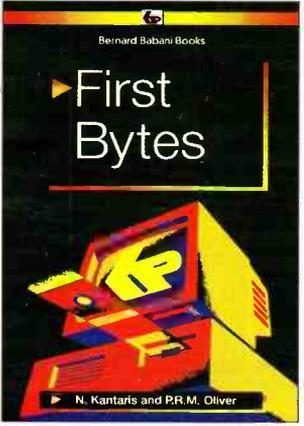


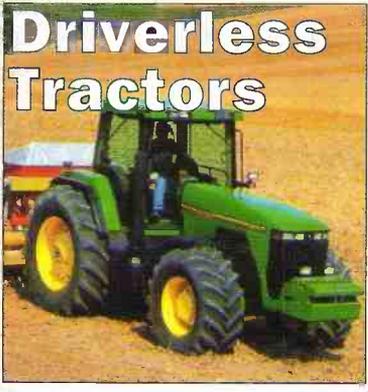
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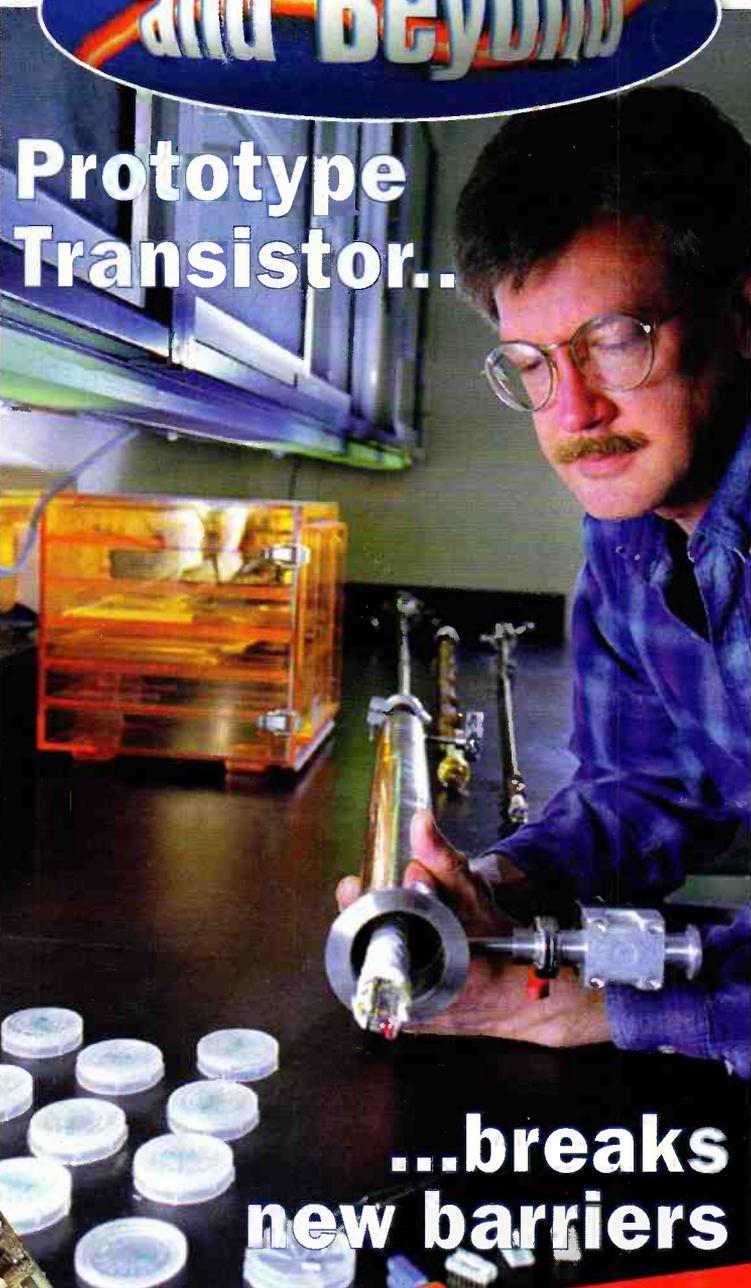
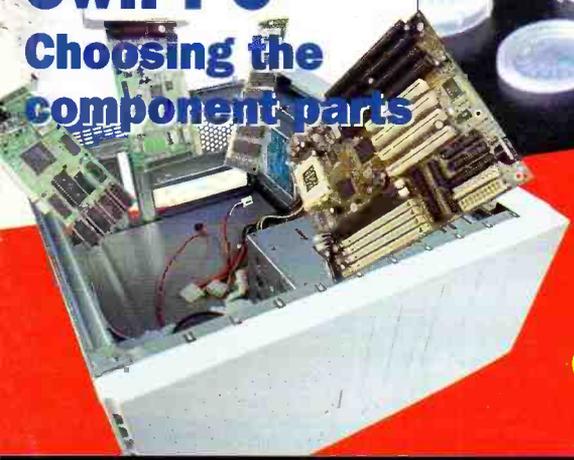
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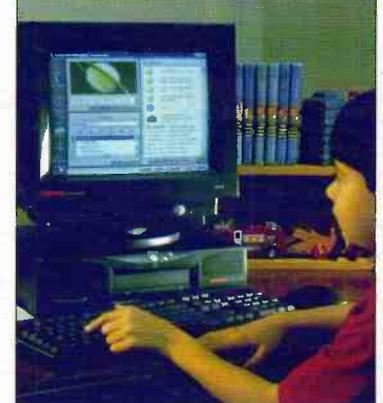
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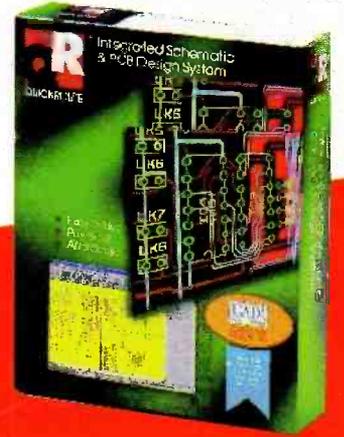
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**REVIEW** Radio Communications

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 ★ Time/Date Stamp ★ Building PCs ★ IBUS Control Module  
**FEATURES** Analogue or Digital? Pt2 ★ Sounds of Nature ★ Getting Onto the Internet Pt4 ★ Dairy Farming  
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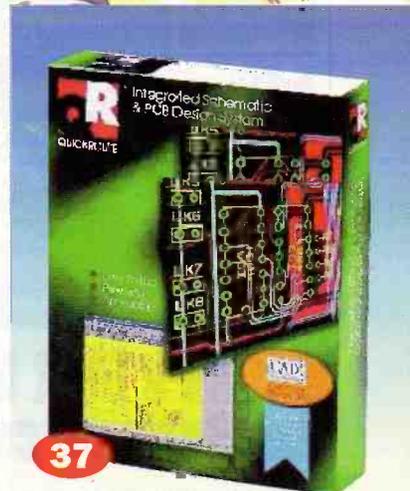
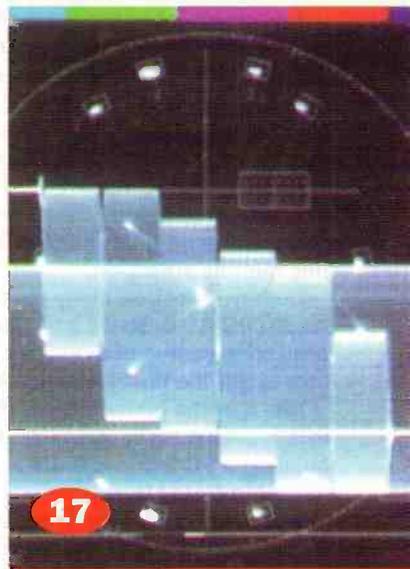
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This exciting issue of the magazine features a free special edition Babani book from the prolific authors Noel Kantaris and Phil Oliver. The book includes extracts from the authors' various Babani books on the most widely used PC software – and provides a 'taster' for the real thing. Maplin stock a large number of these very popular Babani books covering a diverse range of topics.

This month sees the start of what we hope will be a regular monthly feature from the charity-funded Science Line, who are there to answer your questions, over the phone, on a range of science topics from physics to geology, the environment, chemistry, and much more. We intend to print the most widely asked and interesting questions and answers. So if you have a 'science' questions that keeps 'bugging' you then give them a ring, the number is on page 38 along with this months selection.

We have received many queries concerning the Maplin CD-ROM, so we have included a page devoted to answering your questions, and some practical advice on how to get the best from your Maplin CD-ROM.

This months instalment of 'Building & Upgrading PCs' provides an in-sight into the components for building a PC and suggests a shopping list – all available from Maplin.

Unfortunately due to pressure of space, the bench power supply project has been held-over to next month.

**Paul Freeman-Sear, Publishing Manager**

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Driverless tractors

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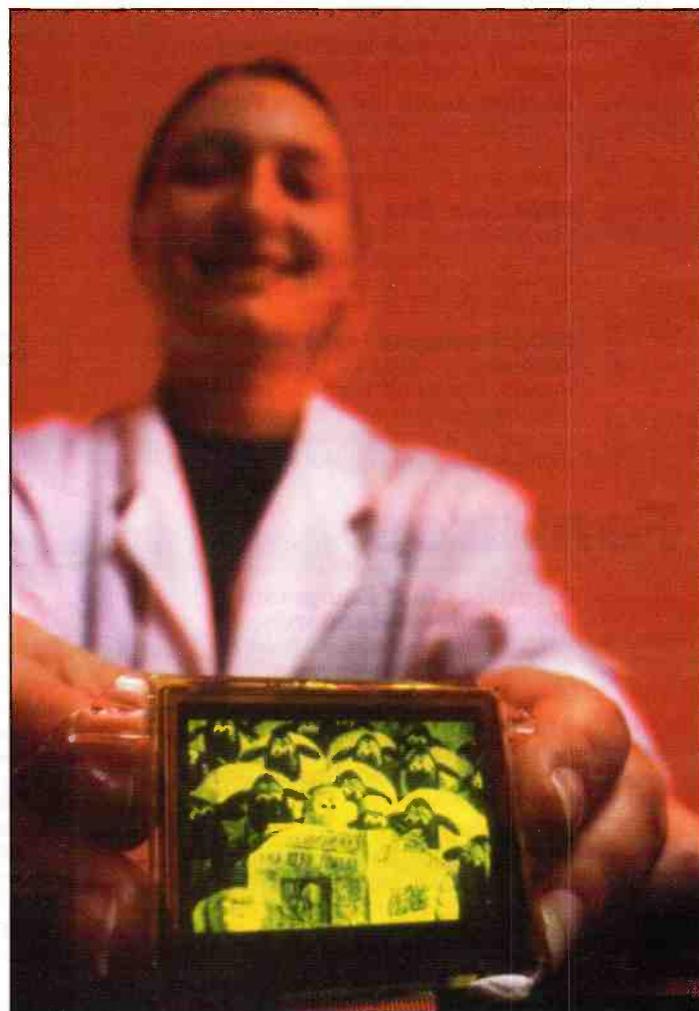
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# NEWS

## REPORT



## Plastic Fantastic TV Screen

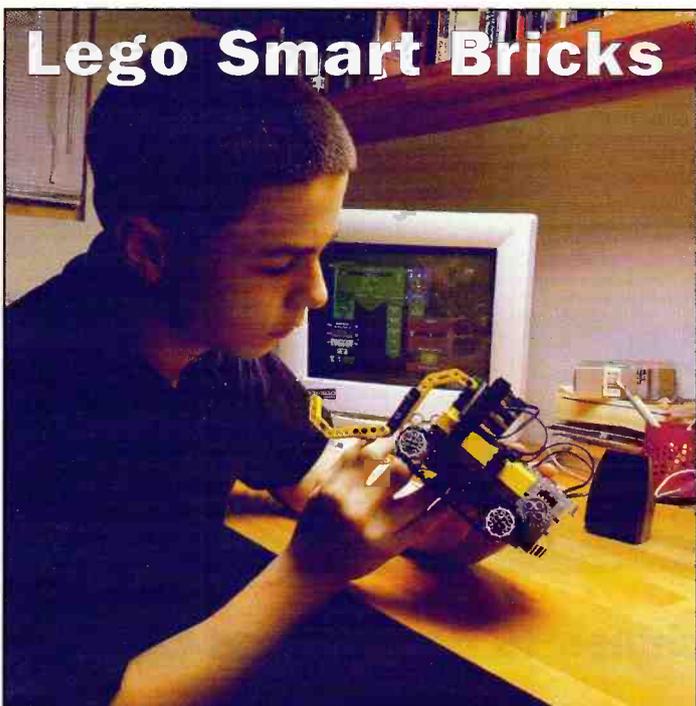
The future is plastic. At least this is the view of Cambridge Display Technology (CDT) and Seiko-Epson who jointly unveiled a prototype light emitting plastic (LEP) television screen in London and Tokyo early this month.

Measuring 50mm square and only 2mm thick, the monochrome prototype display screen can show full television pictures. Unlike LCD screens, the prototype display screen has no restrictions on viewing angles or blurring of fast action shots.

The joint development between CDT and Seiko-Epson is set to deliver a full size colour display screen later this year.

For further details, check: [www.cdt1td.co.uk](http://www.cdt1td.co.uk).

Contact: Cambridge Display Technology, Tel: (01223) 276351.



## Lego Smart Bricks

Lego has unveiled a new generation of intelligent construction toys and learning tools for children. The new products incorporate computer technology in a programmable building brick – an innovation that will allow children to add 'life', personality and behaviour to their Lego toys.

Two new Lego products – Lego Mindstorms Robotics Invention System and Lego Technic CyberMaster – bring construction toys into the information age.

Lego Mindstorms has been developed in co-operation with the Media Laboratory at the Massachusetts Institute of

Technology (MIT), Boston. It is the first in a new generation of challenging, creative learning tools that enable children to use a PC to program intelligence into their Lego inventions. These tools have been envisaged to revolutionise the way children play and learn.

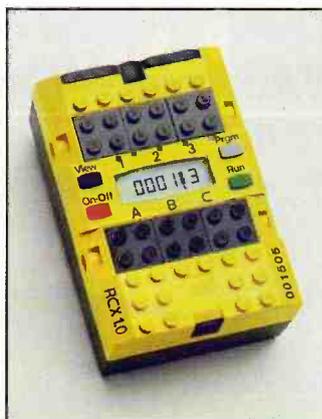
Lego Technic CyberMaster is a natural extension to the Lego Technic building system. It is an adventurous computer-interactive toy with Windows-based software that introduces children to a Lego Technic City of Tomorrow.

For further details, check:

[www.lego.com](http://www.lego.com).

Contact: Lego,

Tel: (01978) 290 900.



## Molecules Act Like Individuals

In experiments that examine the physical behaviour of single molecules, Stanford University researchers have discovered that when identical polymers — long, flexible, spaghetti-like molecules that are found in everything from plastics to living cells — are prepared in the same way and

exposed to the same conditions, they unfold in a variety of different ways.

Speaking to Electronics and Beyond, Steven Chu, Professor of Physics at Stanford University said, "Molecular individualism is a new surprise. We discovered it because we have developed the

ability to visualise and manipulate single molecules. This ability is allowing us to address a number of long-standing questions in polymer science."

For further details, check: [www.stanford.edu](http://www.stanford.edu).

Contact: Stanford University,  
Tel: +1 650 725 1944.

## Silicon Graphics Processor Upgrades

The upgraded R10000 RISC processor from Silicon Graphics clocks in at 250 MHz. Along with the upgraded processor speed, the bandwidth between CPU and cache has been almost doubled,

improving the efficiency of the device by allowing data throughput speeds that match the processor's computing capabilities.

The new device will be used by Silicon Graphics in its

Origin2000 and the CRAY Origin2000 supercomputers.

The MIPS R10000 processor has already allowed the Origin series to set several new benchmarking records. An eight-processor Origin2000 supercomputer achieved world record performance on the Standard Performance Evaluation Corporation's SPECfp95 benchmarks, which measure processor performance and are strong indicators of application performance, attaining a SPECfp95 peak result of 66.4.

For further details, check: [www.sgi.com](http://www.sgi.com), or [www.specbench.org](http://www.specbench.org).

Contact: Silicon Graphics,  
Tel: (0118) 9257500.



## Spring is in the Air

Customers joining Orange on its Talk 15 tariff will automatically be offered 45 minutes talk time for the same price as 15 – £17.63 per month for the first 6 months of the contract.

For further details, check: [www.orange.co.uk](http://www.orange.co.uk).  
Contact: Orange,  
Tel: (0800) 801080.

## Intel Inside Barbie

Intel is working with Mattel and other toy makers to develop technical standards for creating interactive toys. The toys would hook up to a PC and could be programmed to talk, for instance, by parents or children.

For further details, check:

[www.intel.com](http://www.intel.com).

Contact: Intel,  
Tel: (01734) 403000.

## Kodak Invests In Internet Photo Business

Kodak has acquired a majority stake in PictureVision which provides an online posting service for digital photographers in direct competition to Kodak Picture Network.

Both services allow consumers to store and send their pictures over the Internet, but PictureVision's service is typically faster than Kodak's. Kodak plans to join the two services and expand the service so that it's available to people without computers via networked kiosks.

For further details, check: [www.kodak.co.uk](http://www.kodak.co.uk).  
Contact: Kodak,  
Tel: (01442) 261122.

## Competitors Complete Modem Testing

Former rivals, Rockwell and 3Com have announced that they have completed joint testing of their once-incompatible 56 kbps equipment and pronounced the products compliant with the electronic protocol approved two weeks ago by the International Telecommunication Union in February.

For further details, check: [www.3com.com](http://www.3com.com), and [www.rockwell.com](http://www.rockwell.com).

Contact: 3Com,  
Tel: (01189) 228200, and Rockwell, Tel: (01242) 370008.

## Intel Supports Audio Specification

Intel is the first PC company to join the DVD WG-4 audio working group and support its proposed DVD audio specification as a next step in bringing next-generation consumer-quality audio to the PC platform.

For further details, check: [www.intel.com](http://www.intel.com).  
Contact: Intel,  
Tel: (01734) 403000.

## Gimme Space Increases Disk Space

A software utility launched by Alpha Software called Gimme Space enables computer users to increase hard disk space. Gimme Space re-allocates disk space available on hard disk drives, partitions, networks, and Zip drives.

But given the relatively low cost of hard disk storage, computer users might be better investing the £29.95 price of Gimme Space in extra hard disk space.

For further information, check: [www.alphasoftware.com](http://www.alphasoftware.com).  
Contact: Alpha Software,  
Tel: (01189) 814230.

## Encyclopaedia Deal

If you're thinking about investing in reference software, check out the Microsoft Encarta 98 Reference Suite. The Encarta 98 Reference Suite includes Microsoft Encarta 98 Encyclopaedia Deluxe, Microsoft Encarta 98 World Atlas and Microsoft Bookshelf all for £100!

For further details, check: [www.microsoft.com](http://www.microsoft.com).  
Contact: Microsoft,  
Tel: (0345) 002000.

## National Produces First Cyrix 0.25 Micron 6x86MX

National Semiconductor has successfully produced a Cyrix 6x86MX processor on its 0.25-micron process technology. Scheduled to start volume production by the summer of 1998, at the National plant in Maine, US, the 6x86MX processor will be the first Cyrix-designed product to be produced at a National facility. National completed its merger with Cyrix in November 1997.

For further details, check: [www.national.com](http://www.national.com).  
Contact: National Semiconductor,  
Tel: (01475) 633733.

## Microchip Launched Third Part Guide

Microchip has introduced the fifth edition of its Third Party Guide, a comprehensive handbook that features third-party development support suppliers for Microchip's PICmicro family of 8-bit RISC-based microcontrollers, serial EEPROMs and related speciality memory products and KEELOQ code hopping devices.

The 1997-98 edition features 130 companies worldwide who manufacture emulators, programmers, assemblers, simulators, linkers, compilers, software and accessories which directly support Microchip's PICmicro microcontrollers and memory products.

For further details, check: [www.microchip.com](http://www.microchip.com).  
Contact: Microchip,  
Tel: (0118) 921 5800.

## IBM Merger Targets Internet Devices

IBM and CommQuest Technologies have entered into a merger agreement. The two companies intend to speed the development of a new generation of multifunction, low-cost, mobile information appliances, such as single chip, watch-size cellular phones and products that combine cell phone, e-mail and Internet access functions in a single hand-held package.

For further details, check: [www.chips.ibm.com](http://www.chips.ibm.com).  
Contact: IBM,  
Tel: (0990) 426426.



## Windows CE Machines To Be Wireless Enabled



Microsoft's battle to win dominance of the palmtop market against companies such as 3Com with Palm Pilot and Psion with its latest 5.0 machine, is heating up.

By the end of this year, any handheld computer running Windows CE software will be able to use pager technology from Motorola to enable the machine to receive e-mails, news updates and Web pages.

For further details, check: [www.microsoft.com](http://www.microsoft.com).  
Contact: Microsoft,  
Tel: (0345) 002000.

## Newton Killed By Apple

Apple has abandoned its Newton operating system and Newton-OS based products such as the MessagePad 2100 and the e-Mate 300. Apple says the move is in line with its plan to channel all of its software development resources into extending the Macintosh OS.

"This decision is consistent with our strategy to focus all of our software development resources on extending the Macintosh operating system," said Steve Jobs, Apple's interim CEO.

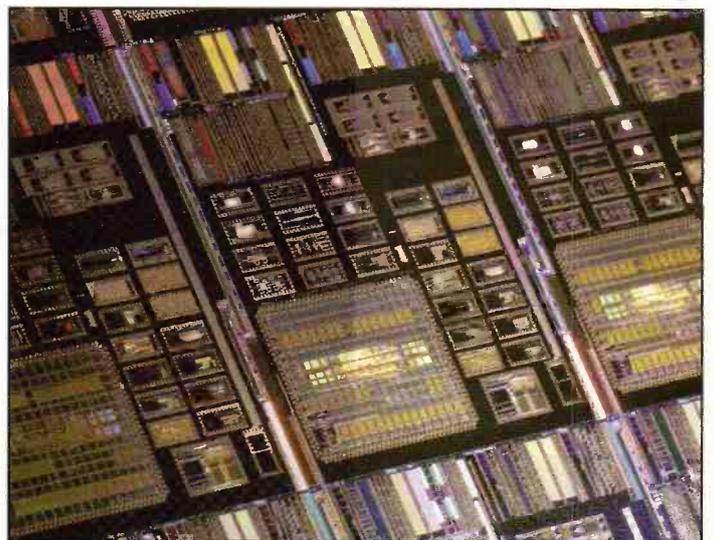
The company will continue to market and sell its current inventory of MessagePad 2100 and eMate 300 computers, as well as to provide support for their installed base of users.

For further details, check: [www.apple.com](http://www.apple.com).

Contact:  
Apple,  
Tel: (0181)  
569 1199.



## IBM Unveils Gigahertz Chip



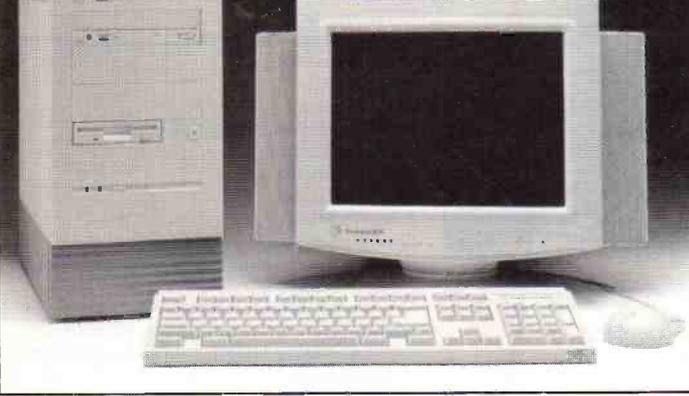
IBM has announced an experimental chip that operates at more than a gigahertz a second and that will be commercially available after the turn of the century. Today's fastest processors typically operate at speeds less than 300MHz.

The IBM 1000MHz chip contains one million transistors and was developed using IBM's existing

0.25-micron CMOS technology. The microarchitecture circuits and testing techniques resulting from this project will eventually be applied to microprocessors, using IBM's recently introduced CMOS copper chip technology.

For further details, check: [www.ibm.com](http://www.ibm.com).  
Contact: IBM,  
Tel: (0990) 426426.

## Europeans on PC Shopping Spree



The European PC market is booming, with analyst house Dataquest, naming it a main sales driver for global PC manufacturers. PC unit sales were up 25% in last three months of 1997, over the same

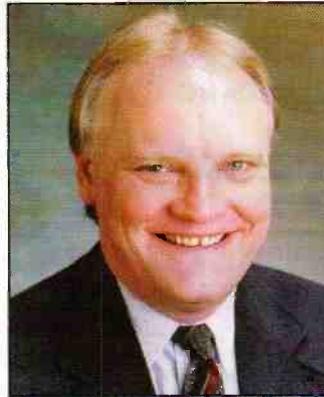
time in the previous year, marking the highest quarterly growth in the past two and a half years.

For further details, check: [www.dataquest.com](http://www.dataquest.com).

Contact: (0800) 716089.

## Intel and ARM Agree License

Intel has reached an agreement with UK-based semiconductor-minnow Advanced RISC Machines (ARM), to develop the StrongARM microprocessor family under license.



The agreement signals Intel's plans to continue support for the StrongARM family of high-performance, low-power microprocessors, following its acquisition of Digital Semiconductor.

"We believe the StrongARM processors have tremendous potential – high-performance, low-power microprocessors are essential to the future of a variety of portable devices and other consumer electronics and embedded applications," said Ron Smith vice president, Intel.

For further details, check: [www.intel.com](http://www.intel.com), and [www.arm.com](http://www.arm.com).

Contact: Intel, Tel: (01734) 403000, and Advanced RISC Machines, Tel: (01223) 400400.

## UK Economy Could Be Heading For Year 2000 Trouble

A Cap Gemini Index published this month indicates that one in six organisations, representing 38% of UK Gross Domestic Product, will fail to meet the Year 2000 deadline for making their systems Millennium compliant.

"The situation seems to be getting worse as the deadline approaches," said Robin Guenier, executive director of Taskforce 2000. "The estimated cost of fixing systems has now risen to £31.8 billion, the figure that we

forecast a year ago. Our forecasting to date has proved to be extremely accurate."

According to the survey, the private sector is spending five times more per employee than the public sector to fix the problem. "The good news is that much of the private sector is at last waking up to the threat of this huge problem. But the public sector is still sleeping," said Guenier.

Taskforce 2000 believes that the Government is lagging

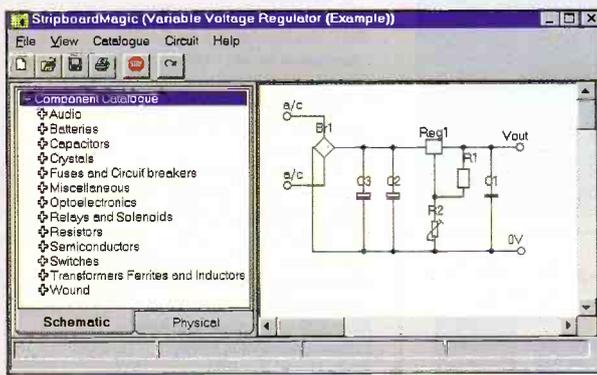
seriously behind the private sector and must "take action now" to avoid serious problems. "Public sector systems controlling the emergency services, medical equipment and traffic management must be top priority," said Guenier.

Despite all this, Taskforce 2000, an independent organisation, which receives funding from the private sector, still believes that the worst can be avoided. "We need a national

programme of radical prioritisation. The problem must be treated as an emergency. Organisations should radically prioritise and treat this problem with the urgency it deserves. This will only happen with unambiguous leadership from senior people, and in particular, the Government," said Guenier.

For further details, check: [www.taskforce2000.co.uk](http://www.taskforce2000.co.uk).

Contact: Taskforce 2000, Tel: 0171 562 7650.



## Stripping the Hassle out of Stripboard

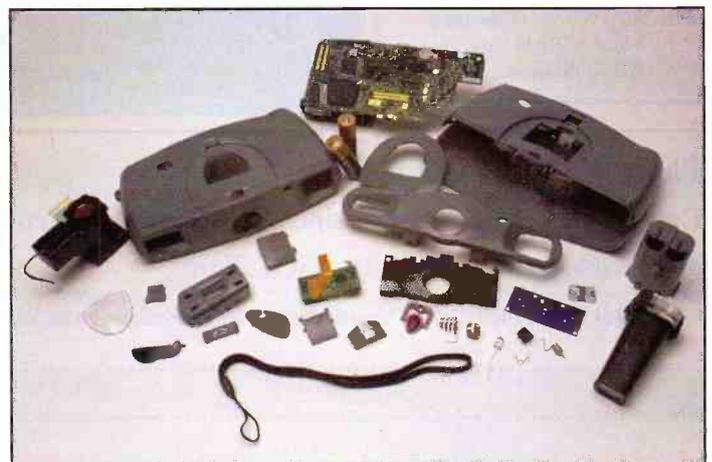
Stripboard Magic is an innovative PC-based computer aided circuit layout program for stripboard and breadboard that takes the drudgery out of translating electronic circuit designs into a practical layout.

Developed by Ambyr and available from Maplin Electronics, priced £39.95, Stripboard Magic features a drag-and-drop circuit editor, component library, automatic circuit layout on stripboard and a detailed construction guide to assembling electronic circuits.

For further details, check: [www.ambyr.com](http://www.ambyr.com).

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

## Polaroid to Launch Intel-Enabled Digital Camera



Polaroid plans to offer consumers easy-to-use, affordable and innovative digital cameras which will capture still images anywhere, anytime – and can also be used for video while connected to the PC, based on Intel technology.

Polaroid expects to offer

digital cameras ideal for those individuals who principally require easy capture, display and exchange of still images and video on the PC, rather than hard copy prints.

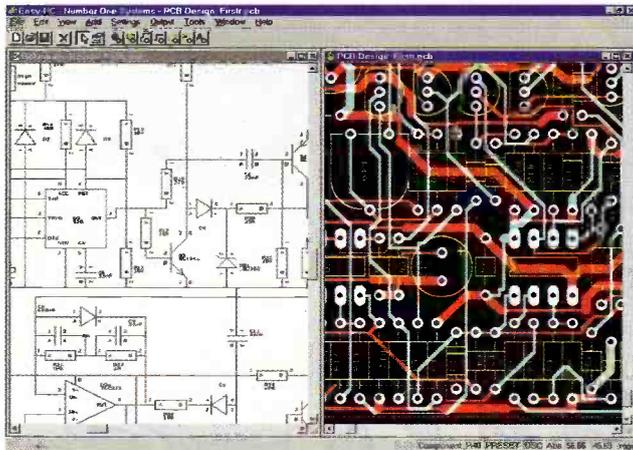
For further details, check: [www.polaroid.com](http://www.polaroid.com).

Contact: (0800) 010119.



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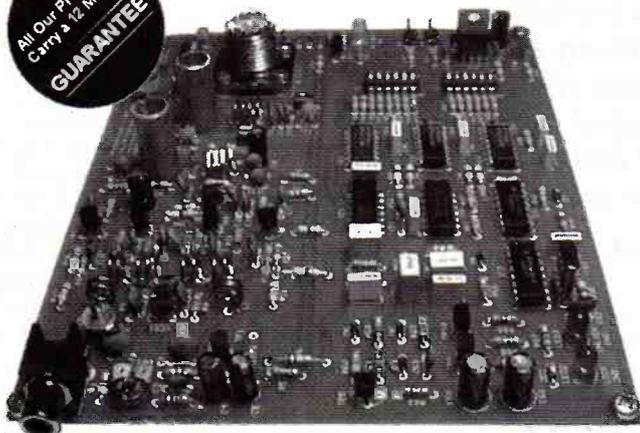
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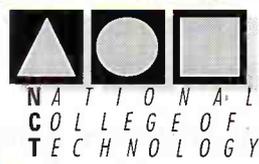
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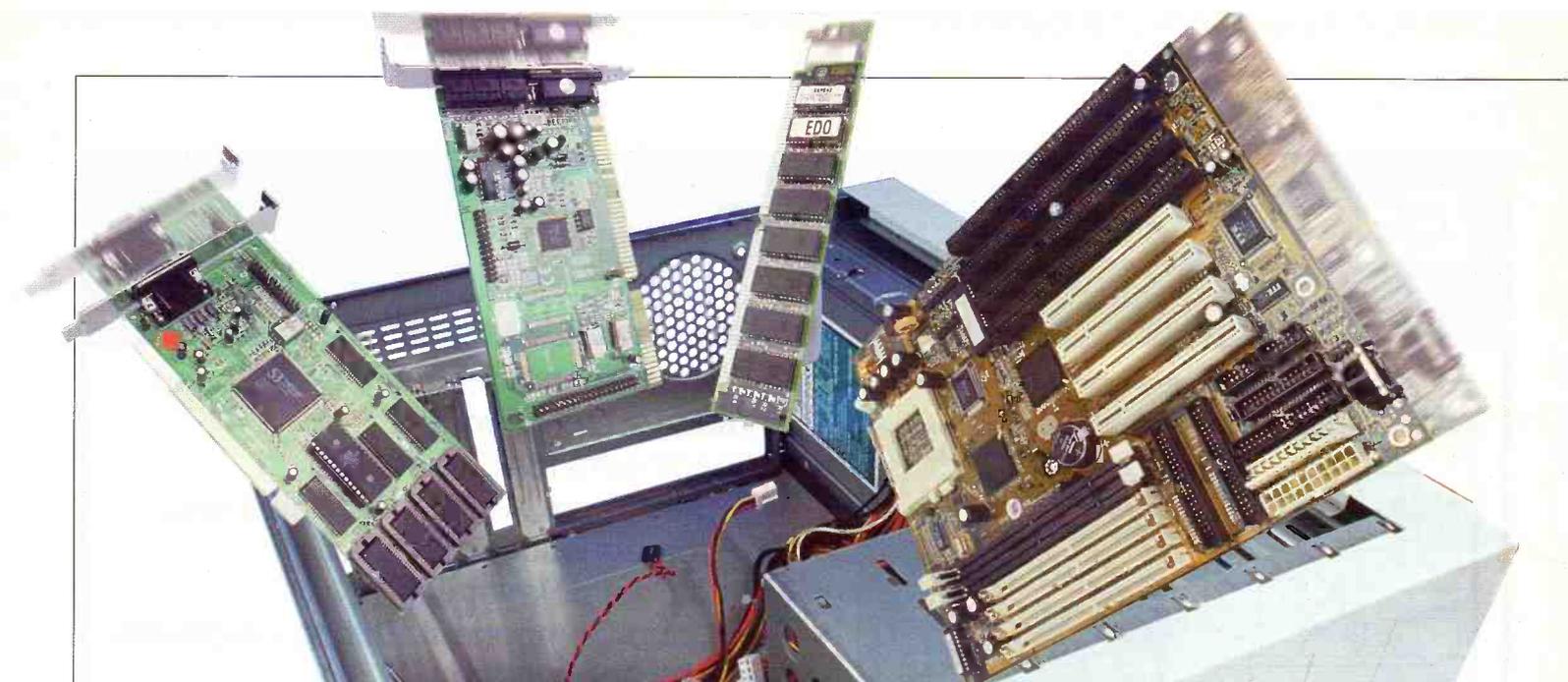


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# Building & UPGRADING PCs

PART 2

by Mark Brighton

*Last month's article by Stephen Waddington looked at a little of the history and background of the IBM compatible PC as well as taking the reader on a guided tour of the inside of a typical PC. Now you know what's in the box, the idea of actually building a PC for yourself may well appeal to you. Even if it doesn't, you should find that this article and those following over the next couple of months give you the confidence to upgrade your PC, or just help you to better understand how a typical system works.*

**W**e are going to start by putting together a shopping list of all the bits and pieces needed to build a fairly fast multimedia PC quite capable of running modern demanding (games!) software, as well as all the standard office packages, which also make good use of the sound and graphical facilities of a modern PC.

The PC will be based on modern high specification products, aiming for a fine balance between well known brands for standard parts and some lesser known but still high quality branded products. At the end of the day we are aiming to put together a machine which will not cost the earth, but will be as capable and fast as other PC's costing hundreds of pounds more.

## The shopping list

### The case

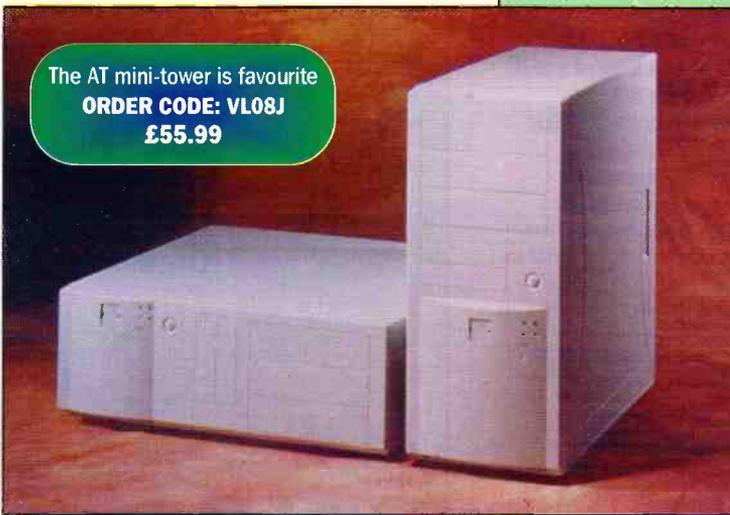
So, first of all we will need a case to assemble the whole system in. Last month's article suggested a midi-tower case to leave room for plenty of expansion and that is a great recommendation if you are the sort of person who is likely to want to fit a range of extra plug in cards and peripherals over and above the standard requirement. If you intend to fit (say) a radio tuner and / or TV tuner card, video grabber card, tape drives, multiple hard drives, special communication or analogue to digital / digital to analogue converter cards or the like, over and above the normal multimedia requirement discussed below, then this is the right choice for you.

However, for the purposes of this article, we are going to choose a normal Mini-tower case, capable of accommodating all of the necessary parts for our PC, plus modest room for expansion in the future. The case chosen for our project PC is the AT Mini-tower case VL08J. This is a well made case featuring a standard 200 Watt power supply with five power connectors (plus the motherboard supply) for disk drives / CDROM drives. The case contains three 5.25" drive bays and three 3.5" bays (one of these is internal only with no front panel access. You would fit your hard drive here).

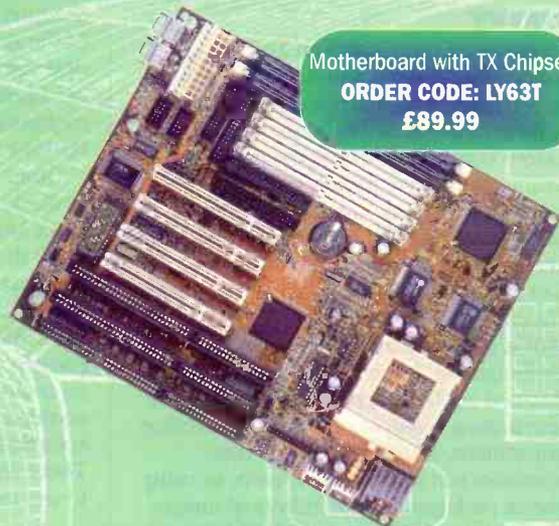
Sufficient mounting holes and hardware are provided to allow any type of motherboard to be fitted, with an optional blanking plate for use where a standard AT motherboard is fitted. There are two main motherboard forms about at the moment, with the original AT standard having a different socket arrangement at the rear of the case.

### The Motherboard

The motherboard is the support system for your computer. Apart from providing the mechanical means whereby all of the bits and pieces of your PC are connected together, the motherboard has a number of specialised support and interface IC's collectively known as the "chipset". These provide what is called "Glue logic"



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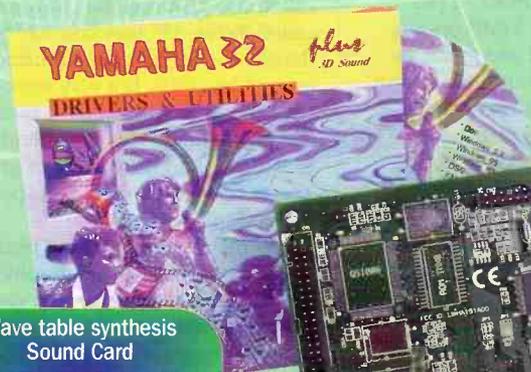
which is a fairly self explanatory name. There are various different chipsets available and the motherboard we are going to suggest that you use here (LY63T) is based on the TX chipset, designed to maximise performance of multimedia applications using MMX technology.

This motherboard has four ISA slots for older plug in cards as well as four of the newer PCI bus slots, so a wide combination of different accessory cards may be accommodated. Note however that, in common with most modern motherboards, the way ISA and PCI cards are constructed means that one of the ISA slots uses the same back panel cut-out as the PCI slot nearest to it, so it's an either / or situation, not both in that slot.

It's a big motherboard too, with four SIMM slots for 72 pin SIMM's and two very long DIMM slots for up to 256 MB of memory.

The motherboard has 512KB of pipelined burst SRAM cache on board. This is blisteringly fast work area memory that is used by the processor as storage for mathematical calculations.

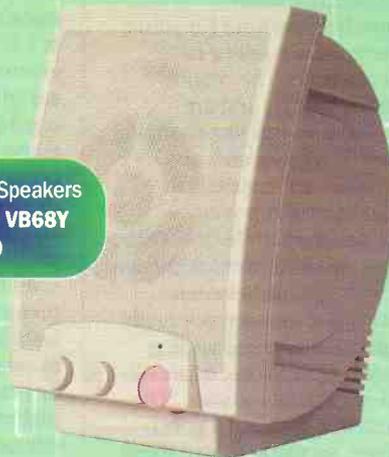
This motherboard is fitted with a "Socket 7" Pentium socket and will accept almost any of the Pentium processors and their clones from AMD and Cyrix or IBM. There are no motherboard links to set up the CPU type used, with a simple BIOS program being used instead. This program is able to automatically identify certain CPU characteristics and will not allow you to make potentially catastrophic mistakes about supply voltages. Any CPU you fit to this motherboard is also thermally monitored for overheating and will be shut down if it does get too hot. A far cry from earlier motherboards, where it was every man for himself, and the possibility of grave consequences for that expensive chunk of silicon and ceramic if you got just one tiny jumper fitted in the wrong place!



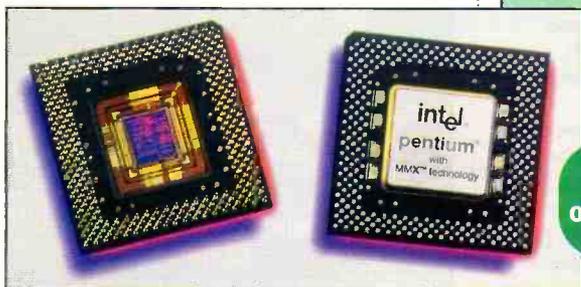
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## Memory

You will need some Random Access Memory for program and data storage while you are using your machine. This comes in the form of SIMM or DIMM memory on modern computers, where the individual memory chips have already been assembled in groups on a miniature printed circuit board. These need to be plugged in to your motherboard (in pairs for SIMM's).

For this series of articles, we have chosen to fit either 32MB of memory, or 64MB. 32MB is really the minimum these days for a fully fledged multimedia machine playing video and audio material from huge source files, running multiple programs in an office environment, with spreadsheets that sometimes run to over 10MB each, or using artwork packages, where individual images often end up 10MB or even 20MB in size.

We have chosen to use either two 16 MB EDO 72 pin SIMM's (2 x NT05F) for the 32MB option, or two 32MB EDO 72 pin SIMM's (2 x NT06G) for the 64MB option. Bear in mind that you could use more, or less, as your pocket allows, but do buy your SIMM's in pairs (you may fit two pairs, identical or different sizes per pair), and make them EDO or Synchronous DRAM. DIMM's may be fitted singly.

## Microprocessor

The Microprocessor or CPU may truly be said to be the heart of the computer. This part more than any other determines the overall performance of your completed system, although you will need to provide the right support in terms of memory and fast peripherals to realise the maximum performance that the faster CPU's are capable of.

The Intel Pentium class processor and its rival versions produced by other manufacturers have been around for some years now and there are a number of different versions available. The original Pentiums ran at 60 or 75MHz and are already museum pieces in this fast changing world! Various speeds are available and basically the faster the "clock speed" in MHz, the faster the PC will run your programs, all else being up to the job. Older Pentium processors are still around at bargain basement prices with speeds between 90MHz and 133MHz, but they are not really fast enough to run the more demanding modern multimedia applications, especially video / audio and 3D games software. The purpose of this article is to build a good multimedia machine, so we will leave these older members of the Pentium family and move on to consider faster alternatives.

For about the same cost as an older Intel Pentium, it is possible to buy a fast "clone" Pentium type CPU made by one of several manufacturers. AMD, Cyrix (now owned by National Semiconductors) and IBM all make their own Pentium class processors. Some of these processors actually run benchmark tests considerably faster than a genuine Intel Pentium and offer broad Pentium compatibility when running software written for a Pentium.

For those of you who feel more comfortable with the "Intel Inside" feeling, the Intel processor will be the natural, albeit most expensive, choice. Maplin can supply

the Intel Pentium MMX (the newer version of the Pentium with arithmetic handling optimised to the types of block moves and modifications associated with 3D multimedia applications) in both 200MHz (LS15R) and 233MHz (LS16S) speeds.

Other manufacturers CPU's are also available with their own versions of the MMX Multi-Media eXtensions. Maplin now stock the K6 series processors from AMD in two speeds. The 200MHz version (LS12N) offers particularly good value for money and the 233MHz version (LS13P) is also correspondingly cheaper than the Intel equivalent. Both offer XXCAL Platinum certified Pentium compatibility and are suitable for all major operating systems. These are the processors we have decided to use for our example system.

## Graphics card

The Video Graphics Adaptor card, once called the VGA card but now more often called SVGA, "S" standing for "Super" to denote the increased resolution on screen over older cards, is a very important part of your multimedia system. It puts together the video image you will spend hours looking at, and the choice of graphics card affects both the quality and speed of your video display.

You may spend anything from about £20 to more than £500 on a graphics card, so it makes sense to decide what you want from your card and how much you are prepared to spend to get it! Firstly, for the purposes of a multimedia machine, forget cheap VGA and SVGA cards with 512KB or 1MB of memory. They won't be capable of displaying the higher resolution screens with enough colours for a smooth and deep display. As a minimum, I would recommend that you look for a card capable of a resolution of 1024 pixels wide, by 768 deep, at a colour depth (number of colours) greater than the 256 colours the basic cards are limited to. "Hicolor" and "Tricolor" modes use 16 and 24 /32 bit memory locations respectively to store many millions of possible colours per pixel, which gives a far more gradual shading effect on photographic and 3D images than the banded images produced using just 256 colours.

All of this extra colour depth uses memory, so you should be looking for at least 2MB of RAM on the card (this will allow up to 1024 x 768 at 16 bit "Hicolor") or preferably 4MB for the choice of even higher X/Y resolutions and full 24 or 32 bit colour at 1024 x 768. The card we have chosen for this example is a 4MB SVGA card based on the S3 Virge 3D graphics chipset. This card (KM99H) will provide an excellent choice of screen resolutions in 16 or 24 bit colour modes at a very competitive price. It has a number of special drawing and 3D movement functions built in to increase graphic refresh speeds for supported programs, but should not be confused with a 3DFX graphics card.

3DFX is a specialised (and expensive) graphics mathematical number cruncher card that sits alongside your actual graphics card and does all the hard work for it at very high speed. Software written for 3DFX (and there are 3DFX versions of many of the latest action games at the moment) will give



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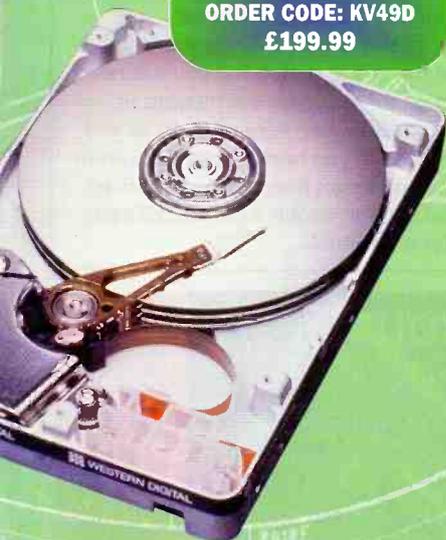
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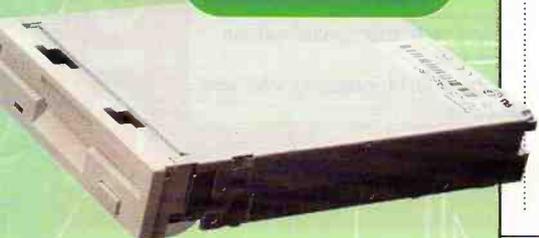
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very smooth fast moving results when one of these cards is used. We have chosen not to fit a 3DFX card into our multimedia machine at present, but will look at this again at the end of the series, when prices should have dropped a little!

### Sound card

This is another essential plug in peripheral for a multimedia machine. Your sound card will allow your software to play music using the cards own synthesiser circuitry, to play sound effects and narrated soundtracks from digital sound files within the program, or audio tracks direct from the CDROM drive via the amplifier in your sound card. Sound cards also add a MIDI capability to your PC (Musical Instrument Digital Interface for controlling, or reading the output of external music synthesisers) and add a joystick port to your system. They also contain analogue to digital converters to take "real world" audio signals from a microphone or line level input from a Hi-Fi or other audio source and convert them into a digital format that may be stored, edited and replayed using your PC and hard drive. A complementary digital to analogue converter performs the reverse process and allows you to play stored material back on your external speakers.

