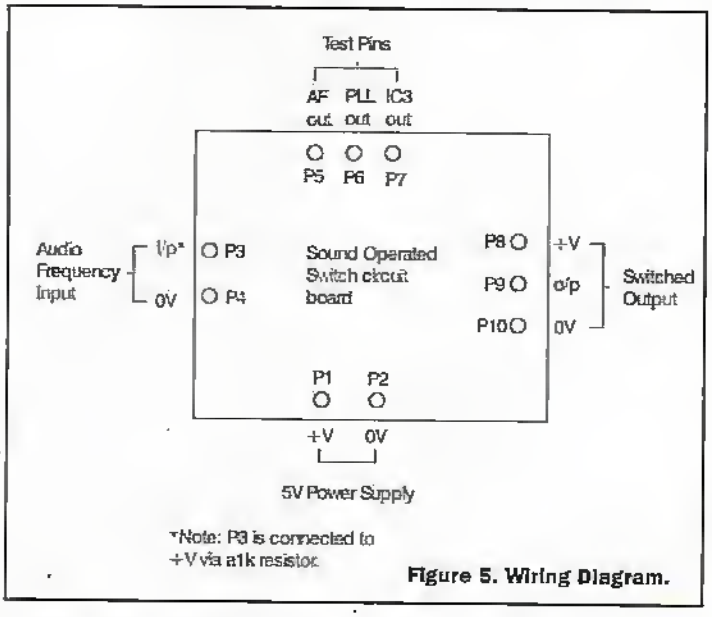


Figure 5. Wiring Diagram.

The gain of the amplifier stage is determined by R5 and R6. C3 rolls off the gain at low frequencies. Two diodes, D1 and D2 have been included to limit the amplitude of the amplifier output at high signal levels. At lower levels the effect of the diodes on the circuit should be negligible. The output signal from the amplifier is coupled via C5 and R7 to the Phase Locked Loop stage comprising IC2 and associated components. The clock frequency of IC2 is determined by R8, VR1 and C7 - variable resistor VR1 allows the operating frequency to be adjusted over a limited range. The output from the Phase Locked Loop is in the form of a switched output on IC2 pin 8, which is normally in a logic high state. However, when the input signal falls within the capture range of the device the output switches to a low state.

This output can be used directly but the logic low condition only persists as long as a valid input signal is present. In many applications a longer duration output is required. With this in mind a simple timer stage based around the TS555 IC has been added. The timer is triggered by negative going pulses at the input. In response, the output at IC3 pin 3 switches high for a period determined by R11, VR2 and C12. Once again the timer IC is capable of driving a low current load directly. However, to allow switching of relays etc. a separate transistor output stage has been added in the form of TR1. A BFY50 has been chosen for this application but there is no reason why other NPN transistors cannot be used as long as the bias parameters are met and maximum ratings for the device are not exceeded. An LED (LD1) gives an optical indication, illuminating when the output is active. D3 helps to prevent damage to the transistor when driving inductive loads such as relay coils. The output of the circuit is made available on terminal P9. P8 and P10 are an additional set of power supply terminals to facilitate easy connection of loads.

Building the circuit

The circuit may be built using almost any type of construction. Matrix board is fine. Start by fitting the lower profile components such as resistors and diodes moving up to the larger components such as capacitors. As always, take care when fitting the polarised components as incorrectly connected components can be hazardous. IC and transistor pinouts are shown in Figure 3. The polarity of the electrolytic capacitors is usually indicated by markings on the capacitor body and the length of the leads. The negative lead is normally marked with a minus (-) symbol on the component body and is also the shortest of the two leads. The polarity of the diodes is marked by a band at one end of the component designating the cathode. The LEDs also have leads of different length, the cathode is usually the shortest lead and is also often marked by a flat edge on the side of the component body (see Figure 4). It is recommended that IC sockets are used as this helps to prevent the ICs from being damaged by soldering and simplifies component replacement. Do not fit the ICs until all other components are soldered in place.

Try to layout the circuit in approximately the same order as shown on the circuit diagram. Fit de-coupling capacitors C4, C6 and C10 close to IC1, IC2 and IC3 respectively. Sometimes problems can be encountered due to clock breakthrough from the IC2 into the input of IC1. This can result in noise and instability. The problem can be reduced considerably by keeping interconnections between components as short as possible. It is also beneficial to run a separate set of supply rails to each IC joining only at the power supply input terminals.

If you intend to use the circuit with an electret microphone this may be connected between P3 (i/p) and P4 (0V). Ensure that the microphone used is suitable for operation at 5V with a 1k series resistor. Where other types of input are being used R4 should be omitted from the circuit otherwise damage to the input device may result.

When you have completed construction, double check your work to ensure that everything is correctly connected. Check the quality of the solder joints and double check component polarities.

Testing the circuit

Figure 5 shows the wiring diagram for the Sound Operated Switch. The circuit can be tested using a signal generator or the output from a microphone. Figure 6 shows how to connect an electret microphone. A suitable regulated 5V power supply will be required for the circuit. The circuit will actually operate up to 9V but this is close to the absolute maximum rating for IC2 and so is not recommended. If only a 9V or 12V supply is available, it is suggested that a 5V regulator is used to reduce the voltage as shown in Figure 7.

Connect the power supply to the circuit; +V is connected to P1 and 0V is connected to P2. If you have a multimeter, it is a good idea to connect this in series with the +V rail set to monitor current. After a very short switch on pulse during which the capacitors are charging the current consumption should not exceed a few mA. If the circuit appears to be drawing excess current switch off and recheck component connections.

If an oscilloscope is available it should be possible to monitor the clock waveform at IC2 pin 5. The circuit output may trigger once immediately after switch-on. This is normal. Connect a microphone or audio frequency signal generator between terminals P3 (i/p) and P4. A signal level of a few mV is generally adequate. Avoid overloading the input by using excessive signal levels. Set VR1 to central position. If you are using a signal generator sweep across a frequency range between approximately 1kHz and 3kHz. When the frequency of the signal generator approaches that of the PLL clock (IC2), the circuit should be triggered illuminating LD1. Disconnect the input signal and allow the circuit to time out. Exactly how long this takes will depend on the setting of VR2 and on component tolerances in the timer stage.

If you do not have access to a signal generator and you have fitted a microphone to the input of the circuit, it should be possible to trigger the unit by whistling loudly. It is necessary to whistle at a frequency within the capture range of the PLL to trigger the circuit but this is not always easy to guess first time. One approach is to start whistling at a low pitch rapidly increasing to a high pitch. When the pitch of the whistle falls within the capture range of the PLL the circuit is triggered. After some practice it is relatively easy to trigger the circuit in this way.

If everything appears to be working correctly, adjust VR1 and VR2 to check the operating range. For simplicity, a suitable frequency counter with a high impedance input (>1MΩ) can be connected to IC2 pin 5 if available although this is by no means essential.

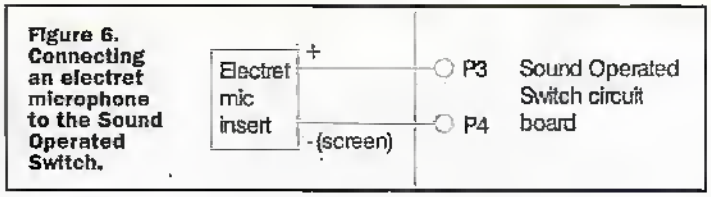


Figure 6. Connecting an electret microphone to the Sound Operated Switch.

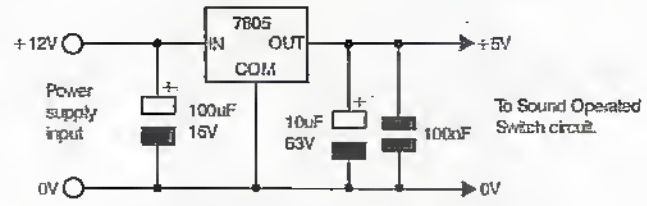


Figure 7. Example of how to use a voltage regulator.

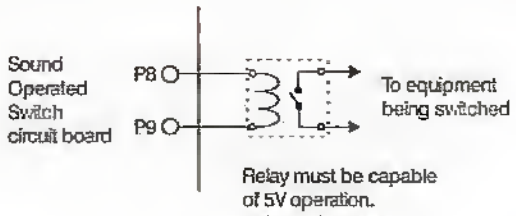


Figure 8. Connecting a relay.

Using the Sound Operated Switch

As mentioned, the Sound Operated Switch is really intended as a general purpose building block. As a result it has not been optimised for specific applications. Some experimentation may be required to obtain the best performance from the circuit.

Switching a Relay

A suitable relay may be connected to the output of the Sound Operated Switch between terminals P8 (+V) and P9 (o/p). This is illustrated in Figure 8. As the circuit stands it is necessary to use a relay that will operate at 5V (e.g. stock code JH12N). However, if R14, LD1 and D3 are omitted from the circuit it should be possible to switch a 12V relay operating from a separate 12V supply line as illustrated in Figure 9. The relay may in turn be used to switch power to higher current loads such as lighting.

Under no circumstances should the unit be used to directly switch the mains supply or other voltages in excess of 50V as this may be extremely hazardous.

Methods of triggering

Simple methods of triggering the circuit have already been discussed but any device emitting a sound of the correct frequency can be used. As mentioned the operating frequency can be adjusted using variable resistor RV1. The frequency range can also be modified by changing the value of C7. Varying the value of C8 and C9 will alter the effective bandwidth of the PLL circuit. In this way the circuit can be modified to respond to sounds over a smaller or greater frequency range. If very low values are used the circuit will even respond to a clap.

The sensitivity of the circuit depends on several factors. Better performance will usually be obtained in a quiet location where the trigger frequency is predominant than in a noisy situation where loud sounds covering a wide spectrum of frequencies are present.

Level Triggering

If you would prefer the circuit to be triggered by sound level as opposed to frequency, you may wish to experiment with the arrangement shown in Figure 10. The concept is very simple. The circuit shown effectively connects to the Sound Operated Switch unit in place of the Phase Locked Loop. The LM311 is a comparator which compares the voltage set up by a potential divider with a voltage related to the incoming AF signal level. The voltage level on pin 3 of the device is compared with that on pin 2. If pin 3 is at a higher level than pin 2 the output on pin 7 switches to a low state. IC2, C5, C7, C8, C9, R7, R8 and VR1 should be omitted from the Sound Operated Switch circuit as they are not required for this configuration.

When used in this configuration, the circuit may be triggered by loud sounds such as clapping or by movement of objects close to the microphone.

Applications

The unit lends itself to a wide range of applications. A simple use for the circuit is to switch on a light by whistling. The circuit could also be set up to respond to set frequency sounds from other appliances. An example would be to switch on a light or sound a loud buzzer if the telephone rings. This may be useful if you are working in an area some distance from the telephone and normally cannot hear it ringing.

The circuit could also be used to detect loud sounds such as breaking glass and if necessary to trigger a siren or alarm system. However, it should be pointed out that the circuit will respond to any sound within its capture range so would generally only be suitable in relatively quiet locations. It is also possible that the unit would fail to detect a sound, so use in security applications can require a considerable amount of thought.

In addition to the main output at terminal P9 there are also outputs at P5, P6 and P7. These are fundamentally intended to be used as test points in the circuit but may also be useful for interfacing to other equipment. Terminal P5 is connected directly to the output

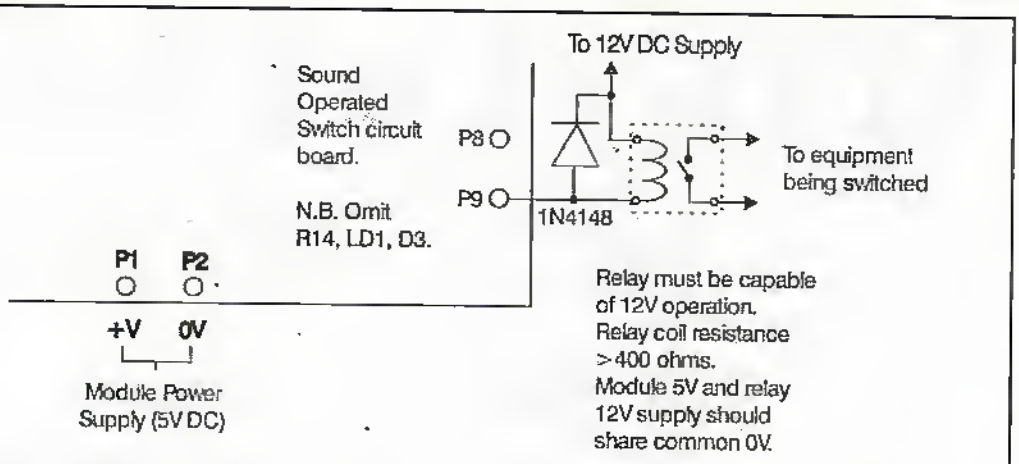


Figure 9. Driving a 12V relay.

of IC1. There is no DC blocking capacitor so there is a DC offset of approximately ½ of the supply voltage at this point.

Terminal P6 is connected to the output of the Phase Locked Loop (IC2). This output normally sits in a logic high condition but switches to logic low when the PLL locks to an incoming signal. As P6 is before the timer it can be a useful point from which to derive trigger pulses for other equipment. When set up correctly, IC2 is capable of responding rapidly to input signals within its capture range. For example, with minor modification the circuit could be used to demodulate low speed data.

Radio amateurs or short wave listeners, who are interested in receiving Morse code may be interested in using the output from P6 to drive a small piezo buzzer. If the audio output from a radio receiver tuned to a Morse transmission is applied to the Sound Operated Switch, The output at P6 will closely track the received Morse code. This provides a novel method of filtering out interfering signals as the circuit will only respond to frequencies within its capture range. By increasing the values of C8 and C9, it is possible to achieve a very narrow bandwidth. The unit can be driven by a microphone positioned close to the receiver loudspeaker but it is probably preferable to use a headphone or record output where this is available. Before connecting the unit, please check that the receiver output is capable of driving the Sound Operated Switch input. Also do not forget to omit R4 if you are driving the circuit directly. It may also be possible to use the unit as an interface between the receiver and a decoder.

The input of the Sound Operated Switch is very sensitive as it is designed to accept signal levels of a few mV from microphones etc. As a result it is necessary to ensure that the input signal level does not overload IC1. The gain of the amplifier stage can be reduced by decreasing the value of R6 (recommended minimum 1.2k). An external attenuator network could also be fitted if necessary.

P7 provides direct access to the timer output. This output operates in opposite phase to the main output at P9. So when the circuit has been triggered and the timer is active, P9 is in a logic low state and P7 is logic high. The source current of this output is only a few mA. Therefore, it is recommended that only high impedance loads (>10k) are connected to P7.

Other Uses

When configured for level triggering as described earlier, the circuit may be used to automatically start a recording device such as a cassette or digital recorder. Similarly the unit could be used to switch on a door phone or video camera when a visitor speaks into the microphone. If a continuous output is required the output from P7 can be used to drive a simple latch. This can be arranged so that the output remains active until the latch is reset.

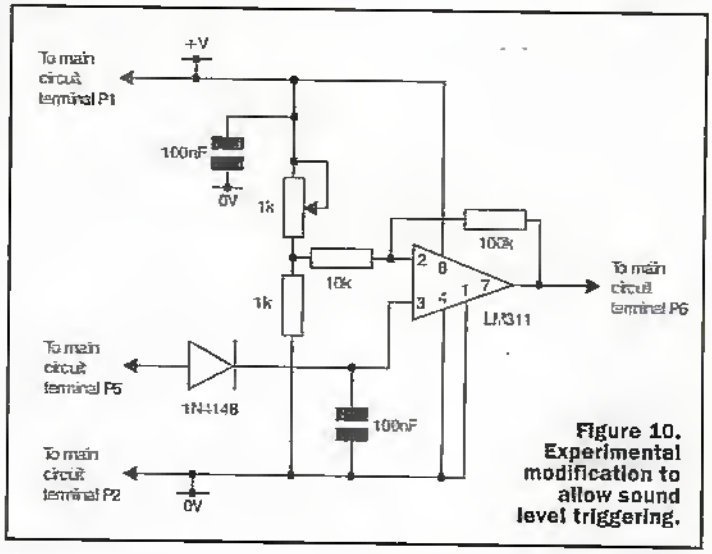


Figure 10. Experimental modification to allow sound level triggering.

Environmental Considerations

The sound operated switch is intended for use in a normal indoor environment. Because of component tolerances and temperature coefficients, variations in temperature will tend to result in changes in the operating frequency of the Phase Locked Loop. The duration of the timeout will also vary. Whether this becomes a problem very much depends on the application. For most non-critical applications, for example when the unit is triggered by whistling, frequency variation is not a problem. There will normally be much more frequency variation in your whistle than from the PLL clock oscillator. However, if the device is being used to detect an electronically generated tone, frequency drift could mean that the PLL clock and the incoming tone end up on different frequencies. This could mean that the circuit will fail to respond and in this case it is probably well worth considering the use of higher tolerance components. In particular use of a close tolerance capacitor in place of C7 may reduce oscillator drift.

Finally...

The Sound Operated Switch is a simple circuit with many varied applications. As long as its limitations are kept in mind, it can provide a very useful building block which can be modified to suit individual needs.

PROJECT PARTS LIST

RESISTORS			
R1, 2, 8	4k7	3	M4K7
R3, 6, 11, 13	100k	4	M100K
R4, 5, 7, 10, 14	1k	5	M1K
R9, 12	10k	2	M10K
VR1	Hor Encl Preset 10k	1	UH03D
VR2	Hor Encl Preset 1M	1	UH09K
CAPACITORS			
C1	GenElect 220µF 16V	1	AT41U
C2, 4-6, 10	Minidisc 0.1µF 16V	5	YR75S
C3	GenElect 10µF 63V	1	AT77J
C7	Poly Layer 100nF	1	WW41U
C8	GenElect 2.2µF 63V	1	AT75S
C9	GenElect 1µF 63V	1	AT74R
C11	Disc 0.01µF 50V	1	BX00A
C12	GenElect 100µF 16V	1	AT40T
SEMICONDUCTORS			
IC1	TL071CN	1	RA67X
IC2	LM567CN	1	QH69A
IC3	TS555CN	1	RA76H
D1-3	1N4148	3	QL80B
LD1	LED Red	1	WL27E
TR1	BFY50	1	QF27E
MISCELLANEOUS			
	DIL Socket 8 pin	3	BL17T
P1-10	Pin 2145	10 pins	FL24B

Diary Dates

Every possible effort has been made to ensure that information presented here is correct prior to publication. To avoid disappointment due to late changes or amendments, please contact event organisations to confirm details.

March 1999

10 to 11 March Software Accounting and Finance, Interactive Information Services, Grand Hall, Olympia, London. Tel: (0181) 541 5040.

12 to 21 March. SET 99, The National Week, Science and Technology, Tel: (0171) 973 3078.

19 March Windows 1999 Show, Olympia, London. Tel: (01256) 381456.

24 to 25 March Software for the Supply Chain, NEC, Birmingham. Tel: (0181) 541 5040.

31 Mar to 1 April Conference on Antennas and Propagation, IEE, University of York. Tel: (0171) 240 1871.

April 1999

1 April. Internet Seminar, Star, Legoland, Windsor. Tel: (01285) 884422.

3 to 18 April Edinburgh International Science Festival, Edinburgh. Tel: (0131) 220 6220.

13 to 15 April NEPCON Electronics, NEC, Birmingham. Tel: (0181) 910 7910.

20 to 21 April Intranet EXPO 1999, Earls Court, London. Tel: (0181) 742 2828.

May 1999

6 May. Internet Seminar, Star, Birmingham. Tel: (01285) 884422.

17 to 19 May Cable & Satellite Mediacast 1999, Earls Court, London. Tel: (0181) 910 7931.

25 to 27 May Internet World UK Spring 1999, Earls Court, London. Tel: 0171 976 0405.

25 to 28 May Ninth International Conference on Metering and Tariffs for Energy Supply International, IEE, Conference Centre, Birmingham. Tel: (0171) 240 1871.

26 to 27 May Embedded Systems, Olympia, London. Tel: (0171) 681 1000.

June 1999

7 to 11 June. 16th International Teletraffic Congress, IEE, Edinburgh International Conference Centre. Tel: (0171) 240 1871.

8 June. Internet Seminar, Star, London. Tel: (01285) 884422.

8 to 10 June. Environmental Technology Show, NEC, Birmingham. Tel: (0181) 910 7732.

21 to 23 June. People in Control an International Conference on Human Interfaces in Control Rooms, Cockpits and Command Centres, IEE, University of Bath. Tel: (0171) 240 1871.

12 to 15 June. Seventh International Conference on Image Processing and its Applications, Manchester. Tel: (0171) 240 1871.

29 June to 1 July. Networks Telecom, National Exhibition Centre, Birmingham. Tel: (0181) 742 2828.

30 June to 4 July. BBC Tomorrow's World Live, Earls Court, London. Tel: (0171) 402 2555.

July 1999

6 July. Internet Seminar, Star, Old Trafford, Manchester. Tel: (01285) 884422.

26 to 28 July. Third International Conference on Advanced A/D and D/A Conversion Techniques and their Applications, University of Strathclyde, Glasgow. Tel: (0171) 240 1871.

August 1999

10 Aug. Internet Seminar, Star, Edinburgh. Tel: (01285) 884422.

23 to 27 Aug. Eleventh International Symposium on High-Voltage Engineering, London. Tel: (0171) 240 1871.

September 1999

1 to 3 September Ninth International Conference on Electrical Machines and Drives, Canterbury Christ Church College. Tel: (0171) 240 1871.

7 to 10 September Ninth International Conference on Artificial Neural Networks, IEE Conference on Artificial Neural Networks, University of Edinburgh. Tel: (0171) 240 1871.

Please send details of events for inclusion in 'Diary Dates' to: News Editor, *Electronics and Beyond*, P.O. Box 777, Rayleigh, Essex SS6 8LU or e-mail to swaddington@cix.compulink.co.uk.

What's On?

Apple Returns at Macworld

The buzz is back at Apple Computer, of that there can be no doubt. Even the most sceptical industry commentators are admitting that co-founder and current boss Steve Jobs has turned around the ailing computer manufacturer.