As you might expect, Sound cards also come in a number of flavours, from harsh and basic through to sophisticated and sublime. As ever, we will try to assess the needs of the job and hit a happy medium. Lets take the all important sound and music generation capability first. I won't go into a long history of all the many previous sound standards here (and there have been a lot of them), but suffice it to say that your sound card must be Sound Blaster compatible for everyday use with minimum hassle. Creative Labs Sound Blaster 2.0 card set the de facto standard for this type of device and it's support was and is so universal among software developers that it has become the card to copy. There are countless Sound Blaster clones and offshoots of the basic Sound Blaster specification, but for our purposes, there are only two important developments.

Sound Blaster Pro followed on from Sound Blaster 2.0 and extended the A/D and D/A capability to full 16 bit storage and playback in stereo, allowing full CD quality audio (amplifier and other hardware specification permitting).

Sound Blaster 32 introduced wavetable sound synthesis, where actual musical instrument sounds were sampled and stored digitally for subsequent playback via a digital signal processing system that produced notes of any musical timbre from just a few stored samples. Previous sound cards used FM synthesis techniques to build an approximation of real instrument sounds that often sounded very electronic and artificial.

There have since been any number of other manufacturers versions of these developments and many of these cost considerably less than the Creative versions. The only caveat here is that some Sound Blaster compatible cards are not quite 100% compatible when it comes down to it, especially if you still run DOS based games or other sound applications.

We have chosen to use a wavetable synthesis sound card based on the Yamaha wavetable device, which also contains the original Yamaha OPL3 FM sound synthesiser for compatibility with older or DOS based software that is unable to recognise the wavetable hardware. The LR99H sound card is capable of producing 32 voice polyphonic music, 16 bit stereo sound with sample rates up to 48KHZ, MIDI compatibility to play "MID" files via the internal wavetable synthesiser or via an external MIDI instrument (connected via a special interface cable which is not provided with the card). It has a built in amplifier and a connector for the audio output of your CDROM drive. It also has a built in IDE-ATAPI CD-ROM interface to directly control your CDROM drive, if required.

You will also need a set of external speakers to plug into your sound card. The type and quality of these will obviously have a great bearing on the sound quality your PC will produce, so very tiny speakers will give a disappointing and often tinny sound output. We are using a set of amplified desktop speakers (VB68Y) with tone and volume controls, that produce quite a respectable sound.

### Hard Drive

Your hard drive will soon become another limiting factor if you don't buy a large enough one in the first place. Extra hard drives are admittedly quite easy to fit, but you do need to start out with something reasonably sized. This is a goal with permanently moving goal posts, as hard drives get larger and larger and application software grows daily. Many game demo's these days use 75MB or more of hard disk space and the size of the professional office suites when fully installed is simply obscene. Those of you who may be considering buying a CDR or CDRW drive to burn your own CD's should bear in mind that you will probably have to create an image file on your hard drive the same size as the target CD, so you will need up to 650MB spare for a full CD image, plus all of your other installed software and data.

We have chosen to fit a 3.2GB Western Digital EIDE hard drive (KV49D) to our example system, which should be adequate for a while. We will explain how to add further drives at the end of this short series, for those of you who feel they may need even more space.

### CDROM drive

Almost every piece of software you will buy these days will come on a CDROM. A CDROM drive has become an essential for any machine and there is no doubt that the capacity to provide up to 650MB of easily accessible information on a single inexpensive to produce disk has really allowed multimedia to come into it's own. If you have seen or used Microsoft's Encarta multimedia encyclopaedia with it's wealth of sound and movie clips and other animated sequences as well as a full encyclopaedia on disk, you will need no further convincing of the value of CDROM based multimedia, especially if you have children in the family. CDROM's bring learning alive and turn homework into a pleasure for young

enquiring minds, as well as showing the kids that there is far more to the PC than endless games (usually involving mindless destruction, I fear).

A multimedia PC needs to be able to play videos smoothly and without hesitation. Early CDROM drives just couldn't do this, but the newer 24-speed and now the latest 32-speed drives do this very well indeed. Indeed, a 16-speed drive will usually be fine, but as we are building a forward looking PC to last some time, we will specify a fast but economical 24-speed unit for our PC, with an alternate 32-speed option. This is one of the many areas in the PC market that never stands still and I fully expect the 24-speed drive to go out of production fairly rapidly as speeds move on still further (48 speed next?).

However, at the moment the 24-speed seems to be the best choice so we are using the Maplin LS27E for our system, with an option to upgrade to the latest 32-speed drive (LQ93B).

### Disk drive

Although the old 3.5 inch floppy drive is used less these days, it still makes sense to fit one, if only to boot from a rescue disk when things go horribly wrong! We have chosen a standard 3.5 inch 1.44 MB floppy drive (ZG44X). Both the floppy drive and hard drive will plug directly into the motherboard, which has an EIDE controller built in as well as the floppy drive and hard drive connectors for two EIDE channels (up to four EIDE drives, master and slave drive on each channel).

### Monitor

It is fairly obvious that you will need a good monitor if you want to get the best out of high resolution SVGA images. Having said that, monitor prices start at a fairly low level these days, but soon go up in leaps and bounds as screen size increases. The cheapest monitors have a 14 inch screen, but these are not the best choice for a system where very detailed graphics will be regularly displayed. We are opting for a 15 inch monitor for our system, where the small extra increase in size does make a significant difference to the sharpness and readability of the display in higher resolution modes.

The LS66W monitor offers a non interlaced scan at rates up to 85Hz for 800 x 600 modes and up to 60Hz at 1024 x 768 modes. Whether or not the flicker introduced by interlaced operation on more basic monitors (where only half the picture information is actually drawn during one scan, with the successive scan of the screen placing the other half of the picture information between the previous lines) is intrusive to you, you will be able to see the improvement in clarity with a 15 inch screen.

For those of you who spend many hours each day in front of your screens, whether professionally or as an avid hobbyist, a 17 inch monitor (LS67X) would be an investment well worth considering. The ease of readability and clarity resulting from this much larger display have to be seen to be believed.

### Keyboard and mouse

Last but not least, every system needs a good reliable keyboard and a mouse to allow you to input data and steer your way around your applications. We are using a membrane keyboard (VL72P) made by Cherry, a well known manufacturer of quality keyboards.

The mouse chosen for this system is a straightforward 2 button type (JT24B). The mouse used here is a PS/2 type, with the smaller mini-DIN connector, to match the sockets used on the motherboard.

### Place your order

So, whether you choose to place your order with Maplin, using the parts we have chosen, or go your own way, now is the time to place your order. Next months article will begin to take you through the process of building your own multimedia PC step by step. Those of you using the parts we have suggested will find it's very easy, as we will take you through each process using exactly the same parts, set up and instructions as you will have there in your hands. What could be easier!

Those of you using other choices should still find the article useful, but you will need to examine those cryptic instructions in often dubious English very carefully as you go. For those of you buying your parts from Maplin, don't forget that reasonably priced technical support is only a phone call away should you get stuck.

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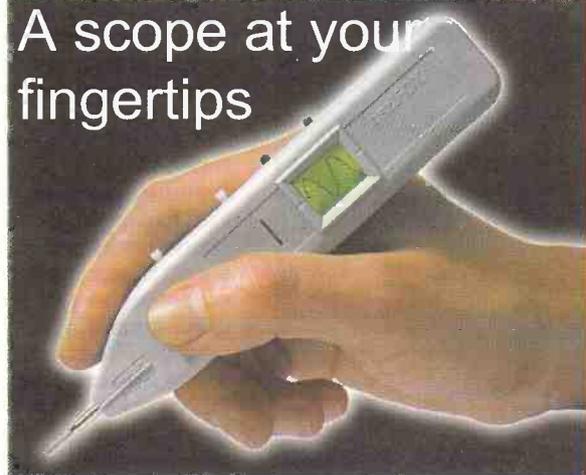
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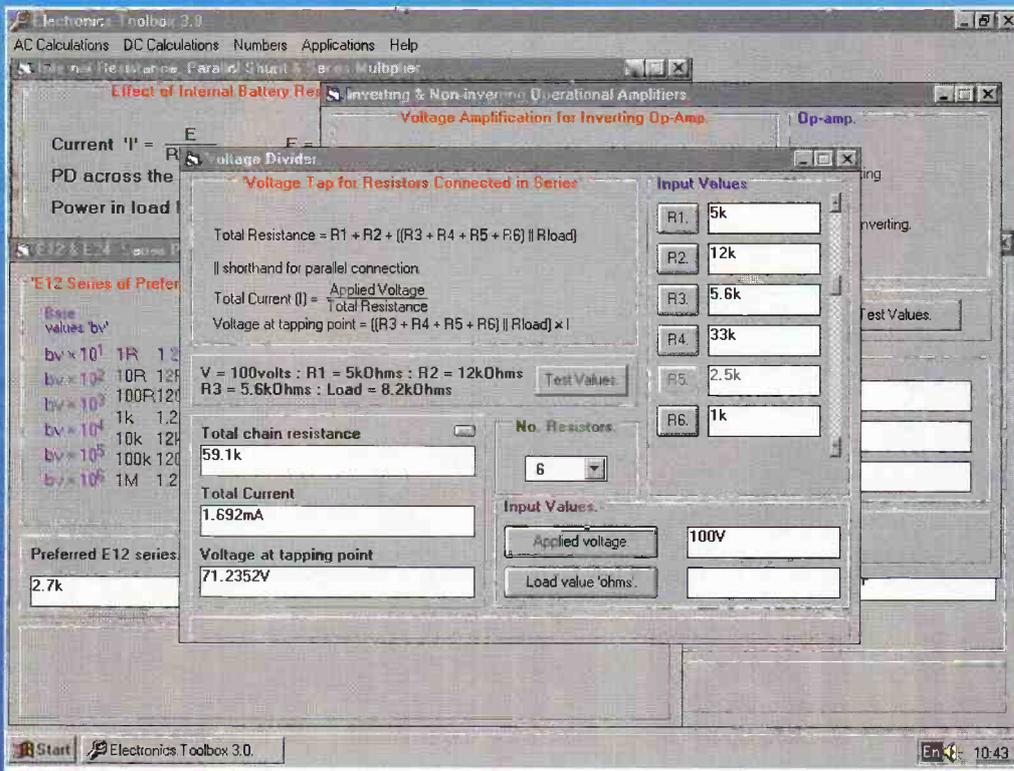
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The default setting for accuracy is four decimal places. However, up to fifteen places may be selected when the output results produce very small voltages and currents.

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Selecting a particular input i.e. voltage, current, frequency etc. is via a dialogue box whereby additional number formatting is performed. Values can be input using electronics symbols i.e. Ohms, kOhms, MOhms or uA, mA and Amps.

## Output Results.

Resultant values are output again using electronics symbols i.e. Hz, kHz MHz or uV, mV, V etc. Formatted numbers are easy to read and readily identify changes. The use of scientific notation is avoided wherever possible to make the calculations meaningful.

One professional recently described the Electronics Toolbox as more useful than his scientific calculator which cost three times as much. This program is not intended to be an educational package as is the case of the Electronics Principles 5.0 title. Its appeal is for a quick and easy calculating solution, without the user having to try to remember or look up a particular formula and where individual component values can be changed to see the effect on the result.

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# ELECTRICAL TEST EQUIPMENT

## Fluke Takes the Lead in Safety Standards

Text by Ken West, Product Marketing Manager for Test Tools, Fluke (UK) Limited

Engineers who analyse multimeter safety often discover that failed units have been subjected to a much higher voltage than the user thought was being measured. This would be typically due to a high voltage spike, or transient, that reached the meter without warning. Capacitors, motors and the increasingly used variable speed drives can be prime generators of spikes. As distribution systems and loads become more complex, the possibilities of transient overvoltages increase. Lightning strikes on outdoor transmission lines also cause extremely hazardous high-energy transients. When taking measurements on electrical systems, these transients are 'invisible' and largely unavoidable hazards. They occur regularly on low-voltage power circuits, and can reach peak values in the many thousands of volts. In these cases, the user's protection depends on the safety margin built into the meter.

### Transient protection

The real issue for multimeter circuit protection is not just the maximum steady state voltage range, but a combination of both steady state and transient overvoltage withstand capability. To protect against transients, safety must be built into the test equipment.

The task of defining a new specification for test equipment was recently addressed

by the IEC (International Electrotechnical Commission). This organization develops international safety standards for electrical test equipment. For a number of years the industry standard was IEC 348. That standard has been replaced by IEC 1010. While well-designed IEC 348 meters have been used for years by technicians and electricians, meters designed to the new IEC 1010 standard offer a significantly higher level of safety.

When transients ride on high-energy circuits, they tend to be more dangerous because these circuits can deliver large currents. If a transient causes an arc-over, the high current can sustain the arc, producing a plasma breakdown or explosion, which occurs when the surrounding air becomes ionized and conductive. The result is an arc blast, a disastrous event which causes more electrical injuries every year than the better known hazard of electric shock.

### Overvoltage installation categories

Within the new standards is the Overvoltage Installation Category which defines the Categories I – IV, often abbreviated to CAT I, CAT II, etc. (See Table 1). The higher the power available, and the higher the possible energy transients, then the higher the CAT number. As a transient, such as a lightning strike, works its way through the system from

a CAT IV area downwards so the electrical impedance gradually attenuates its energy. Thus the requirements in CAT IV are much higher than those in CAT I. (Figure 1 gives a diagrammatic representation of the areas.)

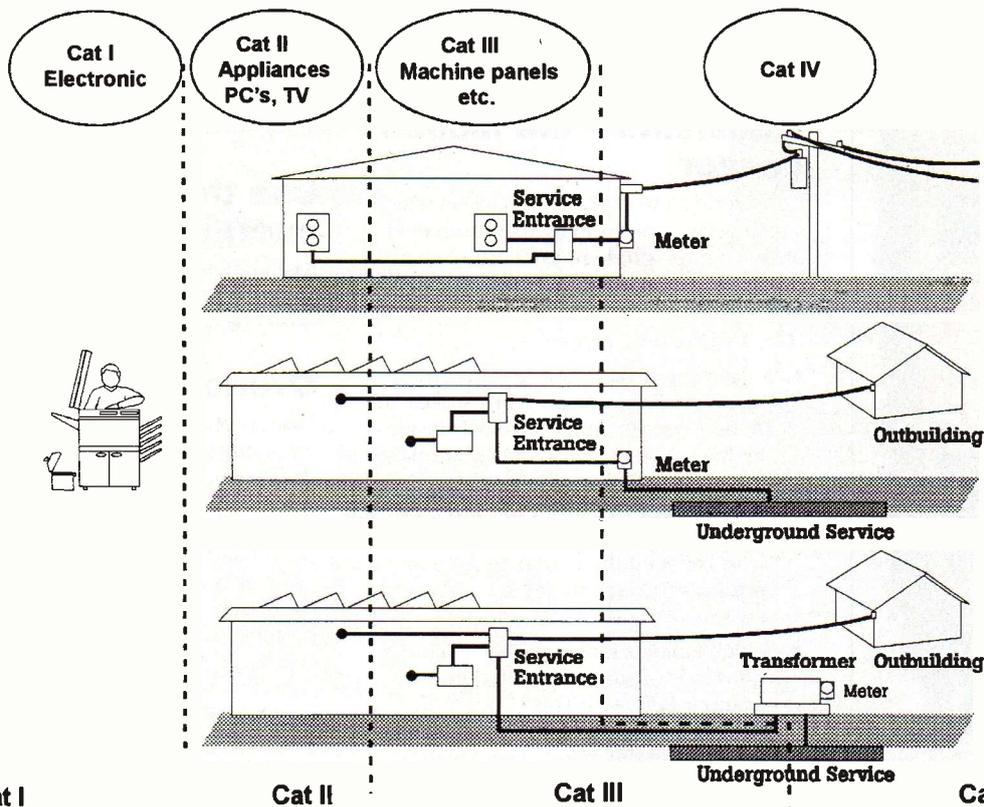
### Shortcuts to understanding categories

Here are some quick ways to apply the concept of categories to every day work:

- ◆ The general rule-of-thumb is that the closer the user is to the power source, the higher the category number, and the greater the potential danger from transients.
- ◆ It also follows that the greater the short-circuit current available at a particular point, the higher the CAT number.
- ◆ Another way of saying the same thing is the greater the source impedance, the lower the CAT number. Source impedance is simply the total impedance, including the impedance of the wiring, between the measurement point and the power source. This impedance is what dampens transients.
- ◆ Finally, a TVSS device installed at a panel must have higher energy-handling capacity than one installed right at the computer. In CAT terminology, the panelboard TVSS is a CAT III application, and the computer is a receptacle-connected load and, therefore, a CAT II installation.

Figure 1.

FLUKE.



- Cat I**
- \* Electronic equipment
  - \* Low energy equipment with transient limiting protection

- Cat II**
- \* Outlets & long branch circuits
  - \* Outlets more than 10m from a Cat III source
  - \* Outlets more than 20m from a Cat IV source

- Cat III**
- \* Feeders & short branch connections
  - \* Distribution panel devices
  - \* Heavy appliance outlets with 'short' connections to service entrance

- Cat IV**
- \* Outside and service entrance
  - \* Service drop from pole to building
  - \* Run between meter & panel
  - \* Overhead line to detached building
  - \* Underground line to well pump

Thus, the concept of categories is simply an extension of the same common-sense concepts that people who work with electricity professionally apply every day.

### Multiple categories

There's one scenario that sometimes confuses people trying to apply categories to real world applications. In a single piece of equipment, there is often more than one category. For example, in office equipment, from the 230V side of the power supply

back to the receptacle is CAT II. The electronic circuitry, on the other hand, is CAT I. In building control systems, such as lighting control panels, or industrial control equipment such as programmable controllers, it is common to find electronic circuits (CAT I) and power circuits (CAT III) existing in close proximity. The solution is of course to plan carefully, and select a multimeter rated to the highest category in which it could possibly be used. In other words, to err on the side of safety.

### Understanding voltage withstand ratings

IEC 1010 test procedures take into account three main criteria: steady-state voltage, peak impulse transient voltage and source impedance. These three criteria together will indicate a multimeter's true voltage withstand value.

There is a very important difference between the 6000V transient for CAT III/600V and the 6000V transient for CAT II-

#### Overvoltage Category

#### In Brief Examples

CAT IV	Three-phase at utility connection, any outdoors conductors.	<ul style="list-style-type: none"> <li>◆ Refers to the 'origin of installation', i.e., where low-voltage connection is made to utility power.</li> <li>◆ Electricity meters, primary overcurrent protection equipment.</li> <li>◆ Outside and service entrance, service drop from pole to building, run between meter and panel.</li> <li>◆ Overhead line to detached building, underground line to well pump.</li> </ul>
CAT III	Three-phase distribution, including single-phase commercial lighting.	<ul style="list-style-type: none"> <li>◆ Equipment in fixed installations, such as switchgear and polyphase motors.</li> <li>◆ Bus and feeder in industrial plants.</li> <li>◆ Feeders and short branch circuits, distribution panel devices.</li> <li>◆ Lighting systems in larger buildings.</li> <li>◆ Appliance outlets with short connections to service entrance.</li> </ul>
CAT II	Single-phase receptacle connected loads.	<ul style="list-style-type: none"> <li>◆ Appliance, portable tools, and other household and similar loads.</li> <li>◆ Outlet and long branch circuits.</li> <li>◆ Outlets at more than 10 meters (30 feet) from CAT III source.</li> <li>◆ Outlets at more than 20 meters (60 feet) from CAT IV source.</li> </ul>
CAT I	Electronic	<ul style="list-style-type: none"> <li>◆ Protected electronic equipment.</li> <li>◆ Equipment connected to (source) circuits in which measures are taken to limit transient overvoltages to an appropriately low level.</li> <li>◆ Any high-voltage, low-energy source derived from a high-winding resistance transformer, such as the high-voltage section of a copier.</li> </ul>

Table 1. Overvoltage installation categories. IEC 1010 applies to low-voltage (<1000V) test equipment.

**Fluke T5 Voltage, Continuity and Current Tester - the next generation of electrical testers.**



1000V. They are not the same. This is where the source impedance comes in. Ohm's Law (Ohms = Volts/Amps) tells us that the 2Ω test source for CAT III has six times the current and power of the 12Ω test source for CAT II.

The CAT III-600V meter clearly offers superior transient protection compared to the CAT II-1000V meter, even though its so-called 'voltage rating' could be perceived as being lower. It is the combination of the steady-state voltage (called the working voltage), and the category that determines the total voltage withstand rating of the test instrument, including the all-important transient voltage withstand rating.

## Creepage and clearance

Multimeters are also required by IEC 1010 to have minimum 'creepage' and 'clearance' distances between internal components and circuit nodes. Creepage measures distance across a surface. Clearance measures distances through the air. The higher the category and working voltage level, the greater the internal spacing requirements. One of the main differences between the old and the new standards is that IEC 1010 has increased spacing requirements.

## Test leads

These too are covered by IEC 1010 so they should be certified to a category and voltage as high or higher than the meter.

## Transients - the hidden danger

Considering a worst-case scenario in which a technician is performing measurements on a live three-phase motor control circuit, using a meter without the necessary safety precautions.

Here's what could happen:

1. A lightning strike causes a transient on the power line, which in turn strikes an arc between the input terminals inside the meter. The circuits and components to prevent this event have just failed or were missing. Perhaps it was not a CAT III rated meter. The result is a direct short between the two measurement terminals through the meter and the test leads.
2. A high-fault current—possibly several thousands of amps—flows in the short circuit just created. This happens in thousandths of a second. When the arc forms inside the meter, a very high-pressure shock wave can cause a loud bang!—very much like a gunshot or the backfire from a car. At the same instant, the technician sees bright blue arc flashes at the test lead tips—the fault currents superheat the probe tips, which start to burn away, drawing an arc from the contact point to the probe.
3. The natural reaction is to pull back, in order to break contact with the hot circuit. But as the technician's hands are pulled back, an arc is drawn from the motor terminal to each probe. If these two arcs join to form a single arc, there is now another direct phase-to-phase short, this time directly between the motor terminals.
4. This arc can have a temperature approaching 6,000°C, which is higher than the temperature of an oxy-acetylene cutting torch! As the arc grows, fed by the available short circuit current, it superheats the surrounding air. Both a shock blast and a plasma fireball are created. If the technician is lucky, the shock blast blows him away and removes him from the proximity of the arc; though injured, his life is saved. In the worst case, the victim is subjected to fatal burn injuries from the fierce heat of the arc or plasma blast.

In addition to using a multimeter rated for the appropriate Overvoltage Installation Category, anyone working on live power circuits should be protected with flame resistant clothing, should wear safety glasses or, better yet, a safety face shield, and should use insulated gloves.

## Use the right high-energy fuses

A multimeter should have the amps inputs protected by high-energy fuses, and only those specified by the manufacturer.

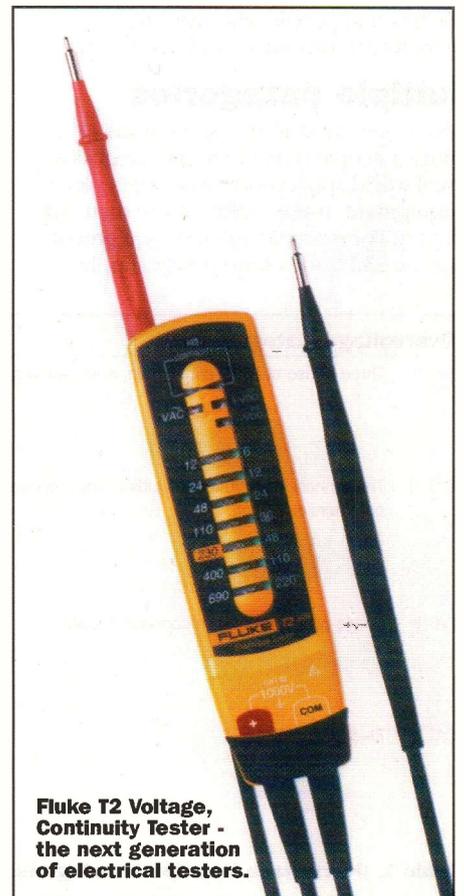
## Overload protection

Fuses protect against overcurrent. The high input impedance of the volts/ohms terminals ensures that an overcurrent condition is unlikely, so fuses aren't necessary. Overvoltage protection, on the other hand, is required. It is provided by a protection circuit that clamps high voltages to an acceptable level. In addition, a thermal protection circuit detects an overvoltage condition, protects the meter until the condition is removed, and then automatically returns to normal operation. The most common benefit is to protect the multimeter from overloads when it is in ohms mode. In this way, overload protection with automatic recovery is provided for all measurement functions as long as the leads are in the voltage input terminals.

Fluke offers a complete line of handheld test tools that are compliant with IEC 1010-1 (EN 61010-1).

Reader enquiries should be directed to Fluke (UK) Limited, Colonial Way, Watford, Hertfordshire, WD2 4TT. Tel: (01923) 216400.

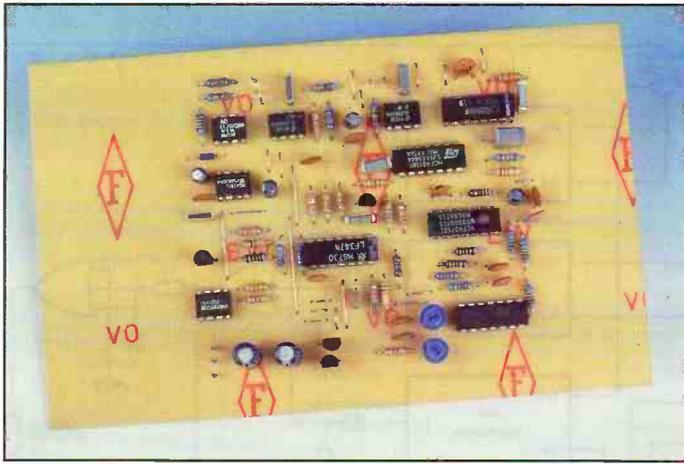
ELECTRONICS



**Fluke T2 Voltage, Continuity Tester - the next generation of electrical testers.**

Overvoltage Installation Category	Working Voltage (dc or ac-rms to ground)	Peak Impulse Transient (20 repetitions)	Test Source (Ω = V/A)
CAT I	600V	2500V	30 Ohm source
CAT I	1000V	4000V	30 Ohm source
CAT II	600V	4000V	12 Ohm source
CAT II	1000V	6000V	12 Ohm source
CAT III	600V	6000V	2 Ohm source
CAT III	1000V	8000V	2 Ohm source

**Table 2: Transient test values for overvoltage installation categories. (50/150V/300V values not included.) Test values and design standards for Category IV are not presently addressed in IEC 1010, therefore the highest-rated meters currently available are CAT III-1000V.**



# ON-SCREEN VIDEO LEVEL METER

## PART 1

by Ian Berry

Anyone working with video in just about any form will appreciate the need to be able to measure the video level produced by cameras or other sources. Looking at a picture monitor is enough to indicate any under exposure as the picture will look dark but this is not sufficient for overexposure as a picture on a monitor will usually appear fine even though the video level produced is too high. Worse still there may be small areas of overexposed picture which may appear fine on a monitor. And then, of course, what happens if

someone turns down the monitor contrast and brightness.

If the video level is too high this can give problems with over-modulated recordings. If the signal is to travel any distance by microwave or satellite link over-modulation can give problems not only for the link sending the signal but possibly also for other users. Over-modulation can make the signal breakthrough into nearby channels which may be in use by others.

Traditionally, the way to measure a video signal is with an oscilloscope or waveform monitor (which is only a

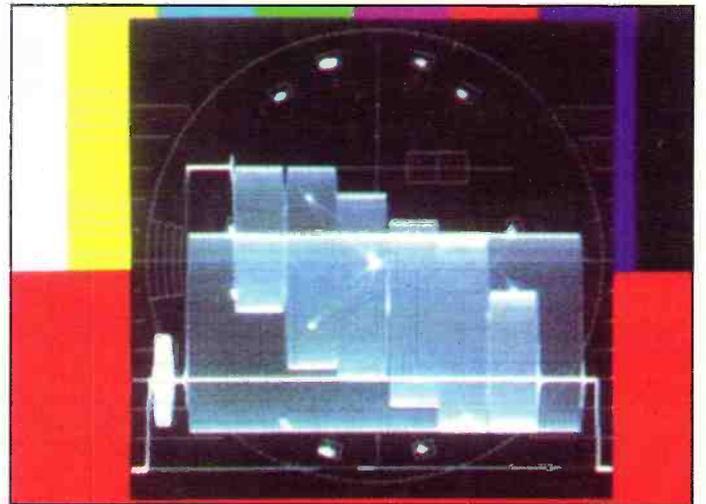


Figure 3. Micro Scope Display.

special purpose oscilloscope with simpler controls). Figure 1 shows a typical video waveform monitor. This type of instrument is usually large, bulky and normally very expensive. In recent years one way round this has been to use a type of virtual waveform monitor which superimposes the waveform display on top of the picture on a monitor thus doing away with the heavy and expensive CRT of the waveform monitor. This means a small and light box which uses little power (it can even be battery operated) and which can be attached to the monitor if required. Figure 2 shows the Hamlet Micro Scope which is typical of such a unit. The

video signal to be measured is applied to the box and an output is generated with the waveform superimposed within the video signal for display on a picture monitor. Figure 3 shows a typical set of displays produced by the Hamlet Micro Scope. There is, of course, still a snag. Such units are still relatively expensive, costing from about £600 for a basic unit up to in excess of £2000 for a model with all the bells and whistles.

As can be seen from Figure 3, the superimposed waveform from such units is a fairly exact replica of the display to be found on traditional waveform monitors, including complex graticules, to allow a large



Figure 1. Picture of typical Video Waveform Monitor.

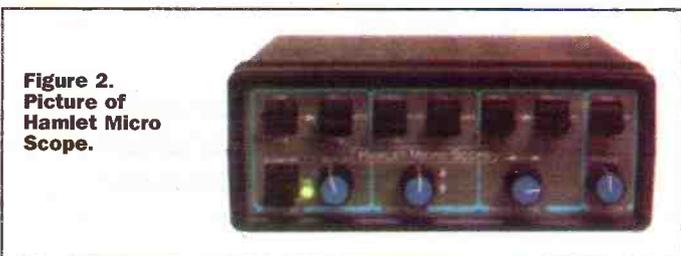


Figure 2. Picture of Hamlet Micro Scope.

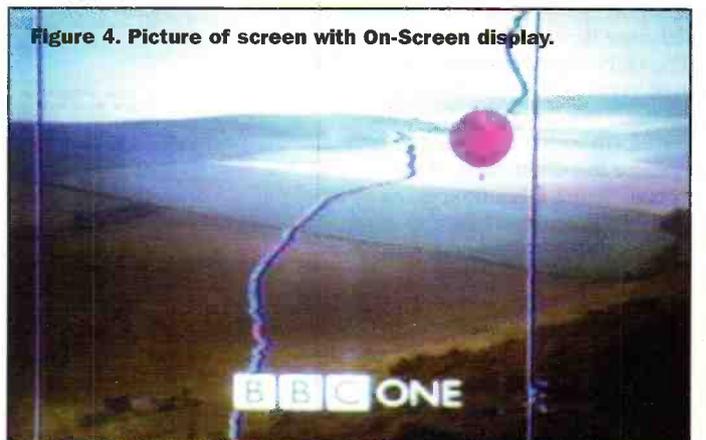


Figure 4. Picture of screen with On-Screen display.

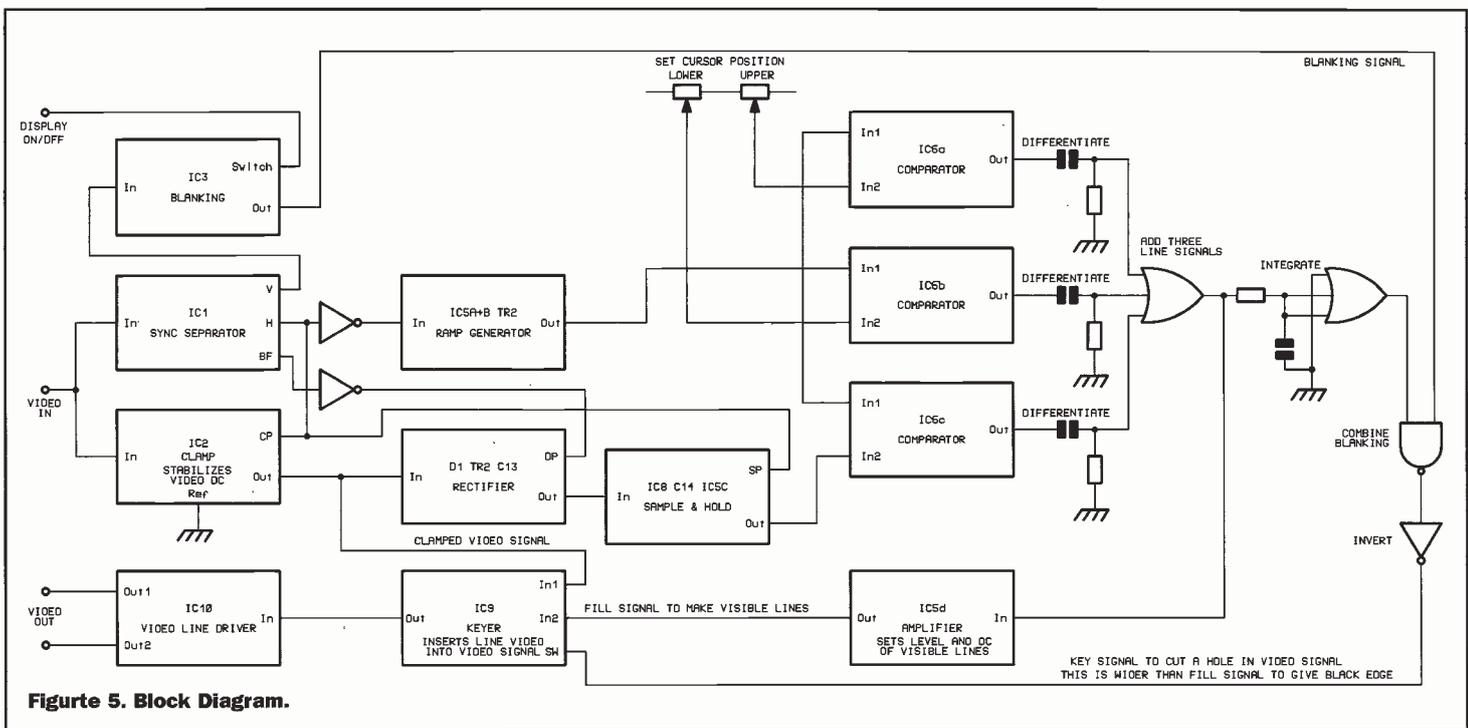


Figure 5. Block Diagram.

number of exact measurements to be made. Just to indicate the level of a video signal a much simpler device may be used.

The On Screen Video Meter display consists of just three thin vertical bars superimposed over the monitor picture. The left hand bar is fixed in place and indicates Black Level (the darkest part of the picture), the right hand bar is also fixed and indicates White Level (the brightest part of the picture). Between these two cursor lines is a third bar, the position of which indicates the actual maximum video level on each line of the picture. Figure 4 illustrates this. In practice, the maximum video level indicated by the centre bar should not be over the white cursor bar as this would indicate overexposure or over-modulation. A means is provided to remove the bars temporarily if they interfere with the viewing of the picture.

### The Works

Reference to the Block Diagram of Figure 5 will serve to illustrate how the unit works. The video signal is input to a sync separator which extracts the timing information from the waveform which is needed to operate the other parts of the circuit. Figure 6 is a timing diagram illustrating how the various pulses are related. The input video also goes to a clamp circuit. This makes sure the video signal is at a fixed dc level before it is applied to the rest of the circuit. If this is not done the video signal would not be measured correctly. If it were

sitting on a positive dc level it would be indicated too high, if it were sitting on a negative dc level it would be indicated too low, and if it were ac coupled with a varying dc level it would sometimes indicate too high

and sometimes too low depending on the brightness content of the picture. Figure 7 shows the effect of dc levels on the indicated video waveform.

The clamped video is rectified and applied to a sample and

hold circuit to ensure that the highest video level is indicated no matter where on the horizontal line it occurs. The output of the sample and hold circuit is a dc voltage proportional to the maximum

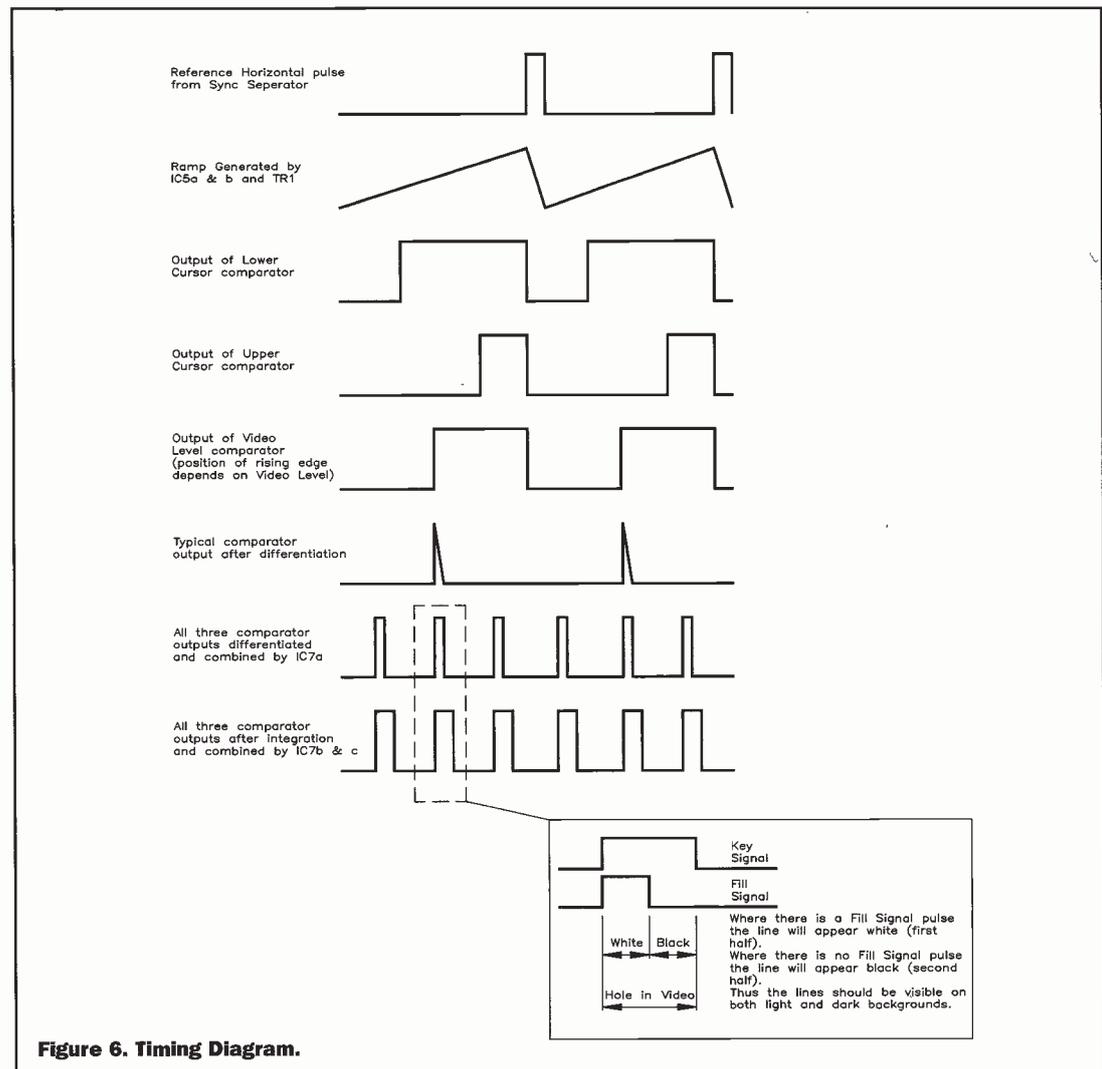


Figure 6. Timing Diagram.

picture brightness on a line by line basis. This dc is applied to one of three comparators. The other two comparators are fed with fixed dc levels from two potentiometers, and these serve to generate the two cursor bars.

The horizontal sync signal from the sync separator is used to generate a sawtooth ramp signal which is applied to the second input of all three comparators. When the dc input from potentiometer, or rectifier, is higher than the ramp level the comparator output is low. When the ramp voltage rises above the dc set by the potentiometer, or rectifier, the comparator output goes high. Thus a pulse is produced, the rising edge of which

indicates where the display will be relative to the left hand side of the picture. There are three rising edges at different horizontal positions corresponding to the black level cursor, the white level cursor, and the video level. Each pulse is differentiated to give a narrow spike which will be displayed on the monitor. The three spikes are combined in an OR gate. This signal is now integrated and applied to another OR gate the effect of which is to approximately double the width of the spikes. These wider spikes are the key signal used to cut a hole in the video signal. The original narrower spikes are the fill signal to be inserted into the hole cut by the

key signal to give a visible bar on the picture. Because the key signal is wider than the fill signal only part of the hole is filled with white bar, the rest appears black. Thus the actual bar produced is half white and half black ensuring it can be clearly seen on all types of picture.

In order that the unit does not attempt to display the signal during the vertical sync and blanking part of the picture, which would give rise to vertical picture instability on the monitor, a vertical blanking signal is generated which is used to gate off the key signal during the vertical blanking part of the video waveform. This part of the circuit is also used to gate-off the key signal completely

if required to remove the bars from the monitor picture.

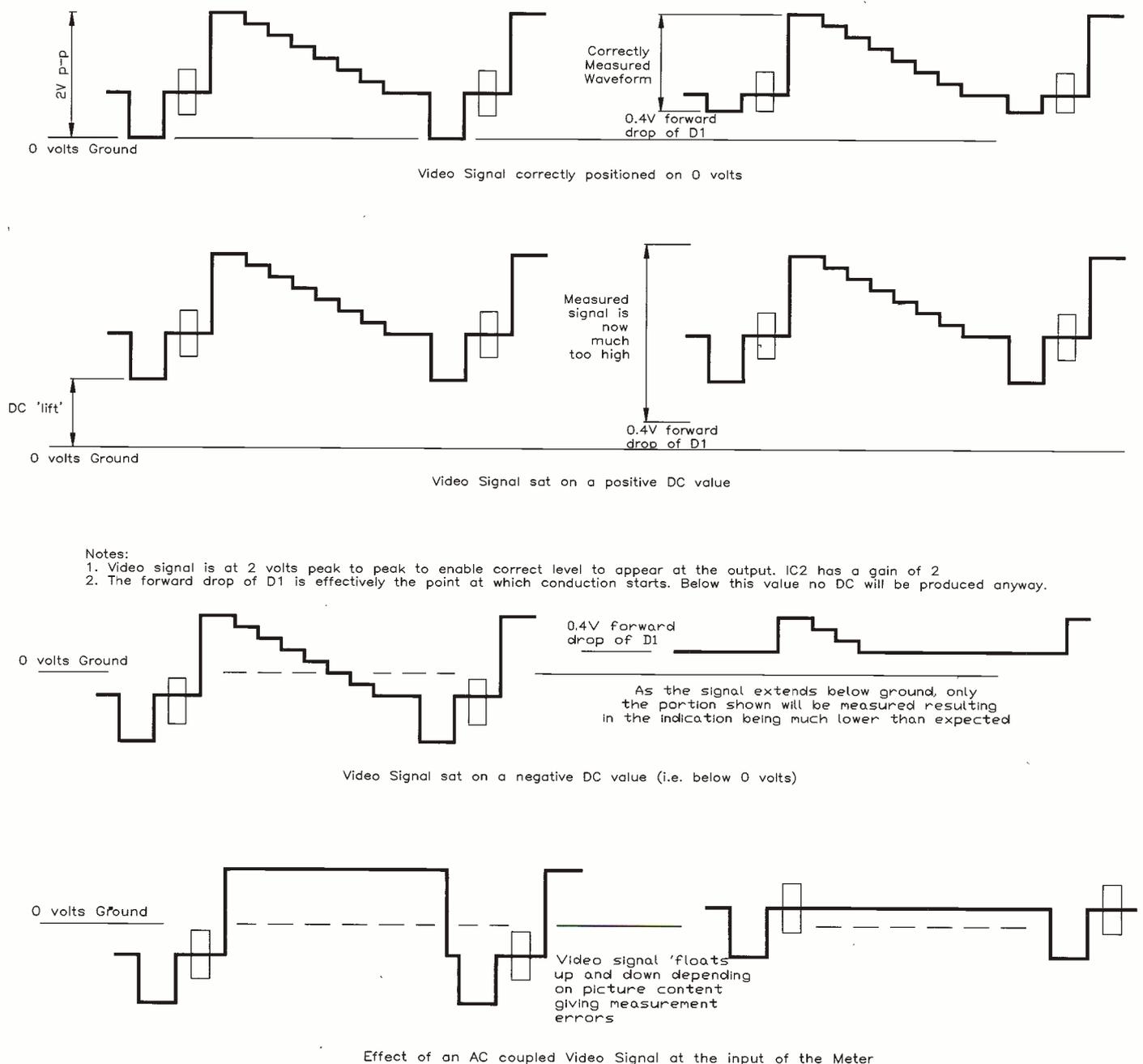
The fill signal is combined with the clamped video signal by a simple analogue switch under the control of the key signal. When the key signal is low the video signal is allowed through. When the key signal is high the line fill signal is substituted. The combined video is input to a video line driver to ensure a correct 75Ω output. A second output can be provided if required.

## Circuit Description

Refer to the main circuit diagram of Figure 8 (over page).

**PART 2 NEXT MONTH**

**Figure 7- Clamp error waveforms.**



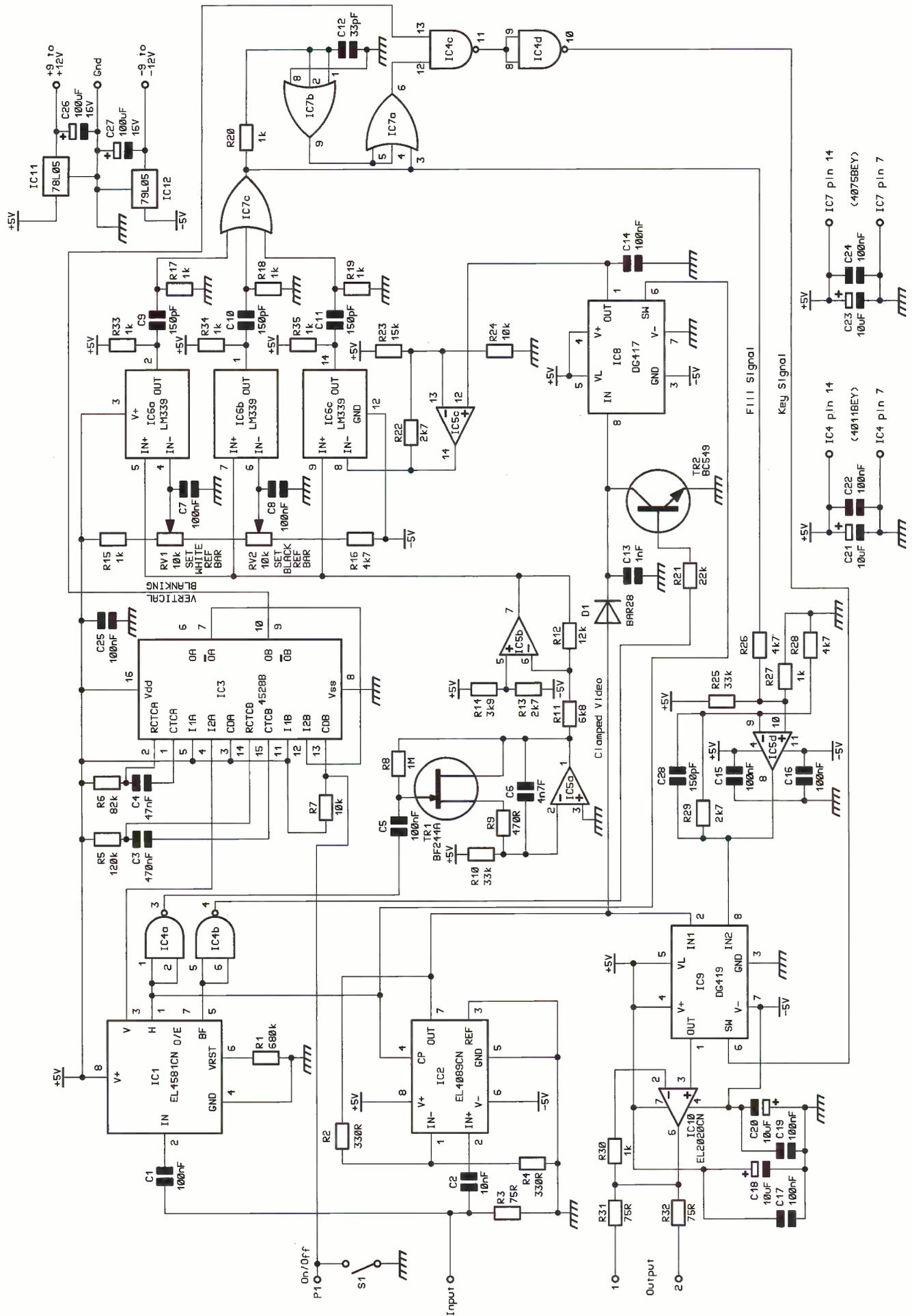


Figure 8. Main Circuit Diagram.

# Making YOUR OWN CDs

## PART 5

Concluding his comprehensive series on CD burning, Martin Pipe looks at how you can make your disc look more polished. A glossary and hints section are also given.

Well, you've made your disc. It may sound good in your CD player, but it is not particularly inspiring to look at, is it? The label booklet and tray card within the jewel case are the ones supplied with the blank medium – an advert for its manufacturer, if you will. Such paperwork isn't included with the jewel cases that tend to be supplied with cheaper CD-R discs. And what of the discs themselves? The more expensive branded ones have an ink label – with space for you to write on – screen-printed on, budget discs do not go this far – all you see is the gold on the upper (label) surface, and the green recording die on the lower (recording) surface. Not only are CD-R's unattractive when compared with commercial CDs, but they are also difficult to identify. This can be particularly annoying if you have burnt many CD-Rs, for audio, MPEG video and/or data.

You are probably thinking that you could identify a particular disc by scribbling on it, or attaching a self adhesive label of some kind. True enough, but there are certain issues that need to be considered – the process isn't as straightforward as it is with floppy discs, or other media that are encased within a stationary protective housing. First of all, there's only one kind of pen that you should use to write on a CD-R disc – and they are comparatively difficult to obtain. Sharp nibs might scratch and damage the protective lacquer on the disc's surface, reducing the long-term life of the data, and so pencils and ball points are right out. That leaves soft-tipped pens,

such as permanent ink markers.

Unfortunately, the choice of suitable pens is restricted. Most tend to use an alcohol-based solvent that might, over time, leach into the protective lacquer and corrupt the disc's contents. The only kind of pen suited to writing directly on CD-R label surfaces is an alcohol-free, felt-tipped permanent marker. The manufacturers of CD-R media recommend water or oil-based inks in their literature. PC superstores and the bigger



stationers don't seem to handle such pens. Indeed, I have only seen them available at specialist CD-R equipment mail-order retailers, such as CD Revolution (<http://www.cdrevolution.com>) and Linefeed (<http://www.linefeed.com>).

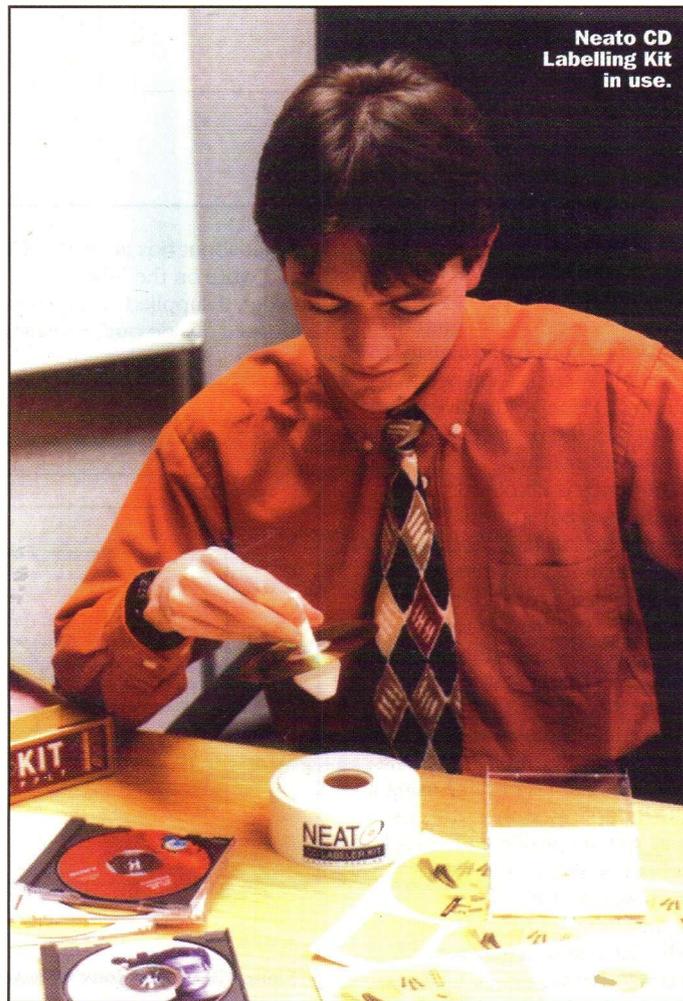
I have enquired as to their availability, but the dealers in question seem to be out of stock permanently! I wonder if Maplin might spot the opportunity? If you're unsure, the safest option would be to write on the hub of the disc,

which is isolated from the recording surface.

What about applying a label? This is indeed possible, but this should only be one that covers the complete disc. Specially designed circular labels, with an appropriately dimensioned hole in their centre and an application-optimised adhesive, are available from various sources – including Avery. They tend to be supplied on A4 sheets, which are suitable for printing by laser and inkjet printers, and are the only sensible labelling option. The availability of CD labels seems to be quite good – certainly much better than that of the pens. They are quite expensive, however – don't expect to pay less than 10 per 50 (i.e. 20p each). Figure 1 indicates the labellable surface of a CD.

Do not be tempted by cheaper alternatives – they could prove more expensive as time goes by! Attaching an address-type label on one side of the disc will alter its centre of gravity, and create an imbalance that could cause the disc to wobble within the CD mechanism as it spins around. The vibration can become a real problem with data discs being read in modern multi-speed CD-ROM drives. These can operate at rotational speeds that can be anything up to 32 times as fast as the mechanism built into a regular audio CD player. At best, you'll get a horrible racket that makes for an effective distraction as you attempt to work or enjoy your music.

At worst, you could get poor data read speeds and errors. It's probably not doing the CD mechanism much good, either – the servos and actuators that control laser focus need to



(<http://www.cambridge-multimedia.co.uk>).

These printers – Copytrax' Matisse (600) and Da Vinci (1170) – are based around the Epson 300 and 600 colour inkjet printers, respectively. They have a special tray for accepting the disc, but unlike dedicated CD printers will also handle regular paper (and could hence produce the jewel case artwork as well). The more expensive Da Vinci model works at a higher resolution than its less expensive brother, and can be interfaced to Macs as well as PCs. Because these printers are based around Epson models, consumables – such as inks – are widely available.

a contents table that can be filled in. A list of the disc's contents could even be generated using a word processor, or from Windows Explorer, Xtree or some such program. Functional, yes – snazzy, no. If you're producing a demo disc for a record company, then attractive artwork will help you to stand above the rest. The inlay could contain comprehensive details about each track, and perhaps information about the band, forthcoming live gigs and a web site from which further details can be obtained.

Such artwork isn't impossible to create with DTP programs like Serif PagePlus, Pagemaker or QuarkXpress. A basic inlay card design program, which simply prints out a list of the disc's contents, is built into most CD mastering applications. More avant-garde efforts can be put together under Photoshop (or, if you've got a PC, the excellent shareware alternative Paint Shop Pro). The artwork can be based around computer-generated images (such as clipart), scanned-in photographs, or snapshots 'grabbed' from the subject matter of a Video CD. The MPEG capture cards examined in last month's instalment will capture still frames from the original footage; the same is true of standard Motion JPEG type capture hardware.

Multiple images, or selected parts of them, can be combined in an eye-catching way. If you're of a creative disposition, artwork can look as good as (or better than) that of commercial CDs. The special effects filters

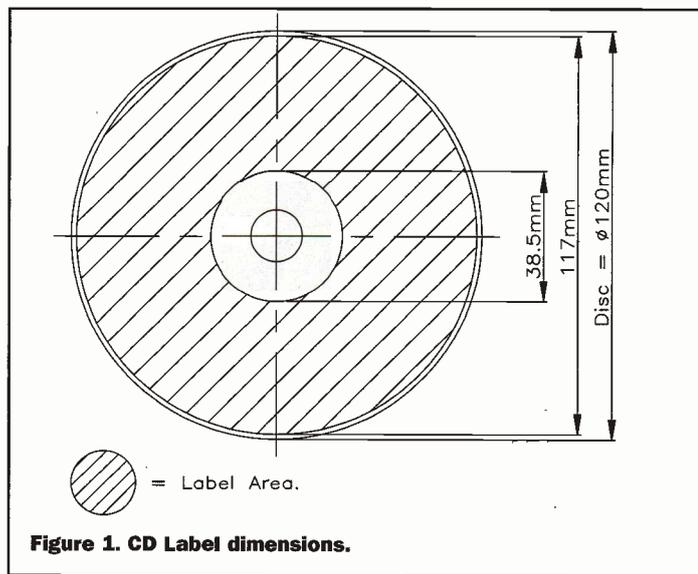


Figure 1. CD Label dimensions.

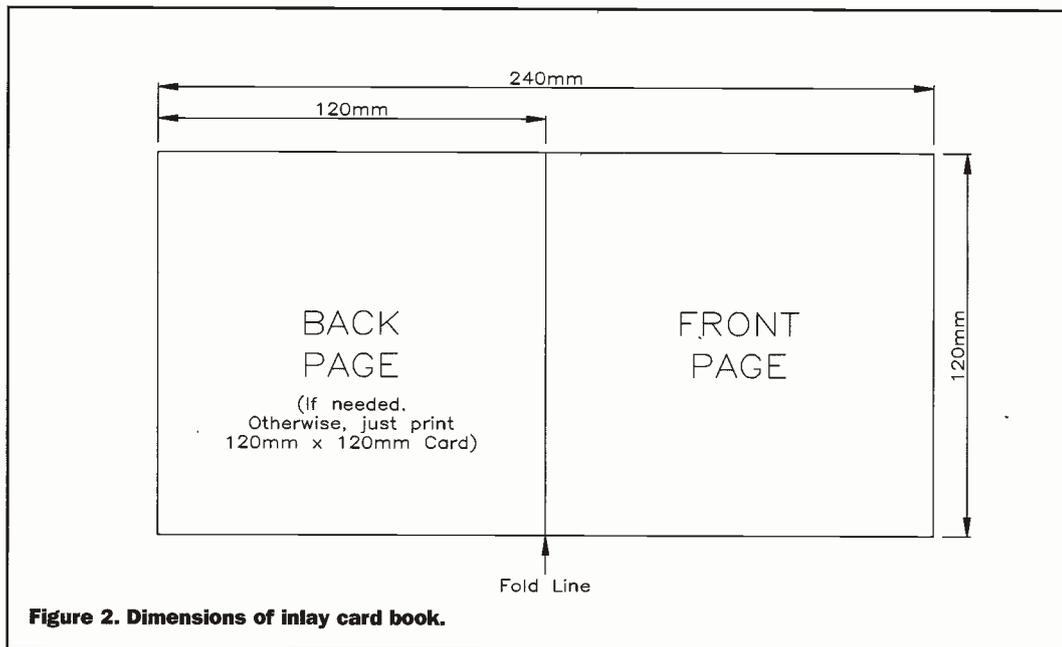


Figure 2. Dimensions of inlay card book.

compensate for the rapid rise and fall of the disc surface as it whizzes past. The drive could wear out prematurely if it is fed with many unbalanced discs. For the same reason, those specially-designed CD labels must be applied properly. If they're not centrally-located, a similar eccentricity could result.

Remember that it's difficult to remove a label once it's been applied – you might damage the protective lacquer. Fortunately, special label application tools are available, and we'll be examining one later. Imbalances are also relevant in the world of commercially produced silver discs, particularly CD-ROMs. The screen-printed labels are designed so that the ink is applied evenly over the disc surface. The other problem is that labels not specifically designed for CD use might well peel off. Remember that the interior of a CD-ROM drive, or

CD player, can get quite warm over a period of time. If that label did become detached from the disc, it could gum up the works of the mechanism. In addition, there is a chance that a non-CD label's adhesive may react with the protective lacquer over time.

If money is no object, it's possible to buy a special type of printer that has no purpose other than to print directly onto CDs – albeit special printable type CDs with a matt top surface. These printers, which employ a colour inkjet-type process, start at £1000 or so. If you're in a business that produces a lot of one-off CD-Rs, or small batches of discs using a CD-R duplicator, then the cost may well be justified. One such printer, which is suitable for both Mac and PC, is the Signature from Fargo. More affordable general-purpose alternatives are available from Cambridge Multimedia

What about box artwork? You could write on the inlay booklet, if supplied – they can be turned 'inside out', revealing

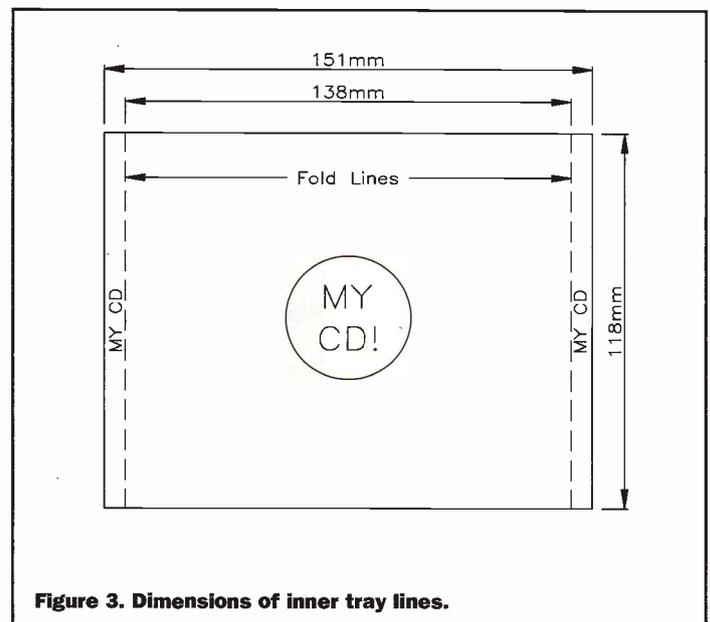
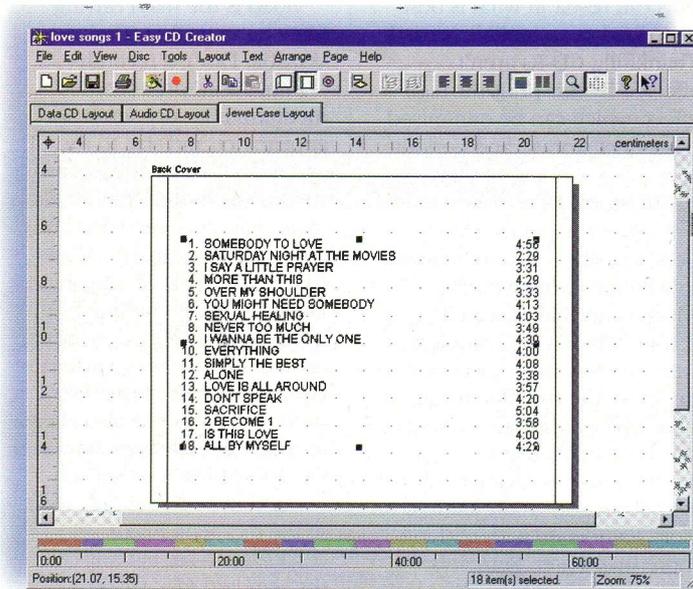


Figure 3. Dimensions of inner tray lines.



**Creating simple box artwork with Adaptec Easy CD Creator.**

built into image editing programs can also be applied to quite astounding effect. The final stage is to enter and position your text, in a colour that contrasts with the background image. Avoid fancy fonts if you can – these can often be quite unreadable, bearing in mind the limited printing area available on the inlay. The resolution of the image should be governed by the resolution of your printer. There's no sense in working at 1200 dots per inch (dpi) if your printer supports 300dpi or less. Remember that the larger the image, the longer it takes to process and the more storage space is required.

Figure 2 gives the dimensions of the inlay card book, while Figure 3 describes the inner tray liner. Note that the latter is longer than the inlay, and has additional flaps for the spines. It's relatively easy to print these items; let's take, as an example, the CD inlay booklet. The print menus in Paint Shop Pro and Adobe Photoshop allow you to specify the size of the printed image – 120mm x 120mm for each page, in the case of the inlay card. If your image covers two pages – which will be folded over – the size you set should be 240 x 120mm. In my experience, you seldom get a print-out of the exact size; on my HP Laserjet, I have to specify 117 x 117mm (or 117 x 234mm). A template from a commercial music CD forms an excellent template for comparison – tweak the image size settings on successive until you get a close match.

Printing both sides of the booklet is also possible. The outer two pages (which are printed on one side of the paper) would generally contain fancy artwork. The inner two pages (printed on the other side) would normally list the contents of the disc – files, songs, video footage and so on. Much control over the printing of a document is available from the configuration menus included within graphics programs (although they're based, in the main, on what the operating system provides), and this includes the specification of offsets. Thanks to this parameter, you can experiment with the alignment of the image on the printed page so that it lines up with the image printed on the other side. Getting it right is very much a trial and error process, but the results can be noted for subsequent projects.

Another important factor, particularly if you're printing the image to a monochrome laser or inkjet, is 'dithering' – the process that uses dots to give the illusion of greyscale (newspaper photos being a case in point). Unfortunately, dithering greatly affects resolution, and text can be discouragingly unreadable. I find that the best option – at least with my LaserJet running on a Windows 95 machine – is 'error diffusion'. This results in a sharp, clean and – above all – readable print.

At the end of the day, it's worth experimenting with quality settings until the best quality print is achieved. In Windows, the dithering options don't

always work with certain programs. I have had problems with Photoshop, but not the considerably cheaper Paint Shop Pro. For some reason, importing the Photoshop images into word processor as a bitmap, and printing them from there, can deliver far better results than outputting directly from Photoshop. I'm still waiting for an explanation of this phenomenon from Adobe!

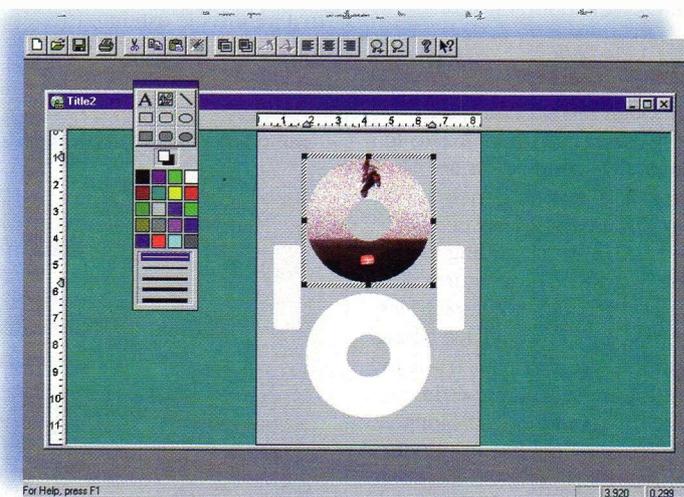
Once the artwork has been printed, it can be transferred to the jewel case. Fitting the inlay card is simple enough – there are retaining lugs to guide you. However, the inner tray liner is, a little fiddlier. First of all, you have to remove the inner CD tray itself, which can be quite awkward, particularly if you don't have long nails. This is because the inner tray tends to mount flush against the back half of the case. I have found a small jewellers' screwdriver to be quite invaluable when prising the two apart. When the two are apart, the original liner can be removed from the back of the jewel case, and the new artwork fitted. When replacing the insert tray, try to prevent it from fouling the spine artwork.

Printing (and fitting) box artwork is one thing, but labels are another. The images have to be circular – and don't forget to allow for that hole in the middle! Most labels consist of an A4 self-adhesive sheet that contains one or more label cut-outs. Unfortunately, they tend to differ in the way they're laid out on the sheet. In most cases, label-specific templates are available for common DTP, graphics and image editing programs. If not, you could design your own – and don't

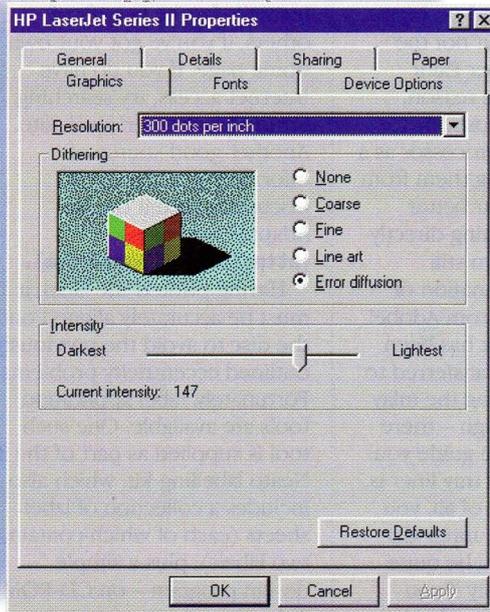
forget to put them on the Internet for the benefit of others, if you've got your own home page. If you do have Internet access, try searching for the labelmaker's web site. Another good source of information is the CD-R discussion forum on the Adaptec web site (<http://www.adaptec.com>).

Having printed the label, it must be accurately aligned on the disc to avoid the previously-outlined eccentricity problems. Fortunately, label application tools are available. One such tool is supplied as part of the 30 Neato labelling kit, which also includes a collection of label sheets (each of which contains two labels), plus a simple design program – on CD-ROM (whatever else?) – for both Windows and Mac. The CD-ROM also contains label templates for other popular applications, such as Quark Xpress, Word and Photoshop, and a wide-ranging collection of copyright-free photographic images at 150 or 75 dpi.

The label attachment tool is stunning in its simplicity, consisting of a cone-shaped positioner, and a cylindrical base piece with an appropriately-sized hole. The backing is peeled from the printed label on a flat surface, and the label placed on the base piece so that its hole lines up approximately with that of the label. Next, the CD-R is placed on the neck of the positioning cone, label side-down, and held in place. The cone and disc are then brought into contact with the cylinder and disc – the conical nature of the positioner automatically aligning the disc and label.



**The CD Face program that ships with Neato.**



**Choose your printer settings carefully.**

It may be simple, but it does work exceptionally well – placement is accurate, and bubble-free. Unfortunately, the CD-Face software is rather poor and appears to include bugs (at least as far as the Mac version is concerned). Basically, you can import an image (or several) and add text – although the latter function obstinately refused to work. The software does have one advantage – it will allow you to import artwork that you have already designed, automatically re-sizing the image and masking it to fit within the Polo-shaped confines of the label. An alignment feature allows you to offset printing so that printing only occurs in the label area. Neato sensibly advises you to make a photocopy of one of the label sheets for alignment purposes, thus preventing waste. You are best advised to use the templates, provided that you have compatible software.

## Disc Care

Although blank CD-R media only has a shelf life of five to ten years, the written discs are capable of retaining their stored data for anything between 50 and 100 years, according to who you listen to. These figures are derived through accelerated life testing, and so we'll have a long wait to determine which – if any – is the most accurate estimate. One thing is sure; to prolong the life of a disc, it is important to treat it properly – remember that CD-R is somewhat less robust than the mass-produced pressed CD. CD-Rs should not

be exposed to excessive heat or humidity. Hence, The car is a less than ideal place for a CD-R, and so you're probably advised to regard any music discs destined for such environments as ultimately expendable – if you keep them there, that is. It is also worth noting that direct sunlight (particularly its ultra-violet content), dust and smoky environments will also take their toll.

At the end of the day, CD-Rs should be stored in a cool, dark, dry place if they're to live life to the max. Archivists – take note! At the end of the day, though, CD-Rs should last longer than magnetic media; there's no risk of slow erasure by the earth's magnetic field, or print-through. The latter affects analogue tape recordings, particularly those made on thinner tapes. The tracks stored on each winding of the tape on its spool can magnetise – albeit to a minuscule extent – the tracks of adjacent windings.

This can result in what is best described as an audible 'ghost'. Thankfully, CD-Rs aren't affected by this print-through effect, which can be minimised by correct storage and periodic winding/rewinding of the tape in question.

A few more points. Don't bend the disc – and try to avoid touching its writing surface, which is normally green in colour. When it isn't required, store the disc in its jewel case to minimise the risk of damage. If – for whatever reason – the disc needs cleaning, use a commercial disc cleaner – if one is available – or a soft lint-free cloth dampened with nothing more than water. Remember that other solvents, such as the alcohol-based white spirit, can cause damage. They could cloud the disc's polycarbonate base, making the disc unreadable. As we've discussed with pens, alcoholic solvents could, over the long-term, penetrate the disc's protective coatings. When using a cloth, always wipe in a straight line from the disc's centre to its outer edges. Don't use a circular motion, as this corresponds to the CD's spiral track pattern.

## Conclusion

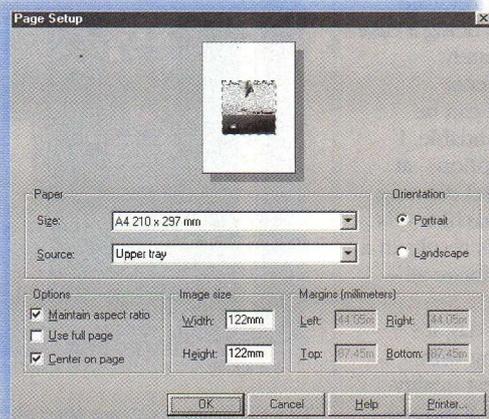
In this series, we've covered a lot of ground. We've seen how economical it is to produce your own audio CDs – something that, like so many recent technological innovations, would have been inconceivable not so long ago. Who would have even remotely envisaged it when CD first made a public appearance in the early 1980s? Of course, the CD medium is no longer just restricted to audio – and we have indeed examined the CD-R's potential for archiving data and storing MPEG-compressed video.

Video is the main driving force behind DVD (Digital Versatile Disc), a recently-introduced pre-recorded medium. It is very similar in appearance and size to the CD, and indeed DVD video players will handle audio CDs. The main difference between DVD and CD is the capacity. While CDs go far short of a gigabyte, DVDs promise anything from 4.7 to nearly 20Gb, depending on the number of recording layers and sides of the disc used. DVD is hence also likely to make an early appearance as a CD-ROM like data carrier.

But that's not the only issue. At the moment, major corporations are fighting over the standard that will be eventually adopted for recordable and rewritable DVD systems. Indeed, many see rewritability as being essential to the long-term survival of the DVD format. Although consumer DVD players are thin on the ground, several vendors are now openly selling DVD-ROM drives. You might also find it interesting to learn that a DVD-Recordable burner has been available for some time. This Pioneer machine sells for close to 15k – but then so did CD-R hardware five years ago. Who knows what the future will bring?

## Copyright Warning

With the equipment and procedures outlined in this article, it is possible to make recordings of copyrighted works. If this is the case, such recordings must be made solely for your own use, and then only if you have the original recordings. If you do not own the copyright, or have permission to copy from the copyright owner, you may be violating copyright law and could be subject to payment of damages and other remedies. If you are in any doubt, please contact your legal advisor.



**PaintShop Pro allows your image to be scaled to fit CD box exactly.**

## Points of Contact

Neato, (0990) 561571.  
Web: <http://www.neato.com>  
Cambridge Multimedia,  
(01638) 743121.  
Web: <http://www.cambridge-multimedia.co.uk>  
Linefeed, (0171) 474 1765.  
Web: <http://www.linefeed.com>  
CD Revolution,  
(01932) 562000. Web:  
<http://www.cdrevolution.com>

## TWENTY CD-R TIPS

1.

Use a good, fast hard disk to avoid the chance of the CD burner's buffer emptying (buffer underrun). SCSI and UltraDMA IDE drives are more than adequate. Fortunately, large buffers in modern CD burners help to counter the effects of short-term data transfer irregularities, such as those associated with thermal recalibration, and so AV-rated drives are no longer essential.

2.

Remember that filling the hard disk close to capacity will affect its transfer speed. In addition, ensure that your hard disk is defragmented prior to burning a CD-R.

3.

Carry out a trial run before burning your first CD-R, or after any hardware upgrade. Most CD mastering applications, including Adaptec Easy CD Creator and Astarte Toast, provide such a facility.

4.

Any interruption in the flow of data could ruin that session or disc, if its long enough for the burner's buffer to empty. If you're on a network, disconnect yourself. Disable any screen savers that might be in operation.

5.

Your CD-ROM drive should, as a rule, be faster than the CD-R burner if direct CD copying is envisaged.

6.

Ensure that your data disc can be read by the intended platform – if Mac, Unix and PC compatibility is needed, choose the ISO9660 format. In addition, remember that audio CD players and older CD-ROM drives don't like multisession discs.

7.

When capturing (or converting) footage for writing to a VideoCD, ensure that the MPEG parameters are set to the appropriate values. Most MPEG capture cards and off-line conversion utilities have 'catch all' presets for the job.

8.

Place the CD-R burner on a level, stable and vibration-free surface. Don't bump the burner during the writing stage!

9.

If your burner is a SCSI model, make it the only device on the chain – if possible – during recording.

10.

Use a short, good quality SCSI cable to reduce the possibility of communications errors – and ensure that the device is properly terminated

11.

Ensure that your power supply is adequate. Invest in a decent UPS if you live or work in an area of questionable power reliability.

12.

Always allow CD-R discs to reach normal temperatures before writing to them. Ensure that discs are clean and dust-free prior to writing

13.

Check that your CD-ROM drive supports digital audio extraction, if you want to make digital copies of CD tracks.

14.

Use your soundcard's line input for recording audio prior to capture. The mike input is simply too noisy – and often mono-only to boot. A RIAA-equalised pre-amp (whether built into a hi-fi system, or a stand-alone device) is needed between a turntable and the soundcard's line input.

15.

If you want to master audio CD-Rs from digital sources, such as DAT or MiniDisc, consider a soundcard with S/PDIF input, such as the Turtle Beach Fiji or Terratec EWS64.

16.

Never bend the disc, touch its writing surface or expose it to temperatures in excess of 10°F.

17.

To maximise their useful life, store archive CD-Rs in a dust-free, cool and dry environment.

18.

Don't identify a disc by writing to its label side with a sharp-tipped or alcohol-based pen. Use an oil or water-based permanent felt marker, or a properly-applied CD label.

19.

Don't apply a label to a disc before it has been burnt. Any imbalance in the disc could be disastrous during the writing phase.

20.

If the session has failed (due to a buffer under-run or whatever), don't discard the disc. I have discovered, for example, that the tracks written up to that point on audio discs will play fine on most CD players.

## GLOSSARY

**AIFF.** Audio Interchange File Format, commonly used to store PCM digital audio on Mac hard disks. 16-bit 44.1kHz stereo captures are of CD-quality, and are hence suited to audio mastering.

**Blue Book.** A new-ish CD standard that allows audio and data to be combined on the same disc. Also known as 'CD Extra' or 'CD Plus'.

**Buffer under-run.** Occurs when the CD burner's buffer empties during the CD-R write stage. It generally means a ruined disc.

**CD-DA.** The original CD digital audio standard, developed by Philips and Sony. Also known as Red Book.

**CD-i.** CD Interactive, which adheres to the Green Book standard, is a multimedia format developed by Philips. Although it failed as a consumer format, it's still quite popular for professional applications, such as interactive information kiosks. Some CD-i players offer hardware support for White Book Video CDs.

**CD-R.** CD Recordable – a WORM (Write Once, Read Many times) medium compatible with existing CD equipment, such as CD-ROM drives and audio players.

**CD-RW.** CD-ReWritable – a variation of CD-R, in which the disc can be erased and replaced by more information. CD-RW drives will also write to CD-R media, which employ a rather different recording layer.

**Close Disc.** To finalise a disc so that no more information (such as further sessions) can be added. Discs must be closed in order to play them on audio CD hardware.

**Digital Audio Extraction.** The process of copying audio tracks from a CD, via a CD-ROM drive, to your hard disk or directly to a CD burner. Not supported by all CD-ROM drives.

**Disc-At-Once** (c.f. track-at-once). This CD recording mode eliminates the two-second gap between audio tracks. It works by

keeping the laser turned on during the complete write, so that run-in and run-out blocks (which account for those two seconds) aren't written for each track.

**DVD – Digital Versatile Disc,** a new two-sided multiple-layered CD-type medium. Storage capacities vary from just under 5Gb to nearly 20Gb.

**Gold Disc.** The CD-R media, so-called because of the reflective layer that can often be seen from the disc's label side.

**Green Book.** See CD-i

**HFS.** The Hierarchical Filing System, as used by Apple's Macintosh

**Hybrid disc.** A CD that can be read by both Mac (as a HFS volume) and PC (as ISO9660). The few CD mastering applications that support hybrid disc creation tend to be Mac programs, such as Astarte Toast.

**ISO9660.** The original cross-platform filing system for CD-ROM, circa 1984. A ISO9660 disc can be read by all CD-ROM drives, regardless of the platform to which they are connected. Long filenames and international character sets are not supported.

**Joliet.** A popular CD standard, developed by Microsoft, that allows files to have long names. Originally developed for Windows 95/NT4.0.

**MPEG.** An industry-recognised set of audio and video compression standards. Used for VideoCD (MPEG-1) and DVD (MPEG-2).

**Multi-session.** A disc to which data is added to incrementally, in one or more sessions. If the data is linked together, it can be seen as a whole by multi-session CD-ROM drives. Avoid unless necessary – it wastes capacity to the tune of 15Mb per session – and don't use for audio CDs.

**Packet Writing.** Part of the Universal Disc Format (UDF), this is a more efficient way of

writing data to a CD. The individual data chunks (or packets) are far smaller than those associated with earlier systems (such as disc-at-once).

**PCA. Power Calibration Area.** A small area at the beginning of the CD-R that the burner uses to calibrate the laser for that particular disc.

**Red Book.** The original audio CD (CD-DA) specification, published in 1981.

**SCSI.** Small Computer Systems Interface. A popular high-performance interface bus, used on hardware that ranges from PCs to mainframes.

**Session.** An area on a CD that contains one or more data or audio tracks.

**Table of Contents (TOC).** Stored at the beginning of a Red Book CD, the TOC stores information that includes the number of audio tracks and their individual lengths.

**Track.** An uninterrupted sequence of data on a CD that could include a collection of files (in a CD-ROM or Blue Book disk) or a piece of music.

**Track-At-Once** (cf. disc-at-once). A CD recording method that turns off the laser between tracks, and writes run-in and run-off blocks between tracks. Those blocks result in the characteristic two-second gap that you hear between successive songs on an audio CD.

**VideoCD.** A system, conforming to White Book, that allows an hour of full-motion video to be stored on a CD. MPEG-1 compression is used, at a rate of 1.15Mbit/s.

**WAV.** Microsoft Windows Wave PCM files, as generated by sound cards. 16-bit, 44.1kHz stereo WAV captures are CD-quality, and are hence directly suited to audio disc mastering.

**White Book.** See VideoCD.

**Yellow Book.** The internationally-agreed standard for CD-ROM.

# Electronics IN AGRICULTURE

## PART 4

### Intelligent Tractors

*George Pickworth examines the changing face of the tractor and how computers have played an increasing role as a labour saving device.*

**F**irst generation farm tractors appeared shortly after the turn of the century and made a significant contribution to food production during the First World War. However, these tractors were abandoned when imports of cheap food were resumed after that war, and as a result much arable land reverted to pastures and horses again dominated agricultural scene.

Tractors made little headway until the 1930's when war clouds loomed again and fears that supplies of imported food would be cut off. However, by this time, first generation tractors, which were assembled from discrete components mounted on a chassis, had been

superseded by second generation tractors; these had engine, gearbox and transmission casing bolted together to form an immensely strong unitary construction. A typical example being the American Fordson.

The American Fordson was the precursor of thousands of Dagenham built Fordsons which together with American tractors, supplied under the Lease-Lend Agreement, enabled Britain to grow sufficient food to avoid starvation during the Second World War.

Unitary construction was inherently sound and could not be improved upon; indeed it remains the basis of modern high power, sophisticated,

computer-managed tractors.

In this study we look at the evolution of modern intelligent tractors and the role of electronics in their operation; these machines transformed the UK from a net importer to a net exporter of food. Let us now progress around what I call the 'Evolution Circle' starting at the top with the 'Intelligent Horses'.

As soon as tractors began to replace horses, farmers discovered that whilst tractors had great power and endurance, they lacked the intelligence of horses which performed many maneuvers on voice commands. Indeed, commands were not always needed as the horses knew what to do.



The classic case of horse intelligence was the horse drawn milk float, the horse moved on from house to house as the milkman delivered the milk. Now, the milkman has to deliver the milk, jump into his float and drive from house to house.

The fact that horses responded to spoken commands relieved farm workers of many tedious chores, so it came something of a shock when they found that tractors did not respond to voice commands, and that they had to perform a number of physical operations to control the tractor; this is demonstrated by the following amusing episode. In 1935, when the ploughman on my fathers' farm was learning to drive the tractor, I well remember him shouting "whoa-whoa" at the tractor as it approached the end of the field and went straight into the ditch.

So, unlike the ploughman with horses, who could control



Photo 1. Fordson Tractor circa 1920: Paraffin fuel, 20kW  
3 forward gears, no silencer. Note unitary construction.

**Photo 2. John Deere 8200, 1997, Diesel, 155kw 16 forward gears, 5 reverse gears, luxury cab, electro-hydraulic controls.**



crops and much of the crop was planted in spring.

## Tractors

Early second generation tractors typically pulled two furrow ploughs, but as they travelled faster than horses, ploughing rate was about three times faster than with a pair of horses. Moreover, tractors did not get tired, so drivers were expected to work for much longer hours than the ploughman with horses. As a result, more land was ploughed in readiness for higher yielding autumn sown crops.

Early tractors did not have cabs and the driver was exposed to the weather, but this was not considered a hardship by farm workers of my generation. Nonetheless, the effect of cold weather was more pronounced with tractor drivers than wagoners because drivers were sitting, rather than walking with the horses, which maintained blood circulation in their limbs.

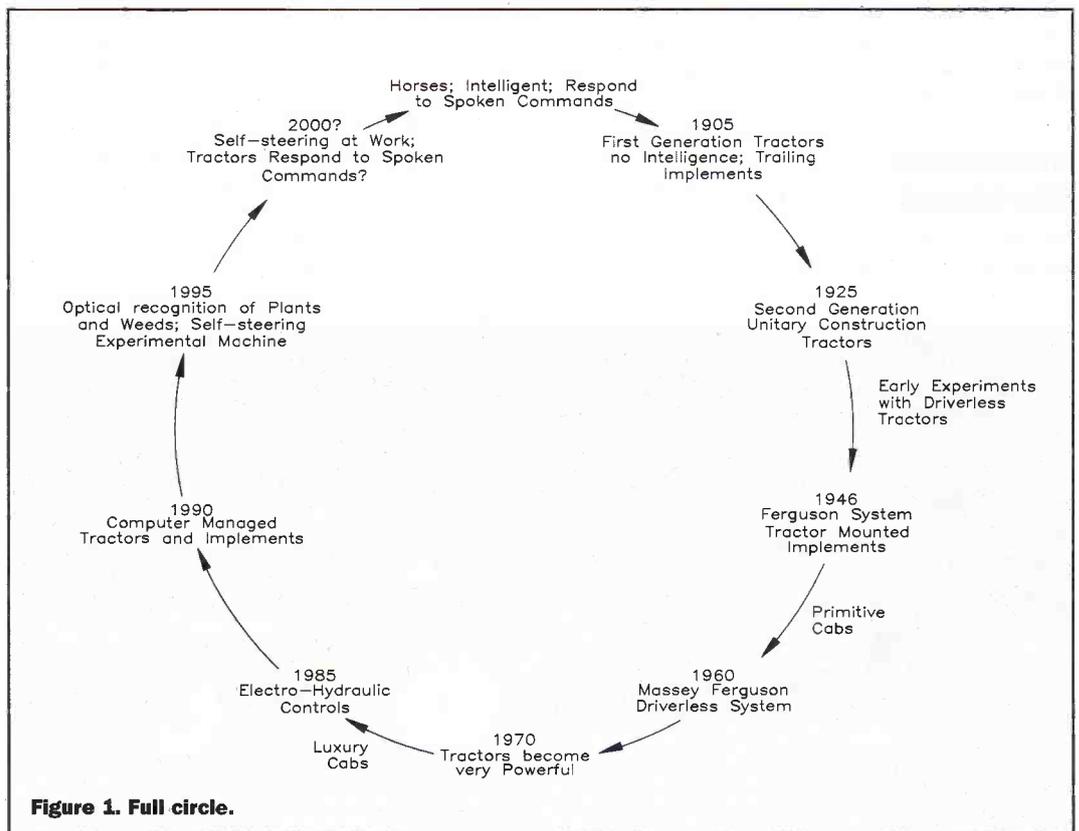
With early tractors, engine noise, vibration, bumpy ride and the awkward controls of trailed implements were the principal cause of driver fatigue. Nonetheless, drivers were often expected to work in the fields for all daylight hours during autumn and winter. Lights were a rarity on early tractors, but where they were fitted, driving continued in darkness.

the horses with voice commands and minimal use of a rein, early tractor ploughman had the significant workload of constantly steering the tractor, plus performing operations necessary to control the implement.

## Endurance

Moreover, with horses, the maximum length of time that could be spent working in the fields was limited by the endurance of the horses; indeed, their welfare was paramount and work had to stop before they were overtired. So, neither the horses nor ploughmen were subjected to excessive hours of work. In fact, the whole farming system was based on the endurance of the horses.

A single furrow plough pulled by a pair of horses could plough about 0.5 hectare/day. Ploughing began in autumn and continued throughout the winter months. Only a limited area of land could be ploughed in time for autumn sown cereal



**Figure 1. Full circle.**

## Noise

A far more serious problem was that drivers were exposed to very high noise levels produced by the tractor engine; silencers were not well adapted to the paraffin fueled engines of those days. The result was that many drivers, including myself, who as a farm boy spent virtually all the daylight hours driving a noisy tractor, now suffer from hearing problems.

As a wireless experimenter, I tried to use my portable radio receiver on the tractor, but engine noise drowned out any sounds heard in my circa 1920 2.0kΩ headphones. Moreover, it was extremely difficult to suppress interference from the magneto ignition system used with those paraffin fueled engines. Suppressers could cause the spark plugs to oil up!

## Shocks

The tractor seat was formed from pressed metal mounted on a primitive spring arrangement; the only cushion was a folded sack. It was therefore not surprising that when going was particularly bumpy, drivers stood on the foot plate with their knees bent to absorb the shocks.

Worse still, drivers had to be contortionists in order to twist around to monitor and adjust the controls of the trailing implements; with some implements this required considerable physical effort. So, it is not surprising that many drivers of these early tractors developed back problems.

## Increased Workload

Because tractors lacked the intelligence of a horse, their

**Photo 3. Marshall Tractor circa 1940, Diesel, single cylinder two stroke. Trailed implement. Driver sitting awkwardly to observe and adjust plough.**



introduction in many cases greatly increased the workload of farm workers. For example, sugar beet was lifted by hand labour and placed into heaps across the field from where it was shoveled onto a trailer for transporting to the railway siding where it was again shovelled in to railway trucks.

It might interest readers to know that as a 17 year old farm boy, it was normal to shovel 20 tons of beet each day plus the work of driving the tractor. It was not only a chore to keep climbing on the tractor to advance it from one heap of beet to the next, but also dangerous in bad weather with mud sticking to one's boots. A horse would have advanced from heap to heap on spoken command.

## Doubled

The introduction of farm tractors often doubled labour requirements; a good example was the self-binder which preceded the combine harvester. As self-binders were originally designed as horse drawn implements, the operator's seat and controls were mounted on the implement.

The self-binder was a rather complicated machine which needed frequent adjustment of its controls to cope with variations in the crop. But with a pair of reins and spoken commands, the operator could control both horses and the self-binder.

When the horses were replaced by a tractor, two

**Photo 4. Ferguson circa 1947, petrol, tractor mounted two furrow plough, with hydraulic control. Ploughing continued throughout the winter.**



**Photo 5. New Holland 1997 tractor mounted six furrow reversible plough. For maximum operating efficiency, both tractor and plough are computer managed. Compare with the Ferguson in Photo 4.**

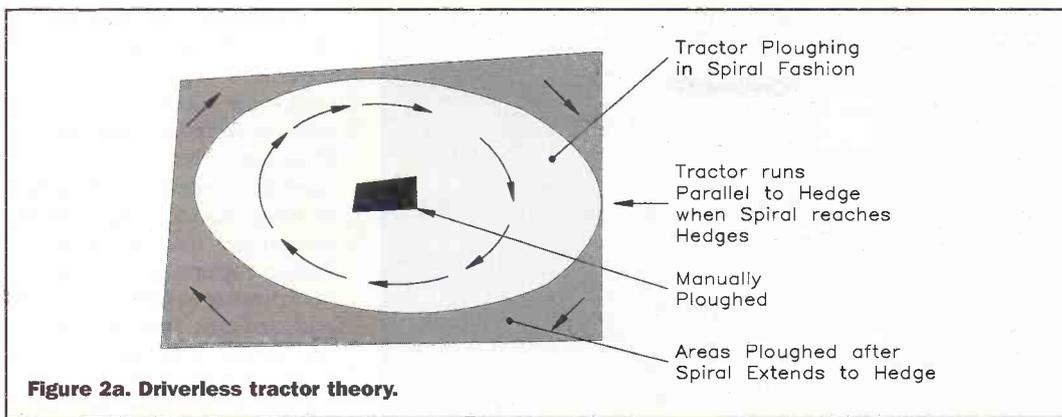


Figure 2a. Driverless tractor theory.

operators were required, one to drive the tractor and the other to operate the self binder. The same applied to early tractor towed combine harvesters, so it is not surprising that there were many ingenious ideas for eliminating the tractor driver. However, as technology did not exist to give the tractor some 'horse intelligence', experiments were conducted with ingenious alternative approaches.

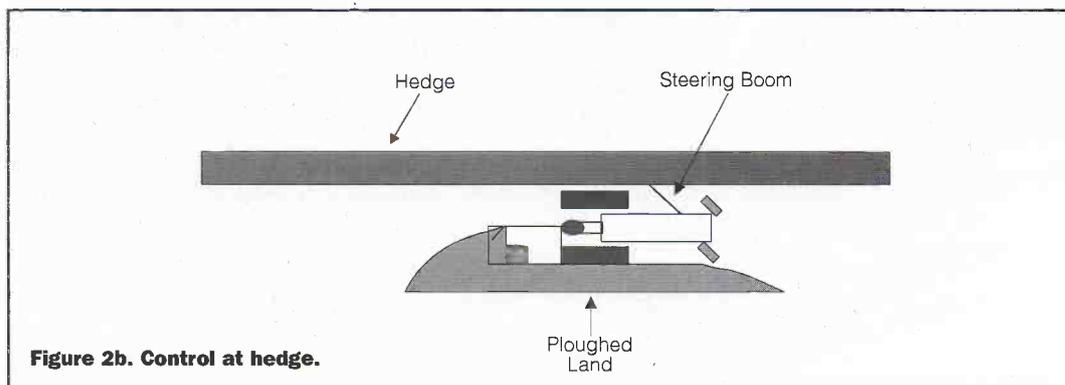


Figure 2b. Control at hedge.



## One Man Band

The most ingenious approach I saw was that of a crawler tractor pulling a grass mower; it was controlled by the operator on the mower by means of a pair of reins.

Control by reins was of course only possible with crawler tractors where steering was by a pair of levers; when pulled, the levers de-clutched the drive to the relevant track causing the tractor to turn in the direction

of the disengaged clutch.

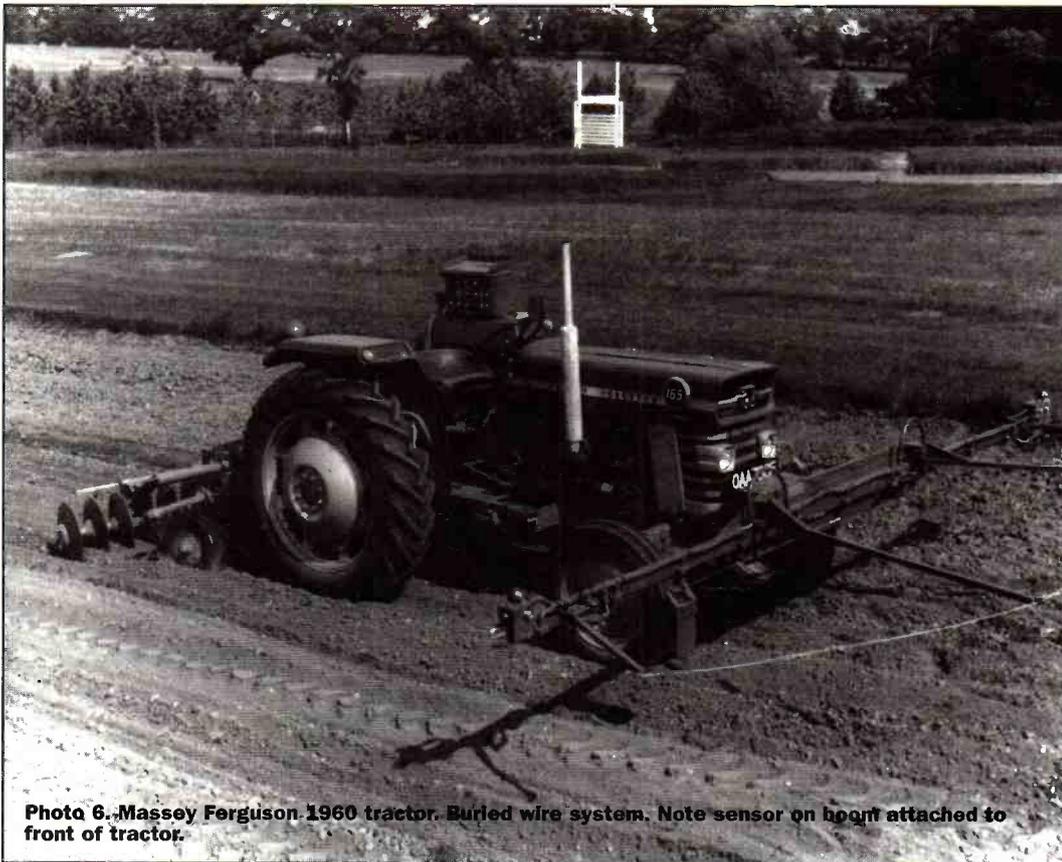
So, the reins were simply attached to the clutch levers. To stop the tractor, both reins were pulled together, thereby de-clutching both tracks and to keep the tractor static, the reins were taughly tied to the mower.

## Driverless

Compared with modern tractors, ploughing with 1930 – 1945 tractors was slow and tedious work. A driver could spend days ploughing a field, so it is not surprising that with operations such as ploughing, interest was shown in driverless tractors.