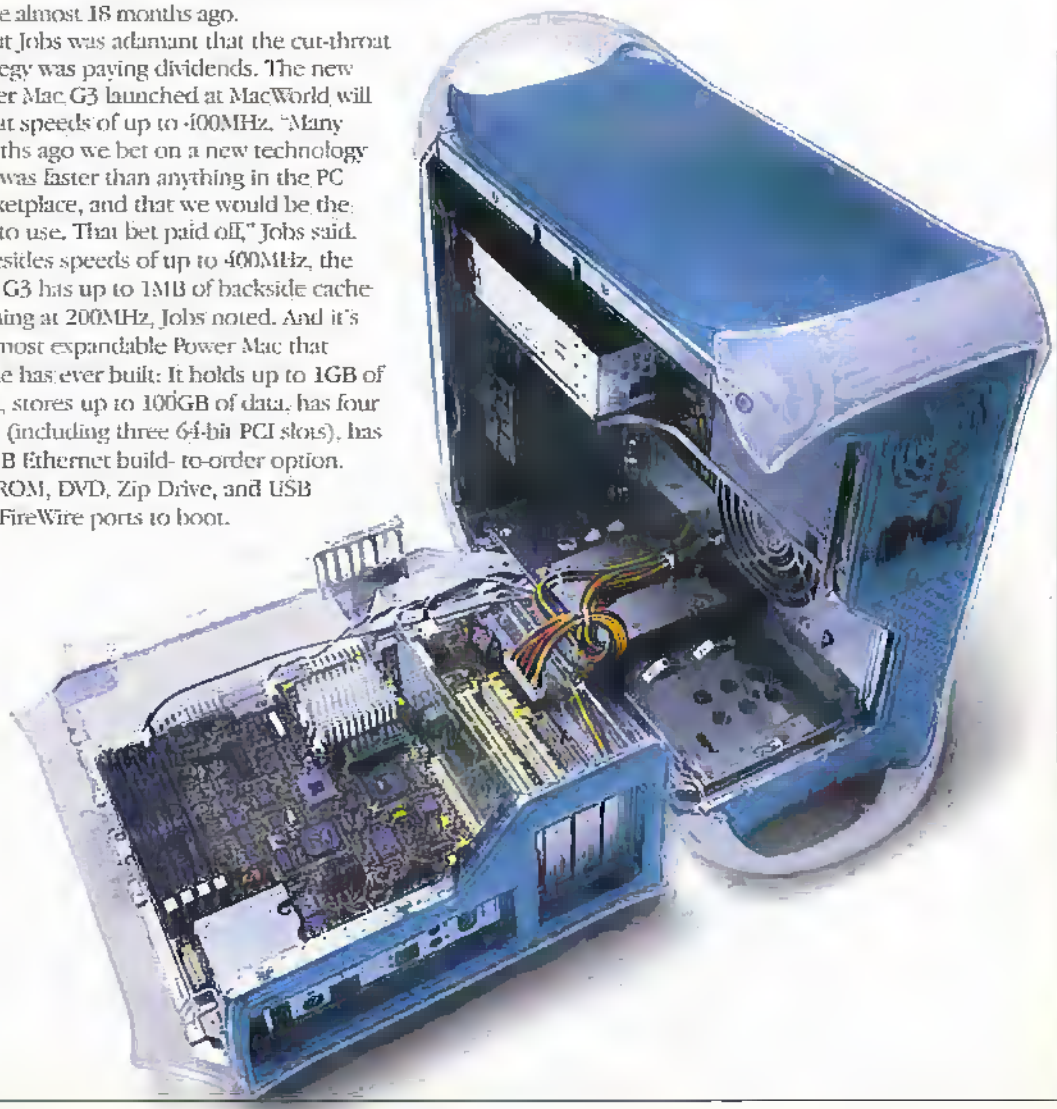
In his keynote speech at Macworld US at the beginning of January, Jobs said it had been an incredible year for Apple. "The Power Macintosh G3 has been an unusually successful new product. Apple has sold 1.6 million G3s - we're set to announce our fifth consecutive profitable quarter, and we're going to kick off 1999 with a bang," said Jobs.

Jobs said his strategy of focussing on core activities was paying off. Products such as the G3 certainly testify to this claim, although there can't be too many Apple Newton users that would agree. The Newton was one of Apple's products that got thrown out of the door when Jobs returned to Apple almost 18 months ago.

But Jobs was adamant that the cut-throat strategy was paying dividends. The new Power Mac G3 launched at MacWorld will run at speeds of up to 400MHz. "Many months ago we bet on a new technology that was faster than anything in the PC marketplace, and that we would be the first to use. That bet paid off," Jobs said.

Besides speeds of up to 400MHz, the new G3 has up to 1MB of backside cache running at 200MHz, Jobs noted. And it's the most expandable Power Mac that Apple has ever built: It holds up to 1GB of RAM, stores up to 100GB of data, has four slots (including three 64-bit PCI slots), has a 1GB Ethernet build- to-order option. CD-ROM, DVD, Zip Drive, and USB and FireWire ports to boot.

"FireWire is not just a point-to-point connection," Jobs said. "It's a bus. And it's a really intelligent bus. Unlike SCSI, you can have a number of computers attached to your FireWire bus." FireWire gives you 400 Mbps digital video, connections to multiple CPUs, plug-and-play, and is hot-pluggable.



Apple is rolling out FireWire on the motherboard of every new Power Mac G3, said Jobs, adding, "There are four million digital camcorders out there, and they all have FireWire jacks. Take that FireWire jack and plug it into the back of your G3, and you get pristine digital video with no added boards," said Jobs.

Other announcements at Macworld included multi-colour versions of the next generation iMac (see News Report) and a series of new games for the Apple platform. For further details, check: <www.apple.com>.

Millennium Issues Reaches Fever Pitch

Contrary to received wisdom, big business in the UK is lagging in its efforts to fix the the Millennium Bug problem according to Robin Guenier executive director of Taskforce 2000. Speaking at the Regent Conference entitled IT Business Trends, in London on 29 January, Guenier claimed that there is increasing evidence of this.

In his speech Guenier said that most large businesses said in 1996 that the job would be complete before the end of 1998. There were, he said, good reasons for this - not least, the need to run their new systems in the real world throughout 1999 so as to go into 2000 with complete confidence that they were fully robust.

"I know of no large business that achieved this. Indeed, most of those that are making good progress tell me that the job is considerably more difficult and is taking much longer than they expected. Where does that leave any businesses that are not making good progress?" said Guenier.

To determine what was really happening, together with the lawyers, Dibb Lupton Alsop, Taskforce 2000 and an independent research firm, Business Strategies, studied the progress being made by the top 1000 companies listed by Dunn and Bradstreet.

The results were appalling. For example, 16% of respondents had not completed their central IT inventory. And 69% had yet to complete the initial remediation of their central IT systems - a job many experts agree should have been done in 1998 to meet the deadline.

"So, what's going on? Why would a Government body deliberately mislead us? If hundreds of big businesses are lagging, that fact surely needs maximum publicity? To misrepresent what is happening is contrary to common sense - to be straight with the public about the state of progress," said Guenier.

Guenier said that there seem to be two possibilities. Either they don't understand the issues - in which case, they urgently need better advice. Or they believe that openness could lead to public panic.

"The reality is that, if we were in the last Quarter of 1999, fear of panic might be justified. But now the priority has to be to get people to recognise that not enough is being done - and to get them to work on fixing the problem," said Guenier.

We take a quick look at some interesting new products that are featured in the new Maplin Catalogue

You can now have all the advantages of switched mode power supply technology in a handy mains plug top case. These high power AC/DC adaptors are realistically priced and are available in a wide range of output voltages. Each can be used with a wide range of input voltages and include a short circuit protection system with automatic recovery. These power supplies are particularly suited to the Velleman universal battery chargers featured on page 58 of this issue.

SPECIFICATIONS

Output voltage tolerance:	5%
Input voltage:	90 - 265V AC
Operating temperature:	0°C to 40°C
Ripple/noise (V pk-pk):	1% (20MHz bandwidth)

Order Code	Output Voltage	Output Current	Max. Output Voltage	Price inc. VAT
PL61R	5V	2A	6.5V	£14.99
PL62S	7.5V	2A	8V	£14.99
PL63T	12V	1.6A	15-17V	£14.99
PL64U	15V	1.3A	17-19V	£14.99
PL65V	18V	1.1A	20-22V	£14.99
PL66W	24V	0.8A	26-29V	£14.99

Note- These are not available until 1st March 1999.

Antex have introduced a new gas soldering iron, the GasCat (order code RD51F, price £25.49 inc. VAT), a compact pocket sized butane gas (lighter fuel) iron for all those applications where a mains powered one is unsuitable. The strong nylon casing will hold sufficient liquid butane for up to one hours continuous use, and is equivalent to a 70W mains iron. The iron is supplied with a 1mm soldering tip fitted as standard and a protective cap which has an integral flint lighter (good for 900 cycles per flint) and a pocket clip. A range of spare tips are available separately. The maximum torch temperature is 1300°C and the maximum tip temperature is 450°C.

For those meatier jobs the latest self-igniting soldering iron from Antex (order code UD16S, price £34.99 inc. VAT) is ideal, being equivalent to a 120W mains iron. The iron features a piezo ignitor and a maximum torch temperature of 1300°C, and a maximum tip temperature of 500°C. On fill of butane gas (lighter fuel) will last up to one hour. A range of spare tips are available separately.

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Software HINTS & TIPS

Can't find the font you're looking for? Too many fonts cluttering up your disk? This month Mike Bedford looks at font management.

It may be hard to believe if you've only been using a PC for a few years but in the days of DOS and dot matrix printers you were lucky if you had half a dozen fixed width fonts. Today, of course, most people have access to dozens of fonts which can be scaled to virtually any size so, from a creativity viewpoint, the sky's the limit. But despite this proliferation of fonts, in fact because of this proliferation of fonts, using them isn't always as quick and easy as we might hope. This month we'll take a look at some of the potential stumbling blocks and give some tips on how to avoid them.

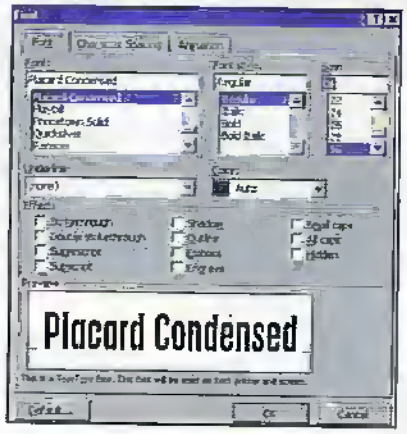
Keep it Simple

Unlike most things we cover in this column, the first point isn't really concerned with how to do something. Instead it's concerned with what you should do. This is a hobby horse of mine, admittedly, but I trust you'll excuse this minor detour. After all there's no point in knowing how to handle fonts if the end result looks apalling. And this is exactly how your documents will look if you're not disciplined in your use of fonts. Looking at some documents I can only assume that the author had worked on the principle 'if I've got 200 fonts then I'm going to use them all'. But this is an area where less can often give more. Rarely will you need to use more than two or three fonts in a document and those bizarre fonts should be used very sparingly for special effects.

Finding Fonts

One of the biggest problems I encounter in using fonts is finding the one I have in mind. Unless you're using fonts on a very regular basis it's rare that you'll remember names so, depending on the application, you might end up trying out literally dozens of fonts. In some applications the Font dialogue box doesn't show you a sample of the selected font. In this instance, therefore, the only way to find a font is to type the text, select it, and then change it to one font after another until you find the one you're looking for. Clearly this could take some considerable time.

However, the fact that many applications, Word 97 for example, do show a preview in their font dialogue box means this gives an easy way to find a font. Simply open up such an application at the same time as the application you're using and use its font dialogue box as a previewer. Word 97's font dialogue box is shown below. Another method which is probably slightly more long winded but gives you a better font preview is to use the Windows 95 Fonts window which is described in the following section.



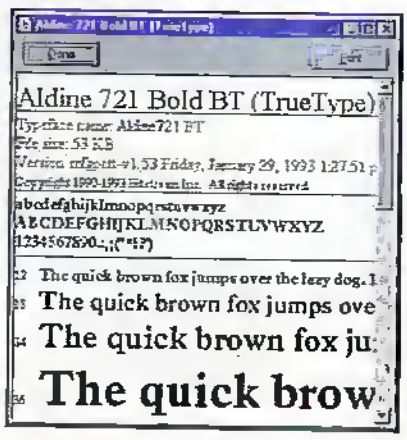
Fonts Window

From the Start button select Settings > Control Panel. Now double click on the Fonts icon and the Fonts window will be displayed. The window lists all the fonts installed on your system. As with the Windows Explorer, you can choose various ways to display this information. Try out 'large icons', 'list' and 'details' by selecting the appropriate option on the View menu and decide which you prefer. You might also like to experiment with the 'list fonts by similarity' option, the use of which is reasonably self-explanatory. Going back to the question of finding a font, try double clicking on any font and you'll find that a sample window is displayed as shown below. You are given the option of printing a font sample from this window. Depending on how many fonts you have, you may like to create a reference file containing print-outs of each of your fonts.

Font Management

How many fonts do you have on your system ? If your system is anything like mine you'll find that you've got hundreds of fonts. But how many do you actually use on a regular basis? How often, for example, do you use the following font?

My guess is that the answer is 'not very often' or, bearing in mind my opening comments, it's a font which only ought to be used on a very occasional basis unless, of course, your company logo happens to use this particular font. With most hard disks now being a few Gigabytes in size, having fonts which you rarely use wouldn't seem to be a problem. Or is it? From the point of view of wasting disk space then, admittedly, a couple of hundred fonts isn't going to make a big difference. But remember the difficulty if finding a given font? Clearly the less rubbish there is on the system the easier it will be to find the font you need. And most of those fonts which are



cluttering up your PC won't be ones you've deliberately put there, they'll be fonts which appeared along with some application you installed. My suggestion, therefore, is to get rid of the rubbish to make it easier to find the fonts you actually use.

This is achieved using the Windows 95 Fonts window which we've already seen. Simply select the font(s) you want to delete and press the delete key. A dialogue box appears asking you to confirm your intention to delete the font(s) and, so long as you click on OK, the font is deleted.

In theory, if you delete a font you can always restore it from the appropriate distribution media. In practice this may be tricky since you won't necessarily remember which application a particular font was distributed with. You may have an application like CorelDraw which comes with hundreds of fonts, most of which aren't installed by default but which could be selectively installed from the CD-ROM as and when they're required. And if you don't happen to have an application with a CD-ROM full of fonts, font libraries can be obtained at a very reasonable price. Admittedly these disks may not have exactly the same fonts as ones which came with some obscure application but I'd find it hard to believe that you'd really need a font which couldn't be found on one of these large font libraries.

So, how do you install a font? This is done from the Windows 95 Fonts window. From the File menu, select Install New Font... Now select the appropriate folder, diskette or CD-ROM and you'll find that the names of all the fonts at that location will be listed. Select the font you require and click on the OK button.

I'll conclude by saying what I often say in these columns. I've not told you everything there is to be known about font management but hopefully I have set you on the path to further discovery. Play around with some of the other features of the Windows 95 Font window and, with a bit of luck, you could become even more productive in your use and management of fonts.

Signaling BY MEANS OF VISIBLE LIGHT

In this first part, George Pickworth looks at the Heliograph.

Photo 1b. Close-up showing unsilvered circle in centre of mirror.

Prior to Hertzian waves and later infrared light, visible light was the obvious medium for signaling systems. The famous Aldis lamp is a good example of a system that used artificial light but as with any artificial light source there were limitations to power and therefore signaling range. On the other hand, the sun provides a light source of almost infinite power.

The heliograph employs a mirror to reflect a beam of sunlight to a distant station. Signaling is by chopping the reflected beam into short or long periods to represent the Morse code. However, as the eye can only follow the reflected ray for a hundred metres or so, a sighting arrangement device is vital to tell the sender that the beam is directed towards the distant station. Moreover, corrections have to be continually made to the vertical and horizontal angle of the mirror as the sun traverses the sky. See Photos 1a and 1b.

In this study we look particularly at the heliograph's sighting system which enabled sunlight signaling to be raised from primitive flashing pre-arranged signals with shields or hand-held mirrors to a true wireless telegraphy system.

Range

The mirrors used with the heliograph are of the highest quality and near optically perfect so the reflected beam is virtually parallel. Obviously there has to be a clear line of sight between the two stations, but, as to be expected, the range increases with mirror size. The following distances are examples of general working ranges for mirrors of various diameters:-

Range	Mirror Diameter
83 miles	12in
83 miles	9in
52.5 miles	5in
37 miles	3in

Under good conditions, reliable two way signaling was possible with stations 100 miles apart - the record attained with a 5in mirror stands at 126 miles between Kompasberg and the Cockscombe mountains in South Africa. For reception of long range signals, the distant station was viewed through a telescope. See Photo 2.

Remarkably, about 40 years ago, I acquired a similar instrument from a trading store in South Africa. It was made in 1916 by

Photo 1a. The author's heliograph on its tripod.

W. Ottway & Co Ltd. No 291 and figures in the study. Unfortunately, I have no reference to this maker and would be grateful for any information.

Operation

The heliograph was portable and signaling stations could be set up in a minute or two. Moreover, the operators became highly proficient and speeds of up to 16 words per minute were frequently attained.

During operation the heliograph was generally mounted on a low and very sturdy tripod; this ensured that the instrument remained 'rock-steady' during keying. See Photo 1. Obviously the slightest movement would put the reflected beam out of alignment with the distant station.

Sun & Hills

Whilst the heliograph could be used anywhere on sunny days, it was obviously best adapted for use in countries having long periods of sunshine and a mountainous or hilly terrain so that signalling stations could be set up on high ground. Obviously, the greater the altitude of the two stations, the less is the limitation in range imposed by the curvature of the earth.

In countries where conditions were favorable, the heliograph was ideally suited to military communications. Space only allows a mention of a few of the numerous theatres of war where the heliograph played a distinguished role and those wishing to know more should read Alan Harfield's excellent little book entitled The Heliograph published in 1981 by the Royal Signals Museum, Blandford Camp, Dorset.

North West Frontier

For many years the heliograph provided the only telegraphic link with the North West Frontier. Messages sent via the heliograph system were known as 'heliograms'.

The heliograph also served in South Africa during the Zulu and Boer Wars, the Middle East, China and indeed Europe during the First World War. The heliograph

Photo 2. The heliograph in Mesopotamia circa 1917. Note unsilvered circle in centre of the mirror. Photo courtesy of the Royal Signals Museum.

was also used for ship to shore signaling and during the First World War it played an important role in the landing at Galipoli.

However, it must have been extremely difficult for the operator on board the ship to maintain the light beam on the shore station because even in the calmest waters, there is always some rolling of a ship. Interestingly, WD & H Wills 'Signaling Series' cigarette cards, circa 1934, showed a picture of a sailor operating a heliograph. See Photo 3.

The heliograph complemented Hertzian wave systems until 1942 when last used at the siege of Sollum Hayat during the desert campaign by the 8th Army.

Night Time

Although designed primarily as a sunlight signaling device, signaling could continue during the hours of darkness by employing an artificial light source. The most powerful source of artificial light, other than the electric arc lamp, was lime-light. For short range work, paraffin lamps could be used.

However, I am puzzled as to why lime-lights should have been used in conjunction with the heliograph, when, like the Begby lamp, the signaling lime-light was in itself a complete signaling device. Lime-lights will be discussed in part 2 of this article. Remarkably, signaling by moonlight was also possible and it is recorded that during WW1, a station set up on one of the pyramids attained a range of 15 miles during full moon.

Limitations

Unfortunately, dust storms could blank out visibility; the same applied to mist or clouds which obscured the sun. Haze, was probably the greatest limiting factor; the dust particles in the air scattered the light beam and often precluded signaling during mid-day.

So, notwithstanding the virtues of the heliograph, it was inevitable that it would ultimately be superseded by VHF Hertzian wave systems which overcame many of the limitations which climate imposed on the heliograph. Nonetheless, as we will see in part 2, the concept of using sunlight as a signaling medium is far from dead.

Evolution

The heliograph evolved from the heliostat, as both employed a similar sighting arm and sighting rod which formed an integral part of the instrument. However, the heliostat differed to the heliograph in that signaling was means of a shutter inserted in front of the mirror, whilst with the heliograph, the mirror was tilted. See Photos 4a and 4b.

The heliograph system proved to be the most successful and the heliostat was abandoned. But there was an instrument that preceded both the above instruments known as the heliourope. This remarkable instrument is discussed in part 2.

Geometry

I feel that the easiest way to introduce readers to the geometry of a Heliograph sighting system is to describe a system I used during the 1930's to communicate with my school friend on Dost Hill about three miles away from Lower Farm where I

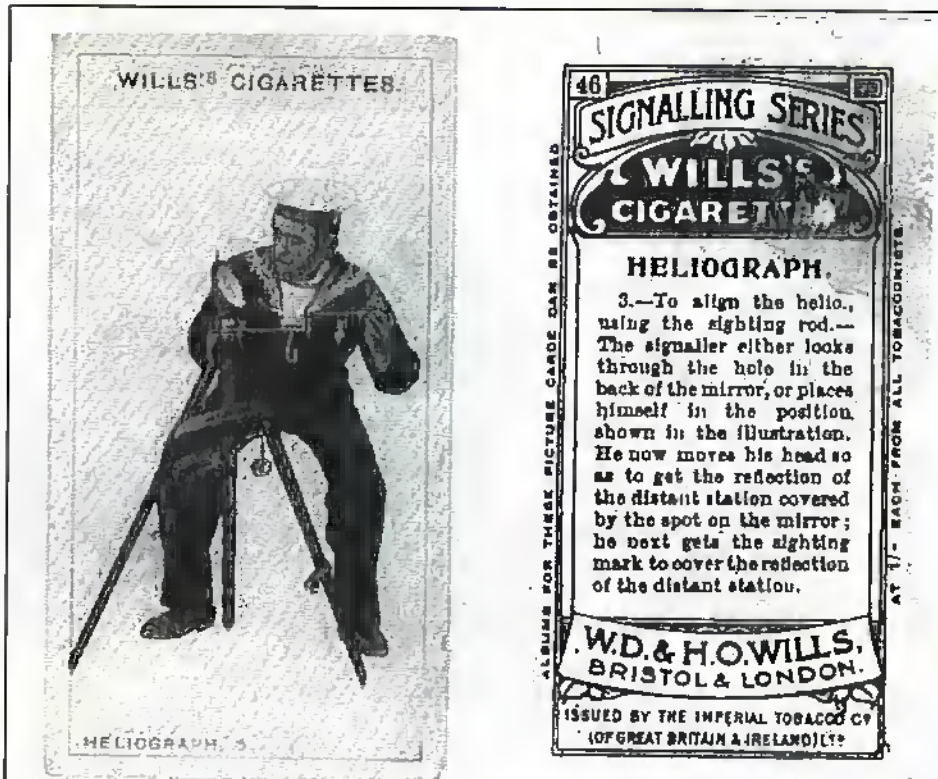


Photo 3. W. D. & H. O. Wills cigarette card showing sailor setting up a heliograph.

Photo 4a. Photo showing keying mechanism and sighting rod.

Photo 4b. Photo showing cranked sighting rod. This is easier to adjust for elevation than the straight sighting rod Figure 4a.

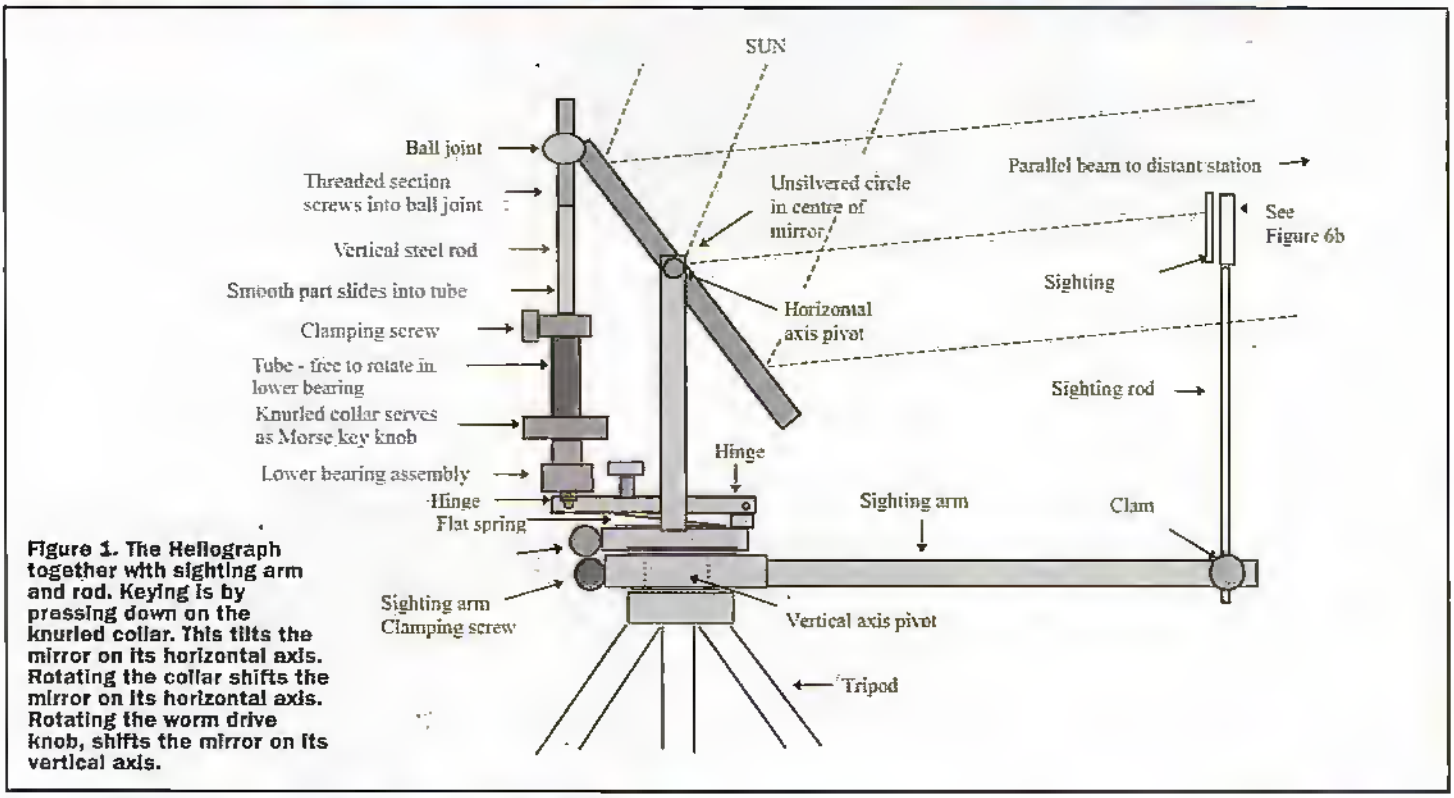


Figure 1. The Heliograph together with sighting arm and rod. Keying is by pressing down on the knurled collar. This tilts the mirror on its horizontal axis. Rotating the collar shifts the mirror on its horizontal axis. Rotating the worm drive knob, shifts the mirror on its vertical axis.

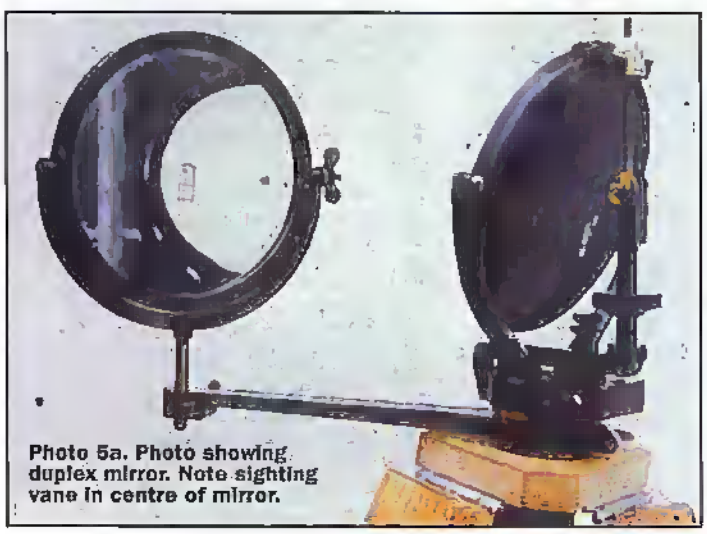


Photo 5a. Photo showing duplex mirror. Note sighting vane in centre of mirror.

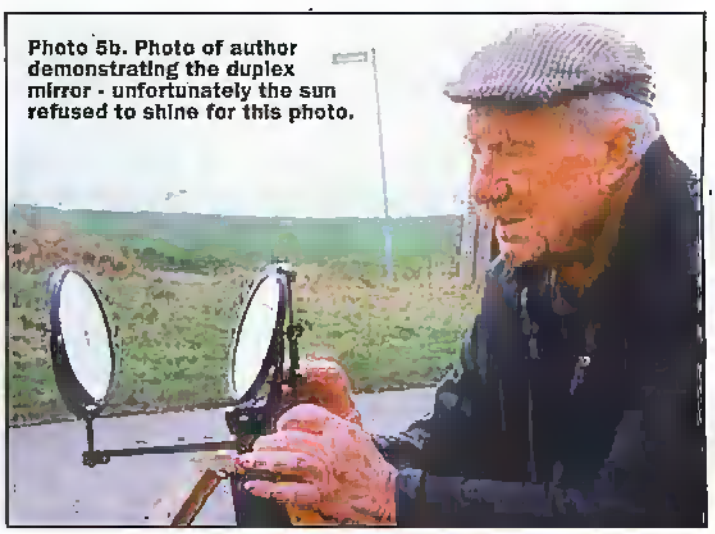


Photo 5b. Photo of author demonstrating the duplex mirror - unfortunately the sun refused to shine for this photo.

lived. The idea for my system came from the already mentioned Wills cigarette cards which also briefly described the heliograph's sighting system. So, being a born experimenter, I decided to construct my own sunlight telegraph system. See Figure 2.

My System

My 'sender' was based on a shaving mirror. The concave magnifying mirror was removed and the plain mirror modified by removing the silver from 5.0mm diameter circle in the centre of the mirror. The mirror assembly was attached to a substantial wooden box by a single screw which allowed the mirror assembly to be rotated on its vertical axis.

The mirror, on its box, was set up in a

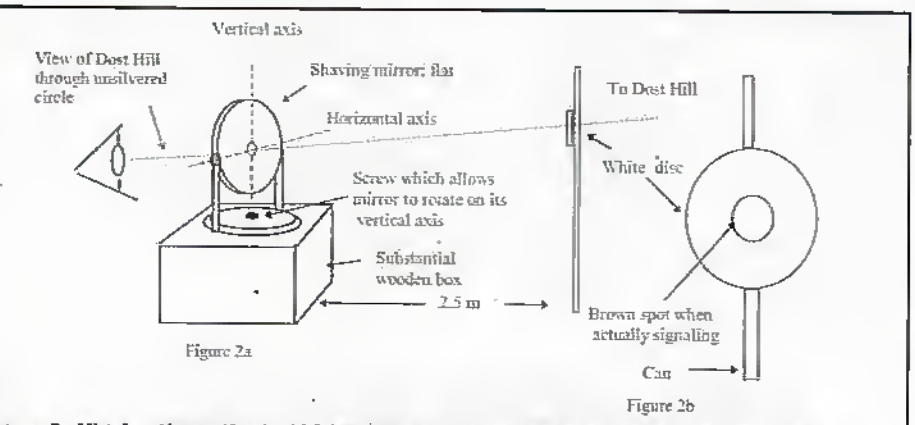


Figure 2. Aligning the author's 1937 system with Dost Hill through the unsilvered circle. When setting up, the white disc is placed to obscure the view of Dost Hill through the unsilvered circle - Figure 2a. During signalling, the mirror is adjusted so that a beam of sunlight illuminates the white disc and the brown spot, caused by the unsilvered circle in the centre of the mirror, is maintained in the centre of the disc - Figure 2b.

field from where there was a clear view of Dost Hill. The mirror was adjusted so as to face Dost Hill and then I viewed my friends position through the unsilvered circle.

Next, following my instructions, my young sister placed a cane in line with my friends position and moved the white disc up or down the cane until it obscured my friend's position.

The mirror was then manually adjusted on its vertical and horizontal axis so that reflected beam illuminated the disc with the dark spot (caused by the non reflective circle in the centre of the mirror) in the centre of the disc. The reflected beam was then directed to my friends position. See Figure 2.

Table Tennis Bat

Signaling was by chopping the reflected beam into Morse code characters by means of a table tennis bat placed in front of the mirror whilst my sister strived to keep the dark spot in the centre of the disc as the sun traversed the sky. Indeed, my system had all the essential features of the heliostat.

Fortunately, the poor quality of the mirror caused appreciable divergence of the beam and alignment was therefore not critical. So, provided the ray illuminated the disc, signaling was satisfactory.

My friend never got around to using the shaving mirror system; instead, he used a hand-held mirror with a sighting cane and disc similar to mine. During signaling he manually directed the reflected beam on the disc for shorter or longer periods so as to represent Morse code characters. Signaling was slow but readable.

The intensity of the flashes observed at both stations indicated that range, even with a poor quality shaving mirror or hand mirror could have been considerably greater than the three miles separating Lower Farm from Dost Hill.

East/West

Signaling between Lower Farm and Dost Hill was facilitated because the line of sight was approximately north/south so during mid morning and afternoon, the sun was more or less at right angles to both stations.

Had Dost Hill been to the east of Lower Farm, signaling with a single mirror would have been impossible during afternoons with the sun when the reflected beam would have the same alignment. But, as we will see, the heliograph overcame this problem by employing a 'duplex' mirror. See Figure 7 & Photos 5a and 5b.

Voice Modulation

Now that I was able to maintain the reflected beam on a distant fixed point as the sun traversed the sky, I was able to experiment with my reproduction Bells circa 1880 Radiophone where the reflected beam was modulated with voice signals and demodulated by a photo electric cell at the distant station.

Interestingly, the 1944 German Modulated-Light-Beam Apparatus (Photophone) which ordinarily employed an incandescent electric lamp as the light source, also had an attachment so that the sun could be used as the light source. More about modulating the light beam in part 2.

Setting Up A Station

There were two types of heliograph. Let us first consider the type where during setting up, the distant station is viewed directly through an unsilvered circle in the centre of the mirror. This generally applied to instruments with 9in and 12in mirrors. Setting up was by using the integrated sighting arm and rod but was essentially the same as with my schoolboy system. See Figure 2.

With the other type of heliograph, the keying mechanism obscures the unsilvered circle so alignment was by viewing the distant station via the reflection from the mirror. This applied to the more common 5in and rarer 3in instruments, and incidentally to my heliograph. See Photo 4 & Figure 3.

Army manuals treat setting up a heliograph station as a precision drill which enabled a station to set up and be operational very quickly; indeed, a highly proficient team could set up a station in 60secs.

My Method

When setting up, account has to be taken of the traverse of the sun and whether the duplex mirror would be required immediately or later. For now, let us assume that the duplex mirror will not be required.

With my own heliograph, the keying mechanism precludes viewing the distant station through the unsilvered circle. So, after the various clamps securing the sighting arm and vertical rod are loosened, I stand in front of the instrument and position my head between the mirror and

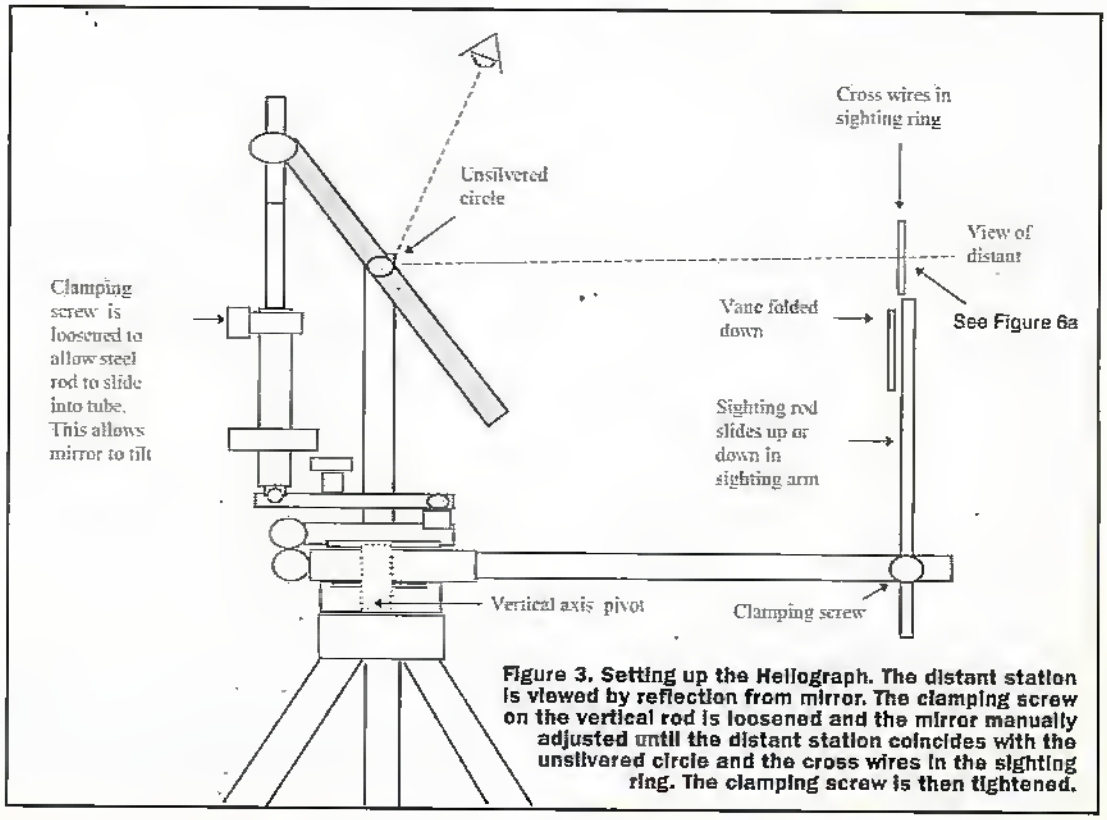


Figure 3. Setting up the Heliograph. The distant station is viewed by reflection from mirror. The clamping screw on the vertical rod is loosened and the mirror manually adjusted until the distant station coincides with the unsilvered circle and the cross wires in the sighting ring. The clamping screw is then tightened.

the sun; I then adjust the mirror so as to observe the distant station through reflection from the mirror. See Figure 3.

The sighting arm is then swung around so as to be in line with the distant station and the clamp tightened. See Figure 5. The sighting rod is then inserted in the end of the sighting arm with the vane folded down so as to expose the aperture and cross wires. See Figure 6a

Whilst still viewing the distant station through refection from the mirror, the height of the sighting rod is adjusted so that the cross wires cover the distant station. The clamp is then tightened and the sighting vane raised - Figure 6b. Standing behind the instrument, I now manipulate the mirror by hand so that the brown spot (caused by the unsilvered spot) falls on the vane at the 'at rest' mark, i.e. the point at which the brown spot falls when the key is not pressed. See Figure 6c.

There are two 'at rest' marks, the upper one is for long range signalling and the lower one for shorter ranges. Obviously, a greater depression angle is required at shorter range to prevent light being seen at the distant station.

The beat adjustment screw (see Figure 4) is then adjusted so that when the 'key' is pressed and the mirror tilts backwards, the brown spot falls on the signalling mark. See Figure 6b. The beam is then directed to the distant station. With short range signalling, the beat is obviously greater than with long range signalling.

Duplex Mirror

The duplex mirror, (Photos 5a and 5b) has the sighting vane inserted in its centre which replaces the sighting vane on the sighting rod. During alignment, the distant station is viewed through both mirrors which are adjusted so that sighting mark coincides with the distant station. The duplex mirror is then clamped in position and all further adjustments are made with the signaling mirror. Figure 7 shows the principle of its operation.

Keying

During keying, the brown spot is maintained on the sighting mark by constantly adjusting the vertical and horizontal angle of the signaling mirror as the sun traverses the sky.

Adjustment of the mirror's horizontal axis is by rotating the knurled collar which also serves as the key whilst adjustment of its vertical axis is by the worm drive knob. Signalling is therefore a two-hand job and adjusting the mirror whilst keying requires considerable concentration by the operator.

MORE NEXT MONTH

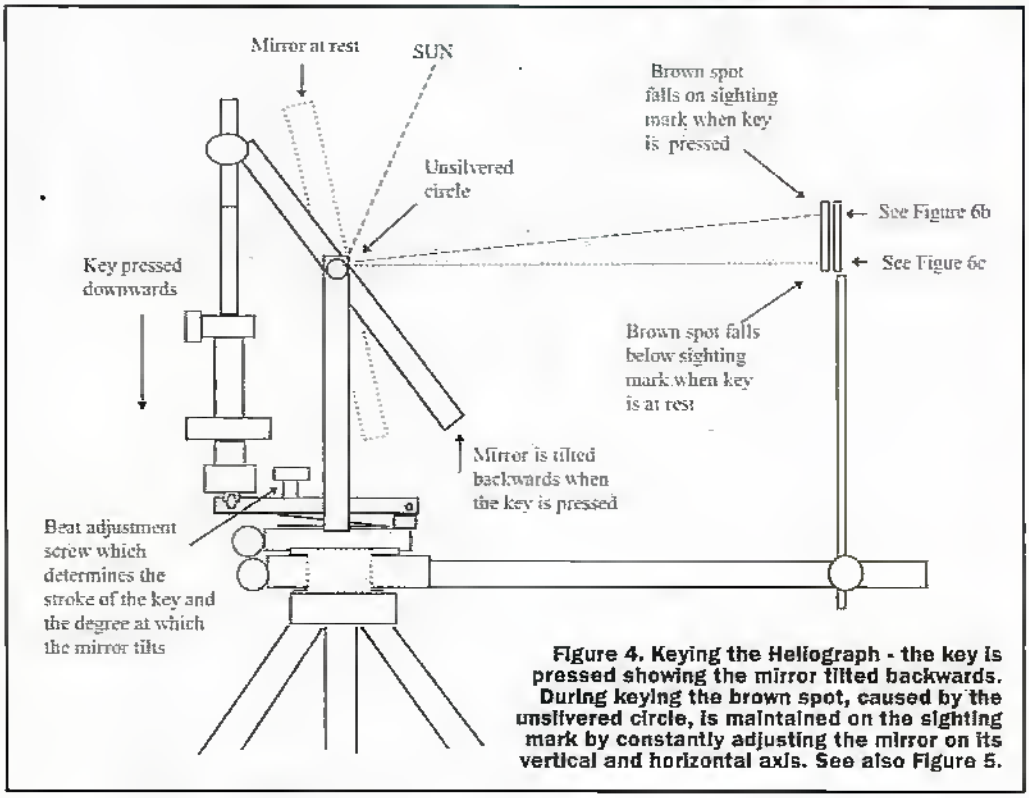


Figure 4. Keying the Heliograph - the key is pressed showing the mirror tilted backwards. During keying the brown spot, caused by the unsilvered circle, is maintained on the sighting mark by constantly adjusting the mirror on its vertical and horizontal axis. See also Figure 5.

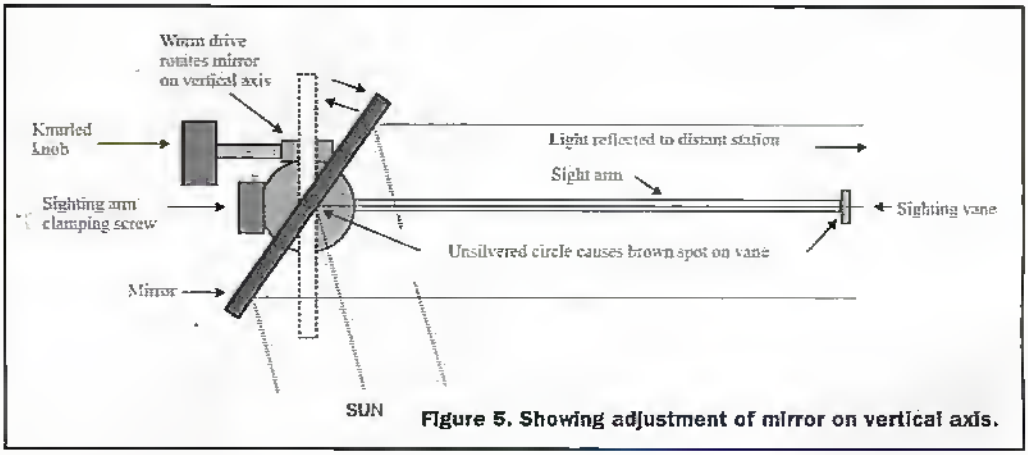


Figure 5. Showing adjustment of mirror on vertical axis.