The first driverless tractor I saw was in 1946. The tractor was manually set up to start ploughing in the centre of the field and progress outwards in a spiral fashion. The tractor was steered by one front wheel running in the furrow produced by the plough during the previous circuit; it was analogous to the stylus of a gramophone record. See Figure 2a.

An arm attached to the side of the tractor was deflected when the ploughing spiral extended to the hedges; this overrode the steering and caused the tractor to run parallel with the hedge until the distance between the hedge and the unploughed land increased. The tractor could therefore plough rectangular or odd shaped fields. See Figure 2b.



**Photo 6. Massey Ferguson 1960 tractor. Buried wire system. Note sensor on front attached to front of tractor.**

Unfortunately, spiral ploughing placed unacceptable stresses on ploughs which are designed to be pulled in a straight line, and this was one of the reasons the system was abandoned. Moreover, advances in tractor and implement design were reducing driver stress, and for the time being, this caused interest in driverless tractors to wane.

## The Ferguson Tractor

A milestone in the evolution of farm tractors was the Ferguson tractor invented by Harry Ferguson shortly before the Second World War. When the American version proved itself, it went into production at Coventry in 1946 and became known as the little grey Ferguson. Early models had a de-rated Standard Car engine and ran on petrol; this overcame many of the problems associated with paraffin engines used with early tractors, and in particular allowed an efficient silencer to be used.

Ferguson integrated tractor and implement into a single unit by using a hydraulically controlled three point linkage system which enabled the implement to be mounted directly on the tractor. Weight of the implement was thereby transferred to the rear wheels of the tractor, and this dramatically increased traction; in fact, it

allowed this lightweight tractor to develop traction equal to a much heavier tractor.

More significant, the driver no longer had to be a contortionist to twist around in order to adjust trailing implements; they were easily controlled by the driver from his seat by simply moving a small lever over a quadrant.

## Little Or Large

In the 1950's many agriculturists saw the 'little grey Ferguson' as the ultimate and that these tractors would revolutionize British agriculture. However, the cost of employing a number of drivers effectively killed off this concept and farmers opted for few large tractors.

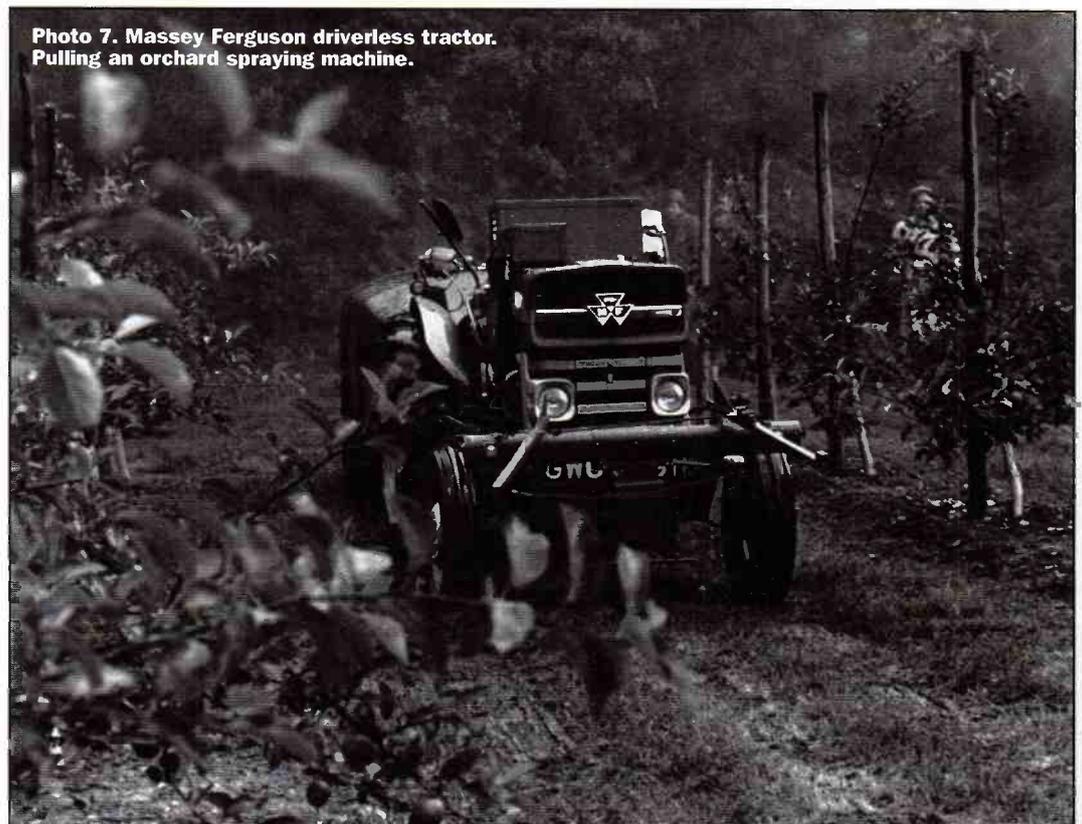
Nonetheless, the Ferguson method of mounting implements directly on the tractor was adopted on large tractors. Moreover, hydraulic lifting and control of the implement meant that the driver no longer had to make physical contact with the controls of trailing implement, so it was now possible to have completely enclosed cabs. Hitherto, cabs had to have open backs.

Changing economic conditions demanded that an ever greater area of pasture land be brought under cultivation, but even with larger tractors, this required operating over periods that severely taxed the endurance of the drivers. The alternative was to acquire ever more powerful tractors. But, in the meantime, interest was renewed in making tractors driverless; moreover, technology for a practical system was now available.

## The Massey Ferguson System

In 1960, Massey Ferguson developed a tractor guidance system based on wires buried in the ground. Obviously, the wires had to be buried deeper than cultural operations - which are rarely deeper than 200mm.

The cable was energized and its magnetic field was detected by a sensor mounted on a cross



**Photo 7. Massey Ferguson driverless tractor. Pulling an orchard spraying machine.**

**Photo 8. New Holland Tractor with computer managed gear changes electro-hydraulic controlled brakes.**



be useful, self steering would have to be extended to guide the tractors from field to field.

## Road Work

Farm tractors are now multi-purpose machines; some, known as 'Fastracks' have a road speed of 60km/h, and are commonly used for transporting farm produce to central food processors. Robotic control of a tractor on the public highway is of course out of the question.

So, the driver remained indispensable not only for road work but to refuel the tractor and supervise critical operations. But, in order to push back the driver fatigue barrier and maximize driving hours, tractors were given luxury cabs and intelligence to relieve the driver of repetitive routine operations. But the driver still has to steer the tractor.

However, there is no reason why tractors should not be self steering when operating in the field but under the supervision of the driver who need not necessarily be in the cab. More about this and intelligent tractors in Part 2.

boom attached to the front of the tractor. Any drift by the tractor to either side of the perpendicular to the buried wire was detected by the sensor and steering was automatically corrected.

Unfortunately, so far I have little technical information on the system, however, by modulating the energizing current to the buried wire with command signals, it was apparently possible to control the operation of both the tractor and implements.

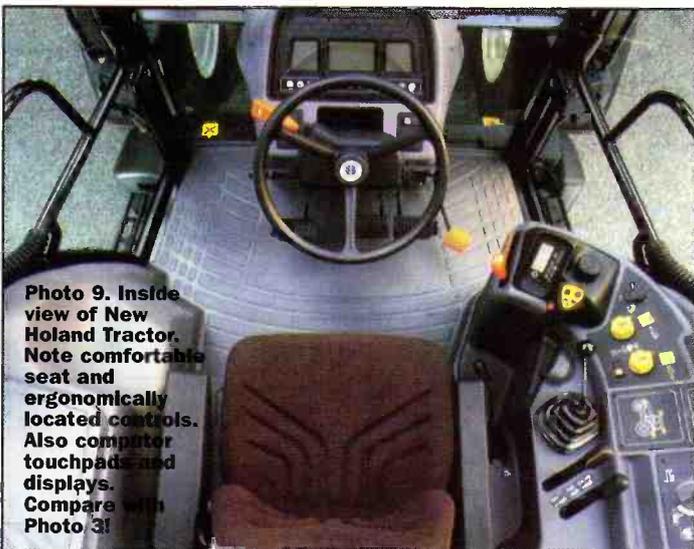
## Demise

The principal drawback to the buried wire system was that it required all implements to have the same effective width,

whereas in practice the width of implements was directly related to tractive effort required to pull it. The soil presented a high a the high resistance to ploughs so they had less effective width than harrows where soil resistance was much less.

The buried cable system would have seemed to have a potential in orchards, where the trees are planted in rows of given width. Furthermore, by making the tractor driverless, hazards to the operator when applying sprays were avoided. Nonetheless, the system did not gain acceptance, principally because an operator had to be available to measure out spray chemicals etc, and this made the cost of intalling the buried cables uneconomic.

As tractors became larger and more powerful the time spent working in individual fields was reduced from days to a few hours, therefore, tractors spend a significantly greater time moving from field to field. So to



**Photo 9. Inside view of New Holland Tractor. Note comfortable seat and ergonomically located controls. Also computer touchpads and displays. Compare with Photo 3!**

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# PROJECT

# MIDI THROUGH BOX

Design by Maplin Projects Team

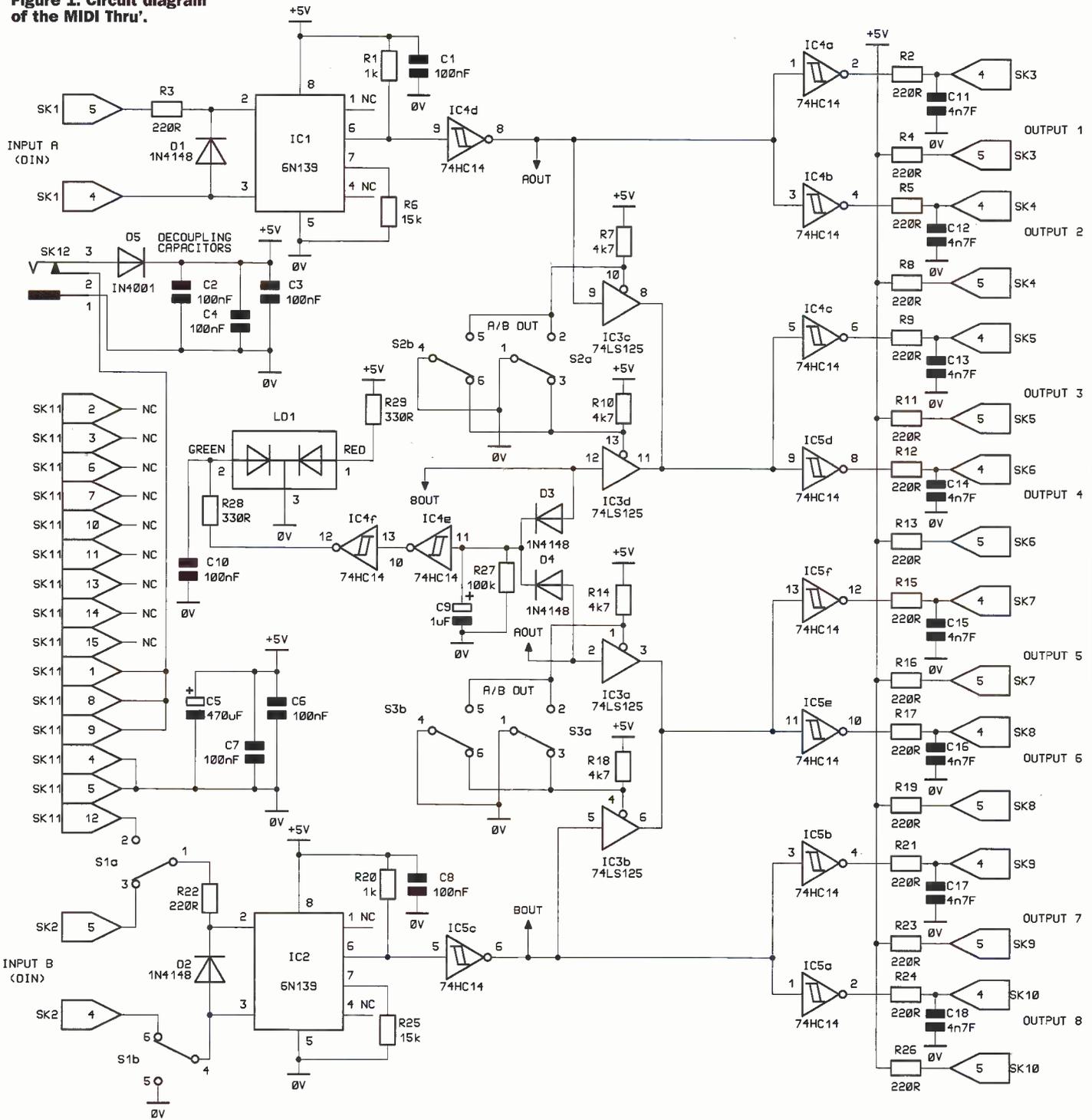
*The Maplin Project Team has not tackled a MIDI thru' box since the one produced for the October '89 magazine. That particular unit is no longer available, so we decided to produce another, with added flexibility and the dreaded CE conformity.*

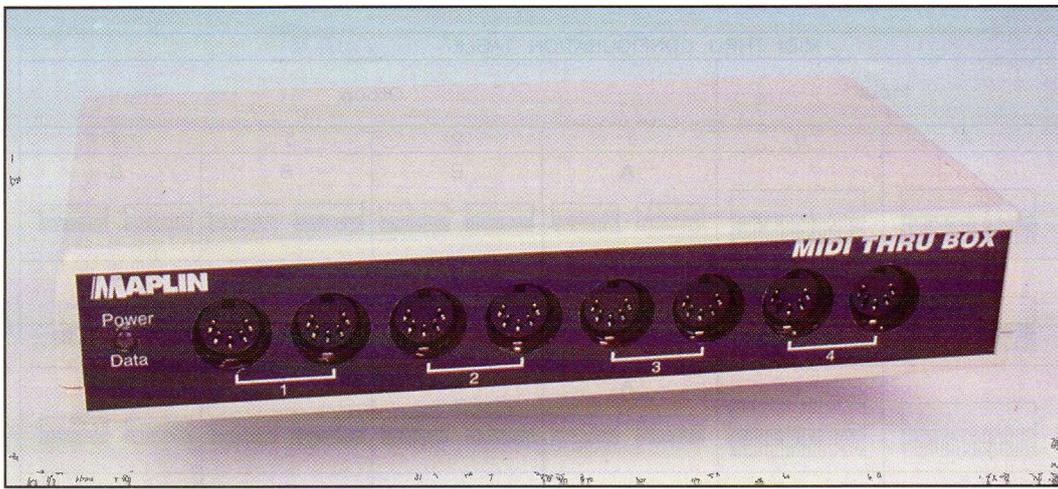
This design features two, opto-isolated, input channels and eight, fully buffered, output channels. One of the input channels can be switched to receive MIDI data from a PC. The eight output channels are grouped into pairs. Two of these pairs have electronic switches that permit selection of input source.

Power is connected from an external, regulated 4.5V to 6VDC supply at 100mA or from the PC game/MIDI port.

This gives the MIDI thru' unit extreme flexibility in choice of connection, and the electronic

Figure 1. Circuit diagram of the MIDI Thru'.





Outputs 3 and 4 can be switched between Input A or Input B. Similarly, Outputs 7 and 8 are tied to Input B and Outputs 5 and 6 can be switched between either input.

PC sound cards are equipped with a MIDI port which is available from the 'Joystick' connector. This connector is often labelled 'Game'. S1a selects between MIDI Input B or PC port. Thus, Outputs 5 and 6 can be configured to receive Input A, Input B or PC Input, MIDI data. The output from the sound card is a voltage signal and S1b is needed to ground the other input of IC2. This arrangement allows R22 to convert the voltage signal to a

switching permits channel changing 'on the fly'.

The bandwidth has been limited to give clean signals while retaining high speed operation. This allows cascading with minimal signal degradation. Further, cheap cables are less likely to introduce problems.

A bi-colour LED indicates both power present and MIDI activity to assist in troubleshooting system set-up.

## Circuit Description

The circuit diagram for the MIDI thru' is shown in Figure 1. One channel will be covered because both channels are almost identical. Any differences between channels will be covered in the appropriate places.

The Midi data is derived from SK1 which incorporates a 220Ω current limit resistor R3 in the loop. IC1, an opto-isolator, has an infra-red LED in the front end. R3 affords overcurrent protection and D1 reverse polarity protection for this LED.

Input A is the input to channel 1 and is unswitched. Channel 2 has an input selector that allows either Input B or PC sound to be selected as its input. Figure 2 shows the MIDI thru as a simple switch box which should clarify the switching arrangement.

The back end of IC1 contains an infra-red-sensitive diode detector. When sufficient current flows in the MIDI input loop, IC1's LED will illuminate and cause a proportional current to flow in the diode detector. This current is amplified by a two stage amplifier built into IC1. R6 provides a turn off path for current from the output transistors base. This value is

selected as a compromise between reduced turn-on and increased turn-off time. R1 is the collector load resistor for the output transistor and is low enough to give a fast signal risetime. The output signal from IC1 is a voltage, rather than a current, suitable for driving the following logic circuits.

The converted MIDI data is fed to IC4d where it is buffered and split three ways. Two routes are to second buffers IC4a and IC4b, which provide the MIDI current loop to Output 1 and Output 2 respectively. The other route is to IC3c which is a tri-state buffer.

This device has a high impedance (effectively open circuit) output when its control pin, pin 10, is high. S2a / S2b are wired so that the pole of the switch, which is connected to 0V, either activates IC3c or IC3d. During the switching period, when both switch contacts are open circuit, both IC3c and IC3d outputs will be tri-state so that no conflict exists. IC3d receives its data from channel 2 so that toggling S2b selects MIDI data from either Input A or Input B. Figure 2 shows the MIDI thru as a simple switch box which should clarify the switching arrangement.

R7 and R10 provide pull-up resistors for IC3c and IC3d control pins causing them to go high when their corresponding switch pole is open circuit. The outputs of IC3c and IC3d are connected together (wire ORed in digital terms) so that the selected channel's data is fed to IC4c and IC5d. This pair buffers and provides the MIDI current loop Outputs 3 and 4 respectively.

It can be seen that Outputs 1 and 2 are always tied to Input A.

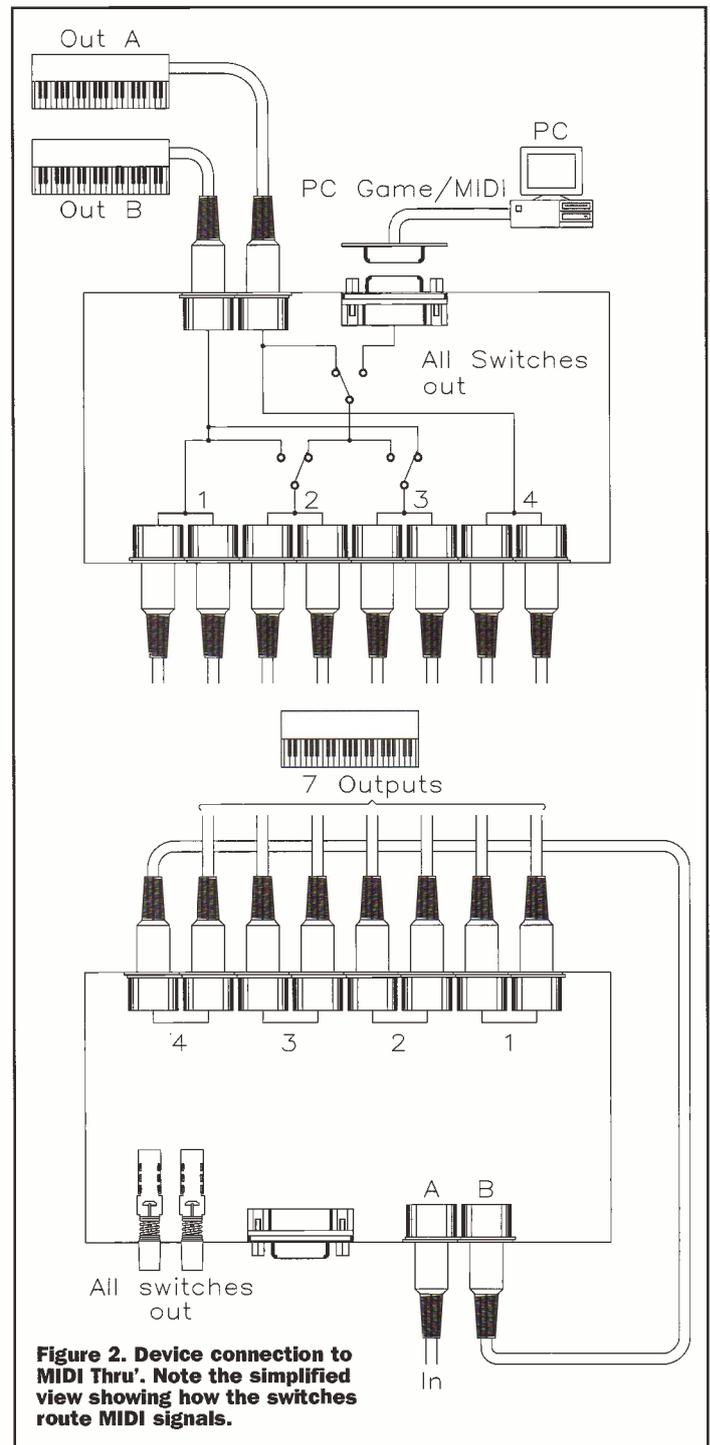
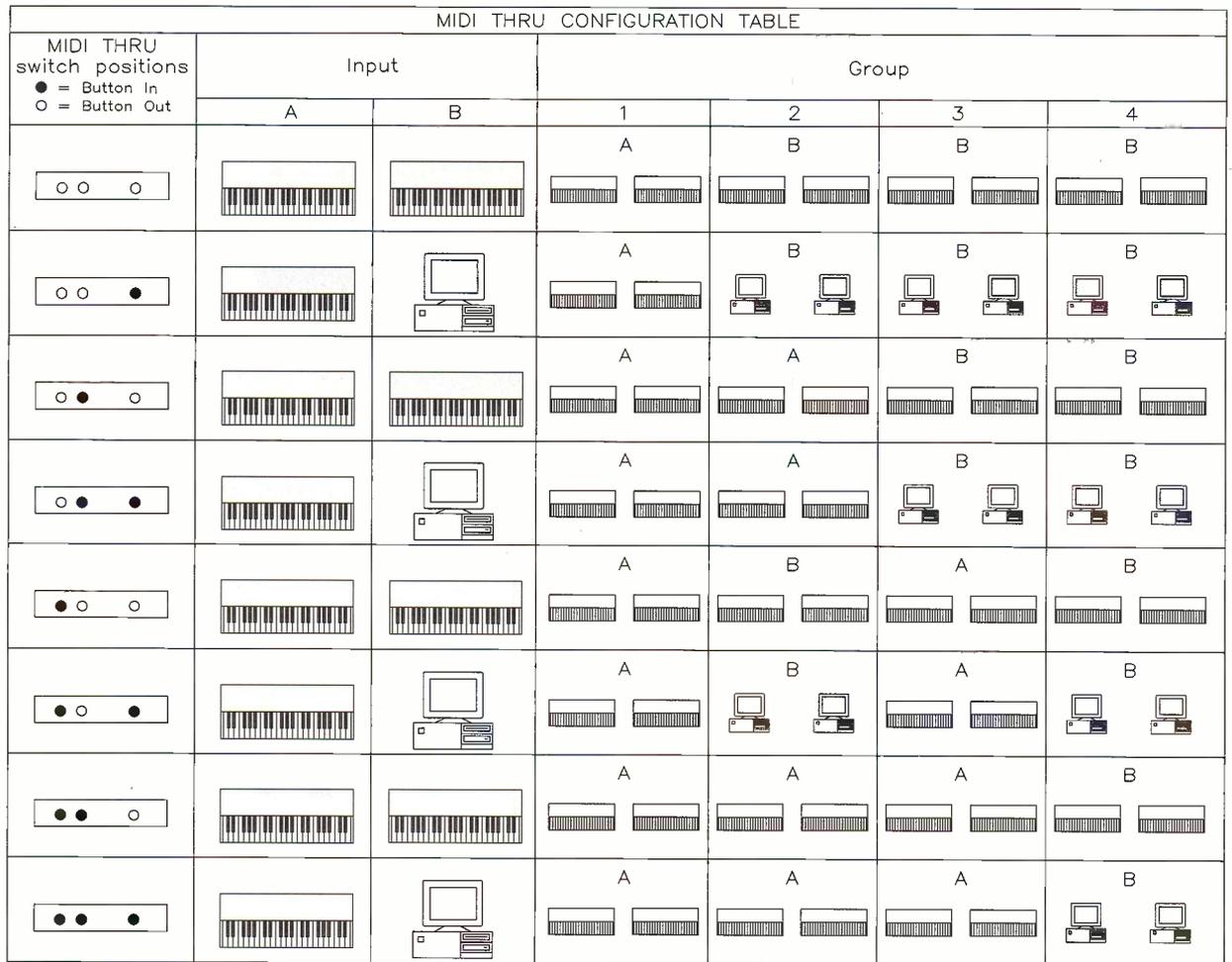


Figure 2. Device connection to MIDI Thru'. Note the simplified view showing how the switches route MIDI signals.

## SPECIFICATION

Input voltage	4.5V - 6VDC
Input current	100mA (Max @ 6VDC)
Bit rate	1kHz



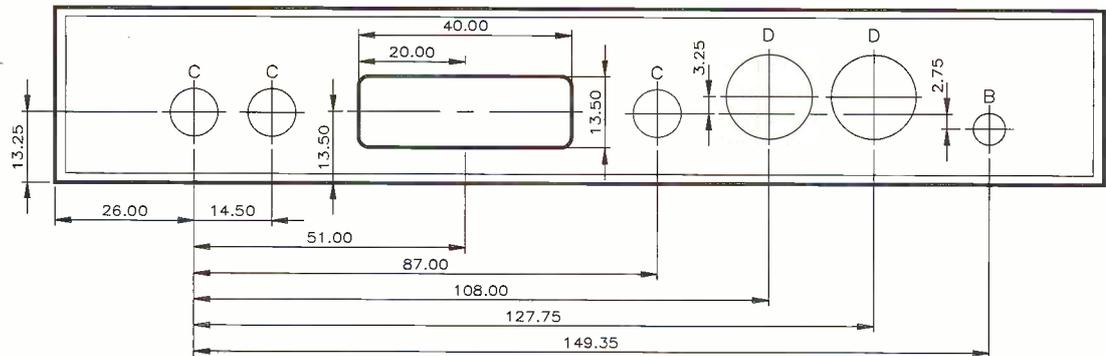
**Figure 3.** MIDI Thru' configuration chart.

current, suitable for IC2's input. The outputs of the channel buffers IC4D and IC5c feed a

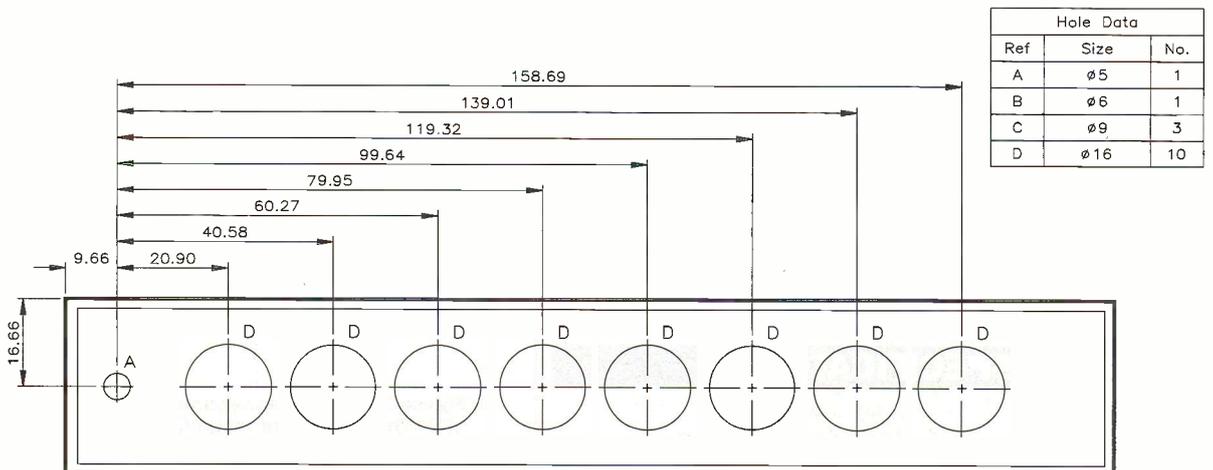
data monitor. The data is wire ORed via D3 and D4 to C9. This capacitor charges rapidly from

the low impedance of the gate and diode series combination. Discharge however is blocked

by the diodes leaving only the path through the input of IC5e and shunt resistor R27. R27



**Figure 4.** Panel drilling diagram.



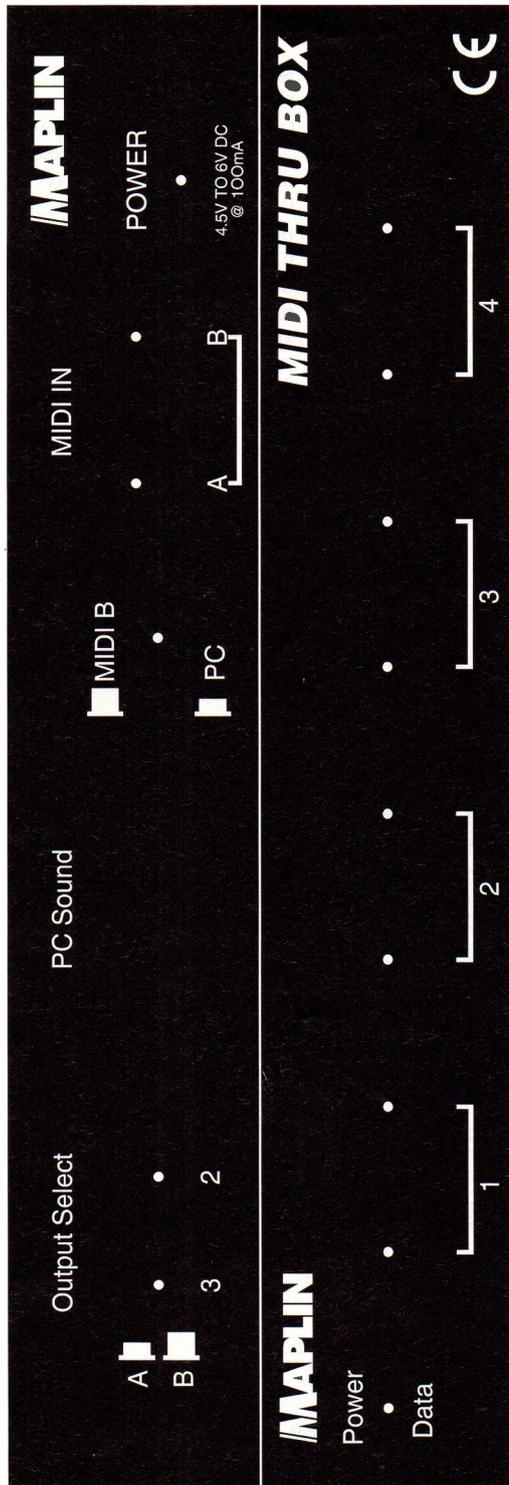


Figure 5a. Full size Panel Labels.

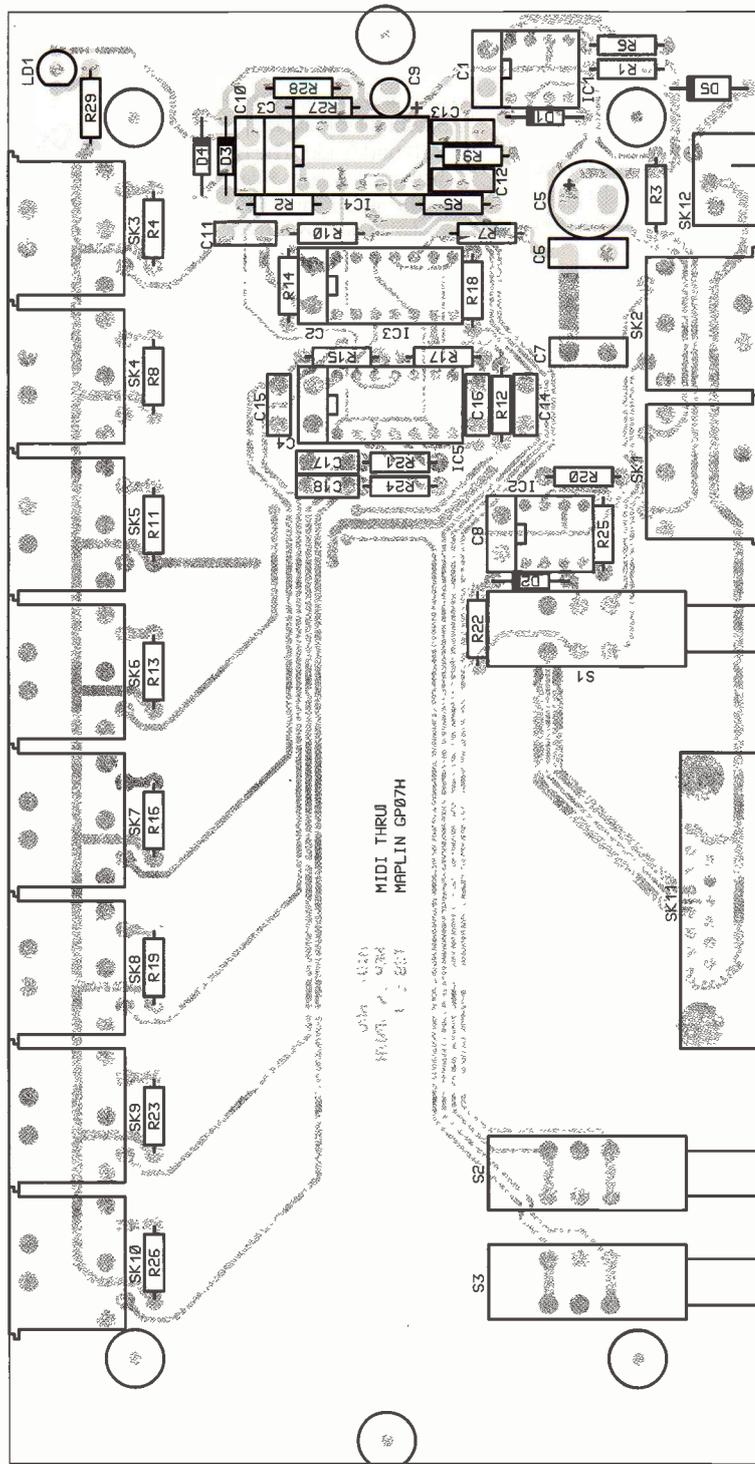


Figure 5b. Component Overlay.

presents a much lower resistance, giving a time constant around 100mS. This is a sufficient delay to make LD1 flash visibly. IC4e and IC4f buffer C9 from the low impedance of LD1. High going MIDI data thus makes the green side of LD1 flash in sympathy. R28 limits LD1's current to around 10mA.

R29 is connected to the supply with the red side of LD1 in series to ground. This LED will light continuously while power is present. When power is applied LD1 will be red. When MIDI data is present LD1

will flash orange / red.

Power is obtained from the PC port unless a plug is inserted in SK12. This external power-input-socket disconnects the PC supply when an external source is used. C5, C6 and C7 provide supply line decoupling. C1, C2, C3, C4 and C8 provide local IC decoupling. D15 serves to protect against wrong polarity connection and drop the 6V maximum supply voltage to a level more suitable for the LSTTL device, IC3.

To conform to CE requirements for Emissions it

was necessary to compress the circuitry into a small zone keeping all tracks short. A ground plane was necessary to avoid the use of a metal case. High frequency harmonics arise on the output tracks. These result from the high speed switching and impedance mismatch between the IC output, track and output connector / cable. Removing them required an RC filter (formed from R2 and C11 in Output 1) close to the IC output. The filter uses the series resistor that converts the

voltage drive back to a current drive for the MIDI current loop.

As a point of interest, the current limit resistor for LD1's green LED is also used, with C10, to form a low pass filter from IC4f. This filter is necessary because of fast transients arising at IC4e's output. CE strikes again!

Just imagine if the contributors to the various electronics magazines, including our own, had to concern themselves with EMC conformity issues. Would anyone publish any more designs? Would the electronics hobbyist continue to exist?

## Construction

Refer to Figure 5, Photo 1 and the parts list for component placing. Start by fitting all the resistors and the five diodes. Next fit all the capacitors except C5 and C9. Next fit the IC sockets and then the remaining capacitors. Fit all the Din sockets, the D socket and the power socket.

We recommend that you drill the case panels now as they can be used to simplify the alignment of the switches. Drilling dimensions are provided in Figure 4. Do not fit any labels yet.

If you are using the recommended case, mount the panels and then fix the board in place using two screws, then fit the three switches. Carefully solder one pin of each switch on the top of the PCB. This procedure simplifies mounting the switch but is not essential.

With the board still in the case, form the legs for LD1 so that its front is just proud of the panel front when it is mounted in the board. LD1 can be tacked in place by soldering one of the pins on the top of the PCB.

If you have a ohmmeter, check that a high resistance is found between pin14 and pin 7 on one (it doesn't matter which)

of 14 pin IC sockets. This will confirm that no short circuits exist between the supply rails.

Remove the PCB from the case and remove the two panels. Solder all remaining pins on the PCB underside. The panel label artwork in Figure 5 can be used as the actual panel label. We make all our prototypes from photocopy paper printed through a cheap ink-jet printer. The results are usually excellent! We use 'Photo-mount' spray adhesive to stick them down and finish them with a lick of 'Letraset 103 matt coating for artwork.' (Giving away all the trade secrets).

Re-fit the labelled panels and the finished PCB. Fit the case lid and screw in place. The MIDI thru' is now ready for use.

## 'Connections'

Figure 2 shows the MIDI thru' conceptually as a set of switches. This diagram should assist with system configuration. Also shown is a method for connecting the MIDI thru' as a single input 7 output unit.

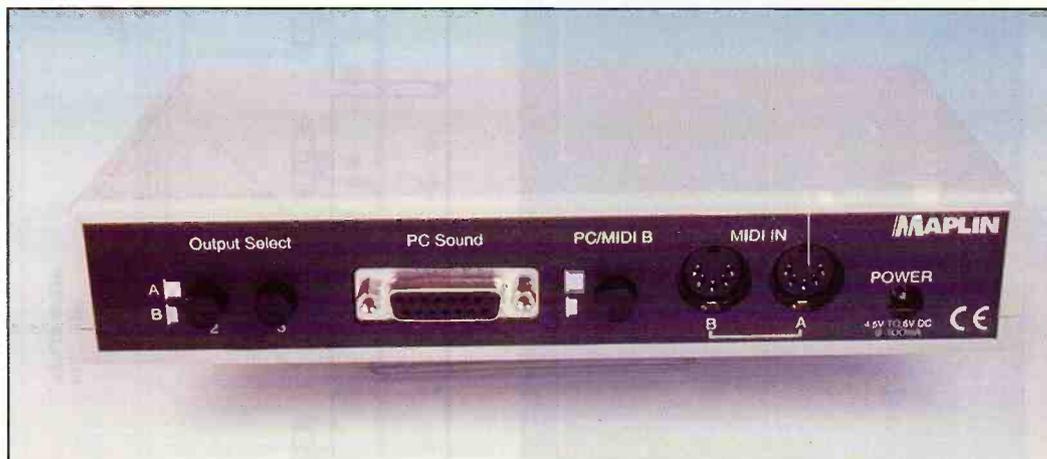
Similarly it is possible to cascade a number of MIDI thru's to allow for large numbers of outputs. The high data rate and clean switching

ensure low signal degradation through successive units.

Figure 3 is a table that can be kept near the MIDI thru'. It shows all the switch combinations diagrammatically.

If the PC port is not used, or the PC can't spare 100mA for the MIDI Thru', an external power supply is required. Do not use unregulated supplies or the chips will fry! A regulated supply between 4.5V and 6V DC is required. Preferably, use a 5V regulated DC supply. The rated current is 100mA and this much current may be drawn when all the outputs are used.

ELECTRONICS



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## PROJECT PARTS LIST

**RESISTORS: All 0.6W 1% Metal film [Unless specified].**

R1,20	1k	2	M1K
R2-5, 8,9,11-13,15-17,19,21-24,26	220Ω	18	M220R
R6,25	15k	2	M15K
R7,10,14,18	4k7	4	M4k7
R27	100k	1	M100K
R28,29	330Ω	2	M330R

### CAPACITORS

C1-4,6-8,10	100nF Ceramic	8	YR75S
C5	470μ 16V	1	AT43W
C10	1μ 63V	1	AT86T
C11-18	4n7 Ceramic	8	WX76H

### SEMICONDUCTORS

D1-4	1N4148	4	QL80B
D5	1N4001	1	QL730
IC1,2	Opto-Isolator 6N139	2	RA59P
IC3	74LS125	1	YF49D
IC4,5	74HC14	2	UB10L
LD1	Bi-Colour LED (3 pin)	1	YH75S

### MISCELLANEOUS

S1,2,3	Push Switch	3	FH67X
SK1-10	5 pin DIN PCB Mounting	10	YX91Y
SK11	15 way D PCB Mounting	1	FG26D
SK12	2.5mm PCB Power Sckt Switched	1	FK06G
	MIDI Thru' PCB	1	GP07H
	MIDI Thru' Leaflet	1	X254J
	Constructors Guide	1	XH79L

### OPTIONAL ITEMS (Not in Kit)

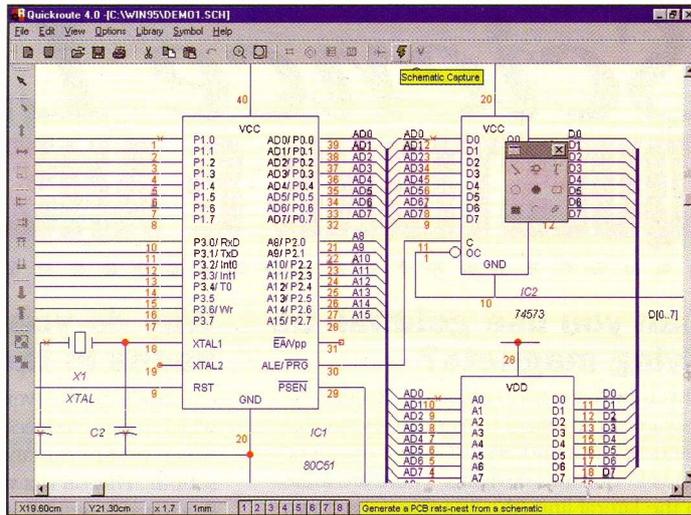
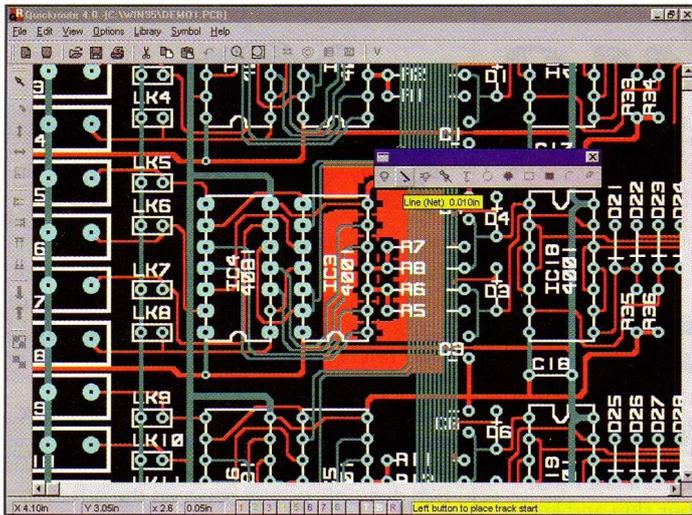
LAN Case 8 x 4	1	BP92A
Mains Adaptor Regulated	1	YB23A
Mains Adaptor Regulated 4.5V	1	MG77J
Mains Adaptor Regulated 6V	1	MG78K

The Maplin 'Get-You-Working' service is available for this project, see Constructors' Guide or current Maplin Catalogue for details.

The above items (excluding optional) are available as a kit.

Order as LU65V (MIDI Thru' Box Kit)

See current Maplin Catalogue for full ordering information.



# Electronics made easy WITH QUICKROUTE 4.0

by Ian Frost

It's not hard to see why Quickroute is so easy to use! Quickroute integrates mixed mode (analogue and digital) simulation, schematic capture, PCB design with autorouting and CAD-CAM support into one integrated environment. Best of all, prices start at just £78.99 (exclusive of VAT) for the complete system with support for 300 pins – less than the price of some simulators alone!

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When you have completed your design, simply click on the schematic capture button, and a PCB rats nest will appear (no messy netlists required!). Use the multi-layer autorouter and/or manual routing to

complete your PCB together with copper fill, etc as required. Finally print your design, or create CAD/CAM files suitable for manufacture (Quickroute even includes a Gerber viewer for checking).

But it doesn't end there! Quickroute 4.0 includes engineering change for automatic updating of your PCB from the schematic, netlist import & export so that you can link to other EDA packages (including many popular simulators), DXF, SPICE and WMF file export together with over 1000 library symbols.

## Specifications

All versions of Quickroute 4.0 include the following features:

- ◆ Modern user interface with dockable tool bars, active buttons, tool tips and on-line help.
- ◆ Multisheet schematic capture with power rail and data bus support at the touch of a button.
- ◆ 32 bit mixed mode analogue & digital simulation
- ◆ Support for a range of SPICE .MODEL statements
- ◆ Copper flood fill
- ◆ CAD/CAM import and export. Gerber viewer.
- ◆ Netlist import and export
- ◆ WMF, DXF and SPICE file export
- ◆ 1000+ Library Symbols
- ◆ Engineering change and design rule checking
- ◆ Links to Electronics Workbench 5, TINApplus, crocodileclips 3 and more!



Quickroute 4.0 is available in 3 versions all of which have identical features. The only difference is the size of design that you can save and print. The size of a design is determined by the number of symbol terminals. The versions are

- ◆ Quickroute 4.0 300 – Max 300 Pins £78.99 (NN95D)
- ◆ Quickroute 4.0 800 – Max 800 Pins £148.99 (NN94C)
- ◆ Quickroute 4.0 Full Access £248.99 (NN93B)

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  - B) Import and Export
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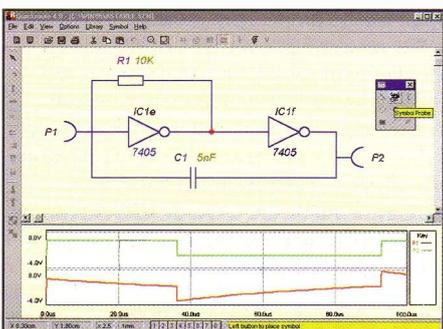
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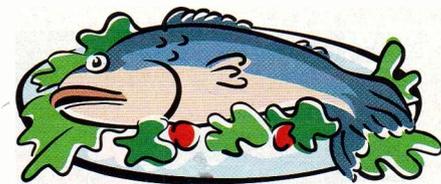
Send your replies to : The Editor, Electronics & Beyond, PO Box 777, Rayleigh, Essex, SS6 8LU.

All employees of Maplin Electronics and Quickroute are excluded from entering. Multiple entries will be disqualified. You may photocopy this coupon.



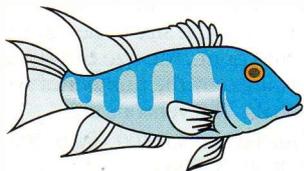
# Science Line

## QUESTIONS & ANSWERS



### Can you use goldfish as living magnets?

This is rather a good question. Recent research (published in *Nature*) shows that rainbow trout and eels do detect magnetic fields in order to navigate. There are areas in the lateral line (the line that runs down the side of the fish) which may detect magnetic fields, and there are also areas in the head which also have this ability. However, since goldfish live in ponds and do not migrate it is unlikely that they will have a similar ability – they rely on sight and smell to find their way around.



### Why don't male mosquitoes bite?

Female mosquitoes usually bite because they need a source of protein for the development of their eggs. Blood is a very good source of protein. Male mosquitoes get all the nourishment they need without drinking blood so don't need to bite other animals.

### When does the next millennium start?

Officially the next millennium does not start until January 1st, 2001. The confusion starts way back in the year 6AD and can be blamed on a man called Denys the Little.

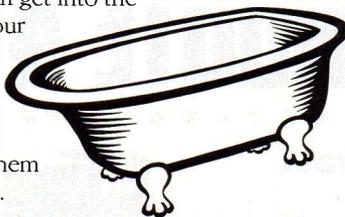
He decided to give up counting years from the beginning of the reign of the Roman emperor Diocletian, in favour of a system starting with the birth of Christ. However, because the number '0' had not been invented yet, he left it out and went straight from 1BC to 1AD. This means the first year of the decade was known as year one, and the second year as year two, and so on. Thus the ninth year of the first decade was 9AD and the tenth year 10AD. So the start of the second decade was not until 11AD.

Similarly, the start of the second century was the year 101. So the start of the next millennium is 2001.



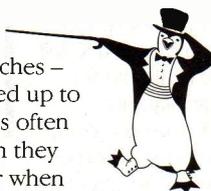
### Why do you get wrinkly hands in the bath?

Our bodies are covered with hairs, each of which has a sebaceous gland at the bottom which pumps out an oily substance called sebum. This oil is a waterproof layer that stops water getting into our skin and keeps our skin supple. Only the palms of our hands and feet are hairless, so do not have this protective layer of oil. This means water can get into the skin of our hands and feet and this makes them swell up.



### Do penguins have knees?

Yes. They walk around on their haunches – with their knees tucked up to their chests. Their legs often stretch right out when they jump out of the water when you can see their whole legs – including knees and rather long thighs.