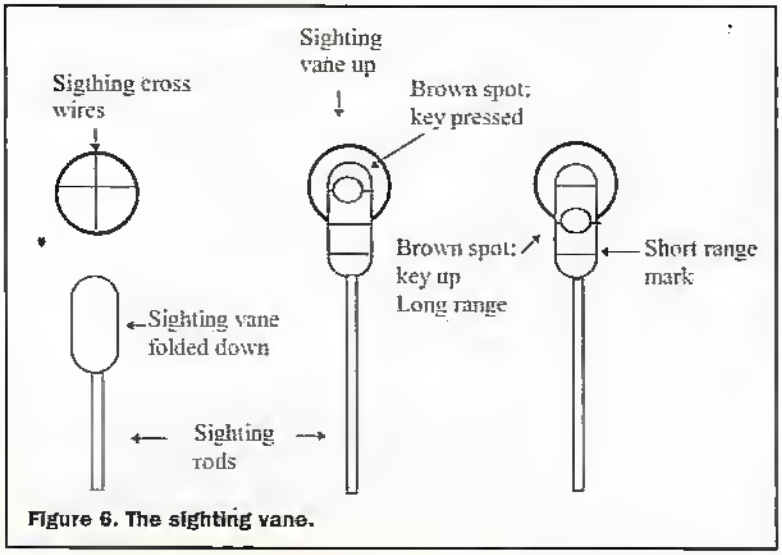


Figure 6. The sighting vane.

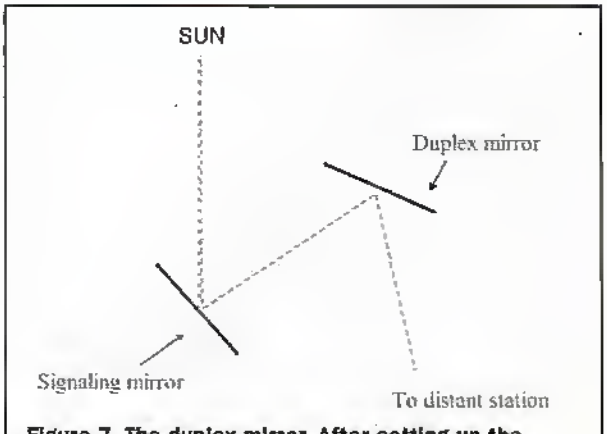
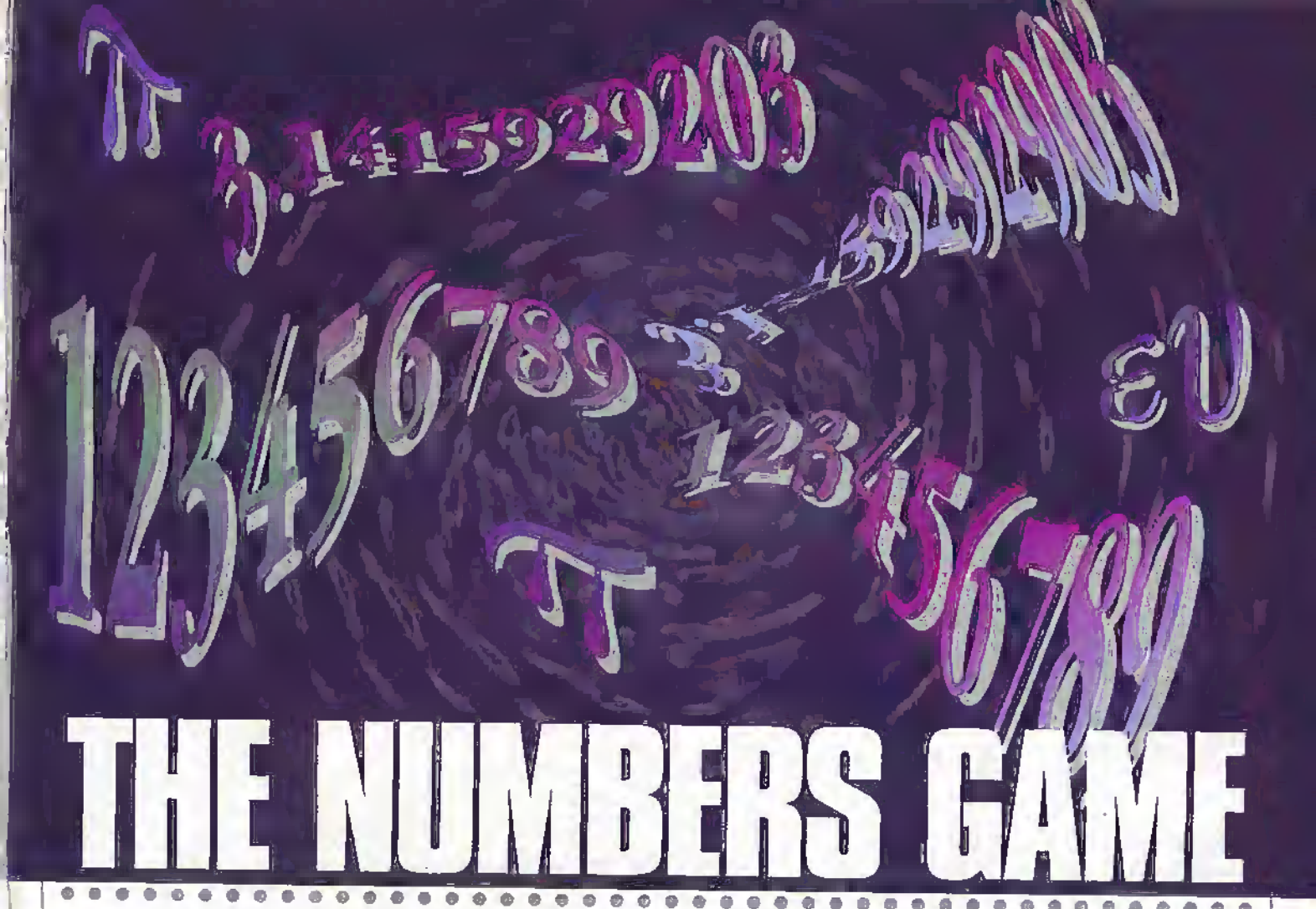


Figure 7. The duplex mirror. After setting up the duplex mirror is clamped and all adjustments to compensate for the transverse of the sun are made with the signalling mirror. A sighting vane is inserted in the centre of the duplex mirror - see Photo 5.



THE NUMBERS GAME

This month Gregg Grant looks at how Perfect, Prime, Imaginary, Irrational and Binary numbers came about.

Introduction

The words associated with numbers - from the Latin *numerus*, meaning exactly that - baffle many people, even those whose work involves manipulating them, such as electronics and electrical engineers. How - for example - did we come by Perfect Numbers, Prime Numbers, Imaginary Numbers, Irrational Numbers and Binary Numbers?

In the case of all but the last example, largely from the ancient Greeks. If there was one mental activity that the Greeks of classical times enjoyed, it was playing games with numbers, rather in the way we - today - enjoy crossword puzzles. One such game involved the addition of the factors of a particular number.

Perfect Numbers

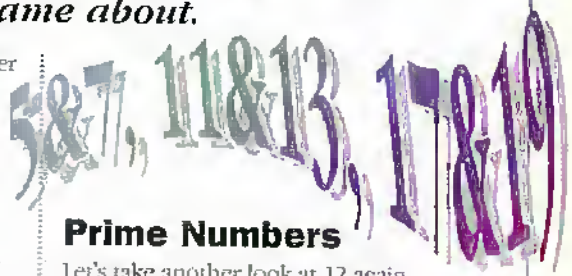
Let's look at the number 12. Its factors are 1, 2, 3, 4 and 6. In other words 12 is divisible exactly by these numbers. The sum of these factors however is 16, which is greater than 12 itself, and so the Greeks termed it an *abundant* number, from the Latin *abundare*, meaning 'abound.' The number 10 on the other hand had factors - 1, 2 and 5 - which added up to 8, a figure less than the number itself. This number the Greeks termed a *deficient* number, from the Latin *deficere*, meaning to 'desert, or 'fail.'

The number 6 however was different again. It had factors of 1, 2 and 3, which added up to the number itself. To the Greeks therefore, 6 was a Perfect Number, from the Latin *per*, meaning 'through' and *facere*, meaning 'to do.'

Another example of a Perfect Number is 28. This number's factors - 1, 2, 4, 7 and 14 - add up of course to 28. By AD 105 or thereabouts, Nichomachus of Gerasa had listed the four known Perfect Numbers, namely 6, 28, 496 and 8128. In 1460 the fifth such number - 33,550,336 - was found, although who made the discovery is unknown. Another seventy six years would pass before Hudalrichus Regius, in his book *Utriusque Arithmetices*, would publish the number.

A further seventy six years on the Italian mathematician Pietro Cauldi discovered the sixth and seventh Perfect Numbers, which are 8,859,869,056 and 137,438,691,328 respectively. By the time the computer had come along, mathematicians had developed formulae for searching for Perfect Numbers. As a result, twenty-one Perfect Numbers are now known. The twenty-first, finally worked out in 1971, has no less than twelve thousand and three digits!

There's no practical use for such numbers of course; they are simply a mathematical curiosity.



Prime Numbers

Let's take another look at 12 again. It can be divided by 2, 3, 4 and 6 and each of these numbers are a factor - from the Latin *facere*, meaning 'to make' or 'to do' - because out of such small numbers a larger one can be made. Equally, there are numbers which have no factors apart from themselves and the number 1. Moreover, numbers of any size can be in this state. Such numbers are known as Prime Numbers or simply Primes, from the Latin *primus*, meaning 'first.'

They're called this so that numbers that aren't Primes can be split up into Prime Factors. 12 for example can be written as 3 x 2 x 2, the number 2 being the only even Prime. All the other even numbers can, of course, be divided by 2 and therefore have that as a factor. Consequently such numbers are not Prime Numbers.

A Prime Number therefore is a number that can't be expressed as the product of two numbers other than itself or 1.

The number 15 for example can be found from multiplying 5 by 3; the number 143 by multiplying 11 by 13 and the number 370 by multiplying 37 by 5 by 2. These numbers, with factors, are termed Composite

Numbers, from the Latin com, meaning 'together,' and ponere, meaning 'to place.' They are, in short, assembled by placing together small numbers.

There is another way of identifying Prime Numbers. Any number, whatever its length, that ends in 2, 4, 5, 6, 8 or 0, whose digits add up to a resultant divisible by 3, is NOT a Prime Number. As long ago as 300 BC, the Greek mathematician Euclid demonstrated that no matter how high you go, there must be Prime Numbers higher still. Therefore the number of Prime Numbers is infinite, a word we'll look at more fully later.

Another oddity concerning Prime Numbers is that, every so often, there are pairs of consecutive odd numbers, both of which are Prime. Examples are 5 & 7; 11 & 13; 17 & 19; 29 & 31; 41 & 43. And such pairs exist the higher up the scale you go. So: are there an infinite number of those also? Frankly, no-one knows, which is one reason why mathematicians are fascinated by Prime Numbers, despite their being every bit as useless as Perfect Numbers!

Imaginary Numbers

If there's one factor associated with numbers it's solidity, reality. A number, dammit, stands for something *tangible*, something that's *there*. Given this, how can you have an Imaginary Number?

The best way to answer this question is to point out that many mathematical concepts long thought of as ancient, are surprisingly recent. In fact, imaginary numbers have been around since AD 62 or thereabouts, when they were first identified by the mechanical engineer Hero of Alexandria. However, until the middle of the fourteenth century they were either ignored, or considered an aberration. Of the two kinds of numbers long familiar to us - positive and negative - the latter too were introduced only in the Middle Ages, so that problems such as 3 - 5 could be sorted out.

Before medieval times it appeared impossible - for example - to subtract 5 oranges from 3 oranges. At this time banking, in the hands of the Lombards - London's Lombard Street is but one of their legacies - was becoming established practice and there was one aspect of their business these money men were very clear about: debt.

The bankers looked at the orange problem as one of debt. If, let's say, you were given 5 apples but only had sufficient money to pay for 3, then you'd owe money on the other two. Which is the same as saying [+3] - [+5] = [-2].

Both these numbers can, of course, be multiplied although the rules for doing so are tight. A positive number, multiplied by another positive number, gives a positive result. Equally, a negative number, multiplied by another negative digit, gives a positive result. However, a negative number multiplied by a *positive* number gives a *negative* result. We can say, therefore that:

$$[+1] \times [+1] = [+1] \quad \text{Eq 1.}$$

$$[+1] \times [-1] = [-1] \quad \text{Eq 2.}$$

$$[-1] \times [-1] = [+1] \quad \text{Eq 3.}$$

So far, so good. Let's now hypothesise - from the Greek *hupothesis*, meaning 'foundation,' which is really little more than saying 'let's suppose' - for a moment. Which number, multiplied by itself, would result in +1? Put another way, what's the square root of +1?

From our own little bit of maths above, there are obviously two answers: equations 1 and 3. In short, $\sqrt{+1} = \pm 1$. Now this is fine where +1 is concerned, but what number could possibly be the square root of -1? One thing's certain: it can't be ±1, nor can it be itself. The solution mathematicians came up with was an Imaginary Number, from the Latin *imago*, relating to '*imitate*.'

The symbol I was designated to represent the square root of -1 by the Swiss mathematician Leonhard Euler, in 1777. This was but one of Euler's many contributions to mathematical symbolism, the majority of which are summarised in Figure 1, below.

∫n: for the sum of the Divisors of n.
e: for the base of natural logarithms
a, b and c for the sides of a triangle
A, B and C for the opposite angles of a triangle
'F': the letter and parenthesis for a function
I as the symbol for $\sqrt{-1}$.
Σ: for the sum.

Figure 1. The mathematical symbols introduced by Leonhard Euler.

Another familiar representation for the square root of -1 - certainly to those of us in electrical and electronic engineering - is the designation *Operator j*, from the Latin *operari*, meaning 'to work.'

Actually I and Operator j are no more imaginary than so-called 'real' numbers such as - in electronics - 0.707 and 1.414, since they can be manipulated with the same facility as the numbers long familiar to us. One thing's certain: many concepts in our respective fields would be a great deal more difficult to grasp without Imaginary Numbers.

Vectors

Another form of Imaginary Number is Vectors, from the Latin *rehere*, meaning to 'convey' or 'to carry.' Vectors are also referred to as *Complex Numbers*, from the Latin *com*, meaning 'together,' and *plectere*, meaning 'to braid,' thus giving *complecti*, meaning 'to entwine.' The earliest laws for manipulating these entwined digits date from the time of Galileo, who first formulated the simple Parallelogram Law for combining forces, based on the Parallelogram of Forces, worked out by the Dutch physicist Simon Stevin, in the early years of the seventeenth century.

The next step forward was taken by John Wallis, probably the most able and influential British mathematician before Isaac Newton. In his *Treatise on Algebra of 1685*, he anticipated the concept of Complex Numbers, although such equations wouldn't be termed that until 1832, when Karl Friederich Gauss suggested this description for them.

The modern development of Complex Numbers only reached a satisfactory state with the work of the Norwegian surveyor Caspar Wessel. In 1798, he published - in the Transactions of the Danish Academy - the technique of representing Complex Numbers in the co-ordinate plane. Unfortunately, Wessel's work received no recognition, and the world had to wait another eight years for the interpretation to be re-discovered by another Swiss mathematician, Jean-Robert Argand.

In his *Essay on a Method of Representing Imaginary Quantities in Geometric Construction*, Argand used Complex Numbers to show that all algebraic equations have roots, as well as introduce the Argand Diagram. This last - now long familiar to those involved in electronics generally - was a representation of Complex Numbers as points in the co-ordinate plane.

Current vector analysis was developed by the American mathematician and physicist J. Willard Gibbs, in his *Elements of Vector Analysis*, published in 1881.

Irrational Numbers

The Shorter Oxford Dictionary views such numbers as 'not commensurable with the natural numbers, not expressible by an ordinary (finite) fraction but only by an infinite continued fraction or an infinite series.' Fair enough: but what sort of numbers are we talking about here?

Sometime between 400 and 390 BC the Greek mathematician Theodorus of Cyrene - who taught Plato mathematics - demonstrated that the square roots of 3, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15 and 17 were irrational.

To somebody not involved with mathematics, this simply means that the numbers are the opposite of rational, or reasonable, since this is what rational means in everyday vocabulary. In itself this is - if not irrational - certainly incorrect. The word is, in fact, derived from *ratio*, itself derived from *rationalis* and ultimately from the verb *reri*, meaning 'to think.' Hence the confusion.

A square number is the result of multiplying a number by itself, one example of which is: 5 x 5 = 25. That's to say that 25 is the square of 5. Conversely, 5 is the square root of 25. In this example I've chosen a whole number to simplify matters, but a square root may not be a whole number.

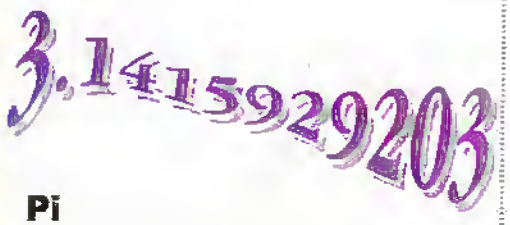
Generally speaking it isn't, it quite frequently being an endless decimal, a good example of which is the square root of 2. '$\sqrt{2}$' - pronounced 'root two' - is usually taken to be 1.414 and its reciprocal, $1/\sqrt{2}$, @ 0.707. Why are those numbers so important

in electrical and electronic engineering? It's all to do with the effective value of an electric current. If, for example, a direct or dc current of 1A flowing through a resistance of RΩ, the resulting energy - manifesting itself as heat - would amount to I²R watts.

'Direct' of course means exactly that. An alternating, or ac, current of 1A wouldn't produce as much heat as its dc equivalent, since it doesn't maintain a constant value. Now the *effective value* of a sine wave of current can be calculated with reasonable accuracy by sampling. That is by taking equally spaced instantaneous values of current and then calculating the square root of their mean, squared, values. It's for this reason that the *effective value* is generally termed the *Root Mean Square* or RMS value.

The figures associated with this exercise are not so much well known, more branded in the mind, of all who are involved in electrical and electronic engineering. The exact *effective value* of an ac current or voltage is $1/\sqrt{2}$ or 0.707 times the maximum value. Conversely, the maximum value of an ac current or voltage is $\sqrt{2}$ or 1.414 times the effective value.

One of the most used irrational numbers has also to do with a ratio, this time one concerning one of the essential shapes in the universe: the circle.



Pi

On the face of it Pi – far more familiar to electrical and electronics scientists and engineers by its lower case Greek letter π - is simply the sixteenth letter in an alphabet used rarely enough these days. In fact one familiar only to scholars in the more esoteric fields of ancient languages and others whose disciplines use mathematics on a regular basis.

However, there's far more to this letter than its image implies. For starters a whole book has just been written about it and its influence on mathematics. Secondly of course, it has – for almost four centuries now - been the symbol for the most enduring irrationality in mathematics: the ratio between the circumference and the diameter of a circle.

By 260 BC the Greek genius Archimedes - the greatest engineer of antiquity - had arrived at a figure of 3.142 for this ratio, a result most of us are more than happy with in our own calculations. The Greeks knew that the curve of a circle - any circle - is slightly more than three times as long as the circle's width. They attempted to work out the precise ratio of the *perimetron* - the measurement around the circle - to the *diametron*, the measurement through it.

It was Archimedes who reasoned that this ratio was greater than 310/71 but less than 310/70 which, of course, works out at roughly the figure so long familiar to us. Today of course, *perimetron* and *diametron* have long been known as the 'perimeter' and 'diameter' respectively.

The Chinese too knew of this irrationality and about AD 200, the mathematician Liu Hui calculated the ratio to 3.14159. He used polygons of up to 3,072 sides in his calculations. Some two and a half centuries later the mathematician Tsu Ch'ung-Chih and his son Tsu Keng-Chih calculated the ratio to 3.1415929203, using a circle three metres across.

There matters rested until 1596, when the Dutch mathematician Ludolf van Ceulen worked out the ratio to 20 decimal places. Later, he'd push his achievement to 35 decimal places. Four years later the English mathematician William Oughtred - who would subsequently give the world the Slide Rule - used the Greek letter π to designate the ratio of a circle's circumference - from the Latin *circum*, meaning 'around' - to its diameter. It was - naturally - the first letter in *perimetron* and, ever since, has become the one letter of the Greek alphabet familiar to virtually everyone!

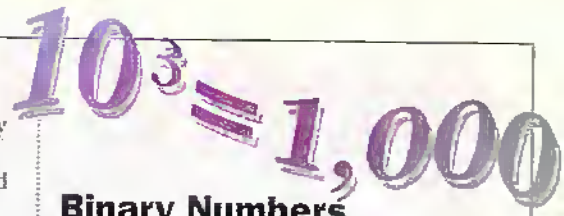
In 1717 the English mathematician Abraham Sharp extended van Ceulen's achievement to 72 decimal places. By 1955 computers had taken over and one model worked out π to over 10,000 places in 33 hours of number-crunching! The sort of task that hints at the ultimate irrationality: infinity.

Infinity

The vast majority of things - even our world itself - have, or at some time will have, an ending. Occasionally in the cinema, the last foot or so of the film you've been watching will show the word *finis*, the Latin word for 'end.' Therefore things that come to an end are said to be finite, from the Latin *finitus*, meaning 'limited.'

However, by no means all things finish, or terminate. A good example, which we looked at earlier, is π. If you were to go on calculating this ratio, you'd find there was no end to your calculating. Put another way π - as a number - isn't finite: it's infinite. The Latin prefix *in* means 'not' which, when added to *finitus*, gives 'not limited' or, in plain English, 'infinite.

"So what sort of reading are we looking at here: infinity?" a colleague asks, implying that symbol ∞ - first introduced by John Wallis in 1685 – is a number, when it isn't. Nevertheless we all - scientists, mathematicians, engineers and technicians - use ∞ to mean exactly that, which is incorrect. However, if ∞ represents anything it's the condition of endlessness. There is of course another, certainly mathematical, way of looking at infinity, and that is as the reciprocal - from the Latin reciprocus, meaning 'alternating' - of zero.



Binary Numbers

Before we get into binary -which comes from the Latin *binarius*, meaning 'two at a time' - let's get a clear understanding of what 'ordinary numbers' are. Those numbers so long familiar to most of us are based on the figure 10: they're '10-based' in short. This means that - using the impending millennium as an example - when we talk of 2,000 we're talking of 2x10³ plus 0x10² plus 0x10¹ plus 0x10⁰ where 10^3 = 1,000; 10^2 = 100; 10^1 = 10 and 10^0 = 1. Which means that 2,000 is 2x1,000 + 0x100 + 0x10 + 0.

To us, thanks no doubt to our 10 fingers, 10-based numbers are part of the very fabric of our being. So much so in fact that we simply write the numbers being multiplied within the system - in this example 2,000 - and think no more about it.

Base 10 of course is by no means the only base in mathematics. The *duodecimal* system - base 12 - has a number of historical and language precedents and roots, not least the words 'dozen' and 'gross' - in other words [12]² - as well as denoting the hours on a clock face.

The *vigesimal* system on the other hand has a base of 20, whilst the *sexagesimal* system has one of 60. This last - the basis of time-keeping and angular measurement - was one of a number of breathtaking mathematical developments of the Sumerians, as long ago as 2,400 BC. Indeed electronic navigational aids would be impossible without this system, which gives us:

60 seconds = 1 minute
60 minutes = 1 degree.

Binary notation however really began in 1678, when the Saxon genius Gotfried Leibniz, in a letter to the Jesuit Joachim Bouvet, introduced the concept of representing every number by the symbols 1 and 0. Leibniz in fact was the first - and greatest - advocate of the base-2 system. To him 1 was quite literally God and 0 the Abyss!

In any system, the value of the base equals the number of different digits, including zero. The smaller the base, the fewer different digits there are, but the greater the total digits. There are - as we noted earlier - 10 digits in the base-10 system and a mere two in the base-2 system.

Let's look at the number 1101. In the base-2 system, this would be [1x2³] + [1x2²] + [0x2¹] + [1x2⁰] or 13, in the base-10 system. Writing the numbers in order in the base-2 system gives us 1, 10, 11, 100, 101, 111, 1000, 1001 and 1010. Therefore despite multiplication and addition being much simpler in the base-2 system, the number of digits is such that the human mind becomes confused. Not so a computer, which is why binary numbers are the staple diet of the world's number-crunchers.

Next time, we'll look into how some of science and technology's biggest machines got the names, acronyms and initials they've been lumbered with.

COMMENT

by Keith Brindley

An interesting report has surfaced, conducted by the IT analyst company Ovum, which points the way forward in telephone communications and the Internet. According to the report, by 2005 the majority of the world's telephone systems will be data networks - rather than the existing analogue-led communications networks of today which were devised and are run for mainly telephone communications. In other words, the Internet and its associated protocols will be the backbone for the telephone systems of the future.

What the report highlights is the fact that new telephone services are being developed that work over the Internet. These services are therefore known as Internet Protocol (IP) services - the idea being that an Internet user can talk with another Internet user, using the Internet rather than the conventional telephone. Currently, IP services are computer-driven, in that each user has to be logged on using the computer before the voice communications can work. Currently also, such services are pretty limited in their ability, because the link from the computer to the Internet is quite a slow one (usually a 56K modem or slower). However, Ovum reckons that over the next six years things will change.

First, the need for a computer to make the IP link will be sidestepped, as purpose-built telephones will do the job. Dialing another user will then be the IP equivalent of dialing existing telephone numbers.

Second, higher-speed links to the Internet will become the norm. Actually, IP telephony as a concept is pretty obvious, and this report merely goes over ground that long-term Internet users are already aware of, and many have been campaigning about for a while. The essence is that it's cheaper to communicate over the Internet than it is over the existing telephone network - at least for long-distance links. The problem at the moment is that while for email and Web browsing the Internet is an acceptable and highly usable medium, for IP telephony it's simply not quite there yet. IP telephony is a fairly technical process, and at the moment you have to know what you're doing to be able to use it effectively. Even if the technical aspects of IP telephone programs can be mastered, the quality of service is still pretty crummy. In the future, IP telephony will just become easier to carry out, that's all. And with faster links the quality of service will improve, so that it will become feasible to transmit video and well as sound - a complete and reliable videophone link with other users is well within the bounds of IP telephony. Several existing implementations demonstrate the power of it, but they're all let down by the network capabilities at the moment. Creating a network capable of allowing full and decent IP telephony is quite a challenge - though not by any means insurmountable.

Now, how telephone companies shape up to this challenge is another matter. Whether or not companies like British Telecom acknowledge the trend, the use of IP telephony is going to increase. While it's the computer geeks and nerds who use it at the moment, it's merely a matter of time before it becomes mainstream. The tools and programs that let individual users conduct IP telephone conversations are improving steadily, in both performance and ability. And of course it's this that's got BT and other operators running scared. If people can communicate around the world in such ways, all for the price of local telephone calls, then people aren't going to phone long-distance. Which means, of course, lower revenues from long-distance calls.

Effectively, the networks of today use digital communications merely as a way to move a telephone conversation from one end of the network to the other. The speech signals at one end are digitised then sent through the network to the other end where they are reverted to an analogue signal again. At all times the digital signal travels in a full and continuous stream. Internet protocols are different, in that they comprise packets of digitised data, created from the analogue voice signal. Packets are split up as they are routed over the network, and rejoined at the other end prior to conversion back to the analogue signal. Each method has advantages. The existing method is comparatively simple, whereas the IP method has an inherent problem with ensuring that packets reach their destination quickly enough to allow real-time conversations.

However, as networks improve generally - which, of course, they do with time and money - IP telephony makes more and more sense. Telephone communications have a large amount of redundancy (gaps between words, sentences, and so on are still transmitted), wasting system resources. IP telephony makes better use of these resources as significant compression can take place so that redundant interludes simply aren't transmitted.

What's called for is a radical change of thought by the telephone companies as much as radical improvements in the communications networks involved. After all, it makes more and more sense to utilise networks better, which is what IP telephony can do - and do well. It's just that telephone companies don't always see the wood for the trees when it comes to radical thinking. The idea that a loss of revenue might occur will be a prime concern, naturally. But long-term increased revenues brought about by a massive shift in the ability of us all to communicate on a world-wide basis simply and cheaply will actually be the result.

BT's no slouch of course. Research into IP is already underway within BT, and the necessary structural arrangements of the network could actually be implemented fairly quickly. It's just a pity that the push to do so will probably come because of other pressures, not because BT is forward-thinking. Cable operators are already looking into cable modems as a means whereby users can have fast Internet access for services such as IP telephony - cable modems allow data rates far in excess of BT's newest ISDN services. New IP telephone services are also beginning to sprout up in the current void. In an ideal world, telephone companies like BT would see the need for new services before they actually existed, and IP telephony would be already with us. Still if Ovum's report turns out to be true, the time's not far off anyway.

Checkout the Ovum Web site at <http://www.ovum.com> to get the Ovum white paper on the report, and to find further details about the report itself: IP: the Impact on Telco Services and Revenues.

Using 7-SEGMENT DISPLAYS

Ray Marston shows how to use 7-segment alphanumeric displays in this special 2-part feature. This opening episode describes basic operating principles.

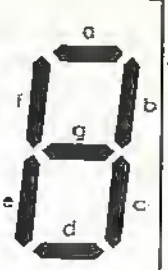


Figure 1. Standard form and notations of a 7-segment display.

7-Segment Displays

A very common requirement in modern electronics is that of displaying alphanumeric characters. Digital watches, pocket calculators, and digital multimeters and frequency meters are all examples of devices that use such displays. The best known type of alphanumeric indicator is the 7-segment display, which comprises seven independently-accessible photoelectric segments (such as LEDs or LCDs, or gas-discharge or fluorescent elements, etc.) arranged in the form shown in Figure 1. The segments are conventionally notated from a to g in the manner shown in the diagram, and it is possible to make them display any number (numeral) from 0 to 9 or alphabetic character from A to F (in a mixture of upper and lower case letters) by activating these segments in various combinations, as shown in the truth table of Figure 2.

Practical 7-segment display devices must be provided with at least eight external connection terminals; seven of these give access to the individual photoelectric segments, and the eighth provides a common connection to all segments. If the display is a LED type, the seven individual LEDs may be arranged in the form shown in Figure 3, in which all LED anodes are connected to the common terminal, or they may be arranged as in Figure 4, in which all LED cathodes are connected to the common terminal. In the former case the device is known as a common-anode 7-segment display; in the latter case the device is known as a common-cathode 7-segment display.

7-Segment Display/Drivers

In most practical applications, 7-segment displays are used to give a visual indication of the output states of digital ICs such as decade counters and latches, etc. These outputs are usually in 4-bit BCD (Binary Coded Decimal) form and are not suitable for directly driving 7-segment displays. Consequently, special BCD-to-7-segment decoder/driver ICs are available to convert the BCD signal into a form suitable for driving these displays, and are connected between the BCD signals and the display in the manner shown in Figure 5. The table of Figure 6 shows the relationship between the BCD signals and the displayed 7-segment numerals.

In practice, BCD-to-7-segment decoder/driver ICs are usually available in a dedicated form that is suitable for driving only a single class of display unit, e.g., either common-anode LED type, or common-cathode LED type, or liquid crystal displays (LCDs). Figures 7 to 9 show the methods of interconnecting each of these IC and display types.

Note that in the case of the LED circuits (Figures 7 and 8) if the IC outputs are unprotected (as in the case of most TTL ICs), a current-limiting resistor must be wired in series with each display segment (about 150R with a 5V supply, or 680R at 15V); most CMOS ICs have internally current-limited

Segments (Y= ON)							Display	Segments (Y= ON)							Display
a	b	c	d	e	f	g		a	b	c	d	e	f	g	
Y	Y	Y	Y	Y	Y		0	Y	Y	Y	Y	Y	Y	Y	8
	Y	Y					1	Y	Y	Y			Y	Y	9
Y	Y		Y	Y		Y	2	Y	Y	Y		Y	Y	Y	A
Y	Y	Y	Y			Y	3			Y	Y	Y	Y	Y	b
	Y	Y			Y	Y	4	Y			Y	Y	Y		C
Y		Y	Y		Y	Y	5		Y	Y	Y	Y		Y	d
Y		Y	Y	Y	Y	Y	6	Y			Y	Y	Y	Y	E
Y	Y	Y					7	Y				Y	Y	Y	F

Figure 2. Truth table for a 7-segment display.

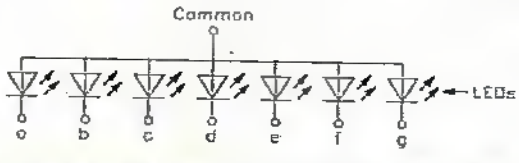


Figure 3. Schematic diagram of a common-anode 7-segment LED display.

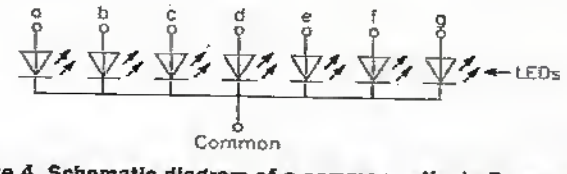


Figure 4. Schematic diagram of a common-cathode 7-segment LED display.

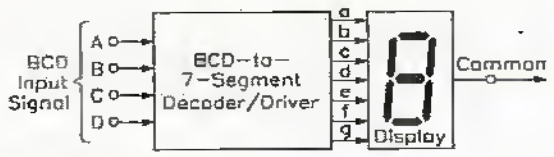


Figure 5. Basic connections of a BCD-to-7-segment decoder/driver IC.

BCD Signal				Display	BCD Signal				Display
D	C	B	A		D	C	B	A	
0	0	0	0	0	0	1	0	1	5
0	0	0	1	1	0	1	1	0	6
0	0	1	0	2	0	1	1	1	7
0	0	1	1	3	1	0	0	0	8
0	1	0	0	4	1	0	0	1	9

0 = logic low 1 = logic high

Figure 6. Truth table of a BCD-to-7-segment decoder/driver.

outputs, and do not require the use of these external resistors. To drive a common-anode display (Figure 7), the driver must have an active-low output, in which each segment-driving output is normally high, but goes low to turn a segment on. To drive a common-cathode display (Figure 8), the driver must have an active-high output.

In the Figure 9 LCD-driving circuit the display's common BP (back-plane) terminal and the IC's phase input terminals must be driven by a symmetrical squarewave (typically 30Hz to 200Hz) that switches fully between the two supply rail voltages (0V and +V), as shown. The full explanation for this is a little complicated, and is as follows.

To drive an LCD segment, the driving voltage must be applied between the segment and BP terminals. When the voltage is zero, the segment is effectively invisible. When the drive voltage has a significant positive or negative value, however, the segment becomes effectively visible, but if the drive voltage is sustained for more than a few hundred milliseconds the segment may become permanently visible and be of no further value. The way around this problem is, in principle, to drive the segment on via a perfectly symmetrical squarewave that switches alternately between identical positive and negative voltages, and thus has zero dc components and will not damage the LCD segment even if sustained permanently. In practice, this type of waveform is actually generated with the aid of an EX-OR True/Complement generator, connected as shown in Figure 10(a).

In Figure 10(a), the basic segment 'a' input drive (which is active-high) is connected to one input of the EX-OR element, and the other EX-OR input terminal (which is notated PHASE) is driven by a symmetrical squarewave that switches fully between the circuit's supply rail voltages (shown as 0V and +10V) and is also applied to the LCD display's BP pin. When the segment 'a' input drive is low, the EX-OR element gives a non-inverted (in-phase) 'a' output when the squarewave is at logic-0, and an inverted (anti-phase) 'a' output when the squarewave is at logic-1, and thus produces zero voltage difference between the 'a' segment and BP points under both these conditions - the segment is thus turned off under these conditions. When the segment 'a' input drive is high, the EX-OR element gives the same phase action as just described, but in this case the 'a' OUT pin is high and BP is low when the squarewave is at logic-0, and 'a' OUT is low and BP is high when the squarewave is at logic-1- the segment is thus turned on under these conditions.

Figure 10(b) shows the circuit waveforms that occur when the 'a' segment is turned on, with the 'a' segment and BP driven by anti-phase squarewaves. Thus, in part A of the waveform the segment is 10V positive to

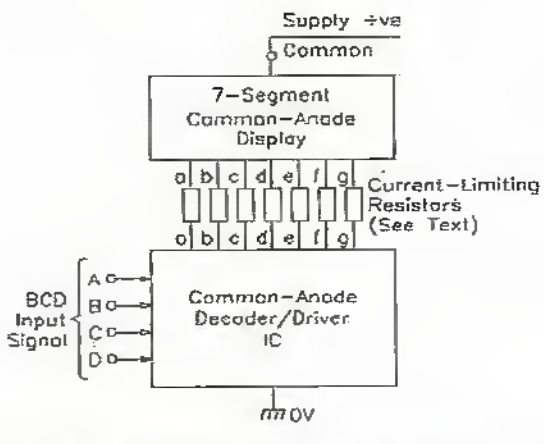


Figure 7. Method of driving a common-anode LED display.

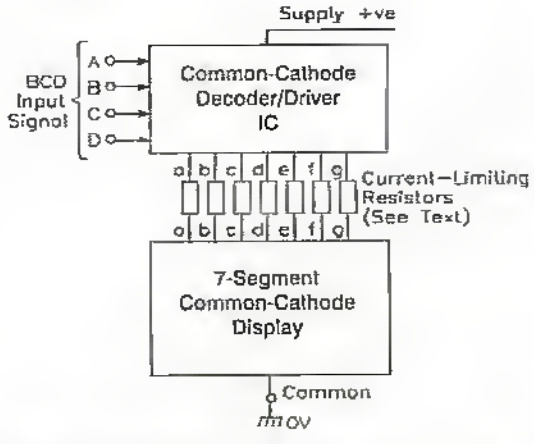


Figure 8. Method of driving a common-cathode LED display.

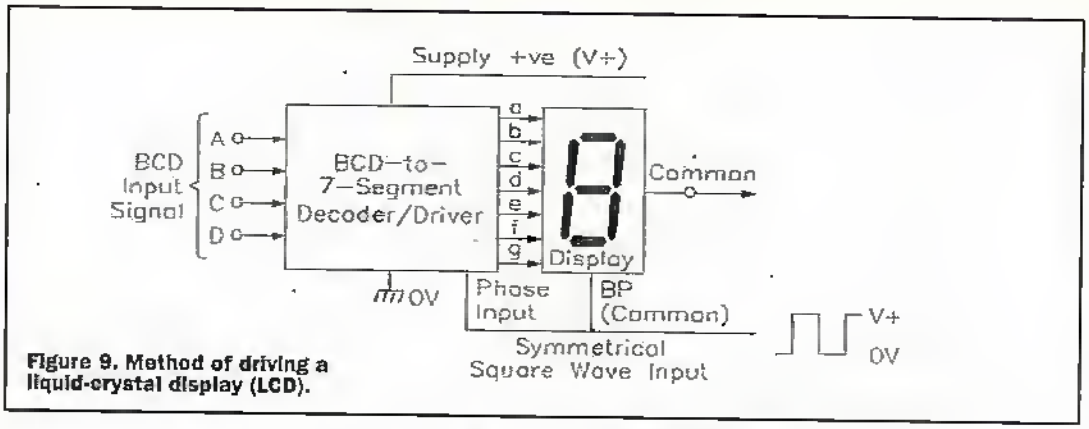


Figure 9. Method of driving a liquid-crystal display (LCD).

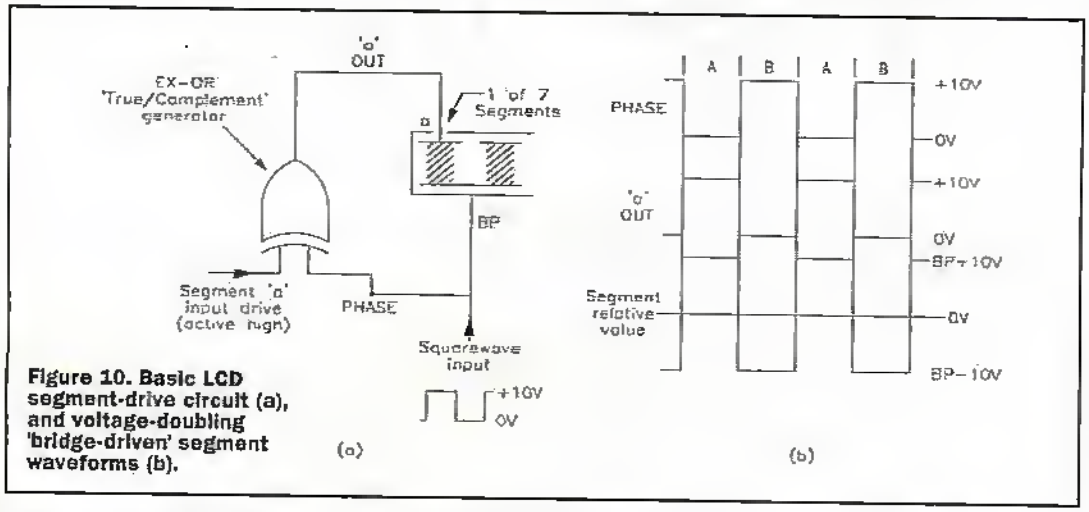


Figure 10. Basic LCD segment-drive circuit (a), and voltage-doubling 'bridge-driven' segment waveforms (b).

BP, and in part B it is 10V negative to BP, so the LCD is effectively driven by a squarewave with a peak-to-peak value of 20V but with zero dc value. This form of drive is generally known as a voltage-doubling 'bridge drive' system. In practice, many LCD-driving ICs (such as the 4543B) incorporate this type of drive system in the form of a 7-section EX-OR gate array interposed in series with the segment output pins, with access to its common line via a single PHASE terminal.

Note that any active-high 7-segment LED-driving decoder IC can be used to drive a 7-segment LCD display by interposing a bridge-driven 7-section EX-OR array between its segment output pins and the segment pins of the LCD display, as shown in Figure 11, in which a 74LS48 TTL IC is used in this specific way.

Cascaded Displays

In most practical 7-segment display applications, several sets of displays and matching decoder/driver ICs are cascaded and used to make multi-digit display systems. Figure 12, for example, shows a very simple way of using three sets of decoder/driver ICs and displays in conjunction with three decade counter ICs to make a simple digital-readout frequency meter. Here, the amplified external frequency signal is fed to the input of the series-connected counters via one input of a 2-input AND gate, which has its other (GATE) input waveform derived from a built-in timebase generator. The circuit's operating sequence is as follows:

When the timebase GATE input signal is low the AND gate is closed and no input signals reach the counters. At the moment that the timebase GATE signal switches high a brief RESET pulse is fed to all three counters, setting them all to zero count; simultaneously, the input gate opens, and remains open for a period of precisely one second, during which time the input-frequency pulses are summed by the counters. At the end of the one second period the gate closes and the timebase GATE signal goes low again, thus ending the count and enabling the displays to give a steady reading of that second's total pulse count (and thus the mean signal frequency). The whole process then repeats again one second later, when the timebase GATE signal again goes high.