### Does eating fish make you brainy?

Possibly. There is some evidence that the nutrients found at high levels in oily fish are important in brain development.

The brain is very rich in docosahexaenoic acid (DHA), a fatty acid which the body can produce but not very efficiently. This means the best source for DHA is your diet. It is found in meat and eggs and in particularly high levels in fish. Oily fish (like mackerel, sardines, herring, tuna) are very high in DHA, whereas, white fish (like cod, plaice, monkfish) only have high levels of DHA in their livers.

It has been reported that DHA improves eyesight, blood circulation and alleviates rheumatoid arthritis. There has been evidence to suggest that it increases learning ability and visual awareness. Rats fed on DHA-rich diets learn to escape faster than those deprived of it – experiments on primates reveal similar results.

Also, there is



evidence that premature babies fed on their mother's milk have a higher IQ, visual acuity and manual dexterity than premature babies fed on formula milk. Formula milk does not contain DHA, whereas human milk does.

However, before you rush out and order a plate of sardines, it seems that the intelligence enhancing qualities of a DHA-rich diet only occurs between the 4th month of pregnancy and the 9th month after birth – during the development of the brain.

Therefore, it seems to be the mother's diet that has the strongest effect on intelligence, not what you eat in latter life!

### Why do men have nipples?

Both boys and girls appear anatomically identical for the first 10-15 weeks after conception – foetuses are basically female until the male hormone kicks in. By that time the tissues that eventually form the nipples have already formed. The mammary ridge that runs from the armpit to the groin has formed and nipples can form anywhere along it (hence the ability to have more than two nipples). The introduction of male hormones later in the development of the foetus halts the further development of the breast, while the female hormones released during puberty allows the breast to develop fully.

## SCIENCE LINE



Science Line was started in March 1994 during the first science week, and is an educational charity funded by the National Lottery, Wellcome TRUST, the Royal Society, OST (Office of Science and Technology), some of the research councils and Channel 4.

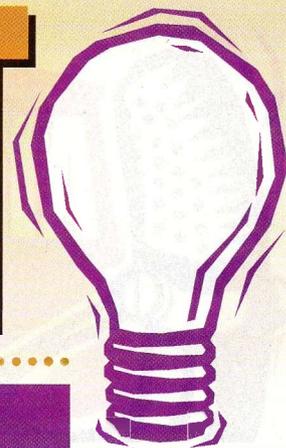
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We answer just over 60% of all calls on the day, with the rest normally answered within a week – after adequate research. The average age of all callers is 28, with 64% of callers being male. 35% of questions are physics or astronomy related, 35% biology or medicine related, 10% chemistry, and the rest on environment, engineering and technology, geology etc.

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ELECTRONICS

# COMMENT



by Keith Brindley



**FileMaker Pro — FileMaker Pro is a powerful yet easy to use database program — but is it the future?**

Things are afoot in the computing world — well, they always are, aren't they; never a day goes by without something happening with major ramifications throughout the industry. And, what happens one day in the industry inevitably creates shock waves so that people outside the industry are affected on later days. Better than that, it's not always apparent that the original cause is going to have the effect that it eventually creates. Something pretty small in technical terms can sometimes have a dramatic result — a little like the typical chaos theory example, in which a butterfly flapping its wings may be able to alter complete weather systems.

One such thing happened recently, when Apple Computers rejigged its main software company subsidiary. I'll get to the actual rejig in a minute, but first I want to explain a little of the background. Apple was the company that effectively created the personal computer industry. Its original computer sold in its hundreds of thousands long before the so-called IBM-compatible PC even made its debut. Following this, in 1984 Apple created the Macintosh personal computer range which, with its graphical user interface, defined what every personal computer user to this day still desires from a computer. More recently, Apple has been having financial problems. Sales of Macintosh computers have fallen (they still sell in their millions each year, mind you) despite having the best, most advanced and most user friendly graphical user interface of all, to the state that many observers believed that Apple would eventually run out of funds and cease existence. Over the last few months, however, the original owner of Apple has re-taken the helm and is in the process of turning the company around. Apple now produces the fastest personal computers available (twice as fast as the latest Pentium II based PCs at some

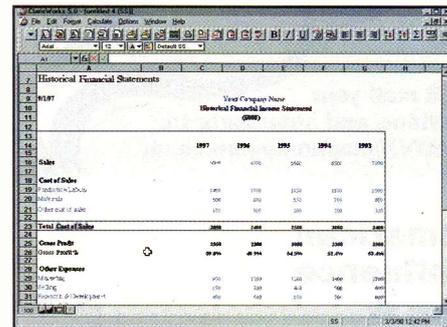
tasks), the latest version of the Macintosh operating system is as far ahead of the latest version of Windows as the original 1984 version was, and sales are again on the up. The recent announcement that Apple was to break up its software subsidiary Claris is just the latest of a long chain of events in this turnaround. Claris produces software not just for Macintosh computers, but for IBM-compatible machines too. Its best-selling software — FileMaker Pro — is the number two selling database software of all time, earning the company millions of dollars in revenue. Other software includes ClarisWorks, another big selling suite of programs available for both Macintosh and Windows PCs, although it has to be said, the lion's share of Claris' revenues over the last couple of years have been from sales of FileMaker Pro.

The rejig involves the company being renamed FileMaker Inc, and selling only the FileMaker Pro product. All Claris' other software products are now sold by Apple itself. Now, in isolation this is a very small thing — a name change, and a small flow of staff from one company to another. But the ramifications may be huge — and here I jump from all the previous facts in this column, to mere speculation about where it will lead.

First, FileMaker Inc in this name change automatically becomes distanced from Apple. There is good reason for this. Some personal computer users — and by this I mean users of IBM-compatible machines running the Windows operating system — are often computer bigots and racists, being anti-Macintosh whether or not a Macintosh is the better solution for a particular task. As a result, they could be anti-Claris software too. A software company called FileMaker Inc, is merely an invisible barrier between the software and Apple, which those computer users will appreciate.

A second possibility is that Apple might be preparing the software company for sale. A single company with a singularly successful cross-platform product would be quite easy to sell. I'll get back to this in a minute. A third possibility is much more subtle. One of the reasons that the Macintosh isn't as popular a computer as Windows computers is the belief that software isn't available for it. Of course this is a fallacy — just about every program available for Windows is also available for Macintosh as well. The key phrase here is just about. For every product available in Windows that isn't available on the Macintosh, there's at least one viable (and usually better) product.

There is, however, one program that isn't available for Macintosh that is an important



**ClarisWorks — ClarisWorks, along with the remainder of Claris' products, now transfers to Apple's direct control**

shortfall — Microsoft's Access database product. For this very reason alone, FileMaker Pro is the major database product on the Macintosh and this hasn't gone unnoticed by either Apple itself or, I conjecture, Microsoft.

Taking this possibility to a conclusion requires more conjecture. Microsoft, as it is for Windows, is the largest software producer for the Macintosh. Its Office products (apart from Access, that is) are on just about every Macintosh users' desktop in the world. Because of this, Microsoft makes considerable money from Macintosh users, and what's more is keen to show its commitment. A few months back Microsoft went so far as to invest \$150 million in Apple. Indeed, the latest version of Office (Office 98) is available — albeit Access-less — on Macintosh first (Windows users will have to wait until the end of the year!). To cap all this off, there are rumours that Microsoft is shortly releasing a database product for the Macintosh.

Of course, there are cynics who suggest that the rejig of Claris could be the payoff Apple has to make to keep Microsoft happy, and might be the real reason behind the \$150 million investment. Apple sells FileMaker Inc, or even better for Microsoft, merely closes it down. But I suggest there may be a happier ending. What if Microsoft buys FileMaker Inc for a nominal amount (merely the second part of its earlier investment)? It then has a ready-built modern cross-platform database solution, and doesn't have to develop a new one for the Macintosh.

Claris' rejig might just be a result of Apple butterfly wing-flapping on Microsoft's behalf. If the rumour about a Microsoft database for Macintosh is true, one way or the other we'll know within a couple of months.

The opinions expressed by the author are not necessarily those of the publisher or the editor.



E-mail your views and comments to: [AYV@maplin.demon.co.uk](mailto:AYV@maplin.demon.co.uk)

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

## American Influence

Dear Sir

English dictionaries continue to show a billion as a million million so why on earth did we adopt the so called 'American' billion of a thousand millions as a standard into our language, when English is not even the official language of the United States of America?

Dougal Paterson

[dougalp@mail.ang.sequel.net](mailto:dougalp@mail.ang.sequel.net)

**When you are a large super power then you tend to have a serious influence in the world – in science, engineering etc., and even your adopted 'language', so if you believe a billion is a thousand million then it tends to 'rub-off' in the rest of the world. Surely, all that matters is that we all follow the same definition.**

## A Cheap High Current PSU?

Dear Sir

Following your interesting review of the Fluke Scopemeter 123 I bought one, after failing to win one in the competition. Using this with the Intelligent Battery Charger I am able to plot battery discharge curves. The Charger provides a near constant current discharge and the Scopemeter plots the battery voltage.

Ideally an accurate  $0.1\Omega$  or less resistor should be placed in series with the battery and the voltage taken from this to indicate if the current is really constant. All I need to do is add a switch and resistors to the Charger to alter R5 to give variable discharge currents. The Charger is a bit frustrating if one wants to just quickly top up a nearly charged battery, as it has to discharge it first. I made a modification to the Charger to add a pushbutton and series resistor of about  $4k$  across R27. Upon pressing the button this fools the IC into thinking the cell voltage has dropped below  $0.8V$  so it starts the charge cycle even though the cells are really well above  $0.8V$ . This has to be used carefully and only on the 12 hour setting as putting a 1 hour charge into a nearly charged

battery could destroy it. Interlocking it with the 12 hour switch would be possible.

How about a power supply or battery charger project based on an old PC computer power supply. These are available from old computers for free and are fairly standard, so a kit that uses one as its basis only needs simple modifications to accommodate the variations in size of the units.

Much of the cost of a high current supply is in the transformer, and these are expensive to post to those of us living abroad, such a project would be very cost effective. I expect your reply will site safety and EMC concerns with such a design, but I do not see these as difficult to get over. The mains switch is the only real safety problem. A voltmeter and ammeter that can be switched around the various voltage outputs would be useful. It may be that a small dummy load would have to be put across all the outputs as they may not be designed to work with unloaded outputs.

E F Chase  
Hong Kong

**A PC power supply certainly provides a cheap, low-voltage, high current source – have any of our readers made use of a such a psu in a project?**

## PC/Mac Power Back-up

Dear Sir

Having enjoyed 'Electronics' for almost all of its issues I'm still waiting for you guys to produce an uninterruptable power supply kit for all us PC (and Mac) users out there who think it would make a nice practical project. I seem to remember that you did an article, or series, that covered UPSs some years ago but don't recall it including much in the way of practical details. I suppose that it would cost little less, or maybe even more, than a

commercially available one but it would be much more fun to make your own – like many of your projects – so, go on, slip the leash on the development team!

Charlie Morriss  
[CE.Morriss@aol.com](mailto:CE.Morriss@aol.com)

**It certainly would be costly! An article did appear in the June 1993 Magazine Issue 66 (XA66W) and showed how to construct a simple uninterruptible power supply based on the 'Handy Mains' 12V/230V mains converter (KR64U) which was driven by a mains/12V sealed lead acid battery power supply combination. I doubt if there would be much change out of £200.**

## ELECTRONICS CORRIGENDA

### Connections Direct

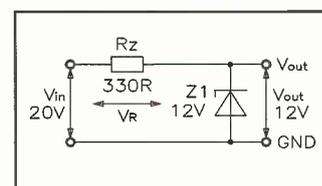
In brochure 1998 issue 1, supplied with Electronics and Beyond issue 124, the UK delivery charge on the order form should be £3.95 for orders under £30 inclusive of VAT.

### Research News – March 1998 issue 123

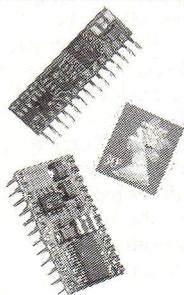
The correct URL address for the radiotelescope images is <http://www.vsop.is.as.ac.jp>

### Loudspeaker Protection System

In this article in issue 123, the zener diode in figure 4, is incorrectly shown. The correct orientation is shown below.



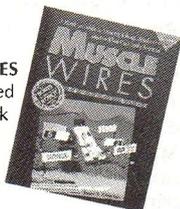
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# Market FUTURES

*In an industry that is defined by continuous re-invention, predicting the future is no easy task. Yet for the last three years, analyst house IDC has thrown down the tea leaves at the dawn of each new year and predicted the landscape of the industry 12 months hence. Here Stephen Waddington reviews the company's ten key predictions for 1998.*

**H**ow would you define 1997 in terms of the electronics and computing business? Maybe it would be by the outbreak of merger madness amongst the IT giants. WorldCom outsmarted British Telecom acquiring MCI Communications. At the same time, 3Com grabbed US Robotics getting access its x2 modem technology as part of the bargain. Cabletron bought up Digital's networking business, while Hayes lined up against the larger networking companies with its acquisition of remote access specialist Access Beyond.

## Chip Wars

In the semiconductor space, Intel maintained its dominance, acquiring Digital's semiconductor business after Digital had accused Intel of breaching a handful of its patents. Elsewhere, National Semiconductor swallowed up Cyrix for £320 million in August, and decided to focus on highly integrated X86 processors for low-cost PCs instead of traditional CPUs.

And then there is the ongoing war for ownership of the desktop browser market. At the beginning of 1997 it had looked as if Netscape was the clear winner when the US legislature ruled that it was anti-competitive for Microsoft to ship Internet Explorer as part of Windows 95. Now it looks as if Microsoft's sheer dominance in the desktop market has guaranteed its position in the browser space – and analysts claim that the US government will soften its position before too long. Market watchers are now focussed on Sun and Java to see if Microsoft will apply similar tactics to stamp its mark on the Web.

**Photo 1.** The Internet commerce Secure Electronic Transaction (SET).



## Risky Business

Making predictions in the electronics and computing sector is a tricky business. How do you make forecasts in an industry when

companies announce new products and then miss shipping dates not only once, but twice and then three times? Microsoft enacted a perfect example of this phenomenon a couple of years ago with Windows 95, and now it looks like Windows 98 is following a similar pattern.

Despite the unpredictability of the industry, for the last three years, analyst house IDC has set out its view of how the industry will look 12 months hence each new year. Its forecasts, often scorned by the industry, have an uncanny knack of turning out to be completely accurate. So when IDC published its forecast for 1998 at the end of last year, we took a close look at its list of ten predictions.

## Premonition

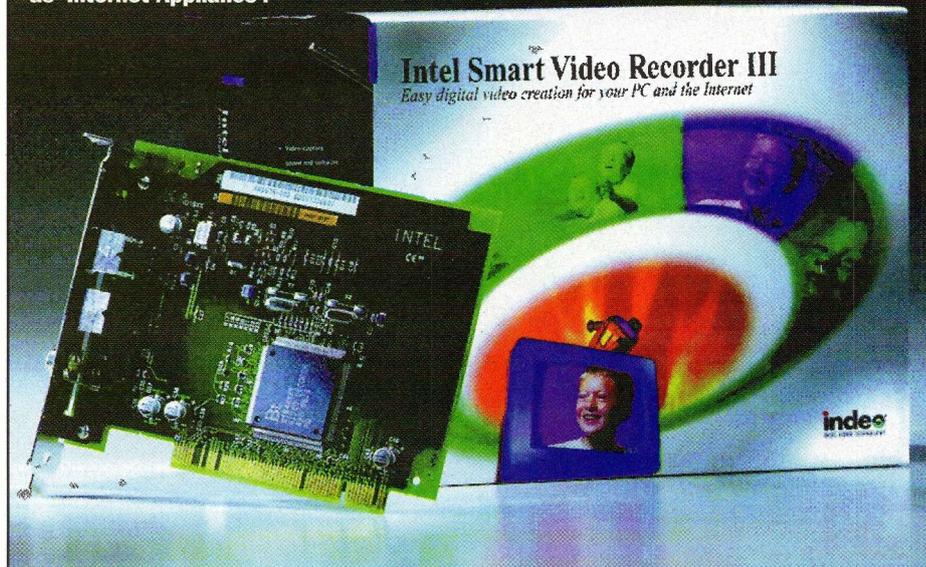
IDC starts from the fundamental premonition that the IT industry is marketplace is completely reorienting around the goal of building and supporting a billion-user wired marketplace by 2005. The key theme that links IDC's ten predictions is that 1998 will see a shift in market power, with growing presence and importance of online businesses, consumers, consumer electronics suppliers, telephone carriers, ISPs, and IS organisations as, through online commerce, the Web meets enterprise computing.

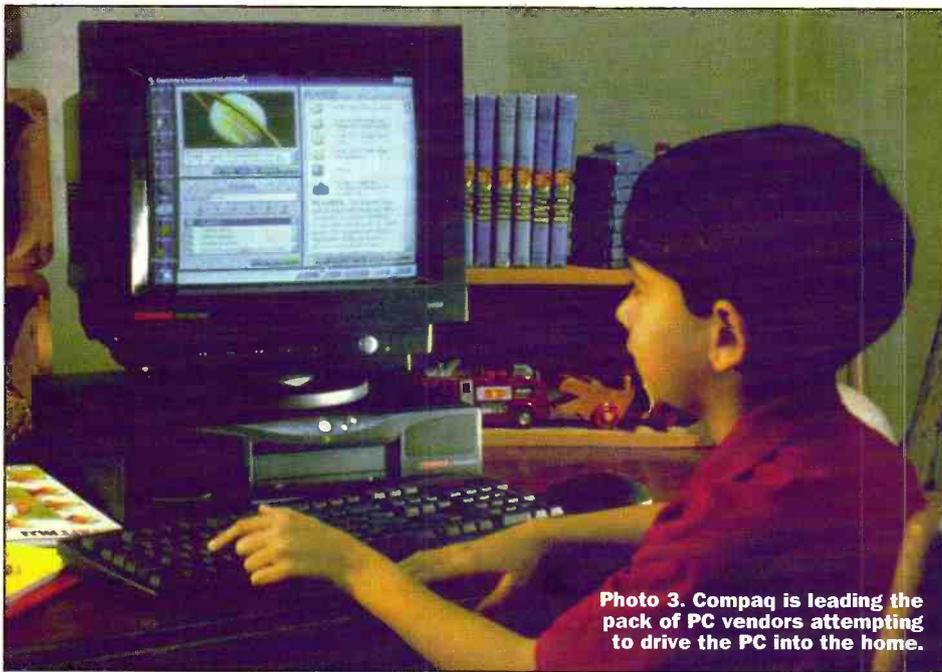
## PREDICTION 1

The Web will edge toward 100 million users while Web commerce exceeds £11.8 billion.

IDC believes that the Web will hit major milestones as an electronic marketplace in 1998. In 1997, there were over 50 million users on the Web, up from 28 million in 1996. In 1998, the Web population will continue to surge. Draft data from the IDC Internet Commerce Market Model suggests that the number of users may reach 90 to 100 million by year-end. This will keep the Web population on target to exceed 200 million by 2001.

**Photo 2.** 1998 will see an explosion of a new category of products known as 'Internet Appliance'.





**Photo 3. Compaq is leading the pack of PC vendors attempting to drive the PC into the home.**

Meanwhile IDC believes that online commerce will continue to surge. In 1998, over £11.7 billion in transactions will be completed on the Web, almost triple 1997's £4.1 billion. The Internet commerce Secure Electronic Transaction (SET) standard backed by Mastercard and Visa shown in Photo 1 is likely to become a global standard if IDC's predictions for the growth of the market are accurate

## PREDICTION 2

The Web will finally reach consumer proportions.

With nearly two-thirds of the world economy coming from consumer spending, a key goal for the Web is to become a true mass market. In 1998, the 'mass-market Web' will materialise in the US as nearly 25 per cent of all US households get online. Although this is a US-centric prediction, it is fair to say that the UK market is not far behind its counterpart on the other side of the Atlantic.

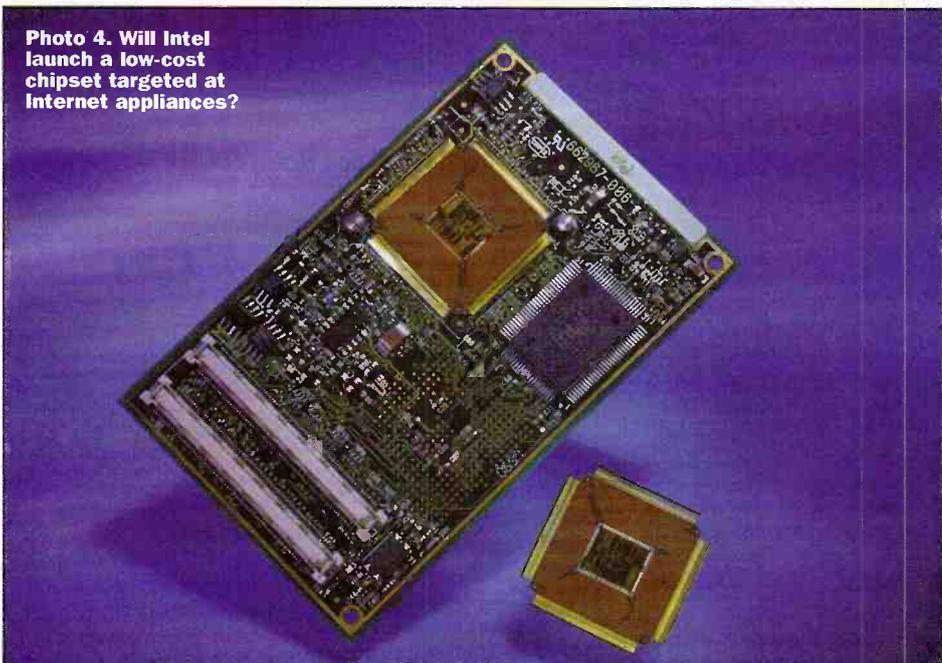
## PREDICTION 3

Information (Internet) appliances and suppliers will invade, challenging the PC in three to five years.

In 1998 IDC predicts that the market will see an explosion of new products introduced in the form of TV set-top boxes, Web-enabled TVs, Web-enabled video devices as shown in Photo 2, Web-enabled videogame consoles, Web-enabled personal digital assistants (PDAs), and more.

IDC claims that this invasion of consumer electronics will have a profound impact on the IT industry. Appliances will redefine 'high volume' for PC suppliers, just as PC suppliers redefined high volume for minicomputer and mainframe suppliers.

IDC is very bullish about the growth of this market. By 2002, annual shipments of information appliances will outnumber those of PCs in a key indicator segment: U.S. consumers. By 2005, information appliances will challenge PCs in total annual unit shipments. By 2010, they very likely to outnumber PCs by at least 10:1.



**Photo 4. Will Intel launch a low-cost chipset targeted at Internet appliances?**

**Photo 5. Browserwars.com plots of the course of the Microsoft vs. Netscape battle for the desktop browser market.**



## PREDICTION 4

PC suppliers will aim for consumers with low cost PCs and appliances.

This prediction is US-centric, where sub-£600 PCs are already the norm. In the UK, PC prices are typically 30 per cent more expensive due to import costs and market forces. In the UK market it is said that the price of PCs will be driven below £1,000 as manufacturers attempt to drive penetration into the home as shown in Photo 3.

## PREDICTION 5

Intel will launch a major non-Pentium chip business targeted at appliances.

IDC believes that Intel will address the low-end PC business and the network computer/Internet appliance business by creating a low-cost Pentium chip, shown in Photo 4 and, perhaps, introducing a completely new low-cost chip family. One candidate for this product line is the StrongARM chip Intel received in its settlement with Digital, although many close to Intel feel that the company does not currently have plans to push StrongARM in any major way.

## PREDICTION 6

Microsoft will win the browser battle and create a new non-Windows Internet appliance platform.

IDC reckons that the injunction preventing Microsoft from bundling Internet Explorer as part of Windows 95 will be very temporary in its effects. In the meantime, IDC believes that Microsoft's primary operating system value proposition may lose in the Internet appliance space to suppliers that optimise around specific appliances, and provide less comprehensive but adequate links to the Windows PC world. Check [www.browserwars.com](http://www.browserwars.com), as shown in Photo 5 for further information.

## PREDICTION 7

The era of megabit consumer Internet access will begin telecom provider's DSL challenges to cable companies.

IDC predicts that in 1998, the era of megabit consumer Internet access will begin in earnest as digital subscriber line (DSL) – the telephone carriers' alternative to high-speed data over cable – will have successful, widespread US trials and begin rapid adoption in 1999.

**Photo 6. IDC believes Internet Service Providers (ISPs) such as UUNET will become a force to be reckoned with by IT suppliers during 1998.**



## PREDICTION 8

ISPs' power will grow as IT customers tip the scales in some key IT market battles.

In 1996, public data network carriers accounted for only 36 per cent of all wide area networking (WAN) equipment purchases. With the rise of the Internet, public network providers are spending a lot more on equipment: by 2000, IDC predicts that they will account for 51 per cent of all WAN equipment spending.

ISPs such as UUNET, shown in Photo 6, are increasingly important consumers of other IT: servers, database management systems, Web server software, management tools, and so on. In 1998, as the power of ISPs over the IT market increases, IDC predicts a surprising resurgence of some market underdogs that uniquely support the Internet-scale needs of ISPs, particularly Unix and Netscape.

## PREDICTION 9

Key Internet technologies for 1998 will include digital certificates, thin software, Web sound, and language translation.

IDC believes that in 1998, among the key technologies and products that support the growth of the Web as a marketplace will be the following:

### Digital certificates

Commerce needs security, and security needs to be both strong and relatively painless to be implemented. IDC predicts that in 1998, digital certificates will begin to catch fire, with the certificate authority business growing from about £76 million in 1996 to over £1.2 billion by 2000.

### Thin (Internet appliance) software

The growth in information appliances has major implications for software. Software that wants to find a home on hundreds of millions of appliances will need to be 'thin' – providing a large amount of functionality for a minimal amount of hardware overhead.

### Web sound

While we're all waiting around for rich visual media experiences on the Web, IDC believes that sound will be happening in a big way on the Web in 1998. Streaming audio such as Real Audio is already becoming commonplace on commercial Web sites. In 1998, users will also begin to access voice, e-mail, and scheduling, and even tap knowledge bases or news sites on the Web via voice-based user interfaces.

## PREDICTION 10

The scramble for unclaimed customer mindshare will drive mega-mergers in 1998.

As the Internet turns the IT marketplace upside down, IS executives are rethinking their relationships with key suppliers. In a

recent IDC survey of 11,000 IS executives, almost 60 per cent could not name a single vendor they considered most important in helping them exploit the Web. The top vote getter was Microsoft, with only 11 per cent. The next closest was IBM, with 7 per cent. Customer mindshare won't stay unclaimed for long.

Furthermore, in 1998, the desire to grab this unclaimed mindshare will drive a large number of mega-mergers. Two of the most likely are:

Netscape and Oracle. Netscape, which has achieved remarkable success in a short time, still needs greater resources to really establish itself as a long-term winner in the important enterprise computing space. Oracle, although a successful company, still has major gaps to fill in its battle against Microsoft: a stronger Web software story, a better offering in the collaborative/messaging space, and a presence in the client software space. Netscape offers all of the above.

Sun and a leading 'enterprise computing' supplier. Sun has a very high profile in the Internet space. Yet IDC survey data shows that Sun's image within the traditional IS organisations is relatively low. Given the high stakes and the unclaimed mindshare, the next two years are a critical time for Sun to bolster its image within the IS community. To do so, we believe Sun will look to merge with a supplier that can bring greater IS management mindshare. Digital is one possibility; Unisys is another. Alternative candidates could come from the IT services segment or PC suppliers that have achieved strong IS visibility.

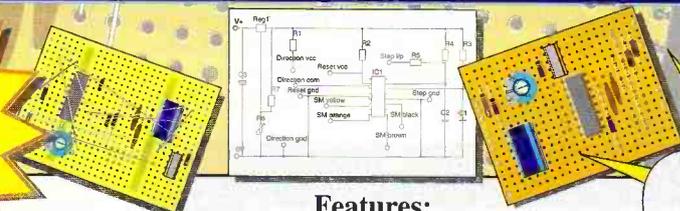
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# Getting On-Line TO THE INTERNET

PART 5

by Mark Brighton

*If you have been following this series and have fitted a modem to your PC, subscribed to an Internet Service Provider and followed all of the set up instructions over the past few months, you will by now have been on line to the Internet. This months article rounds up the series by taking a look at some options on where you go from here. We also help you to find your way through the chaotic snarled mass of inter-linked sites that make up the Internet and take a brief look at the pitfalls and problems you may encounter while you are on line.*

## Finding a site

When you use the World Wide Web, you will usually begin with one of two starting points. You may have made a note of a web site address, also called a URL (Uniform Resource Locator), which may simply be typed into the text line at the top of the browser window. Hit return and your ISP host machine will look up the address and arrange to have the content of the page your address relates to routed all the way through to your PC from the remote site. Alternatively, you may have a specific subject in mind, but not know of any relevant web site addresses, in which case you will use one of the many Internet search engines to find sites whose content contains the keywords you have typed into a free text search line. Photo 1 shows the 'HotBot' front screen, to be found at '<http://hotbot.com>'.

## Search engines

Sites such as HotBot are a real godsend when looking anything up on the Internet, making it easy to browse any number of sites that contain information about your chosen subject. You may type in a single word, a number of words or even a complete phrase such as 'tourism in oxford' (which incidentally returns 36 web sites if searched for as an exact phrase, or 12,599 sites if you search for all the words). After a while, you will become more practised in typing the right selection of words to pin down sites that do contain the information you are after.

The search engine and 'webcrawler' sites return a list of results sorted into the order they feel is most relevant, either in terms of the number of times your search keywords occur, or the closest match to the phrase you typed. Results are typically displayed in

lists 10 or 25 sites deep, so at least the most likely sites are listed on the first screen or two and are easy to browse, even if you do end up with thousands of possible sites listed! Each result has a title name set up as a clickable hyperlink, so just click on the title to go to the site.

If the site you look at doesn't have what you are looking for, just use the 'Back' button on your browser's toolbar to return through the site, back to your search result. One thing you will very rapidly find if you use the Internet regularly as a tourist information source is that almost any British destination has an American namesake, so any search result will usually contain a number of US sites about their version of the town or city you are looking for.

## Super information highway, or the M25 during the rush hour?

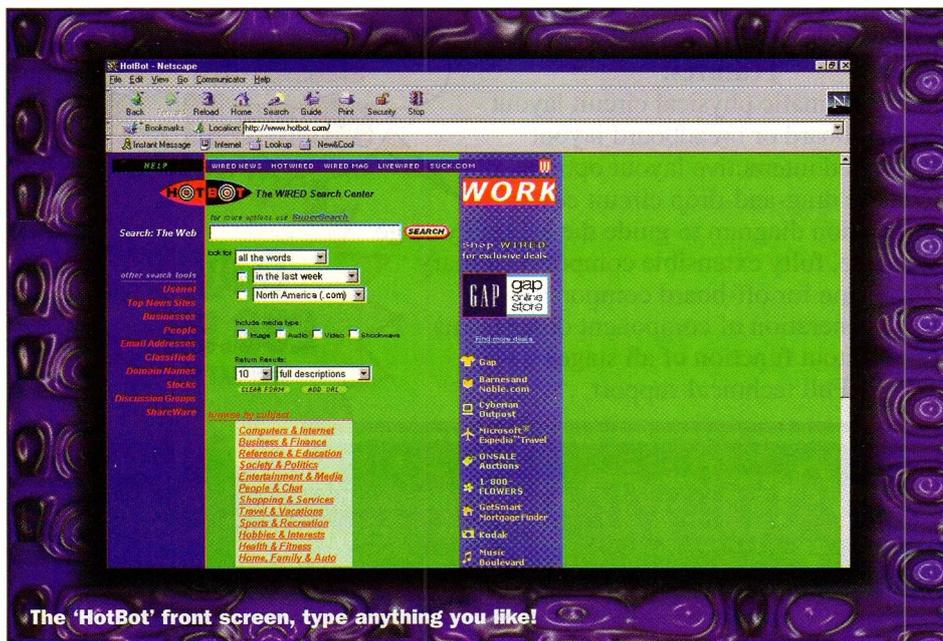
You will also notice that some sites will appear almost instantly on your screen, but others take several minutes just to load their front (Home) page. The Internet is very variable in terms of speed and reliability of connection to any given site, as it may route you through a huge number of other server machines en route to the server hosting the web site you wish to look at. If any one of those server machines is running near it's maximum capacity of users, it will form a data bottleneck that may slow your access to the remote site drastically. If you have to wait forever to see a page appear, or you start to get messages saying the connection has been reset, or the host server is busy, then the best advice is to try again later.

The Internet often slows down considerably when America goes on line. The US has by far the greatest share of world Internet users and there are certain times of day when the overall effect of so very many users coming onto the system at once is very noticeable. Lunch time in the States corresponds with late afternoon / early evening here and also coincides with school / college breaking up in Europe, so net access then is often very slow. Evenings in the UK coincide with schools breaking up in The US, with later evening coinciding with America returning home from work, so the most convenient times here to go on line are often not great for access speed.

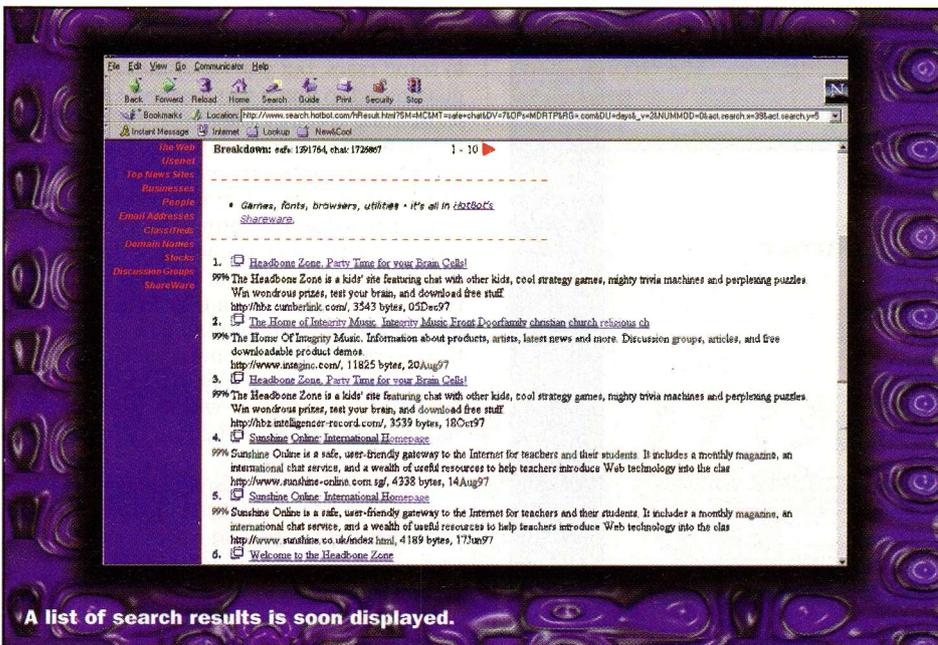
If you can face the harsh light of your computer screen first thing in the morning, the period between about six o'clock and eight o'clock in the morning is one of the fastest times of day to go on line. Later morning is often not too bad, although European users are pretty active by then. It is certainly worth experimenting with different times of day if your favourite site is slow to display on your screen and takes forever to respond to each click of your mouse, particularly if the site is a long way away.

## Children and the Internet

There is absolutely no doubt that the Internet provides a gateway to the world from your own PC and is an indispensable reference and learning tool for all the family, none more so than children. There are many thousands of websites set up to cater for children's interests and favourite subjects. My own boys regularly use the Internet to look up information for their homework, for extra information about



The 'HotBot' front screen, type anything you like!



their computer games and for sites about whatever the latest craze happens to be. From Warhammer 40,000 to Tamagotchi, Sega cheat codes to computer 'Petz', there are sites about every subject imaginable.

If nothing else, using the Internet stops them from playing games for a while! Seriously though, the use of PC's to help with homework research certainly makes the prospect of doing their homework a more attractive one, which has to be welcomed, and it all helps them to develop the necessary skills for using a computer from a tender age.

This brings us on to another area which must be discussed in any introduction to the Internet and children (or anyone who may be easily offended by extreme images and language) using the Internet and that is sex!

## Sex, violence and the Internet

The Internet has always been a place where the right to free speech has been taken very seriously. I have already stated that you will find Internet sites about every conceivable subject out there and sexual interests and practices are certainly no exception. For this reason, children should always be supervised when on line. It is a good idea to find out what they intend to look for before they look for it and to make them aware that you will be regularly checking to see if they need any help while on line, if you can't see the PC screen while they are on line anyway.

Take note of the fact that some apparently innocent search phrases will generate lists of sites with much sexually explicit material and nudity. This is especially applicable to almost any famous female singer, group, actress, presenter or other artiste. For example, typing 'Spice Girls' into any search engine is almost guaranteed to bring up a mixed list of innocent fan sites and sleazy porn sites!

Opinions may vary as to how much you should buffer your children from that big bad world out there, but I don't think anyone would recommend that children had free access to the most extreme material that is available on the Internet. There are other measures you can take to limit access to 'unsuitable' material.

## Censorship

It is possible to run special 'plug-in' programs alongside your browser that, at their simplest, monitor the incoming traffic for any one of a list of banned words. In addition to this basic level of protection, some of these programs use a system of site certificates to limit access to sites with no or insufficient 'safety' certification, or use specific lists of banned sites to limit Internet access. It is usually possible to add your own words or site addresses to the lists provided, but that does mean that you have to be prepared to sit and type all of the crudest words and terms that you can think of into the list (which will be password protected so that little wide eyes can't come across it afterwards).

In reality, these programs are a poor substitute for gentle but persistent adult supervision. There will still be ways to view some sites with 'adult content' even with the censorship software installed. Some of the certificate driven software is so sensitive that it is continually triggered by almost every site visited, no matter how innocuous,

simply because the webmaster of the site concerned has not applied for the relevant certification. At the end of the day, the argument is much the same as for television. You control the buttons that determine the material you receive. Exercise your discretion and be aware that there is no 9.00pm watershed on the Internet!

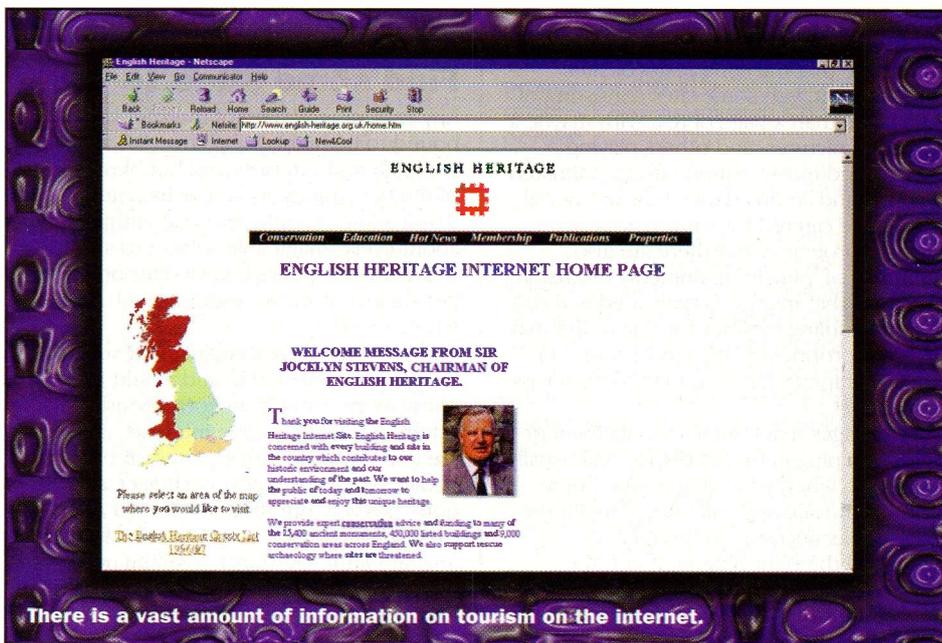
## Alternative or updated browsers

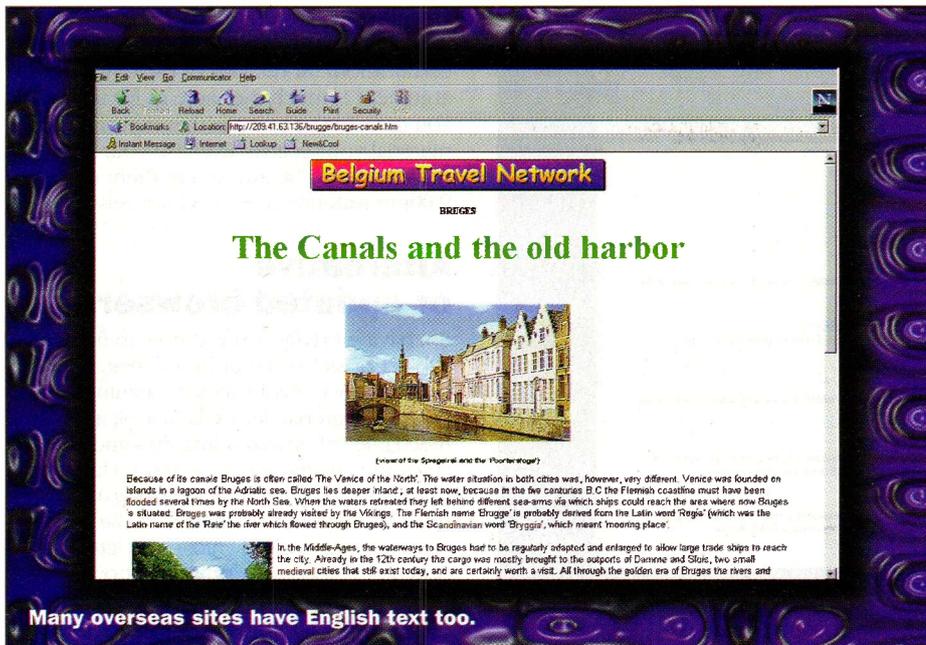
So, having briefly covered how to find the subject or site you may be interested in as well as how to avoid sites containing extreme material, let's take a look at the mechanics of downloading files and choosing an alternative browser. Having done all of our initial set up using Microsoft Internet Explorer, we will go to the Netscape site and download the latest version of Netscape Communicator.

The Netscape home page is at '<http://home.netscape.com>' and this will bring up a menu screen for the whole Netscape site. Choose the 'download' tab at the bottom of the screen to take you to a page listing all of the Netscape products on offer. Click on the Communicator standard edition (or read more about the products and choose another version if you wish) to take you to a page confirming your choice. Click the 'download' button to continue and you will be presented with a screen where you will select your operating system (Windows 95 for our example system), language (English if you are reading this) and software version (standard for our example). Then click on the 'download for free' for users outside the US button at the bottom of the screen, using the scrollbar on the right to scroll your display down first to show the button. This will take you to a screen listing each of Netscape's international download centres and you may select the one nearest you for the fastest download speed.

## Downloading the program file

You will then see a pop up box appear prompting you for a destination directory





about anything. It may be difficult to find an encyclopaedic reference to the subject in some cases, but you are almost guaranteed to find a vast wealth of supporting and incidental material.

The Internet can seem a huge and daunting mega-computer system mindlessly feeding information in response to your typed search terms. On the other, so many of the sites you will find have such a personal and hand built feel and content that you really feel you are looking into an individual's mind and listening to what they have to say. Many if not most web sites allow you the opportunity to contribute your own information, correspond with the 'webmaster' who runs the site, or with others using the site.

At a level of purely human contact, the Internet provides a fantastic medium for people around the world to get to know each other and talk about each other's lives and cultures, discuss world events or local hobbies or whatever you may want. Some of the search engine sites have personals columns for those looking for romance, for pen friends or just for human contact. Don't be put off by anything you may have read about 'flaming' (where naïve users are deluged with unpleasant mail for stepping outside Internet protocol or good manners). Just use your own common sense and be polite and undemanding, especially on first contacts. Try to include enough information for the person you wish to correspond with to become interested and want to reply.

There are even specific web sites set up for children and teenagers to meet safely on line. These are monitored by a webmaster or system operator who will ensure that no unpleasant personalities are able to remain connected, protecting the membership against the less desirable members of the Internet community.

As always with any personal, columns, it is better not to divulge too much about yourself or the address you live at until you have built a relationship of trust with the person concerned. The old advice about conducting any initial meeting in a public place with plenty of other people about holds doubly true for a first face to face meeting with someone you have never actually seen before, as well as making sure that someone knows where you are. Why not take a friend with you?

Then again, you may have no wish whatsoever to meet new people on the Internet, and that is fine too. No-one forces themselves upon you when you go on line. You may spend as long as you like web browsing and never 'meet' a single person if you don't want to. Just use the net as a download facility or library.

There truly is something out there on the Internet for everyone, whether they are computer buffs or have no interest whatsoever in computers. Many people treat computing as a hobby as an end in itself, but it may be just a means to a very different end, especially on line.

If you still haven't tried the Internet, I do urge you to ask a friend or relation who does have net access to show you how easy it is to use and how long it takes to find pages that are about your favourite interest. I think that you will be very pleasantly surprised.

ELECTRONICS

for the downloaded file to go into. This is a temporary directory and will not be used by Communicator / Navigator after installation. I have a directory called 'Ziptemp' (as many downloads are compressed or 'Zipped' using Pkware's .ZIP format) that I always use for program downloads. You may set up a directory anywhere for this, or use an existing directory if you wish. Note the filename, or you may never find it again on your hard drive!

Click 'Save' to continue and the download will begin. Note that the Navigator file is very large, about 10Mb, and will take an hour or so to download. Bear in mind though that you are only paying the cost of a local telephone call, which doesn't compare at all badly with the cost of software from a shop!

Once you have finished downloading the software, use Windows Explorer to go to the directory you have stored the file in and double click the icon for the file to install Netscape Communicator.

## Multimedia and the Internet

If you have spent some time using the Internet and browsing various sites, you will realise that the complexity of sites varies hugely, with some sites consisting of little more than a page of text with maybe a couple of pictures, and others playing background music, sound effects, animated graphics and so on. Many of these 'special effects' are catered for within modern browser programs, but there are also hundreds of 'plug-in' multimedia extension programs that may be downloaded and run to add handling facilities for one of the many different proprietary formats of sound or moving graphics files you may come across on the net.

Most pages that contain special content needing a plug-in for full display will usually tell you so when you bring up the home page on the site and will often contain the link or links necessary to go off and download the right plug-in. If not, the address to go to get Netscape Communicator / Navigator plug-ins is '<http://home.netscape.com/comprod/>

[products/navigator/version\\_2.0/plugins/index.html](#)'. The corresponding address for Microsoft Internet Explorer is '<http://www.microsoft.com/ie/download/>', where you may download various versions of Explorer and plug-in accessory programs.

Once you have downloaded any necessary plug-ins, you will need to exit your browser and run each of the downloaded files by double clicking on them from Windows Explorer. This will run a set up program or wizard that will find the browsers that are installed on your system and make the necessary changes or links to other programs it will set up. After that, every time your browser comes across a page with content needing that particular plug-in, it will use the new software to display that content.

The only problem with all of this extra multimedia complexity on web sites is the bandwidth problem. You can only get so much information to so many people before everything slows down. Even if the connection is a good one and the server isn't too busy, some of the video clips on the net are 10Mb or more in length. You may wait for an hour or more to download a video that plays for just a minute or two.

## Find some sites to try

Any recommendation of Internet sites is bound to be highly subjective. We all have very different interests and hobbies. One of the best things about the Internet is that it allows people with real enthusiasm about every imaginable subject to share that excitement and knowledge about their pet subject, however esoteric, with the whole world.

If there is any new subject that you are becoming interested in and would like to know more about it, or correspond with others sharing the same interests, chances are that there are already sites on the net dedicated to just that very subject, and quite possibly hundreds of them if not thousands! The scale of it is difficult to imagine until you start to use the net regularly and search for different things. It will become second nature in the end to turn to the net when you need to know

# Get more from VISUAL BASIC 3

## PART 2

### Custom Functions, What's This? and 'Me'

by Mike Holmes

#### Standardisation

According to its origins, as indicated by its very name (which is an acronym for Beginner's Symbolic Instruction Code), the educational committee who originally created BASIC decided that said beginners would not initially be able to cope with the idea of having to explicitly declare all the variables they use, as they have quite enough to think about as it is.

So BASIC has this wonderful feature where you can simply use variables whenever you need them – the interpreter (as it was in those days) creates them whenever it comes across references to variables it hasn't already got without making a big fuss about it.

#### Standard Declarations

There is one major drawback to this idea. On one occasion I personally spent fourteen hours trying to find out why a variable kept reading back as zero, only to find out it was simply because I'd miss-spelt its name at some other place! As a result, I now include the following global statement first and foremost in every module of every Visual Basic program I create:

```
Option Explicit
```

This forces me to explicitly declare all the variables used in every block of code. The disadvantage is that I am endlessly having to write 'Dim' this, that or the other all the time, even so it really does make life a whole lot easier. In any event it's a much more professional way of doing things, as explicit variable declarations always were the norm anyway with languages like C and Pascal.

This is also, more often than not, followed by:

```
DefInt A-Z
```

which makes all numeric variables beginning with the letters A to Z and a to z of integer type as default – originally this would make programs shorter and use less memory. Nowadays any difference this would make is negligible, but it should make things run faster, which might make some difference if the CPU doesn't have a co-processor.

Without this statement, the default Visual Basic variable remains the 'Variant' data

type. This wonderful device can be indiscriminately read and written as a string, a number, a date, time, whatever takes your fancy. However, apart from occupying more memory, it sometimes doesn't return its contents in precisely the format you were expecting, so it can be more trouble than it's worth.