Display Latching

The simple cascaded system described above suffers from a major defect, in that the display

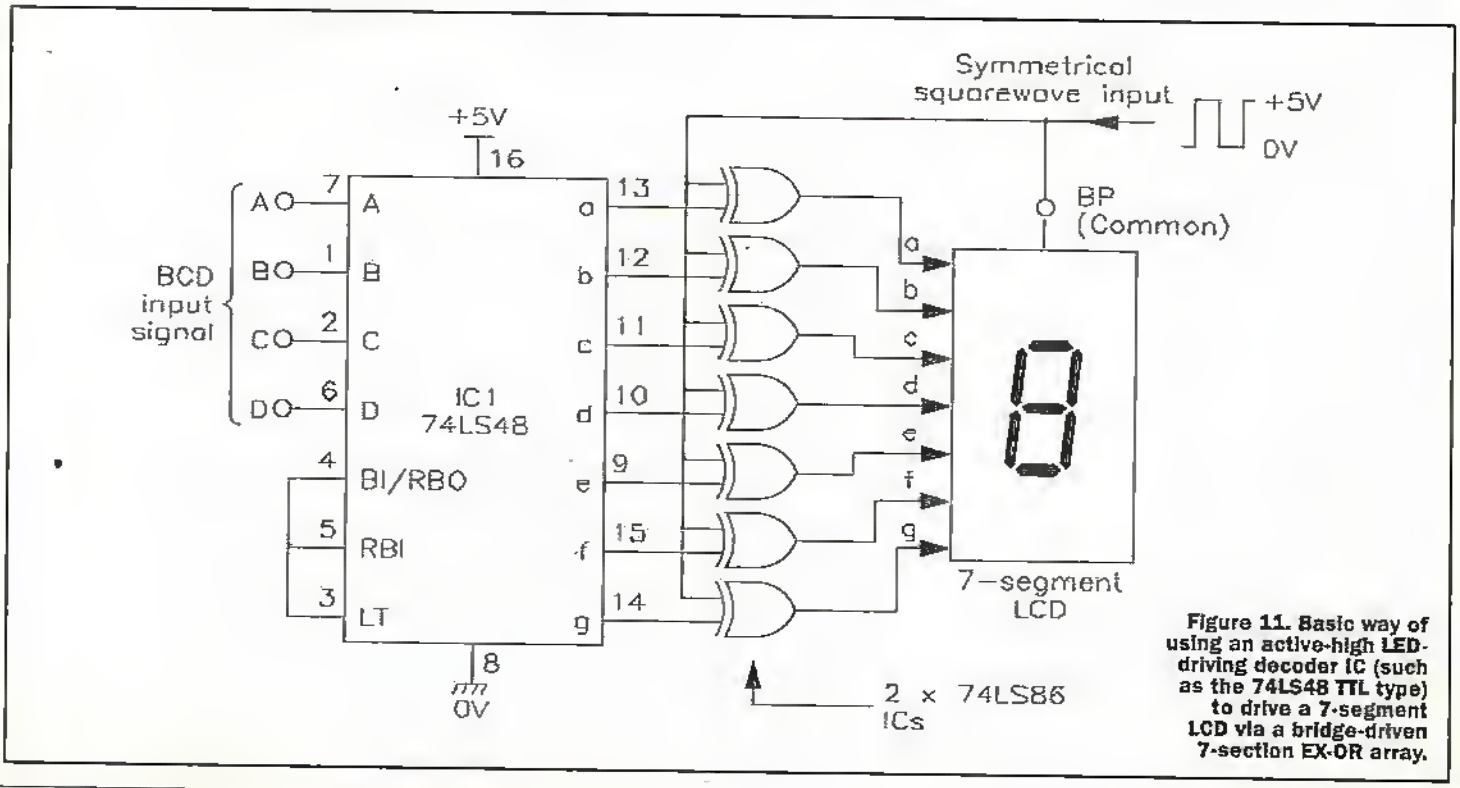


Figure 11. Basic way of using an active-high LED-driving decoder IC (such as the 74LS48 TTL type) to drive a 7-segment LCD via a bridge-driven 7-section EX-OR array.

becomes a blur during the actual counting period, becoming stable and readable only when each count is completed and the input gate is closed. This 'lure-and-read' type of display is very annoying to watch. Figure 13 shows an improved frequency meter circuit that uses display latching to overcome the above defect. Here, a 4-bit data latch is wired between the output of each counter and the input of its decoder/driver IC. This circuit operates as follows:

At the moment that the timebase GATE signal goes high a RESET pulse is fed to all counters, setting them to zero. Simultaneously, the input gate is opened and the counters start to sum the input signal pulses. This count continues for precisely one second, and during this period the 4-bit latches prevent the counter output signals from reaching the display drivers; the display thus remains stable during this period.

At the end of the one second count period the AND gate closes and terminates the count, and simultaneously a brief LATCH ENABLE pulse is fed to all latches, causing the prevailing BCD outputs of each counter to be latched into memory and thence fed to the display via the decoder/driver ICs, thus causing the display to give a steady reading of the total pulse count (and thus the input frequency). A few moments later the sequence repeats again, with the counters resetting and then counting the input frequency pulses for one second, during which time the display gives a steady reading of the results of the previous count, and so on.

The Figure 13 circuit thus generates a stable display that is updated once every second; in practice, the actual count period of this and the Figure 12 circuit can be made any decade multiple or submultiple of one second, provided that the output display is suitably scaled. Note that a 3-digit frequency meter can indicate maximum frequencies of 999Hz when using a one second timebase, 9.99kHz when using a 100ms timebase, 99.9kHz when using a 10ms timebase, and 999kHz when using a 1ms timebase. In reality, many decoder/driver ICs have built-in 4-bit data latches.

Multiplexing

Note from the Figure 12 and 13 circuits that a total of at least twenty-one connections must be made between the IC circuitry and the 7-segment displays of a

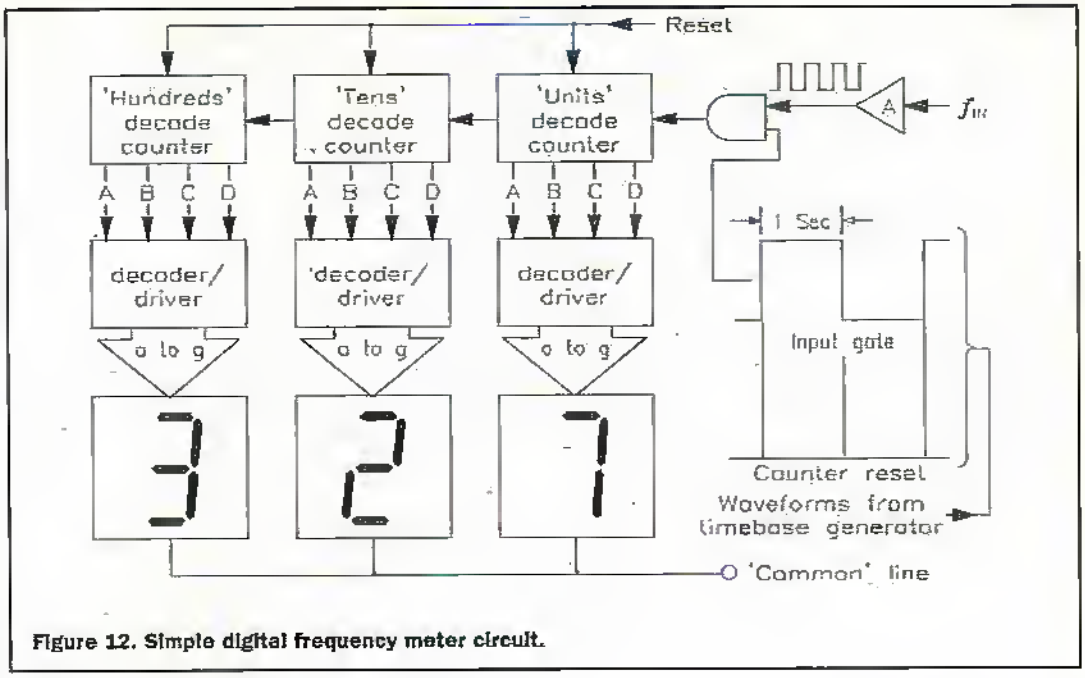


Figure 12. Simple digital frequency meter circuit.

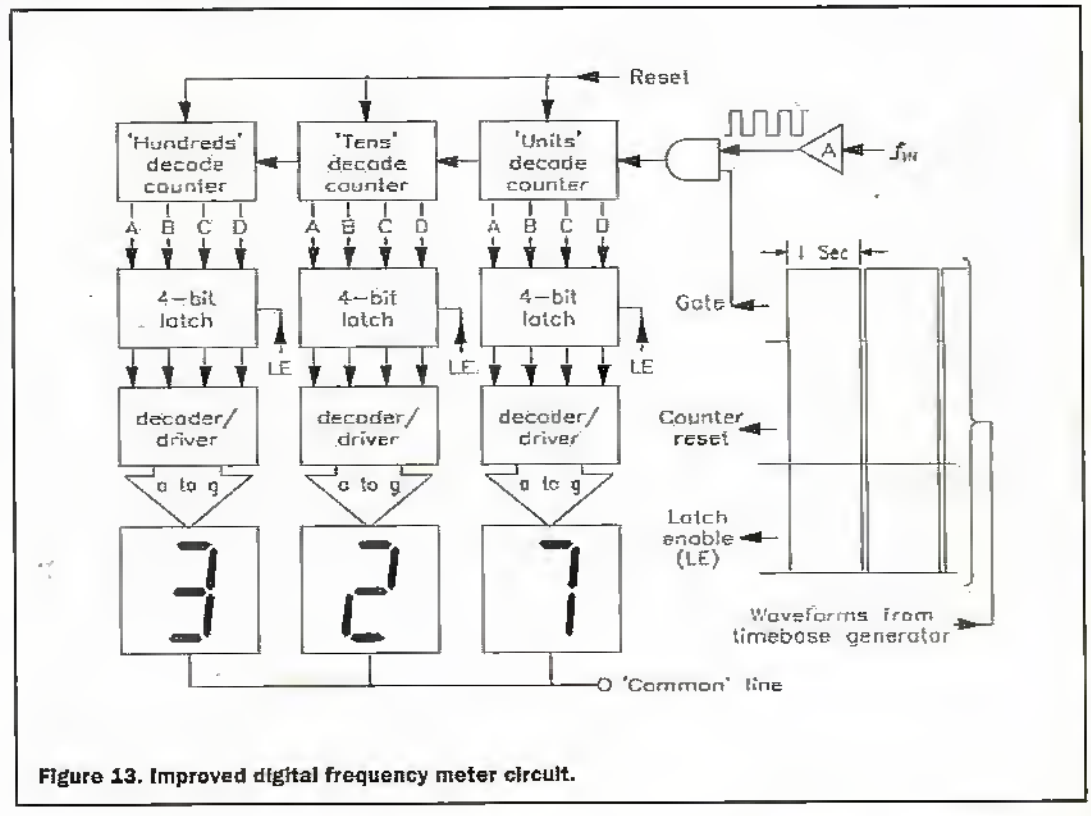


Figure 13. Improved digital frequency meter circuit.

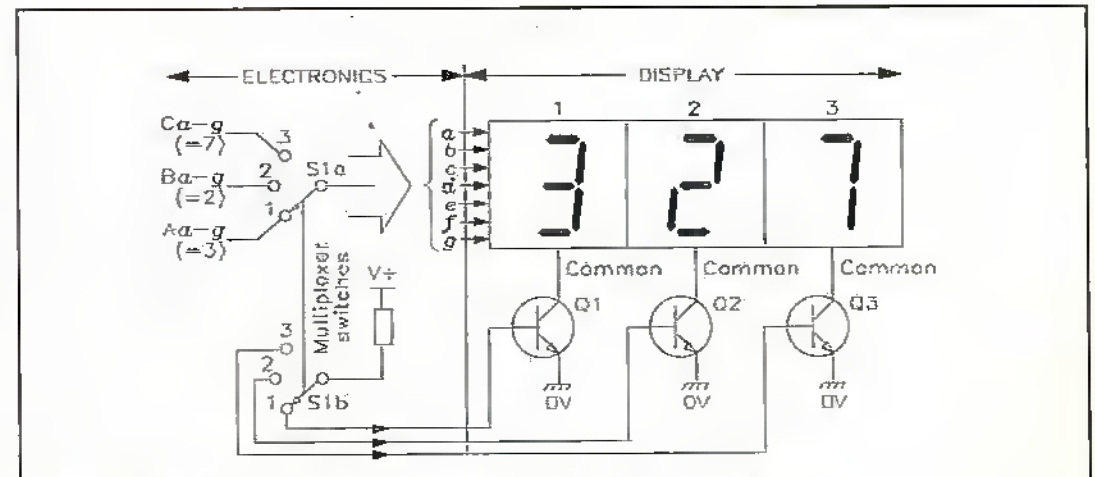


Figure 14. Method of multiplexing a 3-digit common-cathode LED display.

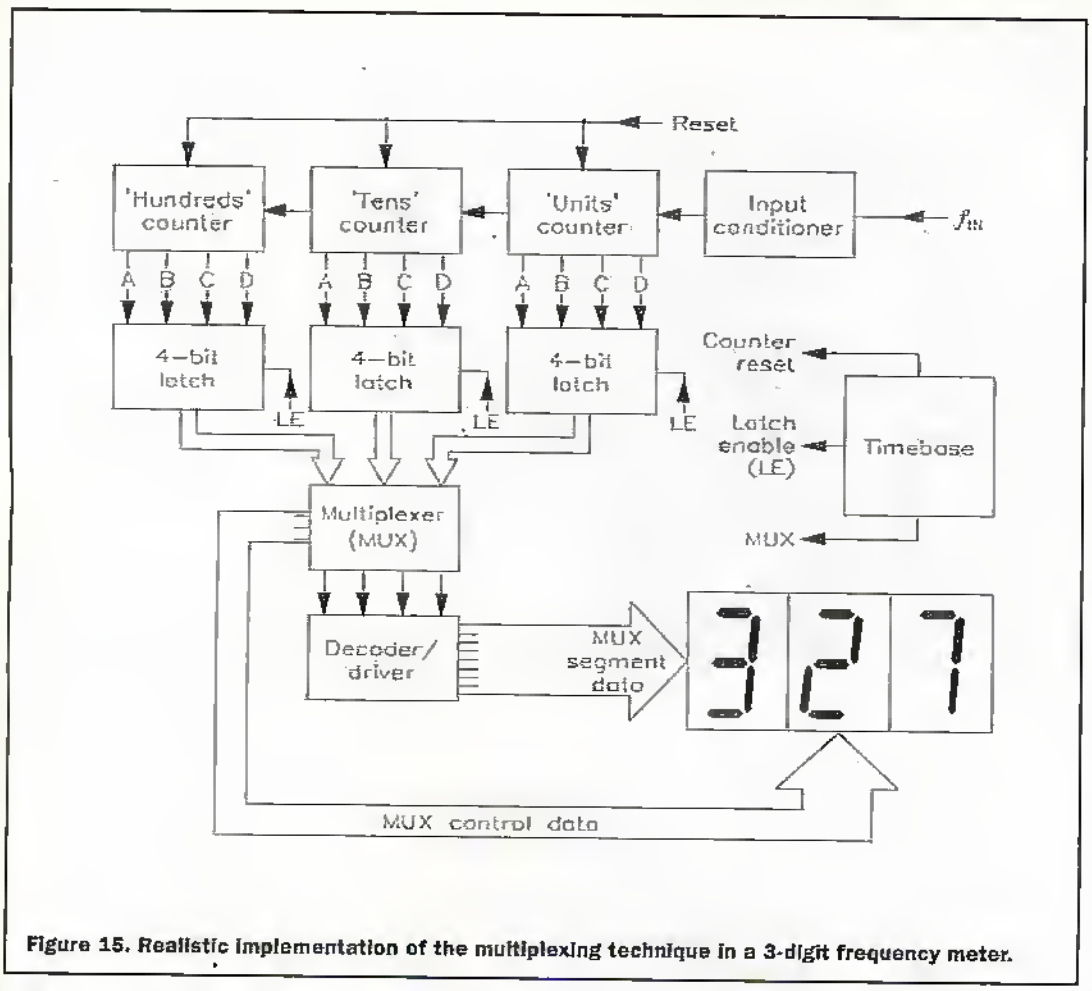


Figure 15. Realistic implementation of the multiplexing technique in a 3-digit frequency meter.

3-digit readout unit; a total of at least seventy connections are needed if a 10-digit display is used. In reality, the number of IC-to-display connections can be greatly reduced by using the technique known as multiplexing. This technique can be understood with the aid of Figures 14 and 15.

Figure 14 shows how each digit of a 3-digit common-cathode LED display can be individually activated using a total of only ten external connections; the circuitry to the left of the dotted line should be regarded as 'electronic', and to the right of the line as 'display' circuitry. In the display, all a segments are connected together, as also are all other (b to g) sets of segments, so that a total of only seven external a to g connections are made to the display irrespective of the number of digits used. Note, however, that none of the 7-segment displays are influenced by signals on these segment wires unless a display is enabled by connecting its common terminal to ground, and in Figure 14 this is achieved by activating switching transistors Q1 to Q3 via suitable external signals, which require the use of only one additional connection per display digit.

Note in Figure 14 that three different sets of segment data can be selected via switch S1a, which in reality would take the form of a ganged 7-pole 3-way electronic switch (with one pole dedicated to each of the seven segment lines), and that any one of the three display digits can be selected via S1b and Q1 to Q3. These switches are ganged together and provide the actual multiplexer action, and should be regarded as fast-acting electronic switches that repeatedly switch through positions 1, 2 and 3. The operating sequence of the circuit is as follows:

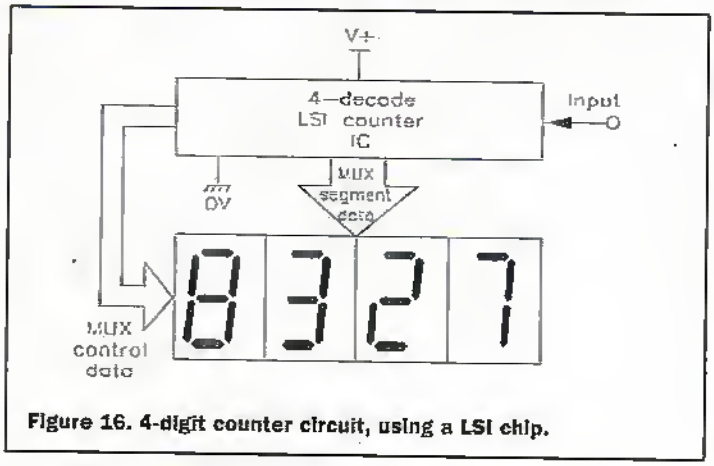


Figure 16. 4-digit counter circuit, using a LSI chip.

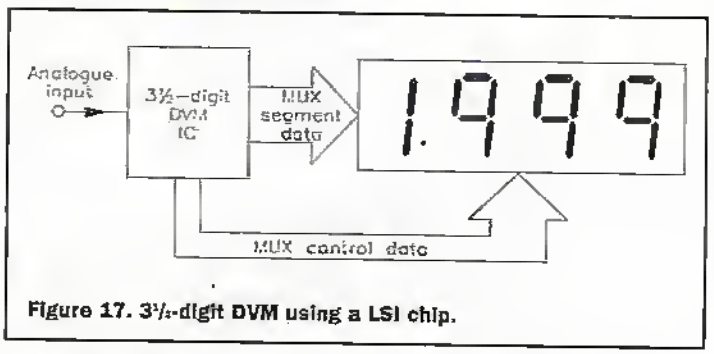


Figure 17. 3½-digit DVM using a LSI chip.

Assume initially that the switch is in position 1. Under this condition S1a selects segment data Aa-g, and S1b activates display 1 via Q1, so that display 1 shows the number 3. A few moments later the switch jumps to position 2, selecting segment data Ba-g and activating display 2 via Q2, so that display 2 shows the number 2. A few moments later the switch jumps to position 3, causing display 3 to show the number 7. A few moments later the whole cycle starts to repeat again, and so on add infinitum. In practice, about fifty of these cycles occur each second, so the eye does not see the displays being turned on and off individually but sees them as an apparently steady display that shows the number 327, or whatever other number is dictated by the segment data.

Note from the above description that, since each display is turned on for only one third of each cycle, the mean current consumption of each display is one third of the peak display current, and the LED brightness levels are correspondingly reduced. In practical multiplexers the peak display current is made fairly high, to give adequate display brightness.

Figure 15 shows an example of an improved multiplexing (MUX) technique, as applied to a 3-digit frequency meter. In this case the MUX is interposed between the outputs of the three BCD data latches and the input of the BCD-to-7-segment decoder/driver IC. This technique has two major advantages. First, it calls for the use of only a single decoder/driver IC, irrespective of the number of readout digits used. Second, it calls for the use of a MUX incorporating only five ganged 3-way sequencing switches (one for the control data and four for the BCD data), rather than the eight ganged 3-way switches (one for the control data and seven for the segment data) called for in the Figure 14 system.

In practice, all of the counting, latching, multiplexing, decoding, timing and display-driving circuitry of Figure 15 (and a great deal more) can easily be incorporated in a single LSI (large scale integration) chip that needs only twenty or so pins to make all necessary connections to the power supply, displays, and inputs, etc. Thus, a complete 4-digit counter can be implemented using a dedicated IC in a circuit such as that shown in Figure 16, or a 3½-digit DVM (digital volt

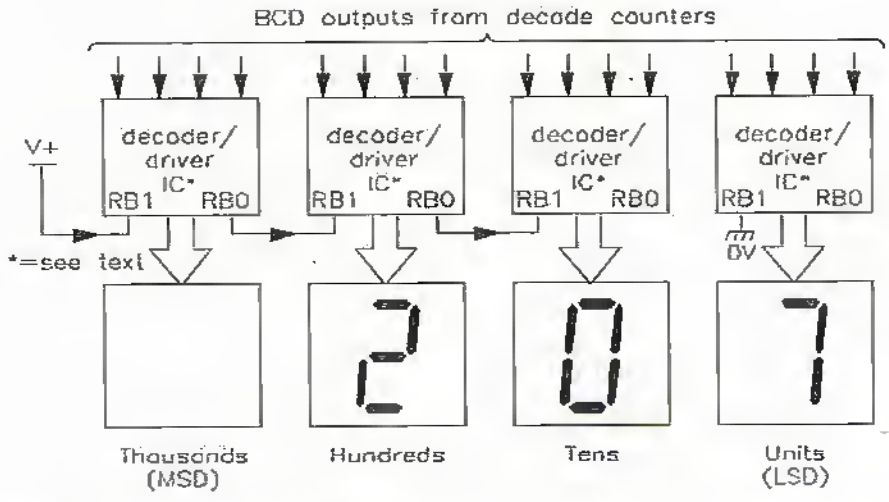


Figure 18. Ripple-blanking used to give leading-zero suppression in a 4-digit counter.

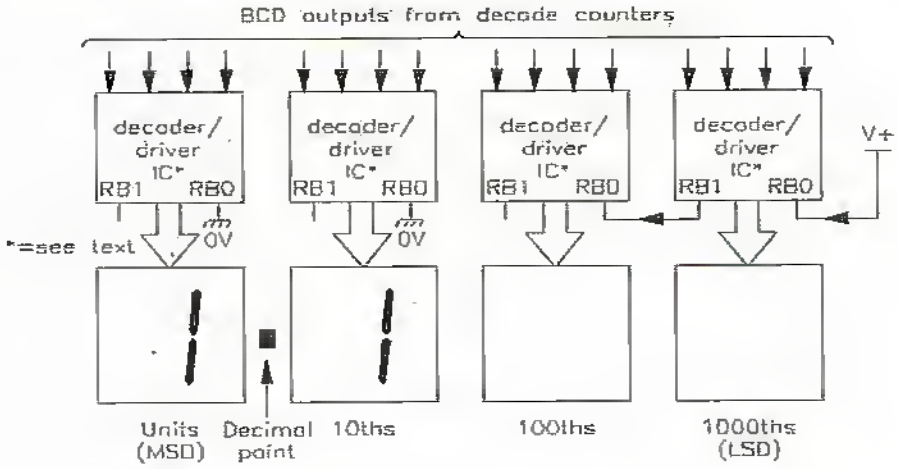


Figure 19. Ripple-blanking used to give trailing-zero suppression of the last two digits of a 3½-digit DVM readout.