Consequently I will only use the 'Variant' type if it is genuinely useful. One such example might be to store a date in a more manageable variable form:

```
Dim dt As Variant, st As  
Long  
  
dt = Now  
st = CLng(dt)
```

resulting in st holding the date portion only of the internal, double precision format of the system date/time as a long integer.

According to the 'DefInt' statement, if I just wrote say 'Dim x' then by default it is a 16-bit signed integer. So, as in the previous example, to create different variable types, for instance specifically double-precision floating point in the case of something called 'Var', I would use:

```
Dim Var As Double, temp As  
String, n As Long
```

although of course the quicker method

```
Dim Var#, temp$, n&
```

is equally valid.

But the best thing about explicitly declaring or dimensioning variables in this way is that you don't have to keep writing %, \$, & or whatever after the variable's name – once defined as a string type, 'temp' is the same as 'temp\$'. Mind you, it also means you can't also have another variable of a different type also called 'temp', and Visual Basic will tell you as much as soon as you try to run the program.

By the way, if you happen to be using VB version 1, then get in the habit of including these:

```
Global Const True = -1  
Global Const False = 0
```

whereafter you can refer to and use True and False values in your code by name.

#### A Global Routines Library

I now use a compilation of such useful bits and pieces in a module I call 'GLOBAL.BAS'. 'GLOBAL.BAS' is included in every new project, or at least a derivative of same. As well as the aforementioned declarations, it also has these:

```
Global FileSpec As String
```

A globally accessible (that is, accessible to any procedure or function in any form or BAS module) string variable containing a filename and path. This might typically be that last accessed by a FileOpen or FileSaveAs procedure.

```
Global DefaultDir As String
```

A globally accessible string variable used to contain a directory path. This might be that which was current when the program started, i.e. its 'working directory'. If you use ChDir\$ in your code then this will no longer be true, and so it may be necessary to 'remember' what the default is supposed to be.

```
Global LoadFlag As Integer
```

Which is useful if you need to record whether your program loaded something or not – Boolean True or False.

```
Global FileDirty As Integer
```

A globally accessible integer variable which is used to flag whether to save current data or not, for instance if 'New', 'Open' or 'Close' menu options are selected. If True (-1), a 'File Not Saved' prompt box should be generated and an option to 'Save As' initiated – Boolean True or False.

```
Global Vector As Integer
```

An obscure flag that I typically use to record a selection choice for use with Select Case or If Elseif conditional blocks. One actual example is a print procedure with half a dozen different modes: to a preview window, to the printer, run the printer setup, do reversed order print, double-sided print – 'Vector' indicates which is the 'target'.

```
Global Const Version =  
"Version: New" 'default  
Global Const Author =  
"Author: New" 'default
```

Useful for defining your program version and compilation date, who wrote it, etc. These can then easily be picked up by an 'About' window.

#### Custom Procedures And Functions – A Summary

```
Function Corrected (ByVal  
Path$) As String
```

This returns a copy of the path always with '\' on the end provided it is not an empty string.

Often, when you want to add a path to a file name, you have to figure out whether the path string needs a backslash on the end or not. The CurDir\$ function and the path properties of DirList and FileList controls don't always add a backslash automatically, except where it is the root directory. You can't simply add backslash to every instance because you might get two of them, and it can become quite a headache finding out whether a particular path string needs one or not.

One classic example concerns opening help files from within Visual Basic – if the backslash is missing between 'path' and 'filename', Windows 95 is actually able to understand what is wanted and just does it, so you don't know that there is anything wrong. Windows 3.x can't do that! Introducing extra code everywhere to validate paths quickly became altogether too much typing. So now I just use, say:

```
Open Corrected$(path) +
filename For Input As #1
```

Problem now solved, for if 'path' is an empty string, then it is left empty by the function, leaving just the file name and the directory implied as current.

Note the use of 'ByVal' as previously discussed in Part 1. This ensures that the string property of a Visual Basic control is also accepted by the function (normally causes an 'invalid data type' error). This equally applies to most of the following too.

```
Function CreatePath (ByVal
DestPath$) As Integer
```

This returns a Boolean True if no error, False if an error occurred. In the latter case the function displays its own error message.

This extremely useful function was borrowed from the VB 'setup kit' setup1 program code. It creates the path specified in DestPath\$ in its entirety to any level (any number of nested sub-directories), because it is also a 'recursive function' (that is it calls itself to create as many additional sub-directories as are required).

The first character of DestPath must be a drive letter, followed by a backslash followed by the remaining path, if any.

```
Typical usage: If Not
CreatePath(newpath) Then
'an error occurred - code
here for handling the error
Else
'OK
End If
```

It doesn't matter if the path already exists, so CreatePath can be used indiscriminately.

```
Sub Incr (Value)
```

Borrowed from a Power Basic example, this merely increments 'Value' by 1. Complemented by:

```
Sub Decr (Value)
```

```
Function EnglishDate () As
String
```

which returns an English date format as dd/mm/yyyy from the internal system

date/time. This may be redundant since you can do this with the Format\$ function anyway, which is what it uses anyway.

```
Typical usage: StringVar$ =
EnglishDate$()
```

```
Function Extract (ByVal
MainStr As String, ByVal MatchStr
As String) As String
```

which returns the first portion of MainStr\$ up to but not including the first occurrence of MatchStr\$. If no match is found, the whole of MainStr\$ is returned. MatchStr\$ can be more than one character in length and the characters can be any single byte values.

```
Typical usage: StringVar$ =
Extract$(MainStr$, MatchStr$)
```

'Extract' is probably my most used function. Typical uses include changing the extensions of file names – this is one 'slightly hairy' example:

```
Open Corrected$(path) +
Extract$(GetFile$(File$), ".") +
".txt" For Output As #3
```

```
Function After (ByVal
MainStr$, MatchStr$) As String
```

Like Extract\$(), but returns everything after the first occurrence of MatchStr\$, not including MatchStr\$. If not found, returns the whole string. In the same vein there is also:

```
Function ScanBack (ByVal
MainStr As String, MatchStr As
String) As String
```

Again like Extract\$() but working backwards from the end of a string instead of the beginning. Together these three functions offer some interesting string manipulation possibilities, and have led on to more specific functions. Originally developed for a specific application, the following pair proved so useful as to qualify for places in GLOBAL.BAS:

```
Function GetFile (ByVal File
As String) As String
```

will return the filename only portion of FileSpec\$ where it is preceded by a full path, also:

```
Function GetPath (ByVal
PathSpec As String) As String
```

which returns the path only portion of PathSpec\$, where PathSpec\$ includes a filename on the end. Routines like this enable me to swap the whole path for the same file name in one statement.

```
Function FileExists (ByVal
FSpec As String) As Integer
```

will return Boolean True if it exists so that IF/IF NOT tests can be made, for example:

```
If FileExists(FSpec$) Then
'process for existing
If Not FileExists(FSpec$)
Then 'process for not existing
```

Because the function actually attempts to fetch the file's attributes, it can verify paths too because directories have the directory type attribute.

```
Function GetWinTempDir () As
String
```

This returns the Windows TEMP or TMP directory path as defined in the DOS environment table, and encapsulates and simplifies the Visual Basic Environ\$() function. Additionally, allows the application to readily use the Windows temporary folder for storing temporary and 'working' or 'scratch' files, which of course it should always do.

If no TEMP definition can be found in the DOS environment table then the function displays a message to this effect and the returned string is empty (= ""). This is an 'error condition'.

```
Function InStrAny (SOffset
As Long, ByVal MainStr As String,
MatchStr As String) As Long
```

A very useful line, being just like the normal Visual Basic Instr() function, but returns the position of the first instance of any of the characters given in MatchStr\$, where found, otherwise returns 0 if none. It is based on the Power Basic Instr() with the same capability.

SOffset determines the scan start position in the string, and both this and the returned position are long integers so that the function can parse strings exceeding 32K in length. Again due to ByVal, the 'string' can be the contents of a multi-line text control object (Text1.Text for 'MainStr').

A typical application may be part of a process for extracting whole words only for a spell checker module by excluding punctuation characters, as in:

```
Const ALPHA = "abcde-
fghijklmnopqrstuvwxyz"
```

```
Dim CPos As Long
```

```
CPos = 1
```

```
Do
```

```
    CPos = InstrAny(CPos,
```

```
    LCase$(Text1.Text), ALPHA)
```

```
    ...
```

```
Loop Until CPos = 0
```

Obviously this is incomplete, but you get the general idea.

```
Function PadLeft$ (ByVal
MainStr As String, Target As
Integer)
```

will return a copy of MainStr padded out with spaces on the left to length Target.

```
Function PadRight$ (ByVal
MainStr As String, Target As
Integer)
```

returns a copy padded out with spaces on the right to length Target.

```
Function Percent (ByVal
LargeValue As Single, ByVal
SmallValue As Single) As Integer
```

returns what percentage of LargeValue is SmallValue, and still works if LargeValue actually smaller than SmallValue.

```
Function Remove (ByVal
MainStr As String, Char As
String) As String
```

Another inspired Power Basic function that I found I could not do without. Removes all instances of single byte 'Char' from string MainStr and returns the result, leaving MainStr unchanged. If 'Char' is actually longer than one character then only the first character is used.

```
Function Repeat (Times As
Integer, ByVal Char As String) As
String
```

The Power Basic syntax of Visual Basic's String[\$]().

```
Function Replace (ByVal
TextString As String, Char As
String, Alt As String) As String
```

Another powerful tool. At one stroke replaces all occurrences of 'Char\$' found in TextString\$ with 'Alt\$' and returns the product to the assigned string variable. 'Char' and 'Alt' can be multiple character strings and of differing lengths.

```
Function Round (Value As
Double) As Double
```

I can't believe Visual Basic doesn't have this. Performs numeric rounding up of a double-precision floating point number to two decimal places (of course you can change that). Vital prior to displaying neat numeric results in labels or text controls without having to put up with the huge, twelve digit fractions on the end.

```
Sub ShellWait (FSpec As
String, WindowStyle As Integer)
```

Have your application run another Windows application and then wait for the latter to close. Uses the Windows API function GetModuleUsage() to wait until a shelled process has terminated before continuing execution. The function is used just like the normal Shell() function.

ShellWait works by firstly recording the instance handle of the started program as returned by 'Shell()'. Thereafter a while/wend loop checks to see if this still exists by repeatedly calling GetModuleUsage, that is, the application is still loaded. Don't forget that 'DoEvents' must also be executed in such a loop otherwise Windows will completely lock up, the only recourse being the 'Reset' button!

When the second application finally unloads the API function returns zero and the loop ends, allowing 'ShellWait' to exit. The API function must be defined at the declarations level of the module:

```
Declare Function GetModuleUsage
Lib "Kernel" (ByVal hModule As
Integer) As Integer
```

However, we are not scheduled to get any further involved in this sort of thing until

Part 3. In the meantime, the only remaining global routine worthy of mention is:

```
Sub Main ()
```

which is an alternative start-up option in the VB project menu. It has the same purpose as the 'main' function in C (and which is not a coincidence).

'Main' provides the option of starting the program in code instead of a window or form. Various things may be done at this point before an actual window is loaded, such as:

```
Logo.Show
Dim x
FileSpec = Command$
x = RegisterUtil() `DLL
check
App.HelpFile = "myhelp.hlp"
DefaultDir$ = CurDir$

Form1.Show
End Sub
```

Execution ultimately passes to Form1. However, one useful thing that 'Main' provides is the ability to write Visual Basic programs that don't use any windows at all. Such a program would simply run, do something, then end.

## Parameter Passing

As with all other forms of BASIC where a final EXE is compiled, you have the option to pass DOS command parameters to the program via Command\$, and VB for Windows is no different. This means you can add options to pass to the program using a PIF file (even directly from DOS in the case of Windows 95).

Where the above example fetches a file name (hopefully!) from Command\$ to FileSpec, you can extend this to include following option 'switches':

```
FileSpec =
Extract$(Command$, "/" )
Dim Com$
Com =
Trim$(LCase$(After$(Command$,
FileSpec)))
```

and then test for certain options:

```
If InStr(Com, "/a") Then `?
If InStr(Com, "/b") Then `?
If InStr(Com, "/c") Then `?
```

Relying purely on 'If/Then' blocks can quickly become unwieldy, so I've come to prefer something a bit more sophisticated like:

```
Do While Len(Com) > 0
Select Case Left$(Com, 2)
Case "/a": `?
Case "/b": `?
Case "/c": `?
End Select
Com = Trim$(Mid$(Com, 3))
Loop
```

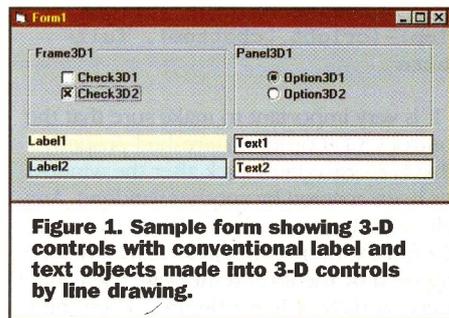
'Trim\$' removes leading and trailing spaces and so allows the user to include spaces, or not, between the various switch

(/) options. In either example, however, the option switches can be in any order and, as it happens, unknown ones are ignored.

## 3-D Controls

The flat, plain white messaging windows of Windows 3.x now look very dated. Most of the more recent applications depend more and more on the mid-grey background colour, with three-dimensional controls on top.

The professional edition of Visual Basic 3.0 includes a small collection of 3-D custom controls that can be used in place of some of its standard black on white, 'flat' looking controls.



**Figure 1. Sample form showing 3-D controls with conventional label and text objects made into 3-D controls by line drawing.**

Figure 1 shows a summary of these basic controls (excluding buttons), replaced by 3-D equivalents all provided by THREEED.VBX. These include the 3-D frame, the 'check box', the option button and an extra one, the 3-D panel.

The panel has several display options, in this instance a grooved outline is contrived to emulate the 3-D frame. However, there are no equivalents for text or label controls, hence Label1 and Text1, by comparison, now look out of place, but not so for Label2 and Text2. These are the same standard controls but where a sunken 3-D effect is emulated by drawing on the background of the form.

The procedure that does this (taken from Visual Basic help) works, in this instance, by examining the 'Tag' properties of all controls on the form. For the record, a control's 'Tag' property is a 'free' do-what-you-like-with-it string property you can use almost as a 'custom' property, and practically all controls and forms have one.

## 'Me'

An included module called OUTLINES.BAS contains four procedures. The primary of these, called OutlineControls, creates a sunken 3-D outline effect for all controls on the form where their 'Tag' properties are set to 'OL' (= OutLine). This is the case for Label2 and Text2 in Figure 1. This routine, borrowed from VB help, draws dark grey lines on the form beside two sides of each control, and white lines beside the other two sides, hence, as with the custom 3-D controls anyway, you only get the best effect if the background is mid-grey.

The routine finds and scans the controls' 'Tag' properties in rotation using the 'Controls Collection' to know what the form contains:

```
For i = 0 To
(CurrentForm.Controls.Count - 1)
```

```

Set cname =
CurrentForm.Controls(i)
If TypeOf cname Is Menu Then
'ignore it
ElseIf (UCase(cname.Tag) =
"OL") Then

```

whereupon the lines are drawn around it using the 'Line' statement:

```

CurrentForm.Line (cLeft,
cTop)-(cright, cTop), drkgray
CurrentForm.Line (cLeft,
cTop)-(cLeft, cbottom), drkgray
CurrentForm.Line (cLeft,
cbottom)-(cright, cbottom), full-
white
CurrentForm.Line (cright,
cTop)-(cright, cbottom), full-
white

```

It is very important to make sure that the control's 3-D border is refreshed properly (that is to say comes back after the window has been covered by another window). Any call to OutlineControls must only be made in a form's 'Paint' event procedure, which is triggered by the form re-drawing itself after being partially or fully obscured. Even then, for this to work properly, the form's 'AutoRedraw' property must be false.

CurrentForm is a variable that receives the name of the window upon the which the routine will find the controls around which to draw lines, and is passed as a parameter:

```

Sub OutlineControls
(CurrentForm As Form)

```

The parent form's 'Repaint' event calls it by simply:

```

OutlineControls FormName

```

which presupposes that 'FormName' is known. Usually it is at design time, but suppose that later you wanted to change the name for some reason, maybe to make a copy for a different project, the call would of course cease to work. Actually this isn't the best way to do this. A far better way is:

```

OutlineControls Me

```

because 'Me' is a keyword meaning literally 'me, the parent form'. It's actual name can be changed as often as you like; it doesn't matter, the above call will always work.

Because OutlineControls is a global procedure, any number of forms, and regardless of what their respective names actually are, can call the same one-and-only procedure. This is very well worth remembering – never have duplicated blocks of code repeated all over the place where only one will do; not only does it save space but it makes corrections and modifications much easier.

This is possible because any routine in a globally accessible BAS module can manipulate a window, its properties and controls once it has been passed the form name (or 'Me') by reference. This is equally true of specific controls – staying on the subject of 3-D drawing:

```

Sub OutlineControl (Source
As Control, Item As Control)
If TypeOf Source Is
PictureBox Then
' can only draw on a Picture
control

```

Here it appears that the procedure doesn't even get to know the identity of the form calling it, but in actual fact it is passed along with the control names:

```

OutlineControl Me.Picture1,
Me.Text1

```

This procedure was added so that it is possible to draw around controls that are embedded within (that is to say, are children of) frames or 3-D panels – there must also be a picture control behind it, and that the control be a child of that too, because you are not allowed to draw on frames or panels, they 'do not support this method'.

Other routines included in OUT-LINES.BAS include:

```

Sub RaisedControls
(CurrentForm As Form)

```

which puts a raised 3-D outline effect around controls whose Tag properties are set to 'OR' (Outline Raised), and:

```

Sub OutlineSingle (Source As
Form, Item As Control)

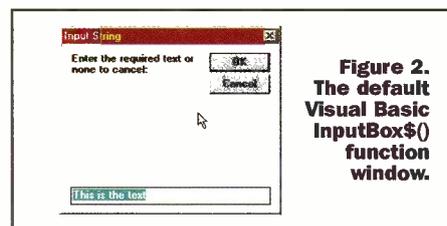
```

which draws a sunken 3-D outline around a specific control on a form where for example its 'Tag' property is already in use for something else other than to contain 'OL'.

## Self-Centring Windows

It is high time we put this and other ideas to practical use. As a first step to producing nicer looking Windows programs, one could do a lot worse than begin by doing away with the standard VB 'InputBox\$( )' function.

This extremely uninspiring looking

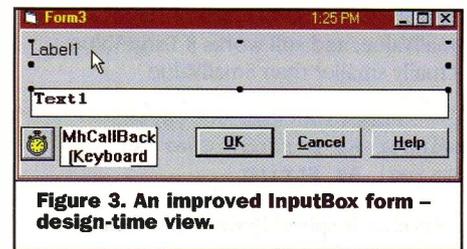


**Figure 2.**  
The default  
Visual Basic  
InputBox\$( )  
function  
window.

window, shown 'in action' in Figure 2, dates back to version 1 of Visual Basic, and even Windows 95 can't make any improvement on its appearance, unlike the case of 'MsgBox'. Actually, the layout of this window makes more sense in the DOS version of Visual Basic 1; it looks too 'square' on a genuine Windows screen.

More seriously, though, the number of characters that can be typed is limited to the visible width of the text input field (or as good as). Once put in a situation where the user is required to manipulate longer sentences, scrapping it for an alternative is the only option.

My own alternative style, that I called



**Figure 3.** An improved InputBox form – design-time view.

'EntryBox', is shown in Figure 3 at the design stage (Visual Basic design environment). Basically, the form is set as 'Fixed single', non-resizable with a 'single' border, and with no Minimise or Maximise options (when it runs).

Calling code can be made to activate the new EntryBox thus:

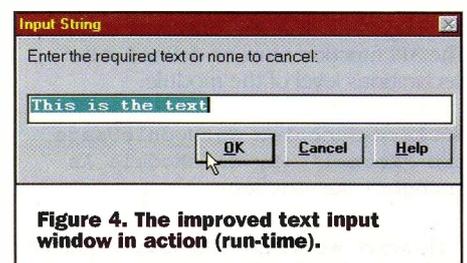
```

Function EntryBox (ByVal LCaption
As String, ByVal FCaption As
String, ByVal Text As String) As
String
Load frmEntryBox
frmEntryBox.Caption =
FCaption
frmEntryBox.Label1.Caption =
LCaption
frmEntryBox.Text1.Text =
Text
frmEntryBox.Show 1
EntryBox = frmEntryBox.Tag
Unload frmEntryBox
End Function

```

which is to say using this function is exactly the same as InputBox\$( ) except you would write EntryBox\$( ). A few points to note are:

1. The text control MaxLength property was set to 255 characters by default, although this can be changed at design time.
2. If you activate PasswordChar for Text1 the module becomes a means for entering a hidden password.
3. To work properly, the form must be shown as modal (.Show 1 method) to force the calling code to wait for it.
4. Rather than have the calling code read Text1.Text, the contents are put in the form's 'Tag' property when you click 'OK'. If you click 'Cancel', 'Tag' is made empty. So 'Tag' should always be treated as the 'product'.
5. In either of the above cases the form hides itself, but doesn't unload. This allows the calling code to continue. The very next thing it should do is read and store the 'Tag' property. The responsibility for unloading the form properly is entirely on the calling code. Failure to do this will result in a compiled EXE that uses EntryBox to end up permanently stuck in memory and impossible to terminate, because the form is still loaded.



**Figure 4.** The improved text input window in action (run-time).

The finished form, complete with a 3-D panel for a background and a drawn 3-D outline for the text control (with a picture control underneath), is shown working in Figure 4. Not only that, the form centres itself on the screen using:

```
CentreForm Me
```

In the load event procedure. This is another global BAS module procedure (naturally):

```
Sub CentreForm (Current As Form)
    Current.Left = (Screen.Width
- Current.Width) / 2
    Current.Top = (Screen.Height
- Current.Height) / 2
End Sub
```

Of course you could just add the same two lines of code to the load event, but it's more intuitive and simpler to write 'CentreForm Me'. There is actually another example in the VB setup kit 'setup1.bas' source code with the American spelling 'CenterForm'. However it is spelt, it has become one of the more frequently used utilities for 'temporary' or 'pop-up' windows.

The 'Help' button (Figure 4) is only usable with the provision that a help file name has been assigned to the 'HelpFile' property of the 'App' object, this being 'the application' (the program). The 'Help' button executes the following:

```
Dim X
X = WinHelp(Me.hWnd,
App.HelpFile, HELP_CONTENTS,
CLng(0))
```

We do not have the scope here to begin discussing this; fuller details about how to call help files from within Visual Basic, itself a complex subject, will be dealt with in Part 6.

## What's This?

The two odd objects at bottom left of Figure 3 (they are both invisible at run-time) are added custom controls (VBXs), and are not quite what they seem. The timer is an alternative to the native VB one and works the same – the only difference being that, unlike the standard one, if you have several of them in one application they don't all use up Windows resources like the normal ones do. Yes, it was news to me, too.

The second object is much more esoteric. Harking back to the discussion concerning the Windows messaging queue in Part 1, what this control does (or, more correctly, one of the things it can do) is to 'jam' the communication path between another control and the actual Windows message queue.

To work, the custom Callback control (which is its name) needs the 'hWnd' property (the 'Windows handle') of the control originating the message, by which it then forms a link, and also the internal Windows code number of a particular message. So if for instance the code is for a key pressed down, the source control receives this event, sends a message to this

effect to be added to the message queue, but Windows never receives it because Callback has pounced on it and blocked it.

To what purpose, you may well ask? Well, just so that Callback can execute program code that's all its own and that does something else, something completely different. It's a way of providing an otherwise standard VB object with a completely new and different response to an event, albeit at the loss of a conventional one.

In the case of the EntryBox form, the message of particular interest is 'right mousebutton down', and the ultimate purpose of the whole preamble is to provide Windows 95 'What's This?' style pop-up help for most if not all of the individual controls on the form, and which, moreover, also works in Windows 3.x (because it's done internally).

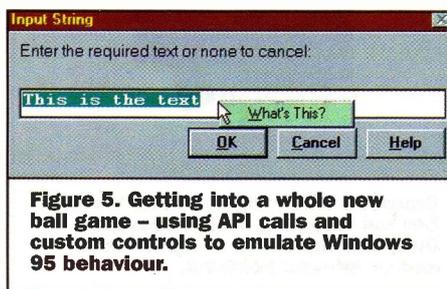
For reasons I won't go into here it's actually highly impractical to provide every control with its own accompanying Callback object. So instead Timer1 is given the task of parsing all controls on the form using the same for/next Controls Collection count-up as mentioned earlier for drawing outlines.

Every ten milliseconds it switches the 'hWnd' link for Callback1 to every other control in turn. At the same time it is tracking where the mouse pointer is on the form, using the 'GetCursorPos()' and 'WindowFromPoint()' functions from Windows' USER.EXE, and determines whether the pointer is over one of the controls of interest. If so, that control's handle is stored.

There is additionally a hidden menu – it's not even visible in Figure 3 – called 'mnuPopUp', with a single drop-down entry captioned 'What's This?'. When the user depresses the right mouse button, Callback1 traps the event and performs:

```
Select Case Msg
Case WM_RBUTTONDOWN:
    hItem = h 'copy Windows
    handle of object
    PopupMenu mnuPopUp, 0
End Select
```

The immediate result is demonstrated in Figure 5. If the control currently underneath the mouse pointer (by courtesy of Timer1) is one of those with a valid 'hWnd' property at the time the button is pressed, Callback1 will always present the pop-up at this same location. This is no great mystery, that is what the standard VB 'PopupMenu' statement is designed to do – take any conventional drop-down menu list and display it as a 'floating' pop-up at the current cursor position.



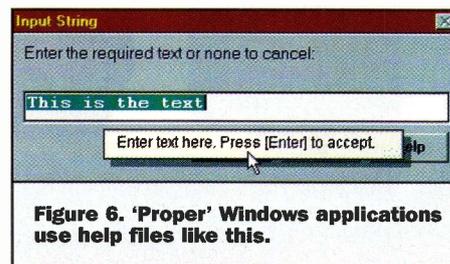
**Figure 5. Getting into a whole new ball game – using API calls and custom controls to emulate Windows 95 behaviour.**

Whether or not there is actually any help topic for this particular item is something else entirely. This is down to the 'What's This?' menu click event, and whether it has a complete list of matching objects and help topics to go with them:

```
Sub mnuWhatsThis_Click ()
    Dim X
    ' Make pop-up help of topic:
    Select Case hItem 'handle of
    mouse pointed object
    Case Command1.hWnd:
        ' help file mode context No.
        X = WinHelp(Me.hWnd,
"utils3c.hlp", &H8,
CLng(PU_ACCEPTBTN))

        Case Command2.hWnd:
            X = WinHelp(Me.hWnd,
"utils3c.hlp", &H8, CLng(PU_CAN-
CELBTN))
        Case Text1.hWnd:
            X = WinHelp(Me.hWnd,
"utils3c.hlp", &H8, CLng(PU_TEX-
TINPUT))
        ' etc.
    Case Else:
        X = WinHelp(Me.hWnd,
"utils3c.hlp", &H8, CLng(21020))
        ' no help available
    End Select
```

The final product is the topic revealed in



**Figure 6. 'Proper' Windows applications use help files like this.**

WinHelp's familiar pop-up style, complete with shadow, in Figure 6 – just like the 'real' programs. I should point out that while the 'utils3c.hlp' reference has no path, WinHelp will begin looking for it in the Windows path – where of course it will find it because that's where it was put.

All in all, this article has shown how we are now being led deeper and deeper into Windows API calls. The very unfortunate side of this subject is that Visual Basic's own API help is next to useless, comprising a mere list of declaration statements but with no clues as to how to actually use the routines themselves – and some of them are very fussy!

For greater insight into some of the above examples, and more useful things besides, such as how to read and write .INI files (in the only way that you should), I leave it until next time.

For obvious reasons it is impossible to reproduce the aforementioned GLOBAL.BAS routine library in its entirety in these pages. If you would like a copy of this and other useful add-on modules for Visual Basic 3, please apply privately to the author, P. O. Box 5773, Laindon, Essex SS15 5FJ. Maplin Electronics plc and its associates cannot be held responsible for the accuracy or otherwise of this information.

# Solid State Relays

## WHY USE THEM?

*Brian Hornsby, product manager for Solid State Relays with Crouzet, discusses how to get the best from Solid State Relays and provides some useful hints, tips and traps.*



**Crouzet's Visual SSR – a PC based applications and selection guide helps users to pick both the right SSR and, most importantly, the right heat sink for any application.**

The name Solid State Relay (SSR) is self explanatory really, a relay, but all solid state. Typically, thyristors or triacs for mains or other high voltage switching are linked to an optically isolated trigger circuit that can be driven from convenient logic levels such as TTL or CMOS. See figure 1. There is no rocket science here, but the whole carefully matched assembly, usually housed in a single epoxy pack with appropriate terminations and mountings, is very convenient to use. Mountings are typically PCB pins in the case of small ones, and DIN rail clips or bolts that correspond to matching heatsinks in the case of bigger ones. Applications include anywhere where substantial loads must be controlled from digital logic or microprocessors, such as process or manufacturing machinery, vending machines, heating and ventilating equipment, traffic lights, lighting control, petrol pumps and computer peripherals such as printers and scanners. Crouzet's



**Crouzet's GMS range of SSRs features DIN rail mounting, front accessible fuse, LED indication of input status and an integral heatsink.**



**Crouzet's GRD90 with its integral heatsink is a fully protected SSR assembly rated at 90A.**

Gordos division is one of the world's largest makers of SSRs, supplying almost 1 in 5 devices used in the USA.

### Why use SSRs over conventional electro-mechanical relays?

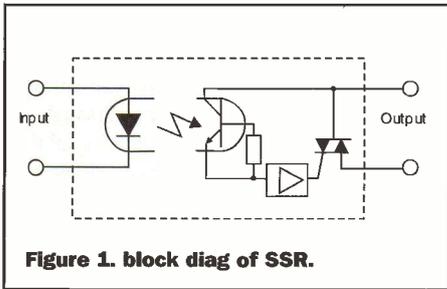
There are several reasons, the most significant ones are the working life, long term cost savings, reliability in harsh environments, tolerance of vibration and shock, acoustic noise, direct drive from digital systems, electro-magnetic emission and speed of switching. Let's look at each of these aspects in turn.

### Relay life

Provided it is properly specified, the output circuits of an SSR have an almost infinite life. The contacts of an electro-mechanical relay (EMR) can wear out, corrode or stick. Similarly the mechanism can malfunction due to wear and tear on the springs, armature etc. A typical life time improvement factor by using an SSR in place of an EMR for a given duty lies between 20 and 100x.

### Long term cost savings

The initial cost of an SSR is usually higher than for an EMR. However, life time costs will normally be far lower due to a combination of purchase costs for replacement relays, and the labour cost of



diagnosing the fault and fitting them. When looking at cost comparisons, don't forget to allow for the extra cost of providing a driver and appropriate power for the relay coil, the SSR will normally be quite happy working directly from the logic signal.

## Reliability in harsh environments

There are sealed relays, but they are costly. Humidity and mildly corrosive gasses cause no problems to the totally sealed SSR. Corrosion of EMR contacts, or even the coil, can be surprisingly rapid in the presence of substances as seemingly harmless as water vapour, never mind really corrosive chemicals.

## Tolerance of vibration and shock

The mechanical toughness of the SSR with no moving parts to resonate compares very well to the EMR. Severe shock can even 'operate' EMRs momentarily. In the long term, quite low levels of vibration contribute to wear and tear on moving delicate assemblies, further reducing the already limited life.

## Acoustic noise

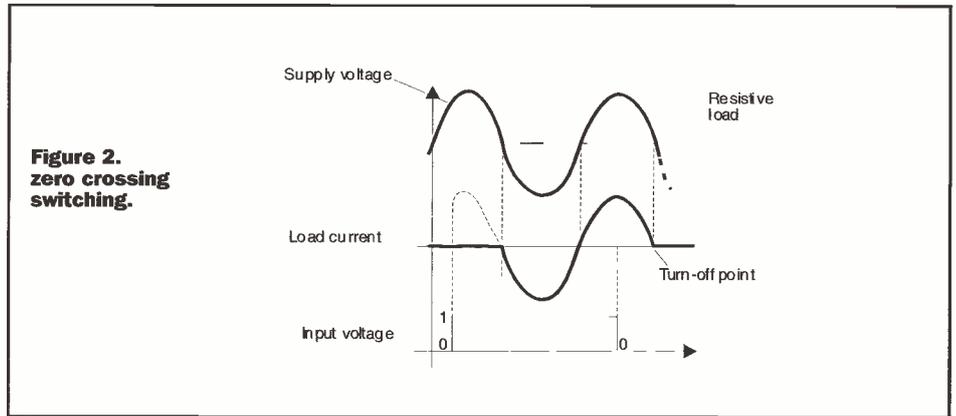
Computer peripherals, white goods such as dishwashers and especially H&V equipment are not popular if they make a lot of noise. EMRs click quite audibly and, to a first approximation, the bigger the load circuit the bigger the noise. SSRs are silent.

## Direct drive from digital systems

Relay coils need power and generate a nasty back emf when de-energised. Special drivers are needed and these need protection with clamp diodes or RC networks. All of these take up space and cost money to provide. Also, the bigger the load, the bigger the EMR coil, whereas the SSR will normally operate from a TTL or CMOS logic signal regardless of the load voltage and power.

## Electro-magnetic emission

For most ac loads, SSRs can be arranged to switch at the zero crossing, thereby essentially eliminating fast current spikes and the associated electro-magnetic interference. See figure 2. EMRs on the other hand make and break the circuit



asynchronously, i.e. at random in relation to the load waveform. This generates switching spikes which causes interference, and with inductive loads, causes discharges at the contacts, reducing their life.

## Speed of switching

Relays take milliseconds, typically tens of milliseconds, to move the armature and the contacts. SSRs switch in microseconds or even nanoseconds and speed can be important in many applications.

These factors and some less prominent ones are summarised in Table 1

## So if they are that good, why doesn't everyone use them in place of EMRs?

Good question. Cost is of course a factor, even with the lifetime cost benefits of SSRs. It is a sad fact of life that service costs do not always accrue to the manufacturer of a piece of equipment, whereas saving a few pence on materials may give a short term advantage in selling price. Also, matching SSRs to the application is a bit more complicated than an EMR. There are a number of application specific factors determining the choice of the right SSR if it is to give the benefits we have discussed above. These include control signal

selection, load characteristics including ac or dc load, synchronous or asynchronous switching, rate of change of voltage, leakage current, load characteristics, matching to appropriate heat sinks and protection against transients and fusing. It sounds a bit daunting, but in fact, provided some simple principles are adhered to, applying SSRs is really not difficult. Let us now consider these aspects one at a time.

## Control signal selection

In most SSRs the control signal activates the emitter of an LED opto-coupler. This device provides typically 4000V isolation and a coupling capacity of no more than say 5-10pF. This provides very good protection from the load circuit at mains and other low frequencies, especially important for medical equipment and domestic appliances. Typically, the opto coupler will turn on when around 2-3V is applied across the terminals, but it is really a current operated device needing around 2mA to operate. This corresponds to around 5mW to switch (in Crouzet's range) anything up to 90A at 660V, not a bad power gain! The opto coupler will turn off again at around 1V dc applied. A series resistor that limits the current to around 20mA allows the device to be used at up to 35V input signal. Crouzet include series resistors on all SSRs, along with a reverse polarity protection diode shunting the LED. See figure 3.

SSR advantages	SSR disadvantages
<ul style="list-style-type: none"> <li>low control power</li> <li>synchronous switching</li> <li>no interference in synchronous mode</li> <li>lifetime and reliability</li> <li>speed</li> <li>no moving parts</li> <li>no contact bounce</li> <li>no wear and tear</li> <li>compatible with digital circuits</li> <li>shock/vibration resistance</li> <li>silent operation</li> <li>waterproof</li> </ul>	<ul style="list-style-type: none"> <li>on state 1-1.5V output volt drop must be selected for ac only or dc only</li> <li>heatsink often needed</li> <li>limited use in very low level circuits</li> <li>susceptible to transients</li> <li>off-state leakage current</li> </ul>
EMR advantages	EMR disadvantages
<ul style="list-style-type: none"> <li>low residual voltages</li> <li>no heatsink</li> <li>price</li> <li>multiple isolated contacts</li> <li>no leakage current</li> <li>parallel contacts</li> <li>ac or dc switching</li> </ul>	<ul style="list-style-type: none"> <li>slow</li> <li>noisy</li> <li>generate EMI</li> <li>limited contact life</li> <li>cannot be driven by digital circuits</li> <li>no synchronous operation mode</li> <li>contact bounce arcs on high currents</li> </ul>

**Table 1**

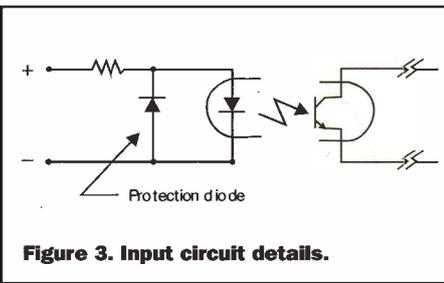


Figure 3. Input circuit details.

## Rate of change of voltage

Capacitance between the anode and the gate of a thyristor can cause enough current to flow to turn it on if the rate of change of voltage is high enough. The maximum allowable static  $dV/dt$  (i.e. while not switching) is usually specified for each device, typical values will be around 400V/ $\mu$ S

## Load characteristics

This is arguably the most critical area and the one that gives the most problems if not addressed correctly. There is not enough space in this article to give advice for all the possible types of load, but we can draw attention to the ones needing special care and suggest some further reading. These are: incandescent lamps, motors and highly inductive loads such as transformers.

Incandescent lamps are simple but nasty! The cold filament has a very low resistance that results in very high inrush currents at switch on. Allow for short term peak current of 35x the steady state current, reducing after around 30mS to 2x rated current. Steady state current is reached after 75-100mS. It is highly recommended to use zero crossing switching as this avoids the worst couple of milliseconds of the current inrush by first applying the power while the supply voltage is low. It is also a good idea to fuse the system (anti-surge fuses of course) critically to protect against short circuits caused by falling filament sections in a failing lamp. Many a dimmer has been destroyed by bits of falling metal inside a light bulb globe.

Motors are a bit more complicated, but less nasty. The key problem is that the electrical power drawn by a motor is a function of the mechanical load and that is often difficult to predict. Typical values for a three phase motor starting under load might be 6-8x steady state current. For a single phase motor the value could easily be 10x. Once we get onto star/delta switching for starting 3-phase motors and reversing circuits for motors, the whole subject gets outside the scope of this article. Generally, for inductive loads, the power factor is the most crucial item. However, specialist products to make the job easy do exist, for example, Crouzet's GAO solid state reversing relay for 3-phase motors, all in one handy block with two logic inputs, 'go forwards' and 'go backwards'. A good rule of thumb is to use zero volt switching (synchronous) units when the power factor is above 0.7 and instantaneous (asynchronous) units when the power factor is below 0.7. Crouzet's useful guide Ref. 67-150-00G provides several pages on the subject of controlling motors. This is also the place to go for more on transformer loads.

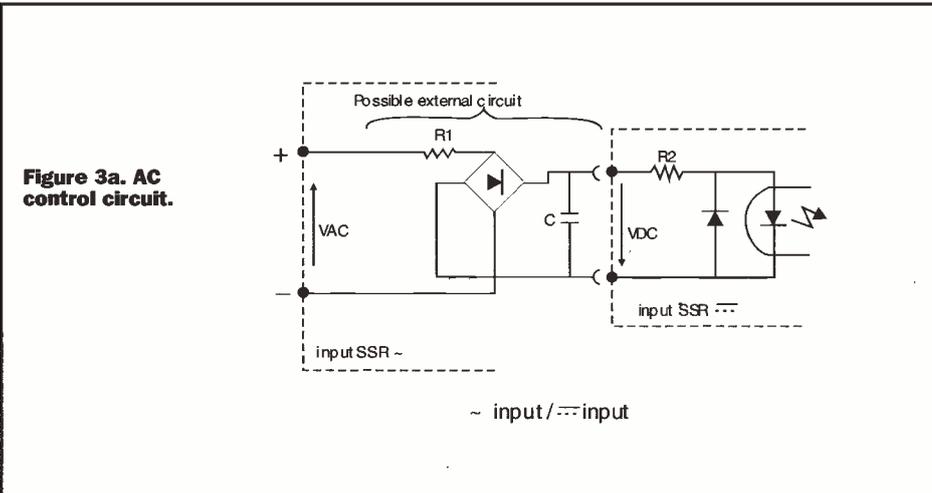


Figure 3a. AC control circuit.

SSRs can also be used with AC control signals by adding a diode bridge and a capacitor. See figure 3a. The value of the resistor R1 can be calculated if R2 is known.  $R1 = V_{ac} \cdot V_{dc} \times R2 / V_{dc}$ . If  $V_{dc}$  is small compared to  $V_{ac}$ , then  $R1 = V_{ac} \times R2 / V_{dc}$ . C is typically 4.7 $\mu$ F. Control current leakage can be a problem when 2-wire sensors or other complex circuits are wired in series with an SSR. See figure 4. In this case, a shunt resistor should be fitted, to limit the voltage across the SSR in the leaky 'off' state of the sensor to no more than 1V.

## Synchronous or asynchronous switching

Simple SSRs usually are manufactured specifically for one or the other, and the right one must be selected for each application. Figure 2 showed how the thyristor inherently switches off at the zero crossing and can be arranged to switch on there too. Figure 5 shows the asynchronous mode. The general rule is to use zero crossing or synchronous switching wherever you can, and only resort to asynchronous switching where the load characteristics make it essential, or where 10mS to the next mains half wave is too long to wait for power. For more details about applications needing asynchronous switching, see the selection on load characteristics.

## AC or DC loads

Dc loads, I hear you exclaim! Surely you can't use SSRs on dc. They use thyristors for the power devices and you can't turn them off on dc. Partly true, but not all SSRs use thyristors, Crouzet offer SSRs with bipolar transistors and MOSFETs up to 30A. You do have to choose before specifying the device though, one of the few advantages of an EMR – they can switch ac or dc.

for a thyristor and 200V/ $\mu$ S for a triac. However, the real test is knowing whether that is enough – a function of the transient noise and supply spikes present in the application. Most Crouzet devices incorporate protective RC networks (snubbers) to limit the  $dV/dt$  value reaching the thyristor, this greatly increases the tolerance to real world transients. This same phenomenon of uncontrolled turn-on can occur when breaking an inductive load at current zero. A snubber filter alone is, however, not usually sufficient to protect an SSR effectively, particularly against high energy stray impulses (spikes). Using a varistor, or metal oxide varistor (MOV), improves the protection. Play safe, buy protected devices!

## Leakage current

An SSR is a two wire device and as such has a leakage current when nominally 'off'. Typical values are 2-10mA and these are further increased on ac loads when RC snubber networks are included. This leakage current is a fact of life and must be allowed for when designing the system.

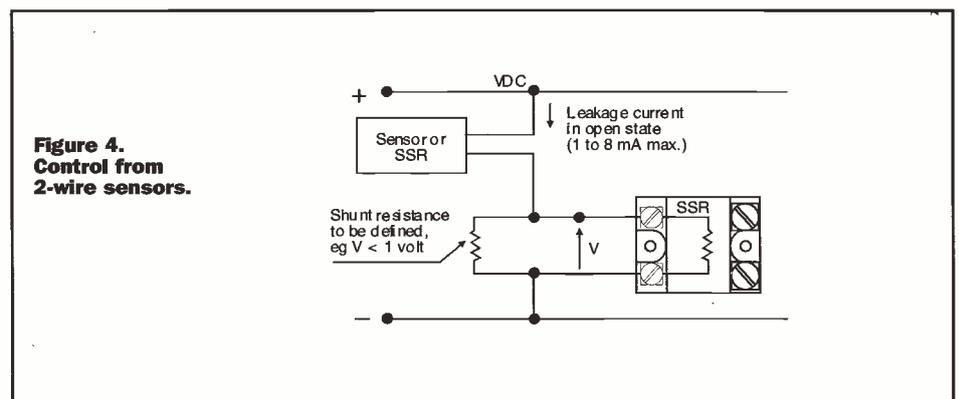
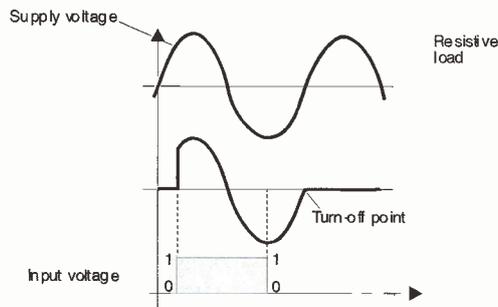


Figure 4. Control from 2-wire sensors.

**Figure 5. Asynchronous switching.**

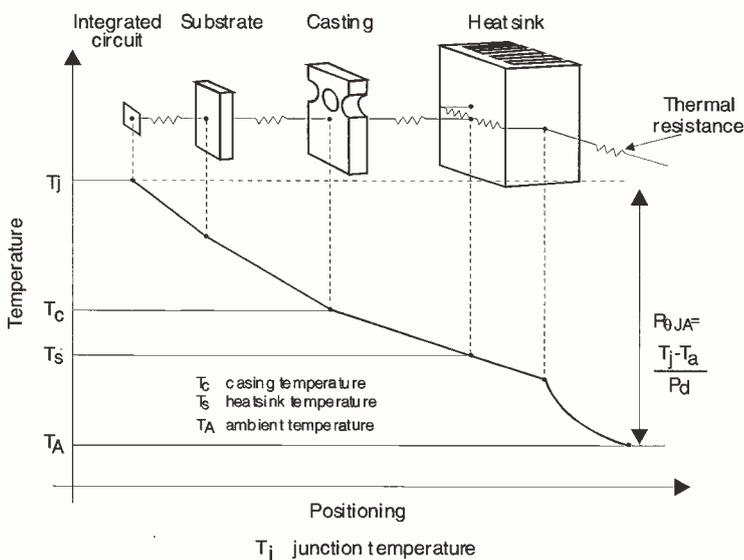


## Matching to appropriate heat sinks

This is the most frustrating aspect of using SSRs for a specialist vendor. No SSR need ever be destroyed thermally if proper precautions are taken. However, many people short cut heatsinks and the results are predictable. The cause of the problem for low frequency circuits is the residual on voltage of the power switching device. A simple case of  $W = I \times V$ , where  $V$  is around 1.2-1.6V for full load. From this we can see that a 100A SSR will need to get rid of around 150W of heat at full load. Fortunately, it is really very simple. A thermal model of the device and heatsink is

resistance of the join between the SSR and the heatsink. *This is where it typically goes wrong!* If the SSR is mounted correctly with thermal joint compound onto a truly flat heatsink, then  $0.1^\circ\text{C/W}$  is easily achieved. Leave out the transfer compound at your peril as it then rises by a factor of 10-20x!  $R_{\theta SA}$  is the thermal resistance of the heatsink. This is given by the makers and models are freely available from 0.5 to  $3^\circ\text{C/W}$ . Don't obstruct the air flow though.

Of course, for many applications, products like Crouzet's GRD range offer a nice trouble free solution. These SSRs come as one piece assemblies including the heat sink with mountings for flat panels or for DIN rail.



**Figure 6. Thermal model.**

shown in figure 6. The law that governs thermal relationships is similar to Ohms law. The following equation shows that  $T_j - T_a$ , which represents the temperature difference between the semiconductor junction and the ambient air, is equal to the sum of the thermal resistances in the cooling path (expressed as  $^\circ\text{C/W}$ ) multiplied by the power dissipated. Simple!

$$T_j - T_a = PD (R_{\theta JC} + R_{\theta CS} + R_{\theta SA})$$

$R_{\theta JC}$ , the thermal resistance between the junction and the case of the SSR is given in the manufacturer's data.  $R_{\theta CS}$  is the thermal

## Fusing

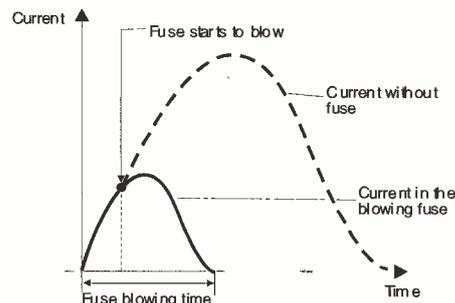
Those of us with a simple electrical upbringing tend to think in terms of fuses having current ratings. To protect thyristors we need to be a little more sophisticated and think in terms of current and time. The key to the whole subject is  $I^2t$ , where  $I$  is the current and  $t$  is the duration. Figure 7 shows this graphically. Match the  $I^2t$  rating of the thyristor given in the makers details to that of the fuse and you are home and dry. However, do be careful with the time base for the  $I^2t$  rating, different manufacturers use different time bases and it is important to ensure that the  $I^2t$  rating of the SSR and fuse have the same time base. Crouzet always specifies  $I^2t$  with a 10ms time base. *Never* use a circuit breaker to protect an SSR. Because the SSR is by far the faster of the two devices, the result will be an expensive SSR protection device for the circuit breaker! An alternative is to massively overspecify the thyristor, something that we as makers really don't mind at all because the bigger ones cost more!

As we said at the start, none of this is rocket science, but there are quite a few things to remember. With this in mind, Crouzet has produced a Windows PC SSR application programme to help you make the right selections. Visual SSR uses a series of menus to request information such as control signal and line voltage and number of phases, then asks what is the load? e.g. resistive, a motor, a tungsten lamp, a transformer etc.. Context specific sub menus relating to the type of load selected then request further detailed information until Visual SSR can offer a number of alternative SSRs from the Crouzet range. By using the prompted menus, Visual SSR ensures that all the important questions relating to each type of application are asked before making a recommendation, greatly reducing the risk of making a selection error, and prompting users to obtain more information where needed. The programme also contains a cross reference guide that enables users to look up the highly competitive Crouzet Gordos equivalent to other popular makes of SSRs. It is supplied on two 3.5in floppy disks.

### Further Information

Enquiries and further information can be obtained from Pam Gibson at: Crouzet Ltd, 108 Hawley Lane Farnborough, Hants GU14 8HY tel: 01252 513211 fax: 01252 542392 e-mail: pamgibson@crouzet.demon.co.uk

**Figure 7. Fuse blowing characteristics.**



# Static

## THE INVISIBLE ENEMY

by Ian Poole

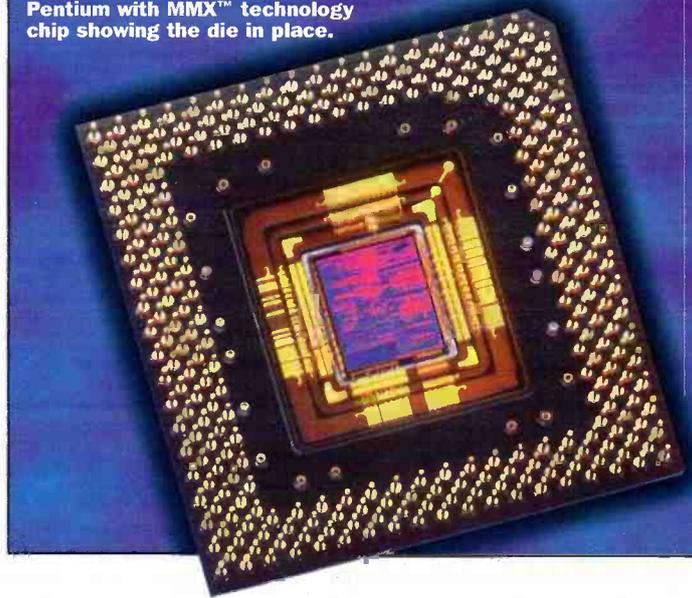
*Static electricity is of major importance to anyone involved with electronics. In the production environment it can cause havoc on a grand scale, resulting in many new boards failing.*

**F**or the development laboratory it is equally important. Often when a prototype board has been worked upon for some time its reliability falls drastically. One of the main reasons for this is that static electricity has caused damage to the devices on the board. For this reason too, the hobbyist should be equally aware of the problems, and take precautions to ensure that its effects are not exhibited on projects which may take many long hours to complete.

ESD, or electrostatic discharge, was a term which was unheard of in the days of valve technology. Even after the first transistors hit the market,

its importance was not realised. Only when MOS devices appeared did people start to notice that they could easily be damaged by static. These devices had enormously high gate resistances, often reaching  $10^{12}\Omega$ , but in view of the very thin insulating oxide layer which was present, they could only withstand voltages of about 30V. Initially the problem was overcome by wrapping a shorting wire around the leads of the device. However, the problem became even more acute after the first CMOS ICs were introduced because the number and variety of devices affected grew. It was also not possible to protect them in the

Pentium with MMX™ technology chip showing the die in place.



same way. As a result, the production output of some companies was severely hit as a remarkably high proportion of boards appeared with faults.

### What is Static?

Static electricity is a normal part of our environment, occurring naturally in everyday life. On some days its effects can cause annoyance. Most people have felt the effect of walking across a room and touching a door handle only to feel the tingle of a small discharge. Other effects which are frequently noticed are hair standing on end after it has been brushed, clothes clinging together and the popular party trick of rubbing a balloon and making it cling to a wall. On a very much larger scale, lightning is a very dramatic exhibition of the power of static electricity.

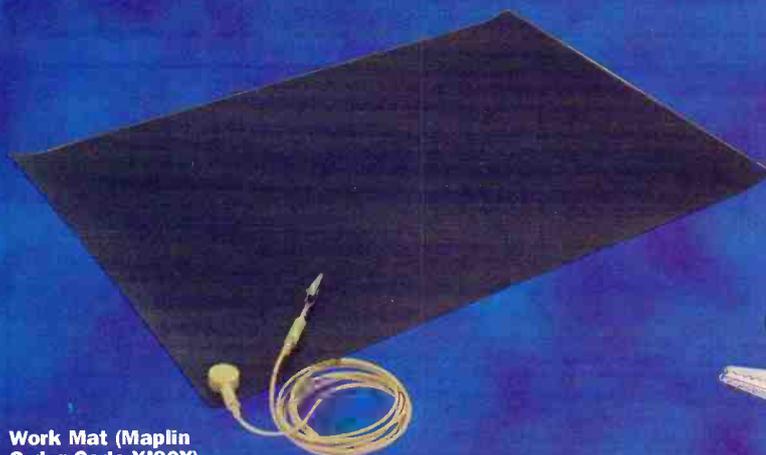
Static electricity is caused when there is a deficiency, or an excess of electrons on an object. If it has an excess of electrons the item becomes negatively charged (as electrons

have a negative charge), and if there is a deficiency of electrons it becomes positively charged.

It is found that like charges repel one another and opposite charges attract. As a result of this, hair, once it is brushed, tends to repel other strands which have the same charge. As a result it tends to stand on end. Similarly, a balloon which is rubbed to give it a static charge will tend to stick to a wall which will have little or no charge.

If an object has a static charge then it will also have an electrical potential. Accordingly when a conduction path exists between two objects there is a tendency for the potential to be equalised. This results in the flow of a current. This current is the tingle which is experienced when a door handle is touched after walking across a room.

The levels of the potential differences can be surprisingly high. The action of walking across a nylon carpet can easily produce voltages of up to 30kV on a dry day. Even a simple action like picking up a

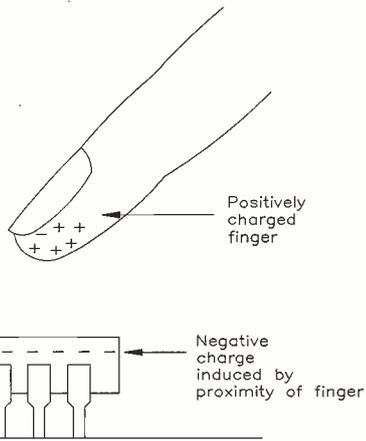


Work Mat (Maplin Order Code YJ90X).



Wrist strap and cord (Maplin Order Code FE29G).

**Figure 1. Static charging by proximity.**



polythene bag can produce a voltage of more than 15kV. In fact, in any instance where there is movement of an insulating material a static voltage is generated.

The level of the potential is governed by a number of factors. One of the major influences is what is known as 'the triboelectric series', and the relative positions of the two materials which are in motion. The position in the series indicates the relative separation. Items like human skin and hair fall towards the positive end, whilst wood and rubber are towards the middle, and materials like polyester, polythene, PVC, and Teflon are at the negative end.

Apart from charging by friction, it is also possible for objects to become charged by proximity, as shown in Figure 1. There is an electric field associated with a charge. If a charged object is brought close to a non charged conductor then it will tend to induce an opposite charge at that end of the conductor. When this happens there is a possibility of electrostatic discharge from the object on which the charge has been induced.

## Damage from ESD

It is not uncommon for very large potentials to be present on all manner of objects and people as a result of the very act of day to day movement and activity. Voltages of 20kV and more are not uncommon. Additionally, the currents caused when a static charge is dissipated can be very large. Figures of up to 30A are not uncommon, although they are dissipated in just a few nanoseconds. The rate at which the discharge occurs depends on a number of factors. A small

pointed conductive item like pliers, or a similar instrument, will give a very fast discharge. A finger gives a much longer discharge although the peak current is likely to be less as shown in Figure 2. With the levels of current indicated it is hardly surprising that damage occurs in semiconductor devices.

Damage occurs in a number of ways. High voltages can cause breakdown of areas in the semiconductor chip or device. It can cause a catastrophic failure as a result of junction burnout or oxide punch through. Tracks may also be caused to burn out as a result of the excess current. Even though the current pulses last for a very short time, the geometries which exist in today's equipment mean that it takes only a nanosecond or so for irreparable damage to occur.

Latent damage which is not

immediately obvious is possibly more likely to occur. For example, a track which has suffered from a surge of current may be only partially melted and the connection may still exist, but in this region there may be stress cracks. Similarly, if there has been dielectric breakdown, craters may be caused which could narrow the width of the track, making it more likely to fail.

Latent damage can be the most troublesome. It can give a degradation in performance which can mean that analogue circuits in particular do not meet their specification. Total failure of a device is also possible. However, both of these problems are likely to occur some time after the equipment has been in service leading to a poor record of reliability and customer dissatisfaction.

The voltages which can cause damage to semiconductor devices are remarkably low. CMOS devices may be damaged by voltages as small as 250V, MOSFETs by only 100V and gallium arsenide devices by as little as 30V. Even bipolar devices can be damaged by discharges of below 400V. When considering the static voltage levels commonly encountered it is easy to see why there is a problem.

Nowadays protection diodes are normally included onto semiconductor chips. Despite their presence, care must still be taken because they cannot guarantee complete protection. With the very large voltages and peak currents encountered this

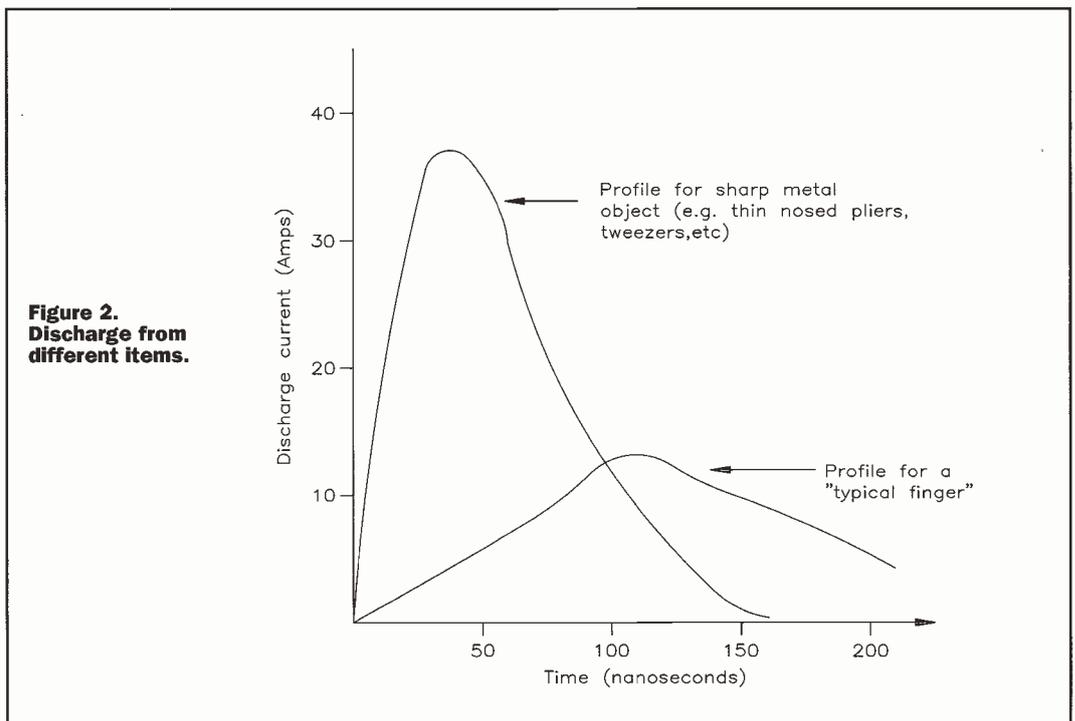
is hardly surprising. Even if they prevent complete destruction of the device there is still the possibility of latent damage.

## Combating the problem

Today many companies reach exceedingly high levels of first time pass rates, and equipment is very reliable over long periods of time. This has been achieved by improving production methods in all areas. One critical element in achieving this is in ESD control. Some simple precautions can enable production first time pass rates to improve along with the long term reliability – both of which are essential for producing products with a sufficiently high level of quality, whilst retaining the low process required to maintain a competitive edge in the market. Indeed, implementing the right procedures and installing some relatively inexpensive plant can be the key element in improving a business strategy.

For the hobbyist attention to ESD can prevent hours of careful and painstaking work from being damaged. In some instances it may be difficult to pinpoint the problem, especially if there is not a wide selection of test equipment available.

One of the first strategies is to treat all components as static sensitive. At one time it was thought that only MOS technologies were at risk. Now with the geometries in ICs falling rapidly even bipolar chips are equally at risk.



**Figure 2. Discharge from different items.**

**Anti-static bonding plug  
(Maplin Order Code AS38R).**



**Wrist strap  
and Heel/Toe  
Strap Tester  
(Maplin Order  
Code AS52G).**

Shrinking sizes of other components has made them more vulnerable as well. In some companies even passive components like capacitors and resistors are treated as though they are static sensitive. This may appear to be rather extreme, but with the size of surface mount components being used in many products, it is certainly a wise approach.

To combat the risk of exposing components to static several approaches must be adopted. To cure the problem at source the generation of static should be minimised. Secondly, an electro static discharge protected area (ESDPA) should be used for all work on components, boards and assemblies.

## ESDPA

There are several ways in which the risk of generating static can be reduced. One of the most cost effective methods of combating static is to only handle boards and components in an area where static will be dissipated. There are a number of ways in which a static protected work area can be created. The work surface must dissipate any static which is generated in a safe manner.

Either a specially manufactured static dissipative work top or bench can be purchased. A more convenient method is often to use a static dissipative mat which can be placed on an existing work surface, (a variety are available: Maplin Order Codes YJ90X, CH48B, CH48C, AS01B). It should be noted that a fully conductive plate is of little use. It is dangerous to work on a board which is powered up on a surface like this for obvious

reasons. However, it is of little use from a static viewpoint. Any charge which is built up on the board must be safely carried away. A fully conducting surface will leak the charge away too quickly with the likelihood of damage. Instead, it is necessary to use slightly conducting surface which will dissipate any charge slowly.

People working on the bench must be prevented from holding any charge. This is done by wearing a conductive wrist strap which is connected to ground with a special interconnection lead, (a variety are available, Maplin Order Codes: FE29G [includes lead], LE82D, AS03D). The interconnecting leads used contain a resistor, typically around 2M $\Omega$ . This is used for two reasons. The first is to ensure charge dissipates slowly and does not cause damage. The second is for safety. (Maplin Order Code AS04E)

The ground connection is most conveniently made via the mains earth, and special static connecting plugs which can

only contact the earth pin must be used. This prevents the likelihood of the bench earth from becoming live. These are generally coloured bright yellow indicating their function. A suitable item is available (Maplin Order Code AS38R) See Figure 3.

To connect the wrist strap, and work surface, an interconnection plate can be used (Maplin Order Codes AS08J, AS09K)

The leads are often exposed to a considerable amount of wear. This means that they will fail occasionally, and to ensure this is captured as quickly as possible they must be regularly tested. Testers are available for this and for testing complete systems (choose from Stock Codes JA61R, AS52G), to provide a simple and easy test of a wrist strap and lead.

Storage of components must also be considered. Often ICs arrive in static dissipative tubes. These have a very thin coating on the inside which dissipates static from the ICs. However, in view of the thickness of the coating, the tubes should not be reused. Instead proper

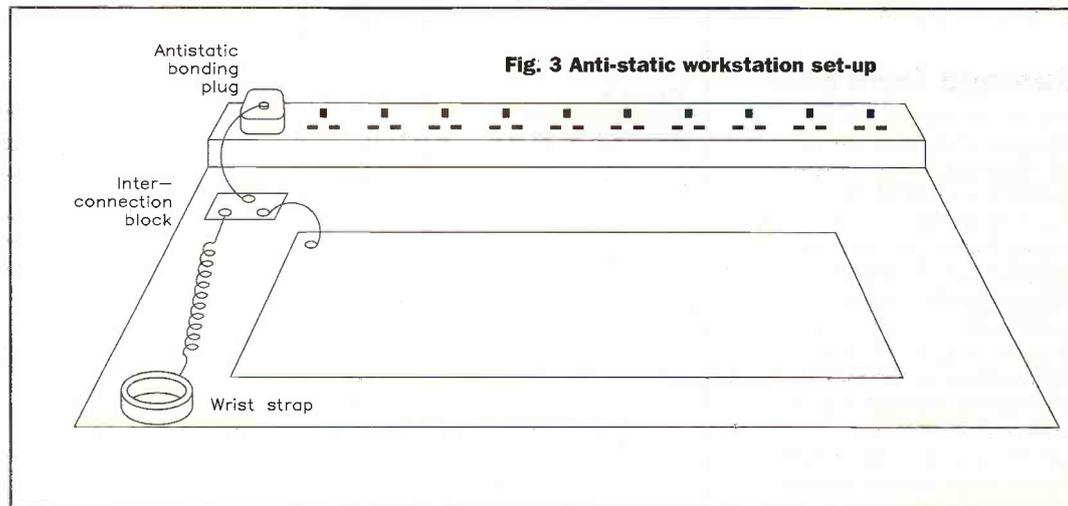
conductive storage boxes should be used (Maplin Order Codes AS12N, AS13R, AS14Q).

Anything which might generate static should be kept out of the static free area. Many everyday items are very good at generating and carrying static. Plastic cups are a prime example. Apart from the fact that it is not good practice to mix food and electronics, plastic drinks cups usually carry a high level of static and can induce a static potential by the proximity.

Polythene bags are another example. Paperwork and sometimes even components come in ordinary polythene bags. If bags are required then the specially coated static dissipative versions can be obtained. These usually have a slight pinkish tint to them. Conductive black bags are available for electronic boards.

In a similar vein, certain items of clothing can present a problem. Ties are a good example. Many of them are made from synthetic materials which can carry a very high level of static. If these fall close to a circuit board then their is the likelihood of inducing static charges onto the electronics. To overcome any problems from clothing, special anti-static 'white coats' can be worn.

Flooring can also help generate static. Those types based on acrylic fibres are particularly bad. It is possible to obtain specially formulated floor coverings which are static dissipative. Alternatively a floor mat (Stock Code AS02C) may be used. Another alternative is to use a static dissipative spray on the floor covering. As the level of static produced is dependent upon the leakage paths available, it is found that the level of humidity has a marked effect on static generation. Many electronics companies successfully



Conductive boxes (Maplin  
Order Code AS12 - 14).



Triple-Ply Static Dissipative  
Workstation Kit (Maplin  
Order Code AS35Q).

use humidifiers to help reduce the generation of static.

Unfortunately, most shoes have a highly insulating rubber sole which will reduce the effect of having a static dissipative floor. To overcome this problem straps can be worn (Maplin Order Code CH44X)

A complete Static Dissipative Workstation kit is available (Order Code AS35Q), and for field service engineers, a special kit is available (Order Code JA62S).

### Summary

If an effective strategy is to be made against ESD then it should encompass all aspects of a production operation. From goods inwards right through to the final output of the equipment it is necessary to treat ESD with the caution it deserves. Just one weak link can mean that devices are exposed to ESD, and this can result in a reduction in yield

and long term reliability. As a result it means that ESD protection must be taken on by the whole operation.

For the hobbyist it is just as important. A few simple precautions may mean that home projects have a higher probability of working.

The cost of investing in static protection is well worth the expense. The cost can soon be recouped by providing increased levels of yield and the

lowering of time taken to rework and repair boards. With the ever decreasing geometries used in integrated circuits and the reduction in size of other components, the problem will only become more acute in the future. The sooner steps are taken to combat ESD the greater the returns.

For the full range of anti-static products refer to The Maplin Electronics Catalogue Section 2.

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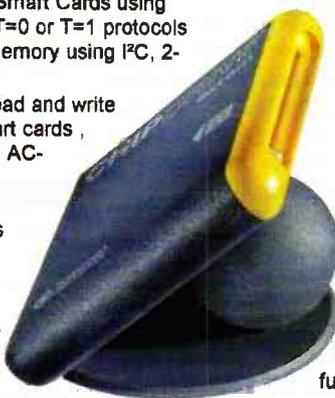
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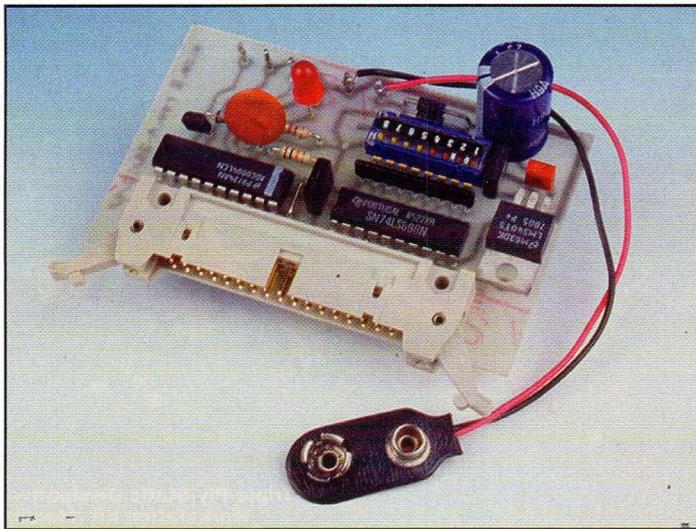
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# IBUS

## ANALOGUE INPUT MODULE

PART 5

**Design & development by Neil Johnson,  
Cambridge Consultants Ltd**

*Continuing the IBUS PC Expansion System, this month's module provides an 8-bit analogue input channel suitable for a number of uses, including monitoring a wide range of sensors. This module adds to the current IBUS range, including the PC-to-IBUS Parallel Port Adaptor (issue 119), digital I/O module (issue 122), opto-isolated input module (issue 123) and relay output module (issue 124).*

### Walk Around The Blocks

Most of the circuit, Figure 1, should be familiar to the regular IBUS constructor, with the exception of the analogue-to-digital converter (ADC), IC3. For newcomers (and to refresh the old grey cells) the entire circuit will be described.

The IBUS itself is a relatively slow parallel 8-bit bus, with eight data bits, eight address bits and read and write strobe

lines. By using such a simple and slow bus the interfacing circuitry can be made very cheaply, using readily available components, while the lack of timing constraints keeps the overall design and layout of the interface as simple as possible.

The connection to the IBUS is made through JP1, a 34-way IDC connector. Connection to the physical IBUS – a length of 34-way ribbon cable – involves no more than crimping a matching IDC connector onto the bus.

The eight address lines, A0 to A7, are compared with the board address by magnitude comparator IC1. When both sets of inputs match exactly, pin 19 goes into a low state, activating the ADC. The second set of inputs to IC1 is provided by 8-way DIL switch SW1 and resistor pack RP1 – so much easier and neater to use than individual resistors.

The heart of this module is the ADC, based on IC3. This is a National Semiconductor ADC0804, described as an '8-Bit Microprocessor Compatible ADC'. The microprocessor-compatible term means the device can be connected to a parallel bus, and looks very much like a small piece of memory. A description of this device is in the accompanying box 'Conversion Therapy'.

To start the conversion process the IBUS 'writes' to the converter, although the actual value is ignored. This triggers the device into running a full conversion cycle, which takes about 100 microseconds. At the end of the process the result is stored in an internal data buffer, ready for reading via the eight data lines onto the IBUS.

The converter clock is controlled by R2 and C6, which together set the clock rate to about 600kHz. The actual clock oscillator is included as part of the converter. The clock frequency is determined by the following equation:

$$Freq = 1/(1.1 \times R2 \times C6)$$

The reference voltage for the converter is generated by precision reference device D3. While drawn as a zener diode it is actually a temperature-stable bandgap reference and amplifier, providing a very stable 1.26V. As the converter amplifies the reference voltage by a factor of two, the full range of input voltage is from zero to 2.52V.

It is also possible to operate the converter over a wider range, up to 5V. This can be achieved by replacing R3 and D3 with 2k2 resistors, thus setting the reference voltage to half the supply voltage, about 2.5V. However, the temperature stability of this circuit will be much lower than that provided by the bandgap reference, D3.

The connection to the outside world is made by a set of solder pins: TP1, TP2 and TP3. The input voltage is applied between pins TP1 and TP2, while TP3

provides a connection to the on-board reference voltage. This is useful for connecting pots, thermistors and other simple sensing elements.

Finally we come to the power supply. This is based on the ever-reliable 7805 fixed voltage regulator, IC2. The components surrounding IC2 provide supply voltage smoothing and decoupling (C1 to C5), reverse voltage protection (D1 and D2), and supply presence indication (R1 and LED1). The module requires a supply Voltage in the range 9V to 25V, or more if the voltage rating of C5 is increased.

### Build It Up

As with all of the previous IBUS modules a key design goal has been ease of construction. To help achieve this all of the components mount directly into the PCB, thus removing the need for any extra fiddly wiring to off-board connectors or components. Note also that all the connections to the board are brought out to the edges of the board, making installation and use much easier.

The board overlay and connection points are illustrated in Figure 2. As there are no special components to consider construction can proceed in the time-honoured fashion. Start by inserting the PCB pins – a slight (emphasis on 'slight') tap with a small hammer will soon knock them into place. Continue with the two wire links, resistors, diodes and small capacitors. Continue with the remaining semiconductors and IBUS connector, finishing with the large electrolytic capacitor, C5.

When finished, give the board a thorough visual inspection and carefully remove any stray solder splashes from the board.

### Testing Time

Your expansion module should now be ready for initial testing. As for the previous modules begin by applying a few Volts to the supply pins, slowly raising the voltage from, say, 2V up to 9V. Make sure the output of the voltage regulator, IC2, rises up to, and then stays at, 5V.

With the board operating at its nominal operating supply voltage also check the voltage across the reference diode, D3, preferably with a digital meter. It should be in the region of 1.26V, within a few millivolts.

The module is now ready for proper functional testing. For this a PC running Windows and the test program, shown in Figure 3, and an IBUS Parallel Port Adaptor (PPA) will be required. Connect the module

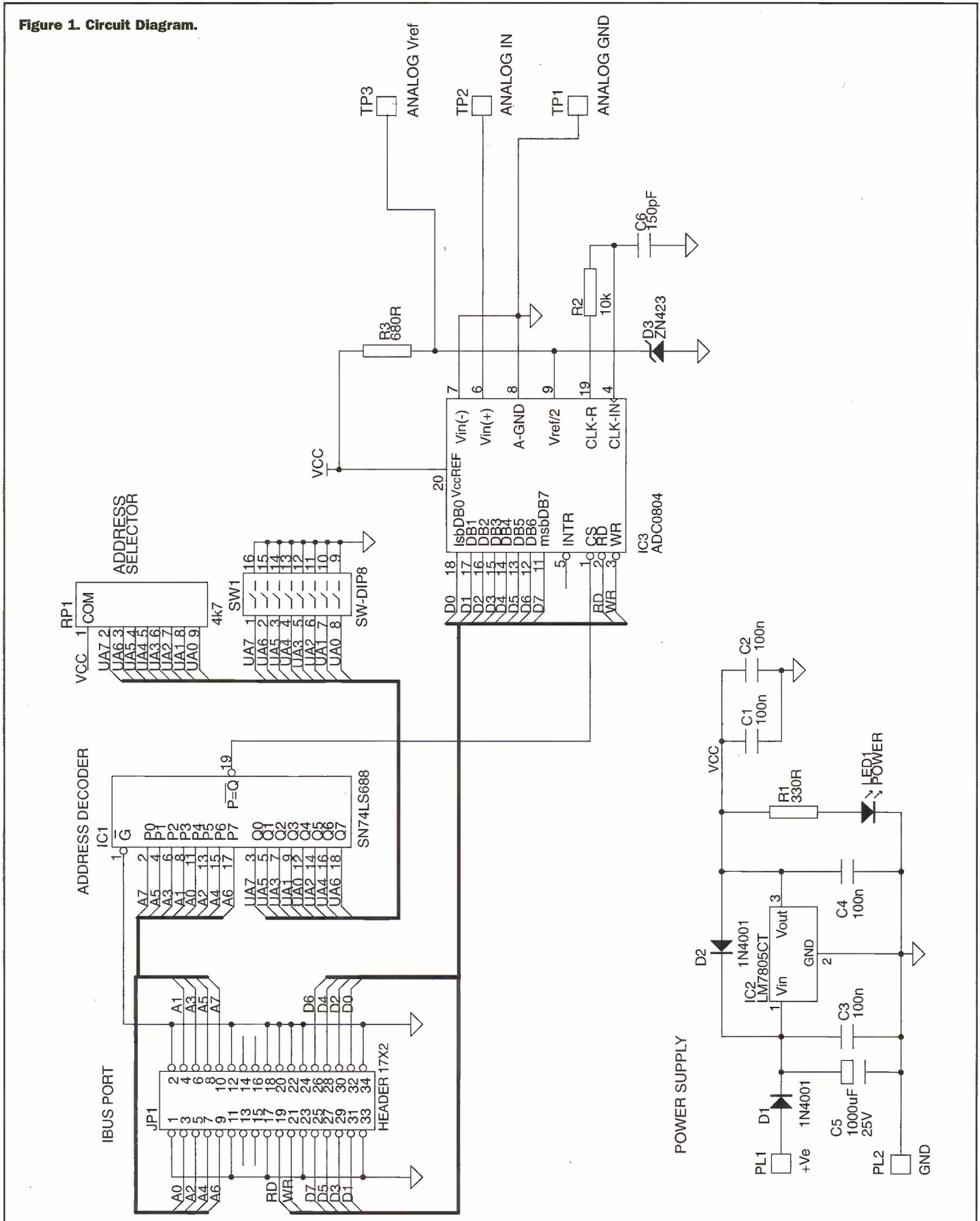
to the PPA, and the PPA to the PC's printer port. Apply power to both boards and start the test program.

To run the program you will need to enter the IBUS address

box of the program. As described earlier this is set by DIL switch SW1. Each single switch corresponds to one bit of the address, with switch 1 setting A0, switch 2 setting A1, and so on. The only complex

part of the project is that the switches operate in the opposite sense – a closed switch represents a '0' and an open switch represents a '1'. Start with all the switches set to the closed position,

Figure 1. Circuit Diagram.



corresponding to IBUS address '00'. Also enter this number into the test program's Address box.

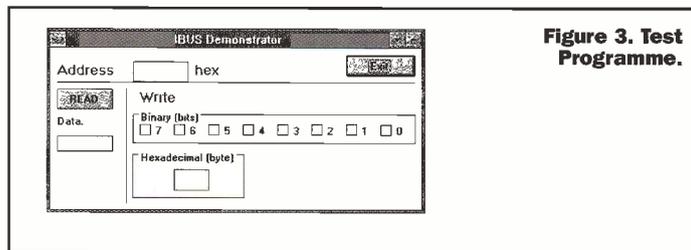
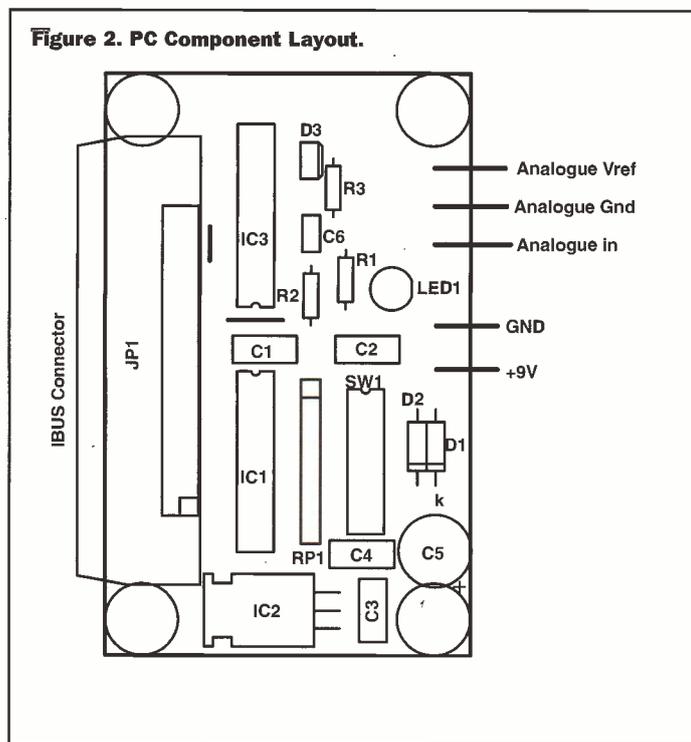
Testing the converter involves triggering a conversion and reading back the data. For this simple test an input circuit using a pot can be used. Connect one end of the track to the ground pin, the other end to the reference voltage pin (Vref) and the wiper to the input pin. With this arrangement the converter result should lie in the range 00 to 7F (hex).

To run the test move the pot to any position, click on one of the Write bit switches, and then on the Read button. If all is well you should see a number appear in the Read data box corresponding to the position of the pot. Try the pot at a number of positions, including both extremes of travel, to make sure the converter is operating properly.

## Applications

With an analogue input your computer has a whole new view of the real world. A host of interesting sensors can be connected to this module for measuring position, temperature, light, weight, air pressure, humidity, and so on.

Presented here are a number of applications for this module, together with some examples using other modules in the IBUS



series. The ideas presented here represent a fraction of what is possible with this module.

For simple monitoring applications a range of sensors

are available. The simple potentiometer used earlier for testing can be used to measure linear or rotary position. With a little mechanical ingenuity you

could measure distance or depth. Together with a spring you could create a simple spring balance for measuring weight.

For light sensing projects use a Light Dependent Resistor (LDR), such as the ORP12, as one half of a potential divider. As light shines on the sensitive face of the LDR its resistance changes, and the resulting change in voltage can then be measured by the analogue input module. This sensor could then be used to monitor ambient light levels. With the addition of some lenses and a lamp a position sensing system could be devised.

A close cousin of the LDR is the thermistor, but this time it is temperature, not light, that is the varying effect. The thermistor could be used to measure the temperature of a liquid entering a processing tank, or monitor the ambient temperature as part of a PC-based weather station. For home automation enthusiasts the thermistor could be used to monitor the temperature of the hot water tank, to tell the computer when to turn on the central heating boiler.

Pressure sensors output a small voltage proportional to the pressure applied, be it atmospheric or compressed gas. The addition of an op-amp and a few components to make a gain stage would enable pressure measurements to be made with this module.

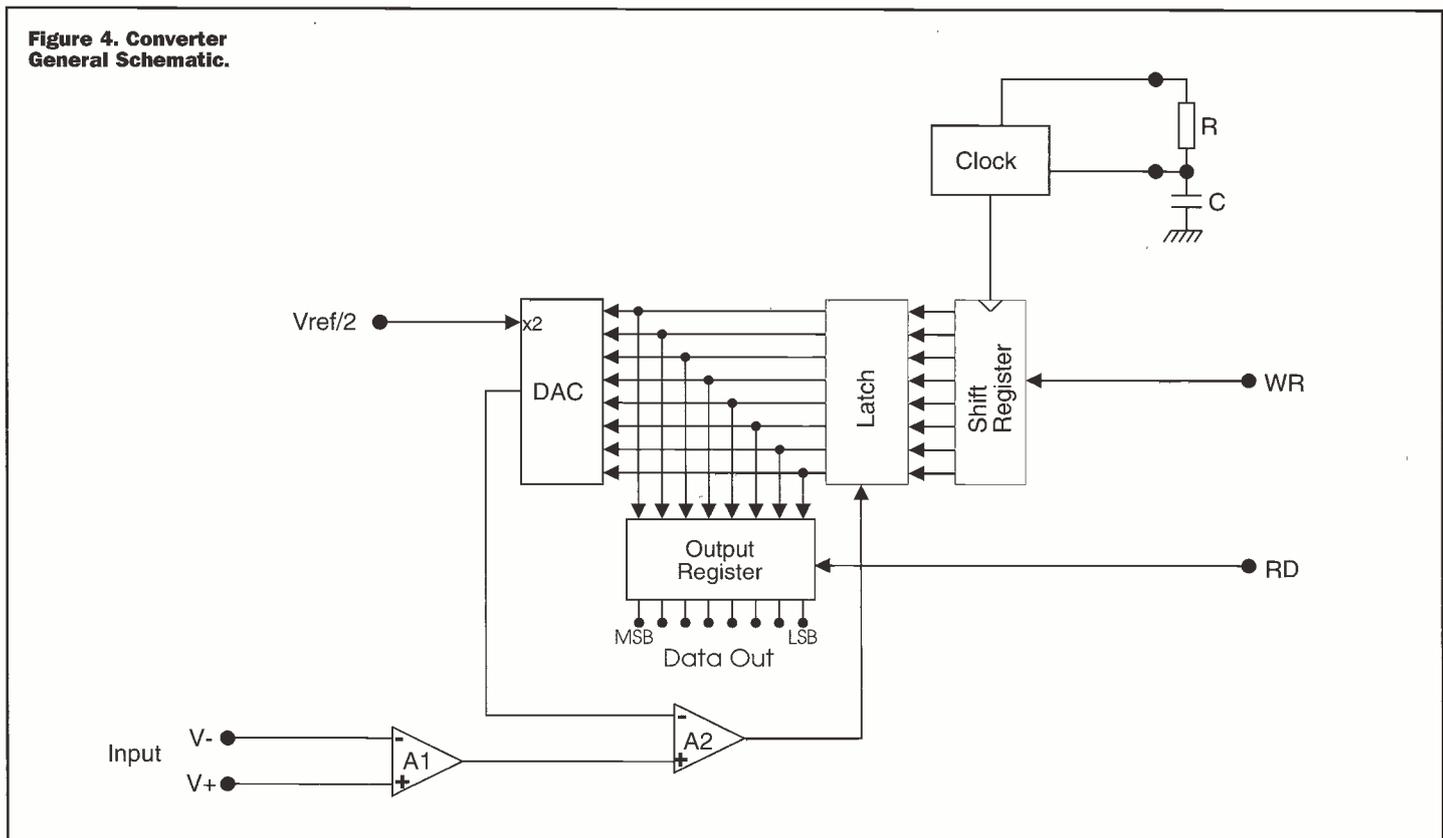
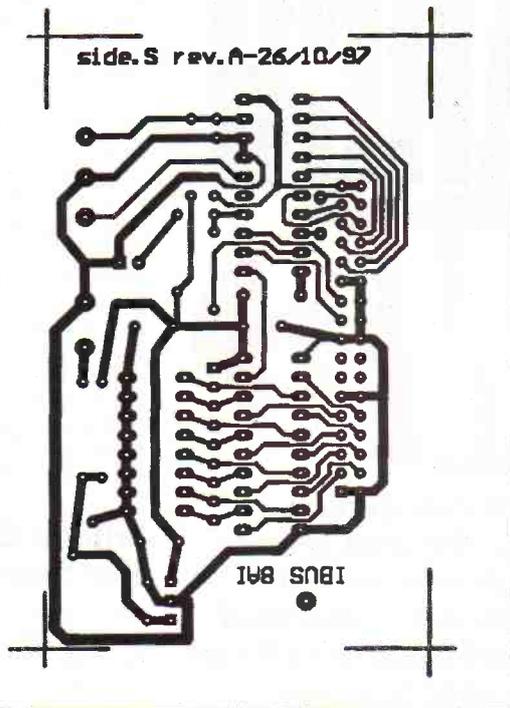


Figure 5.  
PCB Track.



For more accurate temperature measurements than are possible with a thermistor the thermocouple is often used. This generates a small voltage at the junction of two dissimilar metals, proportional to the temperature of the junction. However, this voltage is quite small and will need amplification before being suitable for this module's input.

The electronics workshop offers yet more useful applications. Together with the relay output module presented last month, a multiple input voltage monitor could be built. By sampling each input in turn, and plotting the data on eight separate axes, a lot of experimental data could be collected at the same time. Think of what you could do with an eight channel DVM. The possibilities are endless.

As a final example, how about a computer-controlled power supply. The output voltage could be set by the IBUS analogue output module (to be described next month). The

actual output voltage and current could be measured by the analogue input module, while the outputs could be switched on and off by a relay output module.

These are just a few of the many possible applications of this module. With a bit of ingenuity and creative thinking many more are possible – enough to keep this magazine full of projects well into the next millennium!

### Signing Off

That's all for this month. Next month should see the last IBUS module, providing an 8-bit resolution analogue output channel to compliment this month's module. Until then, happy interfacing!

### Acknowledgements

The author would like to express his thanks to Cambridge Consultants Ltd, Cambridge, for their continued help in providing development facilities for this project.

## CONVERSION THERAPY

The successive approximation technique is a relatively simple and low-cost method, used mainly for general purpose data acquisition systems. As its name suggests, this technique digitises the input voltage through a succession of increasingly accurate approximations. Each one provides a single bit of resolution, starting with the most significant bit (MSB) and progressing to the least significant bit (LSB).

The general schematic of the converter is shown in Figure 4. This is a greatly simplified form, showing only the key components. To describe the operation of this converter, from the analogue input to the digital output, a complete conversion cycle will be described.

The analogue input stage consists of a low noise differential amplifier, A1, whose output is the difference between the two input signals. As part of the design both inputs are protected from over- and under-voltage levels by a network of diodes (not shown).

At the start of the conversion cycle, initiated by the WR signal, the shift register and latch are cleared. The first clock cycle moves a 1 into the top of the shift register. This is fed through the latch and into the digital-to-analogue converter (DAC).

The DAC produces a voltage proportional to the digital input value and the reference voltage,  $V_{ref}$ , which is actually multiplied by a factor of two. The output of the DAC is compared with the output of the differential amplifier by high-speed comparator A2. If the output of the comparator is a 1 the contents of the data input to the DAC is stored in the latch.

The next clock cycle moves the 1 in the shift register down one place towards the LSB, and the whole cycle repeats. After eight approximations the final 8-bit digital value is stored in the output register, ready for reading via the RD signal.

To help further illustrate this process a hypothetical 4-bit conversion is shown below, with each of the four steps explained. For this 'thought experiment' it is assumed that the LSB of the DAC corresponds to 1V, and the input voltage is 9V (well within the possible range of 0 to 15 volts).

**Step 1:** 1 moved into top of shift register  
DAC outputs 1000(binary) = 8V  
Input voltage  $\geq$  8V, so bit is latched

**Step 2:** Shift register shifts one place down  
DAC outputs 1100(binary) = 12V  
Input voltage < 12V, so bit is cleared

**Step 3:** Shift register shifts one place down  
DAC outputs 1010(binary) = 10V  
Input voltage < 10V, so bit is cleared

**Step 4:** Shift register shifts one place down  
DAC outputs 1001(binary) = 9V  
Input voltage  $\geq$  9V, so bit is latched  
Result (1001) is stored in Output Register

The conversion result is 1001(binary), which happens to be the right answer! The 8-bit converter used in this project operates in much the same way, except for a larger number of approximation cycles, each one providing an extra bit of resolution.

## PROJECT PARTS LIST

### RESISTORS – all 5% 0.25watt unless stated

R1	330R	G330R
R2	10k	G10K
R3	680R	G680R
RP1	4k7 8-way SIL resistor pack	RA29G

### CAPACITORS

C1-4	100nF ceramic	RA49D
C5	1,000uF 25V radial electrolytic	AT52G
C6	150pF ceramic	WX58N

### SEMICONDUCTORS

IC1	74LS688	KP49D
IC2	LM7805	QL28F
IC3	ADC0804	QQ00A

D1, 2	1N4001	QL73Q
D3	ZN423 bandgap reference	GS86T
LED1	5mm red LED	WL27E

### MISCELLANEOUS

JP1	34-way IDC right-angled PCB header	FA44X
SW1	8-way DIP switch	QY70M
IC sockets (optional), PCB, solder, wire, 5 PCB pins		

The software accompanying this project, supplied on a 3½" disk, and a set of foil pattern transparencies (two originals) are available from the author at the address below. The disk costs £10 and the foils cost £5. Postage is £2.50 for the UK, £5 for everywhere else. Please send your order, with cheque or postal order payable to 'Neil Johnson', to:

Neil Johnson, IBUS Module, 2 Chapel Field, Dexter Road,  
NORTHIAM, East Sussex, TN31 6PQ, UK.

## Prototype Transistor Offers Leap Frog Potential

Improvements in the transistor of the future may not rely on decreasing its size but rather on a radical change in operation made possible by a quantum mechanical transistor created at Sandia National Laboratories.

The quantum mechanical transistor is the equivalent of turning on a light bulb without closing a switch: Electrons 'tunnel' from path to path through a barrier that, according to classical physics, is impenetrable.

The term 'tunnelling' may bring to mind moles or the highway department, but physicists use it to describe an effect in which particles, like electrons, appear in places where by rights they should not be able to go. In effect, they have tunneled under an energy barrier the same way cars use a tunnel to appear at a new location without having to drive over an impossibly high summit. The atomic-scale effect is explained only by quantum mechanical principles.

## Reality

"We have demonstrated real circuits that work and are easily fabricated," says Jerry Simmons, physicist and leader of the Sandia development team. "It is

# RESEARCH NEWS

*Computing power has grown explosively during the past few decades, but the fundamental electronic components have changed little. Here Stephen Waddington talks to researchers at Sandia National Laboratories about a new type of transistor that one day may leapfrog ahead of today's computing technology.*

not ready to be sold yet, but it is a significant advance."

The device, dubbed Double Electron Layer Tunnelling Transistor (DELTT), offers the promise of significant improvements in the speed of computers and in the accuracy

of sensors. Sandia is a laboratory of the US Department of Energy (DOE).

Photo 1 shows Simmons inspecting the end of a cryogenic sample holder for performing electrical measurements on the DELTT

quantum mechanical transistor. Once loaded with DELTTs, the holder is lowered into a cryostat that varies in temperature from 0.3K to 300K, allowing transistor performances to be tested at different temperatures.

According to Paul Berger, professor of electrical and computer engineering at the University of Delaware, "I was impressed by the multitude of possible uses of the DELTT device, as well as by its simplicity of connectivity." Berger chaired the session at the International Electron Devices Meeting in Washington, late last year in which the first paper on the device was delivered.

## Trillion Operations Per Second?

The very fast device may run at a trillion operations a second, as have other, more primitive tunnelling devices. This is roughly ten times the speed of the fastest transistor circuits currently in use. Actual speed has not yet been measured, says Simmons, because it is "not easy to measure such high speeds, which are near the limits of what can be measured with conventional equipment." The extremely fast device also runs at extremely low power - tens of millivolts and microamps - as compared with the few volts and milliamps needed by

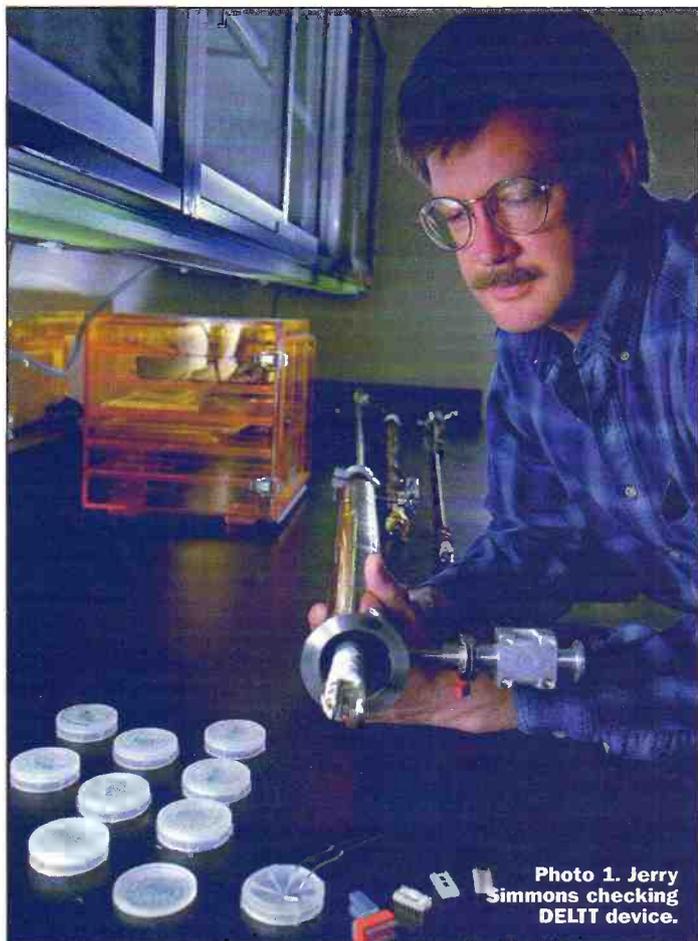


Photo 1. Jerry Simmons checking DELTT device.

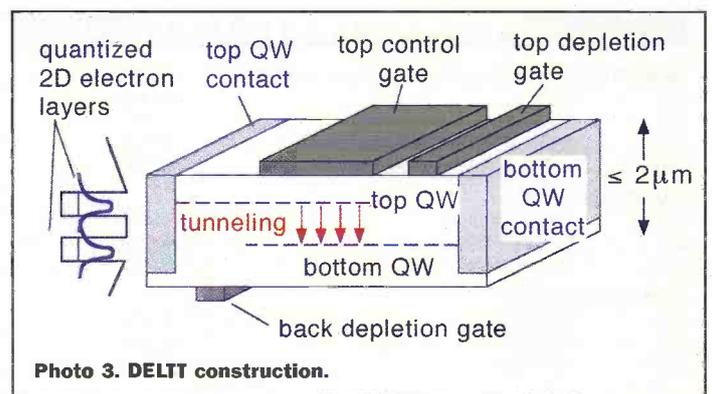
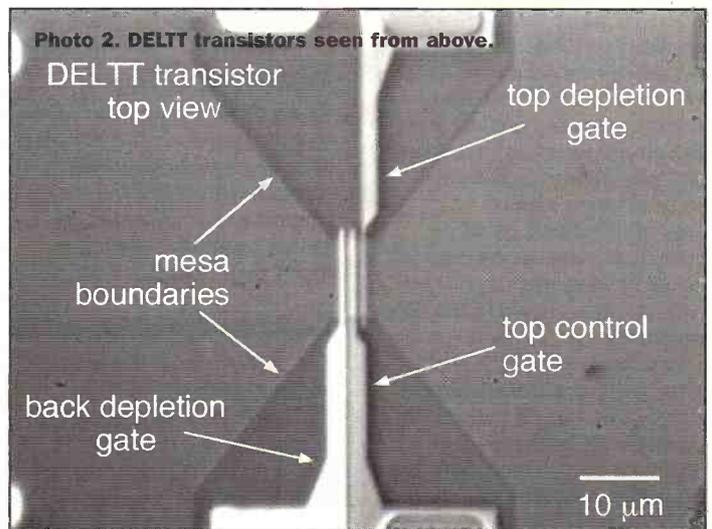


Photo 3. DELTT construction.

transistors currently in use.