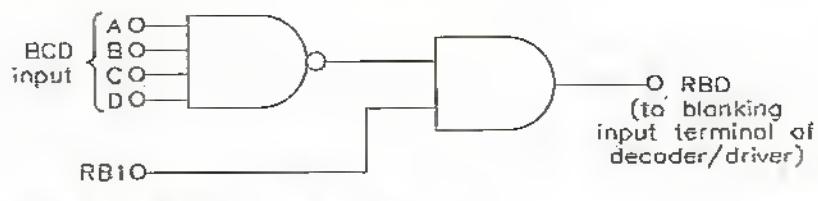


Figure 20. DIY ripple-blanking logic (active-high type).

meter) can be implemented using a circuit such as that shown in Figure 17.

Ripple Blanking

If the basic 4-digit Figure 16 circuit is used to measure a count of 27 it will actually give a reading of 0027, unless steps are taken to provide automatic suppression of the two (unwanted) leading zeros. Similarly, if the 3½-digit circuit of Figure 17 is used to measure 0.1V it will actually give a display of 0.100V, unless steps are taken to provide automatic suppression of the two (unwanted) trailing zeros.

In practice, automatic blanking of leading and/or trailing zeros can be obtained by using a ripple blanking technique, as illustrated in Figures 18 and 19. In these diagrams, each decoder/driver IC has a BCD input and a 7-segment output, and is provided with ripple blanking input (RBI) and output (RBO) terminals. If these terminals are active high they will have the following characteristics.

If the RBI terminal is held low (at logic 0), the 7-segment outputs of the IC are enabled but the RBO terminal is disabled (held low). If the RBI terminal is biased high (at logic-1), the 7-segment outputs become disabled in the presence of a BCD '0000' input (= decimal zero), and the RBO output goes high under the same condition. Thus, the RBO terminal is normally low and goes high only if a BCD '0000' input is present at the same time as the RBI terminal is high. With these characteristics in mind, refer now to Figures 18 and 19.

Figure 18 shows the ripple blanking technique used to provide leading-zero suppression in a 4-digit display that is reading a count of 207. Here, the RBI input of the thousands or most significant digit (MSD) decoder/driver is tied high, so this display is automatically blanked in the presence of a zero, under which condition the RBO terminal is high. Consequently, the RBI terminal of the hundreds IC is high, so its display reads 2, and the RBO terminal is low. The RBI input of the tens unit is thus also low, so its display reads 0 and its RBO output is low. The least significant digit (LSD) is that of the units readout, and this does not require zero suppression; consequently, its RBI input is grounded and it reads 7. The display thus gives a total reading of 207.

Note in the Figure 18 leading zero suppression circuit that ripple blanking feedback is applied backwards, from the MSD to the LSD. Figure 19 shows how trailing zero suppression can be obtained by reversing the direction of feedback, from the LSD to the MSD. Thus, when an input of 1.1V is fed to this circuit the LSD is blanked, since its BCD input is '0000' and its RBI input is high. Its RBO terminal is high under this condition, so the 100ths digit is also blanked in the presence of a '0000' BCD input.

Practical decoder/driver ICs are often (but not always) provided with ripple blanking input and output terminals; often, these are active low. If a decoder/driver IC does not incorporate integral ripple blanking logic, it can usually be obtained by adding external logic similar to that shown in Figure 20, with the RBO terminal connected to the BLANKING input pin of the decoder/driver IC. In Figure 20 (an active high circuit), the output of the 4-input NOR gate goes high only in the presence of a '0000' BCD input, and the RBO output goes high only if the decimal zero input is present while RBI is high.

Next month's concluding episode of this 2-part feature will describe practical 7-segment decoder/driver ICs and circuits.

REVIEW

60 Minute SOLIDSTATE RECORDER

Paul Freeman-Sear tries out this palm sized digital recorder.

Note taking by normal Dictaphone can be a pain at times especially when the tape gets mangled up in the machine. Well all that nonsense is now becoming a thing of the past with the new solid state digital recorders appearing on the scene. Decent length recording machines started to emerge last year. By that I mean up to 60 minutes of recording time. Maplin Electronics has been selling a unit of this capability recently but arguably one might consider the price justification when set against traditional pocket recorder prices. However technology marches on -as ever and so.....

Enter the Panasonic RR-DR60

Now this minuscule silver box of tricks that fits inside the jacket pocket is much nearer the mark - and that's particularly on price and functionality. You have 99 file slots to record messages all in a total time of 60 minutes. Each recorded message is logged for time, date, duration and position in memory and is very quickly and easily displayed. There's a very simple operation for record and once in the record position, the voice activated switch takes over so you do not have to worry about pausing for thought. Yes this whizzo gadget pauses with you so you don't waste time pressing pause buttons and wasting valuable space. There are several speeds when using playback and it intriguingly works by cutting out the blank bits all without changing the pitch. Now that's clever. The nice thing about this box is that you can selectively erase any or all of your 99 recorded messages and there's no whizzing of tape backwards or forwards guessing roughly where your message is. Just dial up the file number and erase - simple. No gaps are left in the recording sequence as all files move up together.

SPECIFICATION

Recording format:	
CELP (Code Exited Linear Predictive)	
Memory:	16Mbit (Flash)
Output power:	Up to 110mW
Battery:	2x AAA cells
Battery life	
playback:	8hours
recording:	10 hours
Dimensions:	
55.8mm x 91.5mm x 13.7mm	
Weight:	46g

automatically. There is also a review scan function where it plays the first few seconds of each file in order to get to your required memo as quickly as possible.

How does it work?

You may well ask. On a linear predictive technique says the blurb. It divides the input sound up into 5ms chunks. It then compares the sound profile of this chunk to known sound source patterns stored in the code book. The most similar pattern is then selected and an associated code number is then stored in its memory. That's neat! So the actual sound is not recorded at all. Playback is generated by running the codes in sequence which then causes the code book patterns to run out the sounds.

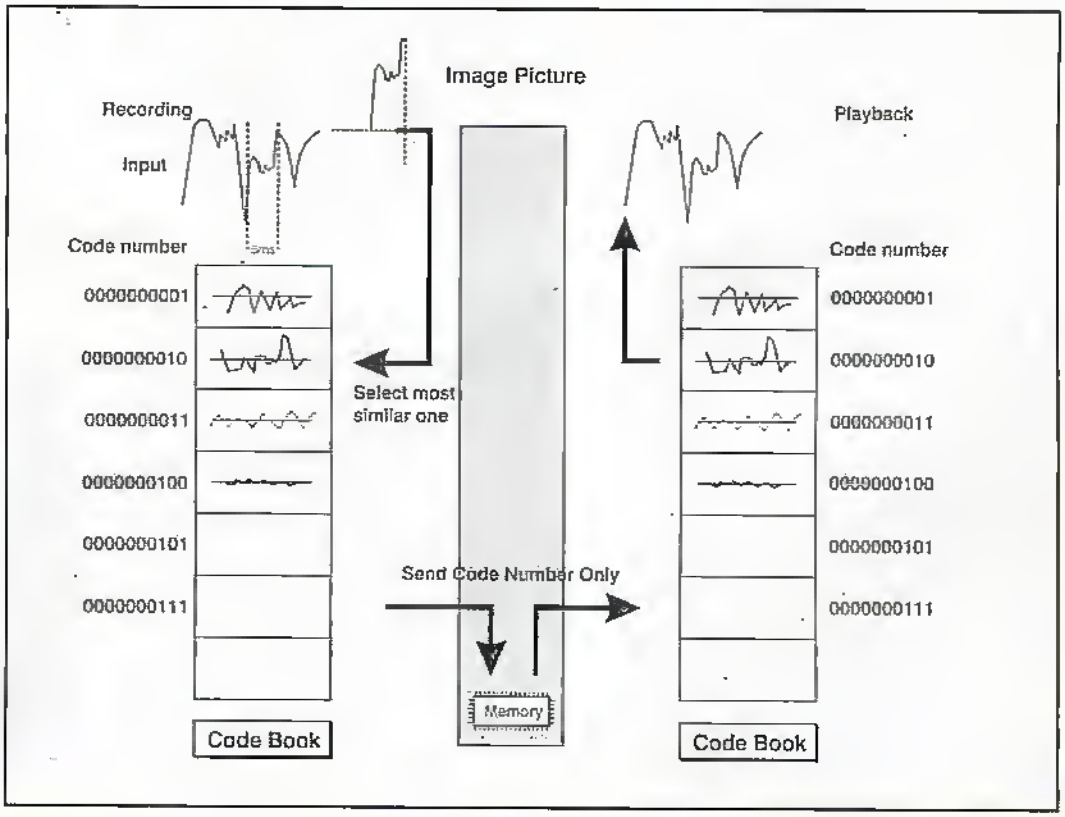
Sound quality is not good but it is intelligible and as a dictaphone, it certainly achieves its aim. Perhaps sound quality will improve as memory capacity increases.

Battery life is good achieving 8 hours on playback and 10 hours for recording all on two 'AAA' alkaline cells.

Conclusion

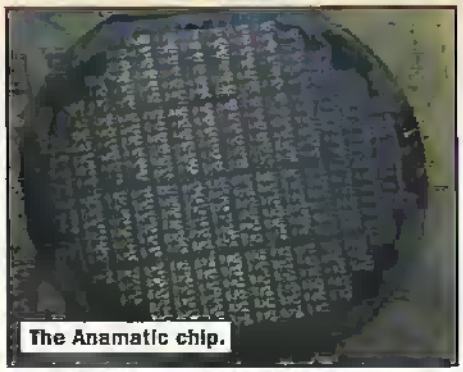
Excellent filing system and battery life. Sound quality mediocre but a must for out and about note takers like estate agents, architects, surveyors, managers and managing directors.

Suggested selling price £89



TECHNOLOGY WATCH

with Martin Pipe



The Anamatic chip.

During IC manufacture, a large number of circuits - possibly hundreds, depending on their complexity - are fabricated on a single wafer. The circuits are tested by complex automated hardware, after which the wafer is cut up to yield the individual dies. Test failures are rejected as scrap, but the working ones pass on to the next stage. Each working die is wired to a chip frame, which also provides us with connection pins to the outside world; the complete assembly is then encapsulated. With today's complex chips - which may contain millions of transistors - the reject rate is quite high. Indeed, with the latest microprocessors production yields may work out at a few percent - only perfect samples will function properly. This is quite wasteful, and does nothing for the price of the final product.

In the late 1980s, Sir Clive Sinclair set up a new company with a maverick IC expert by the name of Ivor Catt. This company, Anamartic, was intended to explore new methods of making complex semiconductor products. Its first invention, Spiral, displayed the ingenuity normally associated with Sinclair projects. With a Spiral device, you don't get a single chip die containing a single circuit. Instead, you get a complete wafer with many circuits. Basically, Spiral tests each circuit in turn, noting each failure in an error map. If it finds a dud circuit, it then moves to one of the adjacent ones until it finds one that works. This process is repeated until the complete wafer is tested, often giving rise to a spiral pattern - hence the name. In use, signals are only routed to working circuits. The end result is that production yields are much higher, particularly if few of those circuits are needed for a functional device. Spiral was originally intended for high-capacity memory devices, but Sinclair also recognised its potential for cheaper parallel-processing computer architectures. Unfortunately, all appears to have gone quiet on the Anamartic front. An Internet search, via Alta Vista, returned precisely zero hits.

However, similar principles form the basis of Teramac, a parallel-processing supercomputer constructed at Hewlett-Packard's Palo Alto research facility in California. The name is derived from 'Tera' (the target speed of trillions of operations per second), and 'mac' (not Apple's finest, but an acronym for 'multiple architecture computer'). As the latter part of its name may suggest, Teramac is not a general-purpose computer, but rather a configurable custom machine which enables special-purpose architectures to be developed, debugged, and refined. The basis of custom computer hardware harks back to the pre-transistor days of Colossus and Tunny. These machines, which were installed at Bletchley Park, were designed with one task in mind - cracking the encrypted German radio traffic of the last war. At one point, there were 10 Colossi in operation at Bletchley Park. Colossus found, within a couple of hours, the 12 wheel settings used by the German Lorenz SZ42 encryption machine operator for a particular message. These wheel settings were then fed to the Tunny machine, which deciphered the actual message.

Terramac - Parallel processing supercomputer.

Despite their vintage technology, these 1940s machines were application-optimised, and could do their job much faster than a modern high-end PC - i.e. a general-purpose machine - running a software emulation. Such is the power of custom computing. Colossus, which employed 2500 valves, was unlikely to have been particularly reliable and probably required constant maintenance. The machine consumed 4.5kW of power in operation, as well as a lot of floor space. It was programmed using a five-hole paper tape, and its results printed out via an electric typewriter. If you're interested in finding out more about Colossus - and how a replica was built from scratch - check out the fascinating web site at http://www.cranfield.ac.uk/ccc/bpark/morebpark.htm, which provided some of the images you see here. Bletchley Park's activities were also the focus of an excellent Channel Four series, 'Station X', that was broadcast recently. Since 1944, much has changed in the world of electronics and computing. The vastly more powerful - and reconfigurable - Teramac custom machine is built into a fridge-sized cabinet. Tests implemented on a single-board Teramac system, which represents a sixteenth of the biggest-possible configuration, outperformed a high-end single-processor workstation by a factor of four. Teramac provides large numbers of programmable gates, wires, and memories that can be configured to implement user designs. The system's most interesting design aspect, however, is that of defect-tolerance - something that would have seemed inconceivable to the Bletchley Park scientists and engineers.

It's some defect tolerance too. The machine at the Palo Alto site had more than 220,000 identified hardware defects - a conventional computer might stop working if one component inside the CPU failed. To achieve this, the Teramac architecture is rather different to that of a regular computer. The basis of this scalable system is a field-programmable gate array (FPGA) chip known as Plasma. A total of 27 of these are built onto a multi-chip module (MCM), which is not that dissimilar to Sinclair's Spiral. Some are used to provide Teramac's logic circuitry, while others act as signal routers. To interconnect the 27 Plasma chips with the outside world, the MCM substrate has 39 layers and over 3,000 output pins. Four MCMs are then fitted to a PCB, which includes an additional controller with 32Mb of RAM. The test 864-FPGA Teramac configuration contained 8 of these PCBs, which are interconnected with ribbon

Lorenz SZ42 encryption machine.

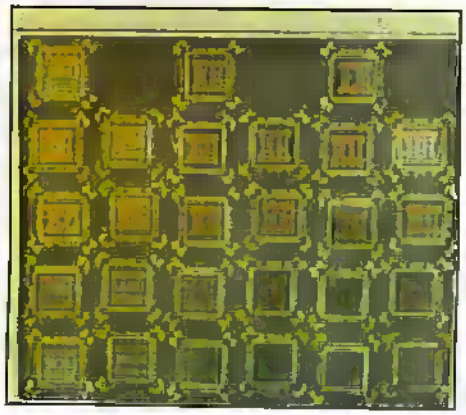
The Collossus (above) and Tunny machines at Bletchley Park.

cables. In total, there is about 40km of wiring inside the prototype Teramac. A fully-loaded Teramac, which hasn't been built to my knowledge, would have 16 such PCBs - this adds up to 1728 Plasma FPGAs and 512Mb of RAM. To communicate with a workstation, a SCSI interface is provided.

All that silicon, wiring and connectivity could mean a lot of potential reliability and manufacturing problems. A fault may be annoying if it occurs on your PC just before you save that spreadsheet, but the consequences could be much worse if the computer in question is a more complex one responsible for policing a vital part of a missile guidance or air traffic control system. Hence the need for fault tolerance, which has been built into mission-critical systems for some time in the form of backup processors and multiple disk arrays. Even if computer failure isn't life-threatening, fault-tolerance is still obviously desirable. Manufacturing costs could be reduced, because fewer chips would have to be discarded. Out of interest, domestic PCs already have a kind of fault tolerance. Very few hard disk drives are completely free of errors, and during pre-sales testing the errors are located and mapped in firmware so that they're ignored in normal use. The errors in question do, however, represent a tiny fraction of the overall drive capacity. In the future, fault-tolerance levels could increase to the point that reliability is higher, despite an increased relative number of possible faults. Decades down the line, the next step - self-repairing systems - could be a distinct possibility.

Teramac's designers decided to test their fault-tolerance theories to the max by intentionally including those 220,000-plus hardware faults - more than one would realistically expect. HP scientists deliberately constructed their Teramac using components that had failed quality-control tests. These reject components were supplied free of charge by the IC manufacturers. HP only had to pay for the Plasma FPGAs that worked - around 20% of the total. The 8-board Teramac prototype - billed as the largest fault-tolerant computer ever - ran special system characterisation software that hunted for defective interconnects and logic gates. This worked by determining a random number using two different resources - different results over different runs allowed the defective components to be isolated. Optimal communication routes between the functional resources were then determined, the computer subsequently using only those components and routes. This is basically what Anamartic's Spiral set out to achieve nearly a decade earlier. Despite the faults - which took Teramac a week to map - the HP scientists were very impressed with the results. Note, however, that they wouldn't have got that far if a crucial 7% of the Teramac's circuitry was built from those defective FPGAs. As you may have guessed, the 7% in question makes up the hardware that diagnoses and corrects errors!

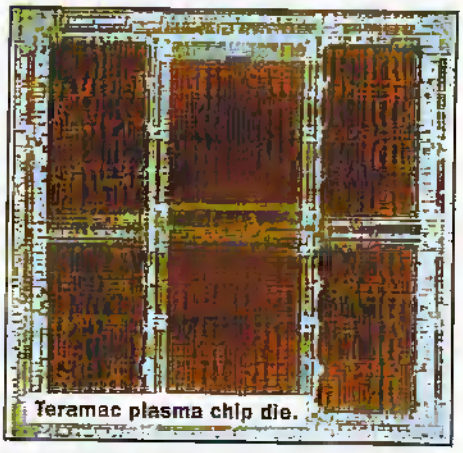
Inside the Teramac and the multi-chip arrangement (below).



That original Teramac, which was constructed in 1995, was donated to Brigham Young University. There, it continues to be used for high-end applications like real-time 3D modelling. Programming the Teramac involves taking existing software algorithms, and converting them to a logic circuit that can be implemented by the hardware. Given the program design and a defect database, a compiler creates a Teramac configuration that implements the design only on the working hardware. One of the academic applications, a three-dimensional filter that extracts the artery structure from three-dimensional medical data such as magnetic resonance imaging (MRI), outperformed a functionally-similar software algorithm running on a high-end HP735 workstation by a factor of four. The researchers at the university believe that designs for a 'half' Teramac configuration are expected to run at more than 100 times the speed of such workstations.

The Teramac has another research purpose. HP, like many other organisations, predicts that high-end computers of the near future won't employ conventional lithographed-silicon technology. Indeed, HP reckons that microprocessors as we know them will reach their practical limits by around 2010. Ten years from now, experimental computer circuitry may be made using nanotechnology - a combination of cutting-edge physics, biology and chemistry. These 'nano-chips' will effectively be 'grown', using a combination of sub-microscopic robots and the controlled grouping together of molecules, and will offer much higher component densities than conventional silicon components. Indeed, we're probably talking about tolerances of a few atoms here. Nano-chips will hence be faster and less power-hungry. Indeed, a high-performance workstation-class CPU the size of a sand grain wouldn't be out of the question. Connecting it to the real world must presumably involve another set of practical problems!

Due to their increased complexity, nano-chip production yields could be much lower than silicon if they were manufactured on the one-circuit-per-die basis currently associated with today's microprocessors. Two of the scientists behind the Teramac, HP's Philip Kuekes and UCLA chemistry professor James Heath, argue that if computers assembled using nanotechnology were designed to be reconfigurable in the same way as the Teramac, they could also function perfectly regardless of their defects. If a certain number of defects could be tolerated, then there would be implications for the production plant. You wouldn't need to spend hundreds of millions of dollars on the super-clean fabs required for modern microprocessors. Out of interest, it is estimated that silicon devices of the complexity predicted by Moore's Law for 2010 would have to be manufactured in a fab costing some $30bn. Even then, production yields would be poor. What's more, only 10 electrons would be required to switch a FET-implemented gate between the two logic states - something that could cause severe problems. Nano-chips look inevitable...

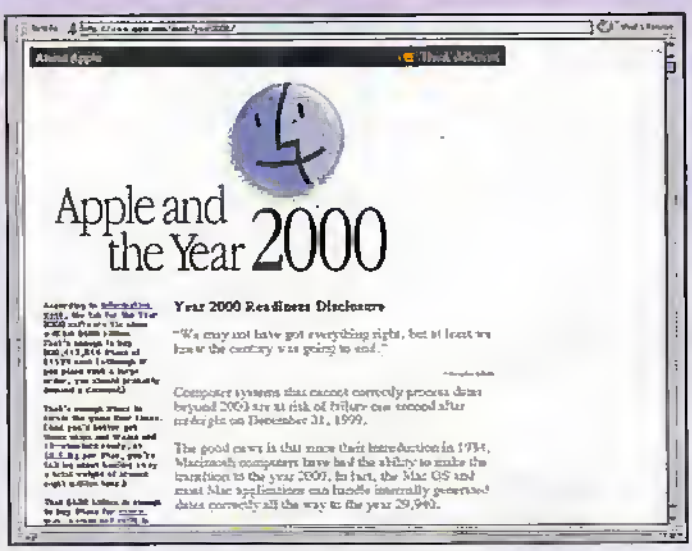


Teramac plasma chip die.

HP computer modelling.

E-mail your comments or suggestions to Martin Pipe at whatpetecix.compulink.co.uk
Or look out for him online! His ICQ ID is 15482544

@Internet



Thumbs up for the Mac

He of Hitchhiker's Guide fame, Douglas Adams once said of being a loyal Mac user "We may not have got everything right, but at least we knew the century was going to end." Apple's taken this quote to heart and setup a Web site to put the Year 2000 computer problem in perspective. Apparently the worldwide tab for fixing the millennium bug will be around $600 billion (£375,000,000,000, give or take a dollar). That frightening sum of money is actually enough to buy every man, woman, and child in the US, Australia, Belgium, Cambodia, Ecuador, Ethiopia, France, Greece and Guatemala a new iMac each (still having 3,000,000 of the little beauties left over). Having said that, if everyone had had a Mac in the first place, of course, the millennium bug wouldn't have even existed. Checkout <http://www.apple.com/about/year2000/> for this and other details.

Pop for the Mac

The new Apple iMac's infamous ease at getting connected to the Internet still relies on the traditional point to point protocol (PPP) procedures most personal computers (Macs or PCs) have to follow when dialling up an Internet service provider telephone connection. On the Mac (any Mac, not just the iMac), the traditional in-built method is with a PPP Control Panel. There are several tools available which mean you don't have to actually open the Control Panel to log on and log off to the Internet — various drop-down menus are available, and there's an in-built Control Strip module, to name some examples. Now, while it's no big deal opening the Control Panel, tools like these centralise the function and make logging on or logging off literally a single action, and are quite cool to use, making the Mac (and iMac) quite simply the easiest personal computer to get onto the Internet.

In the latest version of the Mac's operating system (MacOS 8.5) the PPP Control Panel has been given extra functionality and has been renamed Remote Access in the process and this has meant that some of the tools have needed a minor update to cater for it. One of the best tools for the job is PPPop, and it's now at version 2 which includes full MacOS 8.5 compatibility.

While operating in the same way it always has - a single-click button to control the logging on and logging off processes, as well as showing you whether you're online or offline - PPPop version 2 adds quite a few new features too. From the PPPop Server menu you can now change all necessary Internet settings (PPP, TCP/IP, and modem) directly. This is a real boon for those users who have more than one Internet service provider. For example, you can change connection from a CompuServe account, to an AOL account, to a standard Internet service provider account all from within PPPop. Even better than this, PPPop now includes user profiles, so different people, with different Internet settings, can access individual accounts simply by changing PPPop profile. Dad can have his Internet account, Mum her CompuServe account, little Jimmy his AOL account, and little Janie her bulletin board service – all with a simple change of profile.

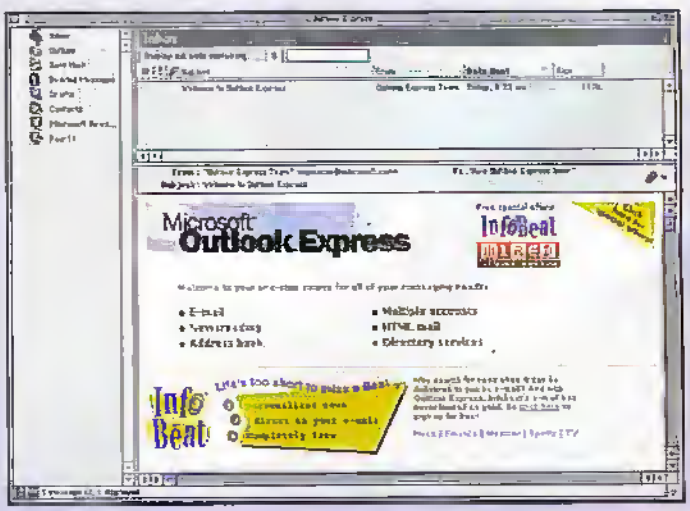
You can, as always, configure PPPop to display a timer showing details of connection and total times on the Internet. You can specify applications (Web browser, email, and so on) to launch and quit as you log on and off, and there's a new window displaying IP addresses of your Mac and the Internet service provider's server as well as bytes being throughputted. However, the real beauty is that all of this peripheral stuff can be in the background, with just the tiny PPPop button displayed and controlling the whole process.

PPPop is shareware, priced at $20 ($10 for upgrades) and is money well spent. Get it from the usual Mac archives, or direct from the author's Website at <http://homel.gte.net/frie/>.

Outlook for the Mac

Microsoft has released version 4.5 of Outlook Express for the Macintosh (along with version 4.5 of Internet Explorer). This free email client software has been upgraded in several ways, not the least of which are: multiple signature support, coloured quotes, drag-and-drop self-repairing installation, better attachment handling (AppleDouble is now supported which means you can send attachments to both Mac and PC users without thinking about format), along with increased rule support.

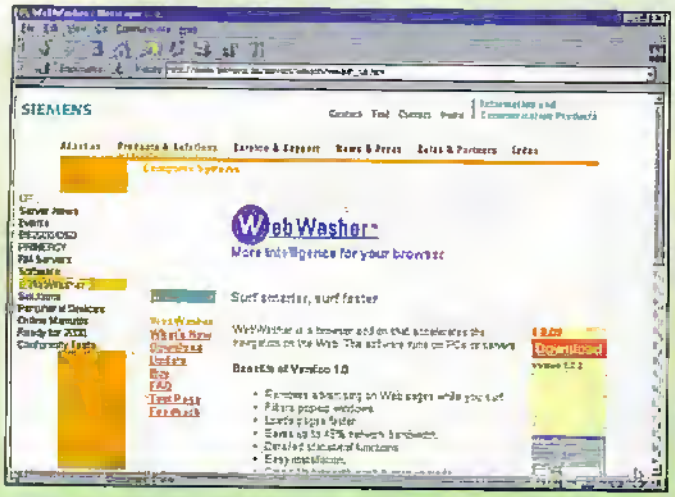
Outlook Express is the default email client for current Macs, but is still a largely underused program. Most Mac users use either Eudora or Claris Emailer - both of which are pucka-paid-for applications. Outlook Express, on the other hand, is available as a free download from Microsoft's new Mac-centric Web site, at <http://www.microsoft.com/mac/>, where you'll find information about all Microsoft Mac products. Outlook Express is definitely worth a look if you're considering getting a new email client, or if you're running an earlier version.



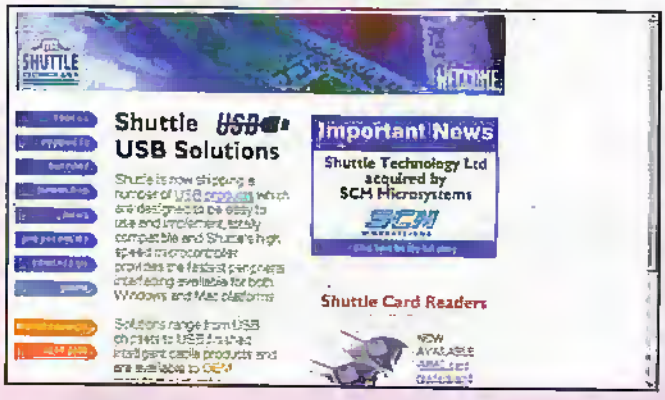
Surf the Web Free of Ballast

After successful in-house use, Siemens is making its WebWasher tool available to all Internet users as a freeware program. WebWasher is a powerful filter program, which is installed on PCs and supplements the Internet browser. The software utility can be downloaded from the Web at <www.siemens.de/servers/wwash/wwash_us.htm>.

Its functions enable users to filter out material that is of no interest - advertising material for example - rather than having to load it across the network. The volume of data transmitted can be reduced by up to 45% using this program. Users can freely configure and change the filter functions so that additional data, such as large charts, are not loaded.



Predictable Passwords Provide Pathetic Protection



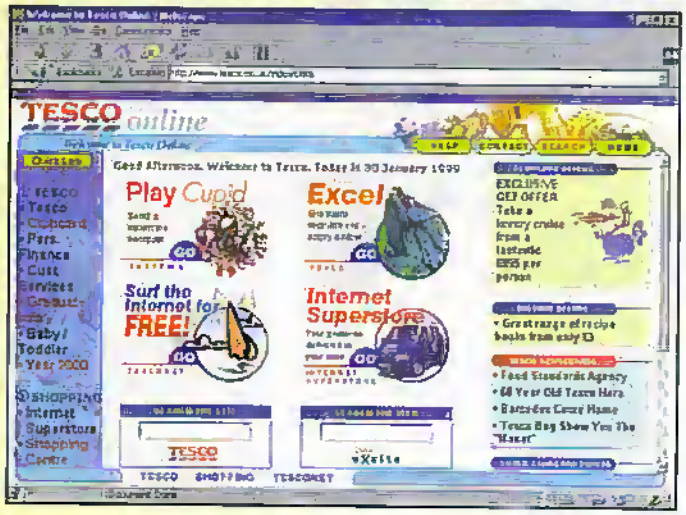
A survey by connectivity company Shuttle Technology at <www.shuttletech.com> has revealed the majority of people select passwords that make them easy prey for hackers in applications like banking, restricted Web sites and network access.

Shuttle surveyed 100 corporate users, and discovered 15% of people choose their date of birth and 49% select their partner's name, or the name of their children or pets. Of the men surveyed, 20% choose their favourite football team as passwords.

80% of people justified choosing simple passwords because they were afraid of forgetting more complex word and number combinations. Some even admitted having a 'one-for-all' password, like their birthday, which they use for PC, credit card and bank account access, making them even more vulnerable to fraud.

Shuttle believes that the traditional user password will never provide adequate security. Its requirement for human recollection makes is instantly fallible. Instead Shuttle recommends the use of James Bond type technologies such as retinal scanning and fingerprint recognition.

Barcodes Come Home to Shop

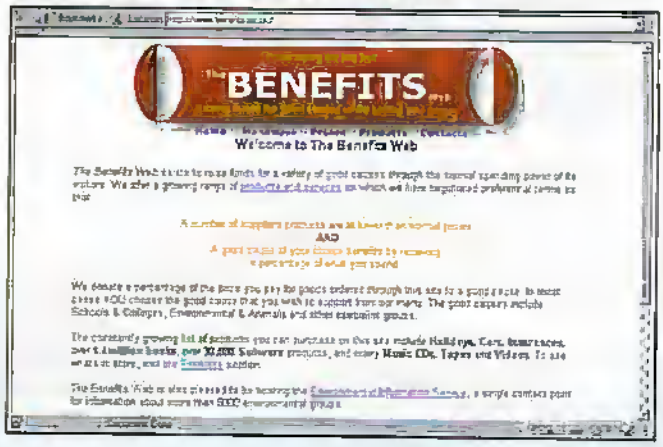


Supermarket giant Tesco has introduced a hand held barcode in a bid to entice more customers to shop from home over the Web. The Palm Pilot Scanner allows online Tesco customers to scan the barcodes of products in their home to add on to their Internet shopping lists.

The new system works with the online service already offered by Tesco to make home shopping simpler and more efficient. When connected to the Tesco Home Shopping software, on-line customers can re-order products they have at home as well as add to these with over 20,000 products available through Tesco Home Shopping.

Palm Pilot Scanners are available to customers via the Tesco Web site at <www.tesco.co.uk>. Tesco introduced home shopping over the Web in 1996 and is now believed to be one of the world's leading users of e-commerce.

Help a Charity with Stress Free Shopping

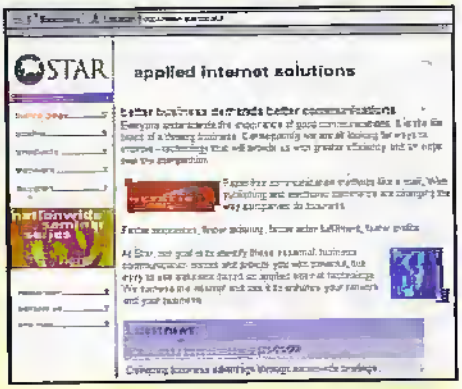


If you find the sales like a trip to hell and back, or if the words - 'department store' fill you with dread, help is at hand with a new Web site, which for the first time combines Internet shopping with charity fund raising.

Called the Benefits Web, the new service allows the shopper to buy goods and services ranging from books to holidays and from insurance to cars at discount prices and then nominate a good cause to receive a percentage of the price paid.

Norwich-based Saint Christopher Benefits has set up the Benefits Web at <www.benefits.co.uk>. The company is currently adding national charities and similar bodies to their existing database of 26,000 UK schools and 1,800 environmental groups who look set to get substantial income each year from the donations automatically credited to them every time a purchase is made using the system.

Star Unlocks Internet Potential



Internet solution provider Star at <www.star.co.uk> is hosting a series of nationwide seminars outlining the business advantages to be gained from the Internet. The briefing sessions began in January in London, and end in August in Edinburgh.

The seminars are aimed at users looking to develop and exploit their Internet connectivity to grow their business. Star's experts will cover the latest technology available, including ISPs scanning emails for viruses, saving time by backing up remotely via the Internet, email/fax integration, and network performance monitoring and optimisation.

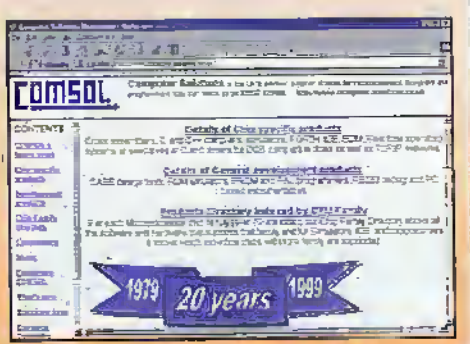
The most recent developments in business applications and how to use the Internet as a marketing tool will also be discussed in detail. Legoland and Old Trafford are among the venues for the briefings – see *Diary Dates*.

Sun Lets Jini Out of Bottle

Sun has unveiled its Jini 1.0 source code at <java.sun.com/products/jini>, which enables any digital device to be networked to other devices, regardless of the underlying software or hardware. The technology sets up basic rules for how to connect to the network, share information and interact with other devices.

Embedded Web

Computer Solutions has set up a Web site for engineers developing microprocessor and microcontroller based products at <www.computer-solutions.co.uk>. Computer Solutions has helped to design and developed everything from 32-bit multi-terminal systems with thousands of inputs to true single chip applications. The site contains a database of microprocessors and details of tools that are available for support.



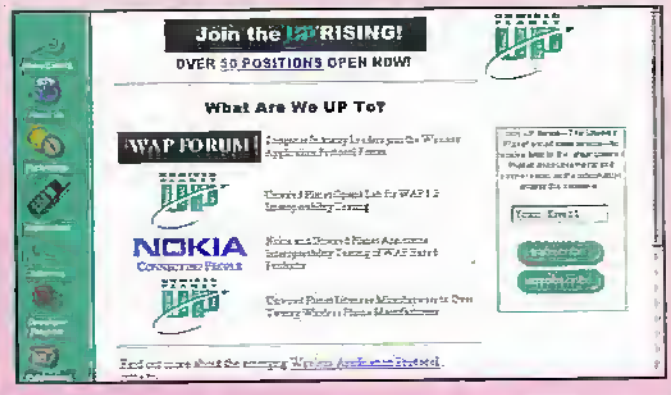
Unwired Planet Opens WAP 1.0 Lab for Mobile Web

Unwired Planet at <www.planet.co.uk> has started peer-to-peer testing and created an open testing lab which is freely available on the Web for performing interoperability testing between Unwired Planet products and providers of the Wireless Application Protocol (WAP) 1.0 gateways and browsers.

Access to the lab is open to any WAP Forum member company and testing can begin immediately. Nokia is collaborating directly with Unwired Planet to build WAP capability into future versions of its mobile phones.

WAP is the standard for Internet content and advanced telephony services in digital mobile phones and other wireless terminals. The WAP Forum has published a global wireless protocol specification for all wireless networks that will be contributed to the appropriate standard bodies.

WAP enables manufacturers, network operators, content providers and application developers to offer compatible products and secure services on all digital devices and networks resulting in greater economies of scale and universal access to information. WAP Forum membership is open to all industry participants.



History of the Internet

Release 4.0 of Hobbes' Internet Timeline, an authoritative history of the Internet is now available by e-mail from timeline@hobbes.mitre.org or on the Web at the Internet Society site at <www.isoc.org/zakon/Internet/History/HIT.html>.

Filtering Software Gets Smarter

Filtering software used in schools and public libraries has been criticised for being too broad in its efforts to screen out material. Such software cannot tell the difference between phrases such as 'large breast' and 'breast cancer research', refusing to action either search.

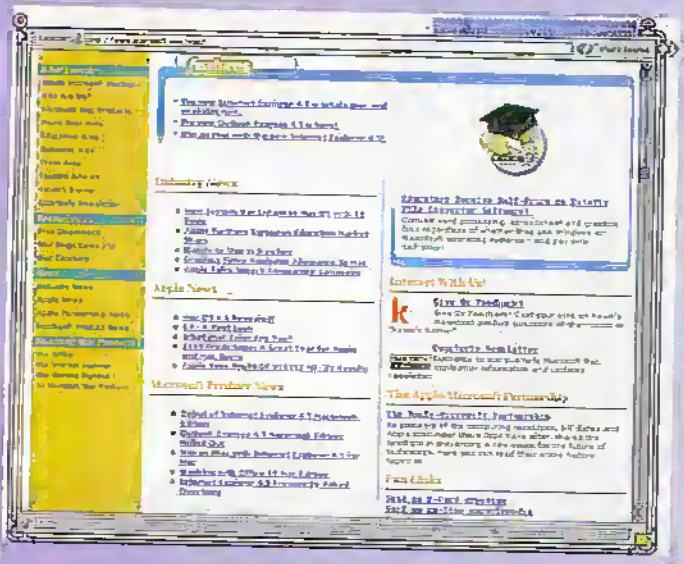
Now a company called RuleSpace at <www.rulespace.com> says it may have a solution: its WebChaperone software is based on an artificial-intelligence engine called the Intelligent Content Recognition Technology, and is designed to differentiate between legitimate content and pornography.

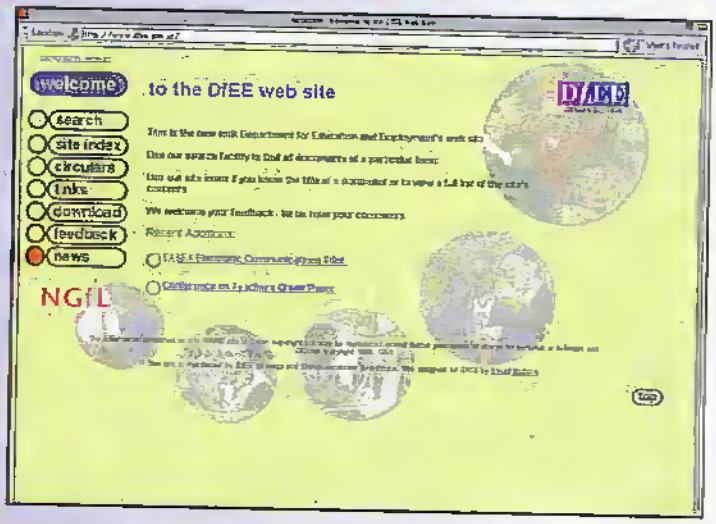
Site Survey

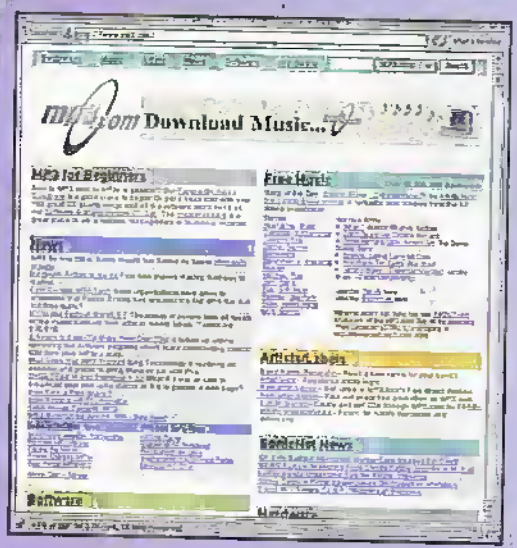
The month's destinations

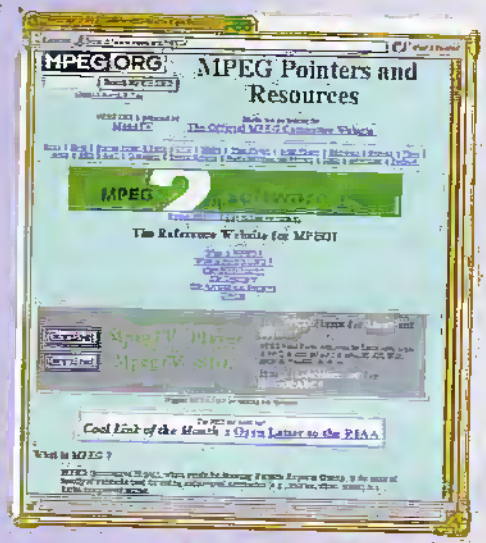
There are a couple of portable mp3 players available, the best is probably the Diamond Rio. See it, and even buy it from Maplin (Order Code VA78) or at <http://www.diamondmm.com/products/current/rio.cfm>.

Teachers (and indeed anyone) can find significant resources on the Department for Education and Employment's Web site, at <http://www.dfee.gov.uk>. The new Green Paper on education is highlighted at the moment. The whole Green Paper can be downloaded as Adobe Acrobat format pdf files, and there's even a response form on the site to send in your responses. The department even wants us to believe that someone will read them all.



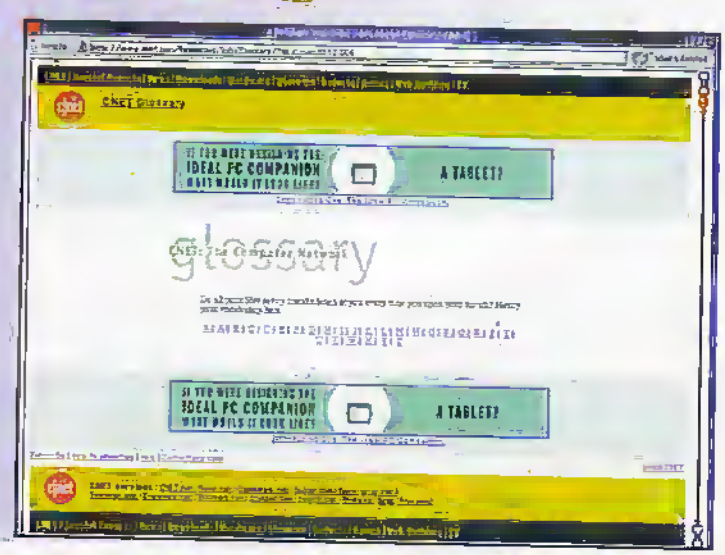






Finally, the best glossary of terms we've yet found on the Internet and related topics has been created by c|net, at <http://www.cnet.com/Resources/Info/Glossary/>. Now you can find out what Gouraud and Phong shading really mean!

There's a buzz on the Internet about the digital recording of audio in the format known as M-PEG Layer 3 (or mp3 for short). It's a highly compressed method of storing audio in a reasonably high-quality manner, which makes it ideal for storing on computers or — better — hand-held players. The compression ratio of mp3 files to equivalent CD tracks is around 1:11, so in theory, you could get over 10 CDs worth of sound on one CD (if that makes sense). The technology is new, but several Web sites offer information and software which allows you to create mp3 files on your computer. Checkout mp3.com, on <http://www.mp3.com> where you'll find lots of specific information, and links to other sites. Also, for a more general look at the subject of M-PEG compression, take a look at <http://www.mpeg.org> where again, there are several related links. As you might expect, the record industry is a little wary of mp3, thinking of it as a means of piracy of music CDs. However, it's really no more so than audio cassettes, and even CDs.



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