Photo 2 shows the DELTT transistor as seen from above. The semiconductor epitaxial layers of the DELTT transistor, which contain the two layers of electrons, are sufficiently thin (0.25 microns) as shown in Photo 2, that light can penetrate them, rendering gates on both sides of the device visible. The top and back depletion gates allow independent contact to the two electron layers, while the top control gate turns the transistor on and off.

That electrons travel so rapidly in the DELTT gallium arsenide transistor means that normal electrical processes that slow down transmission of information - like scattering of electrons by crystal imperfections that behave much like potholes in the electrons' pathway - can be minimised.

From Sandia's point of view as a US national defence laboratory, the device might someday be put to work in satellites and smart missiles to process information faster, with less payload and much lower power consumption than today's devices.

Because the device is also tuneable, it could act like an energy spectrometer on a chip. This could allow sensitive detection of chemical and biological species like nerve gas

and anthrax. This will help to combat bio-chemical or chemical-terrorists by allowing more rapid and reliable detection of minute concentrations of toxic materials at customs and airports, on the battlefield and via airborne platforms.

Other possible uses of the modified structure would be as an optical detector in the far infrared. Incoming photons would be used to add energy needed for a transition between electron states, causing the device to turn on in only a narrow energy band.

Actual use of the transistor by industry may be years ahead in the future because of other engineering problems to be tackled. These include questions of temperature - the device now works only at temperatures at or below 77 degrees Kelvin, though rapid improvement, using existing technology, indicates it should be operating at room temperature by next year, says Simmons.

Another problem involves designing millions of such circuits on a chip, as is currently done with ordinary transistors. Because of the Sandia device's multifunctionality - it has three positions, off-on-off, instead of the normal transistors' two on-off states - the same amount of work can be performed with

significantly fewer transistors, and chips would have to be completely redesigned.

## How It Works

Electrical contact is made to the top quantum well (QW) of the DELTT transistor only by the source, and to the bottom quantum well only by the drain as shown in Photo 3. In both cases this is accomplished by using the top and back depletion gates to remove electrons from the quantum well which one does not wish to contact. Tunnelling between the two quantum wells occurs only when electrons in both wells have identical momentum and energy, which can be controlled by the top control gate.

The total thickness of the semiconductor layers is kept less than two microns, allowing the back depletion gate to be brought close to the quantum wells and the entire device to be made small.

The technique relies in part upon the dual wave-particle nature of matter. In the device, two gallium arsenide layers, each only 150-angstroms thick, are separated by a 125-angstrom aluminium-gallium-arsenide barrier - the equivalent of the yards of two houses separated by a sturdy fence.

Ordinarily, gallium arsenide electrons in one yard do not have the energy to climb the fence to reach the other yard. But the tiny thickness of the barrier causes the electrons to behave like waves, which can poke into the barrier.

When an electron is adjusted to have the same energy and momentum states in both regions - something that can be done by applying a voltage to these regions - it can pass from one region to the other without any scattering, as occurs in normal electron motion due to crystal imperfections. In effect, they tunnel under the barrier fence.

Previous attempts at building tunnelling transistors had been made by researchers who created layers side by side on a surface. This proved too difficult a task for current technology to manufacture accurately at 1,000 angstroms or the even smaller dimensions necessary. A novel design change allowed Sandia researchers to stack all DELTT layers vertically; using molecular beam epitaxy (MBE) or chemical vapour deposition (CVD), which enabled single-atom layers to be grown. MBE and CVD are the same processes used to make, among other products, semiconductor lasers for compact disc players, and are readily available technologies.

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# Security

# ELECTRONIC

# SYSTEMS

# & CIRCUITS

PART 8

*Ray Marston describes circuits that react to temperature, voltage, current, or resistance in this month's episode of the series.*

**S**ecurity circuits that react to temperature, voltage, current or resistance have many practical applications in the home and in commerce and industry. Temperature-sensitive circuits can be used to automatically activate alarms, or safety devices, when one or more monitored temperatures goes above or below a preset level, or when two temperatures differ by more than a preset amount. Such circuits can be used to give warning of fire, frost, excessive boiler temperature, the failure of a heating system, or over-heating of a piece of machinery or a liquid, etc., and may use thermostats, thermistors or various types of solid-state device as their temperature-sensing elements. The first half of this month's article presents a selection of practical temperature-sensitive security circuits.

Circuits that react to an input voltage, current or resistance also have many practical applications, since these inputs may in fact be derived from the output of a transducer that monitors a parameter such as motor speed, liquid flow rate or pressure, or rate of linear movement, etc. The second half of this article presents a selection of practical voltage-, current-, or resistance-sensitive security circuits.

Note that most practical circuit shown in this article are designed to activate a relay under the 'alarm' condition, but that in most cases this relay can be replaced by a ready-built 12V piezo-siren module if required.

## Temperature-Sensitive Security Circuits

### Thermostat Fire Alarm Circuits

One of the simplest types of temperature-sensitive circuit is the thermostat-activated fire alarm. Figure 1 shows the practical circuit of a relay-aided, non-latching alarm of this type. Here, any desired number of n.o. thermostats are wired in parallel, and then connected in series with the coil of a relay, and one set of the relay's n.o. contacts are wired in series with the alarm bell so that the bell operates if the relay turns on. Normally, the thermostats are all open, so the relay and alarm bell are off. Under this condition the circuit consumes zero standby current. On the other hand at 'overheat' temperatures, one or more of the thermostats closes, and thus turns on the relay and thence the alarm bell. Note that push-button switch S1 is wired in parallel with the thermostats, enabling the circuit to be functionally tested by operating the push-button.

The basic Figure 1 circuit gives a non-latching form of operation. If required, the circuit can be made self-latching by wiring a spare set of n.o. relay contacts

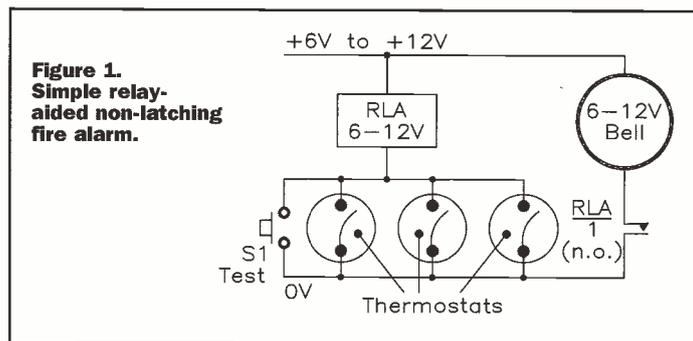
in parallel with the thermostats, as shown in Figure 2. Note that n.c. push-button switch S2 is wired in series with these relay contacts, so that the circuit can be reset, or unlatched, by momentarily operating S2.

The thermostats used in the above two circuits must be n.o. types that close when the temperature exceeds a preset limit. When the thermostats are located in normal living areas they should be set to close at a temperature of roughly 60°C (140°F), but when they are located in unusually warm places – such as furnace rooms or attics – they should be set to close at about 90°C (194°F).

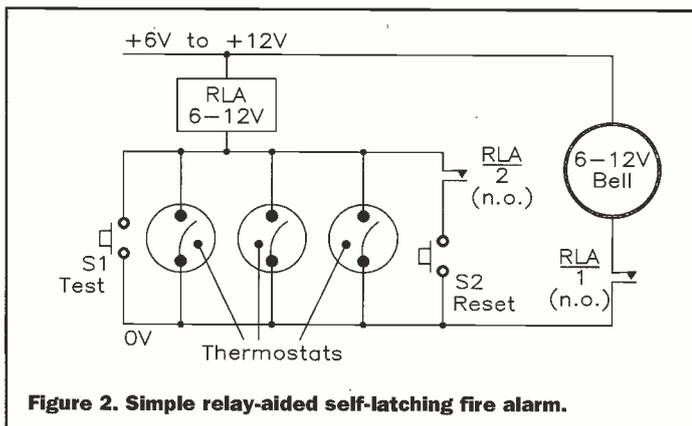
## Over-and-under-temperature security circuits

Most over-temperature (and under-temperature) security circuits activate a relay or an alarm unit when a monitored temperature rises above (or falls below) a preset level. This may range from well below the freezing point of water to well above the boiling point of water. Precision circuits of this type usually use one or more thermistors, or solid-state devices, as their temperature-sensing elements.

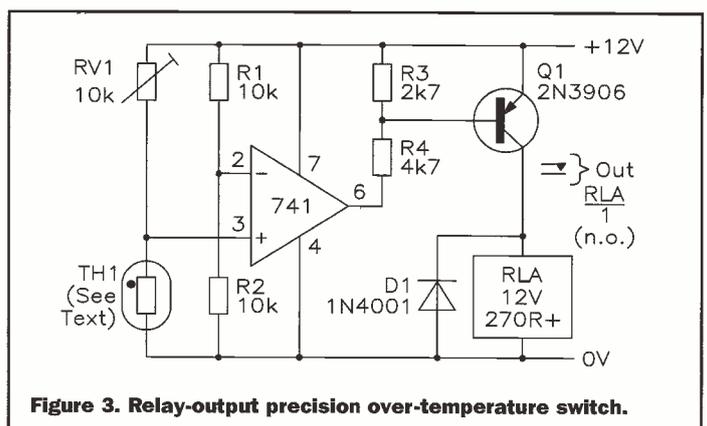
Two useful over-temperature security circuits (and two under-temperature circuits) are described in this section. The first two circuits use an inexpensive n.t.c (negative temperature coefficient) thermistor as a temperature-sensing element. This device acts as a temperature-sensitive resistor that present a high resistance at low temperatures, and a low resistance at high temperatures. The thermistor circuits described in this and following sections of this article have all been designed to work with thermistors that present a nominal resistance of 5kΩ at the desired operating temperature; however, all of these circuits will, in fact work well with any



**Figure 1.** Simple relay-aided non-latching fire alarm.



**Figure 2.** Simple relay-aided self-latching fire alarm.



**Figure 3.** Relay-output precision over-temperature switch.

n.t.c thermistors that present a resistance in the range  $1k\Omega$  to  $20k\Omega$  at the required 'trip' temperature.

Figure 3 shows the practical circuit of a simple but very sensitive over-temperature switch that has a relay output. Here, the thermistor (TH1) and RV1-R1-R2 are wired in the form of a simple Wheatstone bridge in which R1-R2 generate a fixed half-supply 'reference' voltage. TH1-RV1 generate a 'variable' output voltage that is inversely proportional to the TH1 temperature, and is trimmed (via RV1) so that it almost equals the R1-R2 reference value at the required 'trip' temperature. These two voltages are fed to the input of the type 741 op-amp which is used – in conjunction with transistor Q1 – as the bridge's balance detector and relay driver. The 741 op-amp is used in the open-loop mode in this circuit, and its action is such that its pin-6 output is driven low (to negative saturation) if its pin-3 (non-inverting) input is more than a few millivolts negative to the pin-2 (inverting) input, and is driven high (to positive saturation) if pin-3 is significantly positive to pin-2.

Suppose, then, that the bridge is adjusted so that it is close to balance at the desired

'trip' temperature. When the temperature falls below this value the TH1 resistance increases, so the 741's pin-3 voltage rises above that of pin-2, and the pin-6 output voltage thus goes to positive saturation and consequently applies no base drive to Q1; Q1 and the relay are off under this condition. However, when the temperature rises above the 'trip' value, the TH1 resistance decreases and the 741's pin-3 voltage falls below that of pin-2, and the pin-6 output voltage thus goes to negative saturation and applies heavy base drive to Q1; Q1 and the relay are driven on under this condition. Thus, the relay goes on when the temperature rises above the preset level, and turns off when the temperature falls below the preset level.

Important points to note about the Figure 3 circuit are that, because it uses the bridge sensing configuration, its accuracy is independent of variations in supply voltage, and that the circuit can respond to TH1 resistance changes of less than 0.1%, i.e., to temperature changes of a fraction of a degree.

Figure 4 shows the above circuit converted into a precision under-temperature switch by simply transposing the op-amp's pin-2 and pin-3 input connections; alternatively, the Figure 3 can be made to give under-temperature operation by simply transposing the R1 and TH1 positions, or by redesigning the Q1 output stage so that it uses an npn transistor in place of the pnp device.

The Figure 3 and 4 circuits use

a thermistor with a nominal trip-level resistance value of  $5k\Omega$  as its temperature-sensing element, and this thermistor dissipates several milliwatts of power under actual working conditions. In some special applications this power dissipation may cause enough self-heating of the thermistor to upset its thermal sensing capability. In such cases an alternative type of temperature-sensing device – such as an ordinary silicon diode – may have to be used.

Ordinary silicon diodes have temperature-dependent forward volt-drop characteristics, and can thus be used as temperature-sensing elements. Typically, a silicon diode gives a forward volt drop of about 600mV at a current of 1mA. If this current is held constant, the volt drop changes by about -2mV for each degree Centigrade increase in diode temperature. All silicon diodes have similar thermal characteristics. Since the power dissipation of the diode is a mere 0.6mW under the above condition, negligible self-heating takes place in the device, which can thus be used as an accurate temperature sensor.

Figure 5 shows how general-purpose silicon diode D1 can be used as a thermal sensing element in an op-amp over-temperature relay-switch circuit. Here, zener diode ZD1 is wired

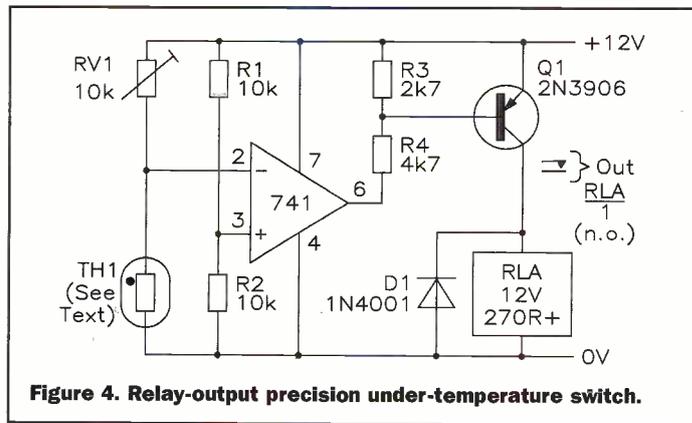


Figure 4. Relay-output precision under-temperature switch.

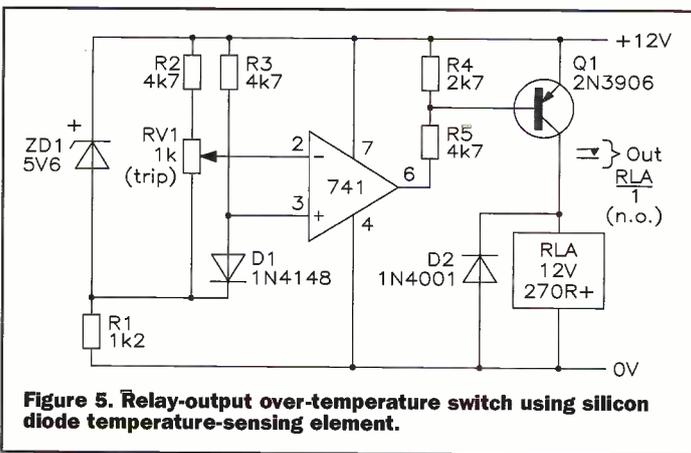


Figure 5. Relay-output over-temperature switch using silicon diode temperature-sensing element.

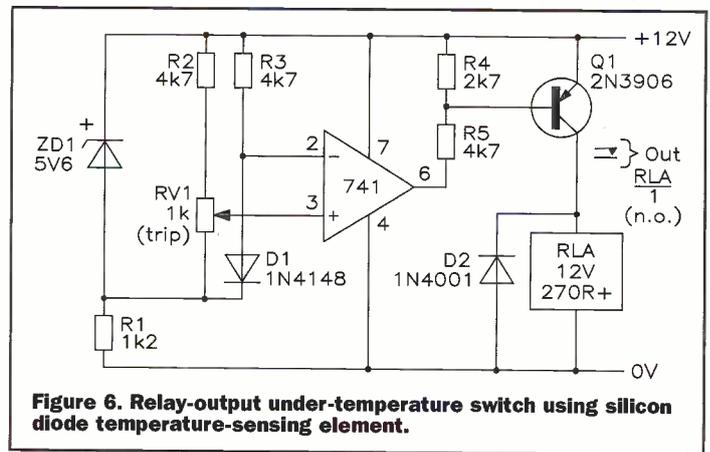
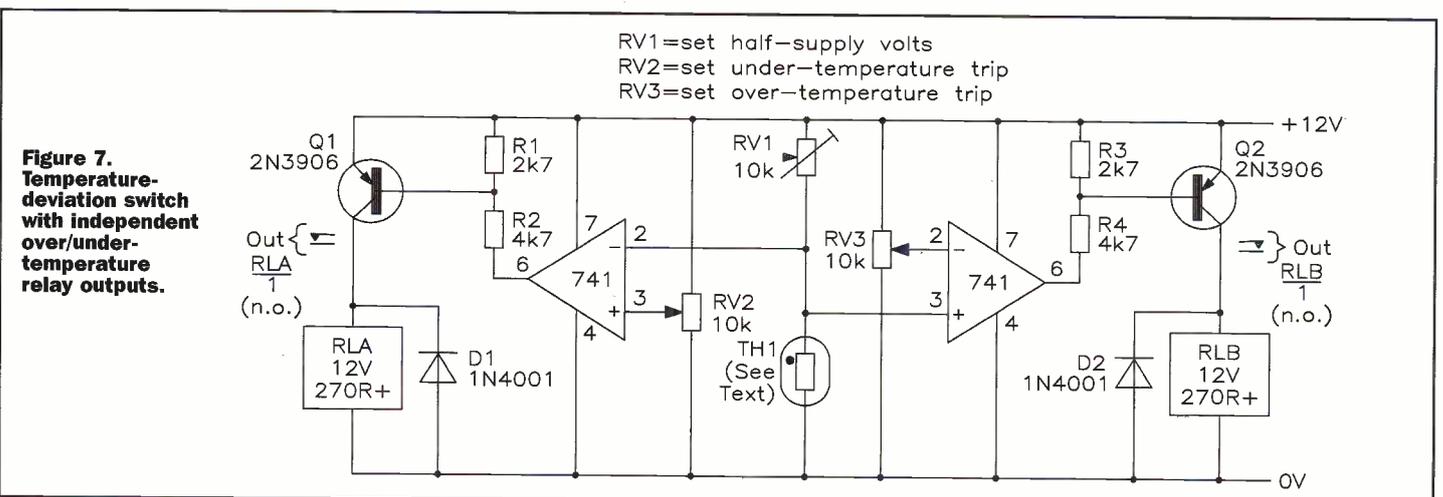
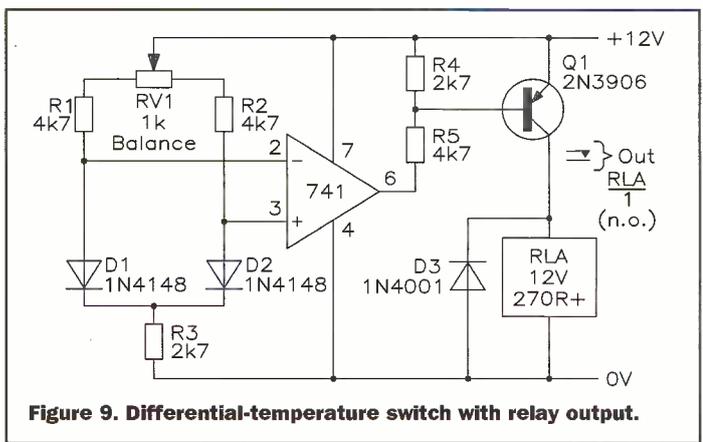
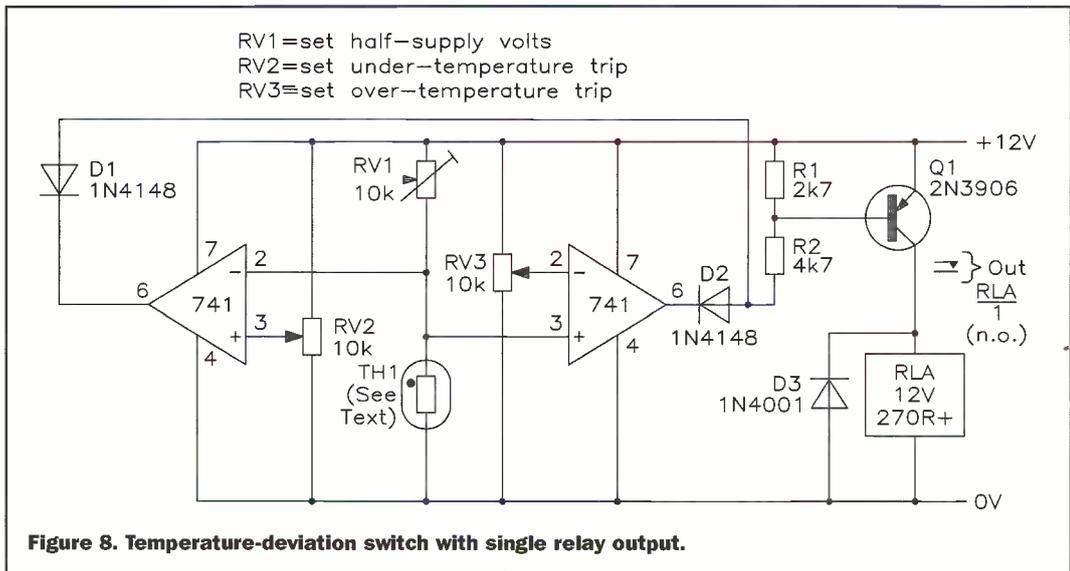


Figure 6. Relay-output under-temperature switch using silicon diode temperature-sensing element.



RV1=set half-supply volts  
RV2=set under-temperature trip  
RV3=set over-temperature trip

Figure 7. Temperature-deviation switch with independent over/under-temperature relay outputs.



in series with R1 so that a constant 5.6V is developed across the two potential dividers formed by R2-RV1 and R3-D1, and a near-constant current thus flows in each of these dividers. A constant reference voltage is thus developed between the R1-RV1 junction and pin-2 of the op-amp, and a temperature-dependent voltage with a coefficient of -2mV/°C is developed between the R1-RV1 junction and pin-3 of the op-amp. Thus, a differential voltage with a coefficient of -2mV/°C appears between pins 2 and 3 of the op-amp.

In practice, this circuit is set up by simply raising the temperature of D1 to the required over-temperature trip level, and then slowly trimming RV1 so that the relay just turns on. Under this condition a differential temperature of about 1mV appears between pins 2 and 3 of the op-amp, the pin-3 voltage being below that of pin-2, and Q1 and the relay are driven on. When the temperature falls below the trip level the pin-3 voltage rises above that of pin-2 by about -2mV/°C change in temperature, so Q1 and the relay turn off. The circuit has a typical sensitivity of about 0.5°C, and can be used as an over-temperature switch at

temperatures ranging from sub-zero to above the boiling point of water.

Figure 6 shows how the operation of the Figure 5 circuit can be reversed, so that it functions as an under-temperature switch, by simply transposing the pin-2 and pin-3 connections of the op-amp.

### Miscellaneous temperature switches

Each temperature-sensitive circuit shown so far in this article activates when a monitored temperature goes either above, or below, a preset

level. The present section shows three other types of temperature-sensitive security circuit. Two of these circuits activate relays if the temperature deviates from a preset level by more than a preset amount, and the third activates a relay if two monitored temperatures differ by more than a preset amount. In all cases, the relay(s) can be used to operate any type of electrical alarm or slave device.

Figures 7 and 8 show the circuits of a pair of temperature-deviation switches, which activate if the temperature deviates from a preset level by more than a preset amount. The Figure 7 circuit has independent over-temperature and under-temperature relay outputs, while the Figure 8 circuit has a single relay output that activates if the temperature goes above, or below, preset levels.

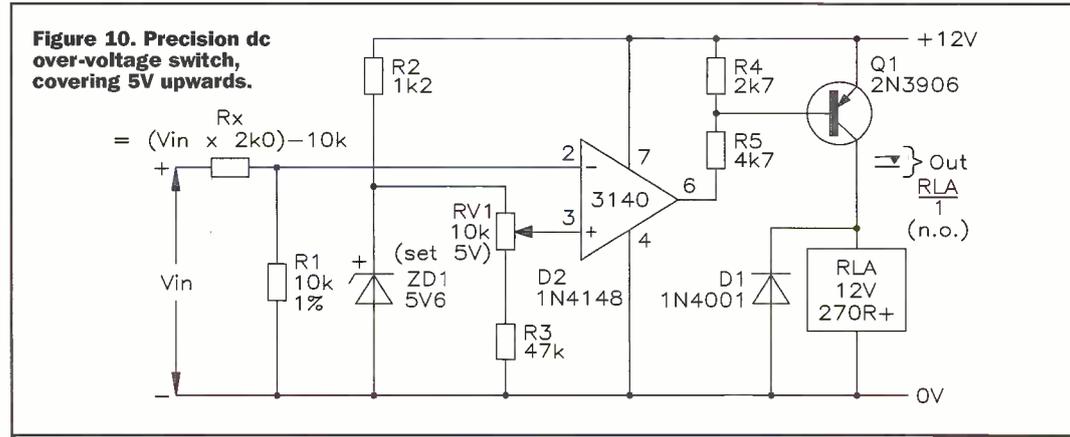
Both of these circuits are made by combining the basic over-temperature and under-temperature circuits of Figures 3 and 4. The right (over-temperature) half of each circuit is based on that of Figure 3, and the left (under-temperature) half is based on that of Figure 4. Both halves of the circuit share a common RV1-TH1 temperature-sensing network, but the under-temperature and

over-temperature switching levels of the circuits are independently adjustable. Each of the two op-amp outputs of the Figure 7 circuit are taken to independent transistor-relay output stages, while the two op-amp outputs of the Figure 8 circuit are taken to a single transistor-relay output stage via the D1-D2 gate network. The procedure for setting up the two circuits is as follows.

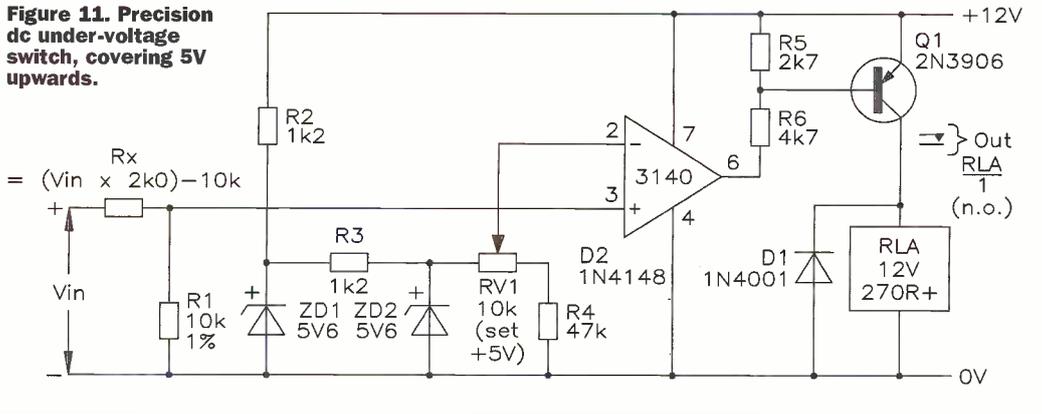
First, set RV2 and RV3 to mid-travel, then, with TH1 at its normal or mid-band temperature, adjust RV1 so that half-supply volts are developed across TH1. Now fully rotate the RV2 slider towards the positive supply line, rotate the RV3 slider towards the zero volts line, and check that no 'trip' condition is indicated (relays off). Next, reduce TH1's temperature to the required under-temperature trip value and adjust RV2 so that the appropriate relay goes on to indicate the 'trip' condition. Now increase the TH1 temperature slightly and check that the relay turns off. Finally, raise the TH1 temperature to the required over-temperature trip level and adjust RV3 so that the appropriate relay turns on to indicate the 'trip' condition. The circuits are then ready for use.

Figure 9 shows the circuit of a differential-temperature switch that activates a relay if two monitored temperatures differ by more than a preset amount. The circuit uses a pair of silicon diodes as temperature-sensing elements, and activates the relay only when the temperature of D1 is more than a preset amount greater than that of D2, and is not influenced by the absolute temperatures of the two diodes.

In this circuit, general-purpose silicon diodes D1 and D2 are used as temperature-sensing elements. A standing current is passed through D1 from the positive supply rail via RV1-R1 and R3, and a similar current is passed through D2 via RV1-R2 and R3. The relative values of these currents can be adjusted over a limited range via RV1,



**Figure 11. Precision dc under-voltage switch, covering 5V upwards.**



thus enabling the forward volt drops of the diodes to be equalised, so that they give zero differential output when they are both at the same temperature.

Suppose then that the diode voltages have been equalised in this way, so that zero voltage differential exists between them. If now the temperatures of both diodes are raised by 10°C, the forward voltages of both diodes will fall by 20mV, and zero differential will still exist between them. The circuit is thus not influenced by identical changes in the temperatures of D1 and D2.

Suppose next that the temperature of D2 falls 1°C below that of D1; in this case the D2 voltage will rise 2mV above that of D1, so the op-amp's pin-3 voltage goes positive to that of pin-2, thus driving the op-amp output to positive saturation and holding Q1 and the relay off. Finally, suppose that the temperature of D2 rises 1°C above that of D1; in this case the D2 voltage will fall 2mV below that of D1, so the op-amp output goes into negative saturation and drives Q1 and the relay on. Thus, the relay turns on only when the temperature of D2 is above that of D1. The circuit has a typical sensitivity of 0.5°C.

The above explanation assumes that RV1 is adjusted so

that the D1 and D2 voltages are equalised when the two diodes are at the same temperature, so that the relay goes on when the D2 temperature rises a fraction of a degree above that of D1. In practice, RV1 is usually adjusted so that the standing bias voltage of D2 is some millivolts greater than that of D1 at normal temperatures, in which case the relay will not turn on until the temperature of D2 rises some way above that of D1. The magnitude of this differential temperature trip level is fully variable from zero to about 10°C via RV1, so the circuit is quite versatile. The circuit can be set up by raising the temperature of D2 the required amount above

that of D1, and then trimming RV1 so that the relay just turns on under this condition.

## DC Voltage-Activated circuits

Figure 10 shows the practical circuit of a precision dc over-voltage switch that activates only when the input voltage is greater than some pre-set value in excess of at least 5V. Here, the op-amp is used in the open-loop mode as a dc voltage comparator, with a Zener-derived 5V reference applied to the op-amp's non-inverting pin-3 input, and with the test voltage applied between the pin-2 inverting input and ground.

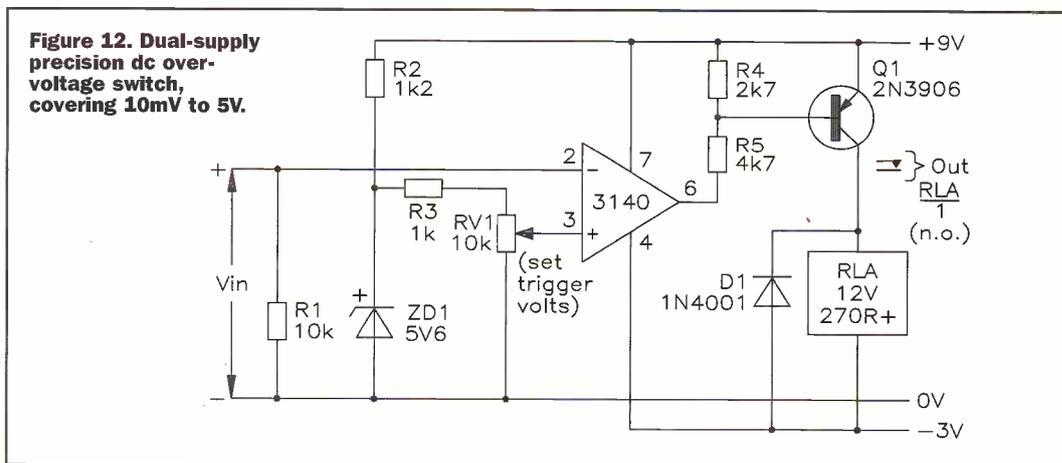
The circuit action is such that the op-amp output is positively saturated, and Q1 and the relay are off, when the pin-2 test voltage is fractionally less than the pin-3 5V reference value, and Q1 and the relay go on when the test voltage is greater than the 5V reference value.

Note in Figure 10 that Rx is wired in series between the input test voltage and the 10k (R1) impedance of the inverting input of the op-amp, and enables the circuit to be 'ranged' so that it triggers at any required voltage in excess of the 5V reference value. The Rx value for any required trigger voltage is determined on the basis of  $(2k\Omega \times V) - 10k\Omega$ . Thus, for 50V triggering,  $R_x = (50 \times 2k\Omega) - 10k\Omega = 90k\Omega$ . For 5V triggering, Rx must have a value of zero ohms.

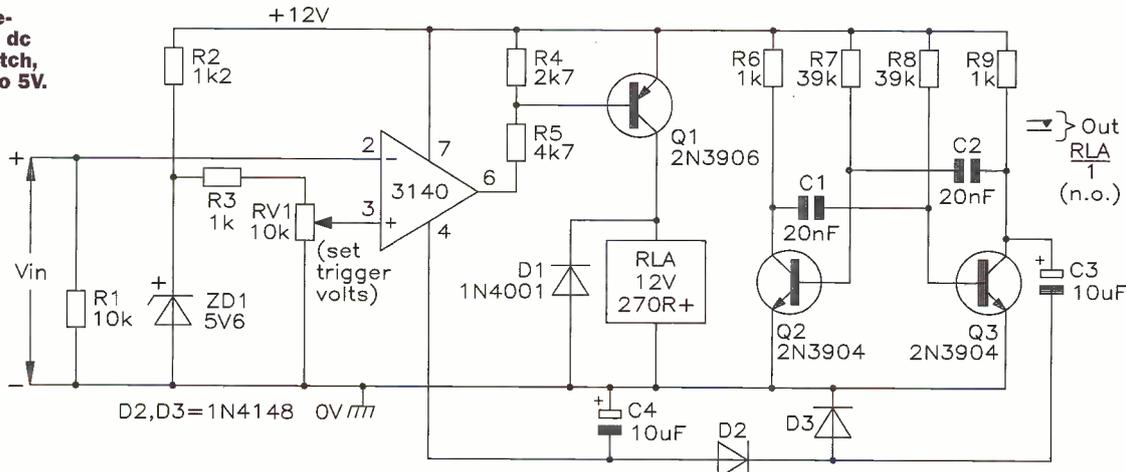
The Figure 10 circuit is very sensitive and exhibits negligible back-lash. Triggering accuracies of 0.5% can easily be achieved. For maximum accuracy, either the power supply or the Zener reference voltage of the circuit should be fully stabilised.

The Figure 10 circuit can be made to function as a precision under-voltage switch, which turns on when the input voltage falls below a preset level. Simply transpose the inverting and non-inverting input pin

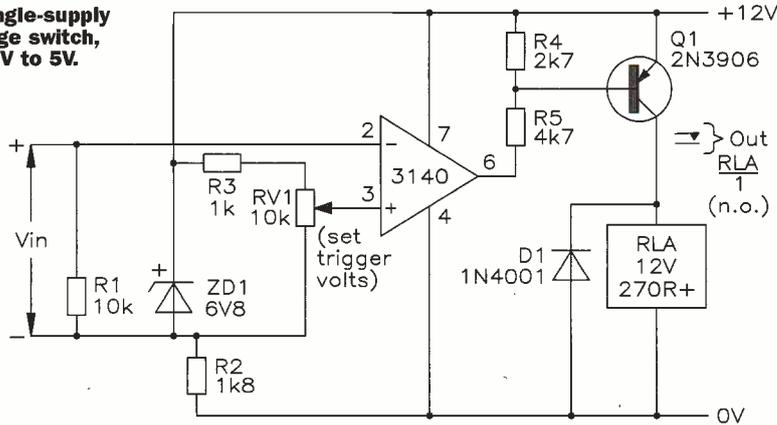
**Figure 12. Dual-supply precision dc over-voltage switch, covering 10mV to 5V.**



**Figure 13. Single-supply precision dc over-voltage switch, covering 10mV to 5V.**



**Figure 14. Single-supply dc over-voltage switch, covering 10mV to 5V.**



connections of the op-amp, as shown in Figure 11. This circuit also shows how the Zener reference supply can be stabilised for high-precision operation. Note in both of these circuits that, once 5V has been accurately set via RV1, the final triggering accuracy is determined solely by the accuracies of Rx and R1. In high-precision applications, these resistors must be stable high-precision types.

Figure 12 shows how the Figure 10 circuit can be modified for use as an over-voltage switch covering the range 10mV to 5V. In this case, the input voltage is connected directly to the op-amp's inverting input terminal, and a variable reference voltage is applied to its non-inverting input terminal and is adjusted to give the same value as that of the required trigger voltage. The circuit action can be reversed, so that the design acts as an under-voltage switch, by transposing the input pin connections of the op-amp. Note that the Figure 12 circuit uses two sets of supply lines (+9V and -3V), to ensure proper biasing of the op-amp.

Figure 13 shows how the Figure 12 circuit can be adapted for operation from a single set of supply lines. Here, Q2 and Q3 are wired as an astable multivibrator or squarewave generator. The output of this generator is used to provide a negative supply rail for the op-amp via the voltage-converting and smoothing D2-D3 and C3-C4 network. This gives a negative output of about 9V when unloaded, but this output falls to only 3V to 5V when it is loaded by connecting it to the pin-4 'negative supply' terminal of the 3140 op-amp.

Finally, Figure 14 shows the circuit of a dc over-voltage switch that covers the range 10mV to 5V and uses a single floating supply. Here, the op-amp is again used as a dc voltage comparator, but its positive supply rail is set at 6.8V via the floating supply and Zener diode ZD1, and its negative rail is set

at -5.2V via the ZD1 and R2 combination. The monitored input voltage is fed to the pin-2 inverting input of the op-amp, and the Zener-derived reference voltage is fed to the pin-3 non-inverting input of the op-amp via potential divider R3-RV1. This reference voltage can be varied between roughly 10mV and 5V, and this is therefore the voltage range covered by this over-voltage switch.

### AC Voltage-Activated circuits

The five voltage-activated switches shown in Figures 10 to 14 are all designed for dc activation only. All of these circuits can be modified for ac activation by interposing suitable rectifier/smoothing networks or ac/dc converters between their input terminals and the actual

ac input signals, so that the ac signals are converted to dc before being applied to the switching circuits.

Figure 15 shows the practical circuit of a precision ac over-voltage switch that is designed to work with sinewave signals in excess of 2.5V r.m.s. Here, the ac signal is converted to dc via the voltage-converting and smoothing network formed by Rx-C1-D1-D2-C2-R1, and the resulting dc voltage is applied to the pin-2 inverting input of the op-amp via R2. A Zener-derived 5.6V reference voltage is applied to the op-amp's non-inverting input terminal, and the circuit action is such that - when Rx has a value of zero - Q1 and the relay turn on when the dc voltage on pin-2 exceeds 5.6V.

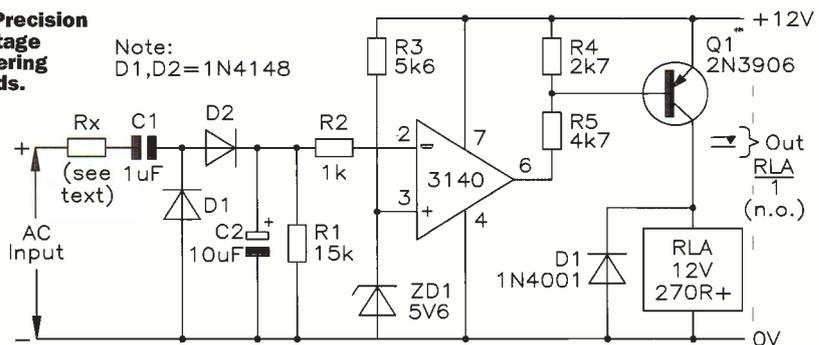
It is important to note in Figure 15 that the voltage-converting and smoothing network actually gives a dc

output voltage that is somewhat less than the peak voltage value of a symmetrical sinewave input signal. This type of network can not be used to measure the r.m.s values of non-symmetrical or pulse-type waveforms. Also note that the action of the Figure 15 circuit can be reversed, so that it acts as an under-voltage switch, by simply transposing the input terminal connections of the op-amp, as shown in Figure 16.

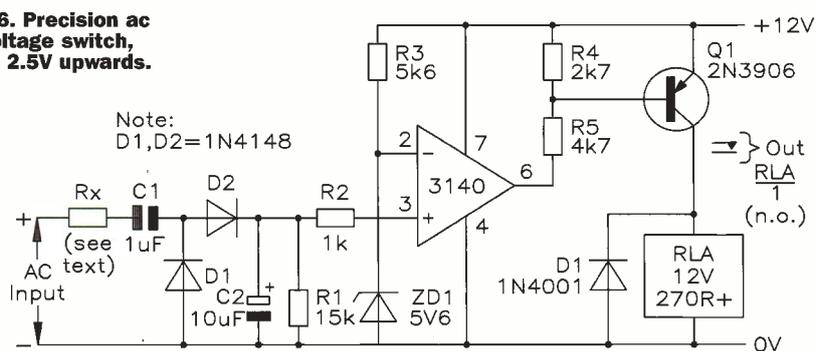
The Figures 15 and 16 circuits both have a basic input impedance, with Rx reduced to zero ohms, of 15kΩ (= R1), and under this condition, a sinewave of about 2.5V r.m.s is needed to activate the switch. Consequently, when Rx is given a finite value it acts as a potential divider with the 15kΩ input impedance, and enables the circuits to be triggered at any required ac input level in excess of 2.5V. The Rx value is chosen on the basis of roughly (6kΩ x V) - 15kΩ. Thus, if a circuit is to be activated at an input signal level of 10V r.m.s, Rx must have a value of about 45kΩ.

If required, the effective sensitivities of the Figure 15 and 16 circuits can be increased, so that they trigger at sinewave input levels substantially less than 2.5V r.m.s, by simply feeding the ac input signals to the inputs of the switching circuits via fixed-gain transistor or op-amp preamplifiers. Alternatively, the simple ac/dc converters used in these circuits can be replaced by high-gain precision types.

**Figure 15. Precision ac over-voltage switch, covering 2.5V upwards.**



**Figure 16. Precision ac under-voltage switch, covering 2.5V upwards.**



## Current-Activated circuits

Each of the five dc voltage switch circuits of Figures 10 to 14 can be used as a DC (power-level) current switch by simple feeding the monitored DC current to the input of the voltage switch via a current-to-voltage converter. A suitable converter circuit is shown in Figure 17.

In Figure 17, the op-amp is wired as a non-inverting  $\times 100$  voltage amplifier, with its gain controlled by the ratios of  $R_1$  and  $R_2$ . The test current is passed through input resistor  $R_x$ , which has its value chosen so that 50mV is developed across it at the required trigger current, thus giving 5V output from the op-amp under this condition; this 5V output is used to trigger the external voltage switch. The circuit's  $R_x$  value is selected on the basis of  $R_x = 50/I(\text{mA})$

where  $I(\text{mA})$  is the desired trigger current in milliamps. Thus,  $R_x$  needs a value of  $0R5\Omega$  at a trigger current of 100mA, or  $0.05\Omega$  at a trigger level of 1A, and so on.

Note that the Figure 17 type of converter circuit can also function as an AC current-to-voltage converter, and can be used to make an AC current switch by connecting its output to the input of a suitable ac voltage switch circuit.

If required, an op-amp circuit can be built specifically for use as a DC over-current switch by using the circuit shown in Figure 18. Here,  $R_x$  is again used to develop 50mV at the desired test current level, and this voltage is applied to the inverting pin of the op-amp. A Zener-derived reference of approximately 50mV is applied to the non-inverting input terminal of the op-amp; this reference voltage can be

adjusted over a limited range via  $RV_1$ , thus providing a limited control of the circuit's sensitivity.

Thus, the Figure 18 switch circuit's relay turns on when the current-derived input voltage exceeds the 50mV reference voltage. The circuit's action can be reversed, so that it acts as an under-current switch, by simply transposing the op-amp's two input terminals connections. In either case, the value of monitor resistor  $R_x$  is chosen on the basis of

$$R_x = 50/I(\text{mA})$$

where  $I(\text{mA})$  is the desired trigger current in milliamps. Thus,  $R_x$  needs a value of  $0R5\Omega$  at a trigger current of 100mA, or  $0.05\Omega$  at a trigger level of 1A, and so on.

## Resistance-Activated circuits

Figure 19 shows the practical circuit of a precision under-resistance switch that turns on when the value of a monitored resistance falls below a specific value. Here, the op-amp is again used as a voltage comparator, with its output fed to the coil of relay  $RLA$  via transistor  $Q_1$ . However, in this case the voltage on the op-amp's non-inverting input pin is set at half-supply volts via potential divider  $R_1$ - $R_2$ , and the voltage on the inverting input pin is determined by the ratios of  $R_x$  and  $R_{ref}$ . In effect, these four

resistors are wired as a Wheatstone bridge, and the circuit action is such that the relay turns on when the value of  $R_x$  falls below that of reference resistor  $R_{ref}$ , i.e., when the bridge goes out of balance in such a way that the voltage on the op-amp's inverting input terminal rises above that on its non-inverting input terminal.

In this circuit,  $R_{ref}$  must have the same value of the desired  $R_x$  'trigger' resistance value, which can have any value in the range  $100\Omega$  to  $1M\Omega$ ; the minimum usable resistance value is dictated by the current-driving capability of the circuit's power supply (and the power dissipation limits of  $R_{ref}$  and  $R_x$ ), and the maximum value is restricted by the shunting effect that the op-amp's input impedance and leakage impedance has in the effective value of  $R_{ref}$ .

The accuracy of the above circuit is (within sensible limits) quite independent of variations in power-supply voltage, and the 'switch' circuit is capable of responding to changes of less than 0.1% in the value of  $R_x$ . The actual accuracy of the circuit is determined by the precisions of  $R_1$ - $R_2$  and  $R_{ref}$ , and in worst-case terms is equal to the sum of the tolerances of these three resistors, i.e., it equals  $\pm 3\%$  if  $\pm 1\%$  resistors are used.

The action of the above circuit can be reversed, so that it acts as a precision over-resistance switch, by simply transposing the input pin connections of the op-amp, as shown in Figure 20. This circuit also shows how the basic accuracies of both designs can be improved by adding an  $RV_1$  'set balance' control to the  $R_1$ - $R_2$  potential divider chain. This control enables the bridge to be very precisely balanced (even when using  $\pm 5\%$  tolerance  $R_1$ - $R_2$  components) so that the circuit 'switches' when the value of  $R_x$  varies from the marked value of  $R_{ref}$  by only  $\pm 0.1\%$  or so. In this case, the true accuracy of the circuit is equal to the tolerance of  $R_{ref} + 0.1\%$ .

Figure 17. DC current-to-voltage converter.

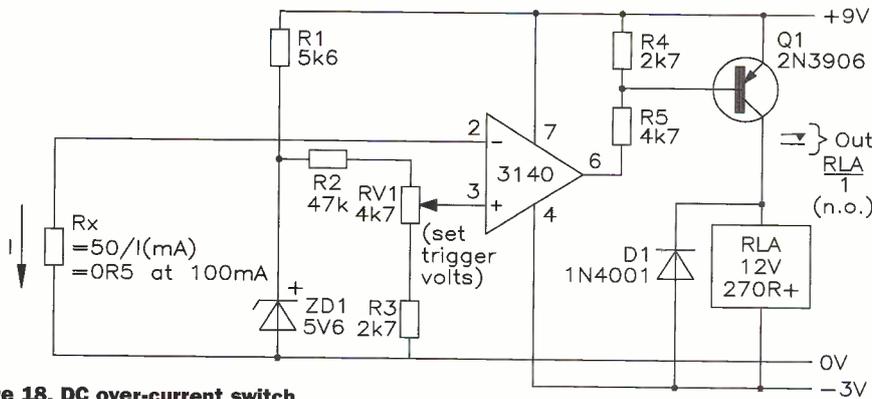
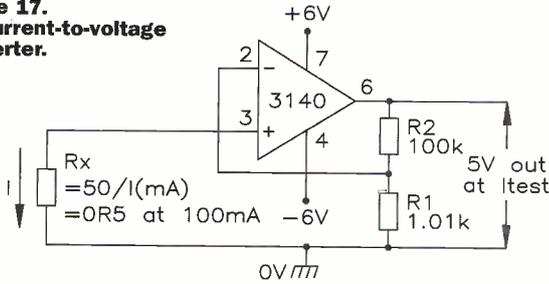


Figure 18. DC over-current switch.

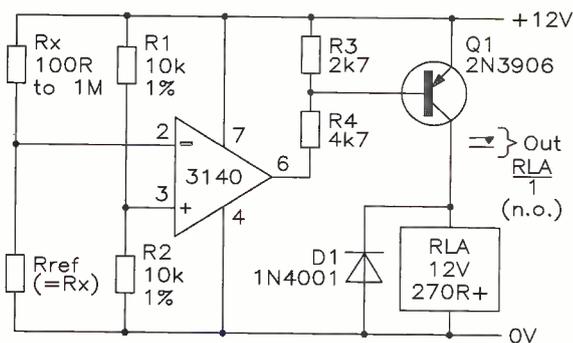


Figure 19. Precision under-resistance switch.

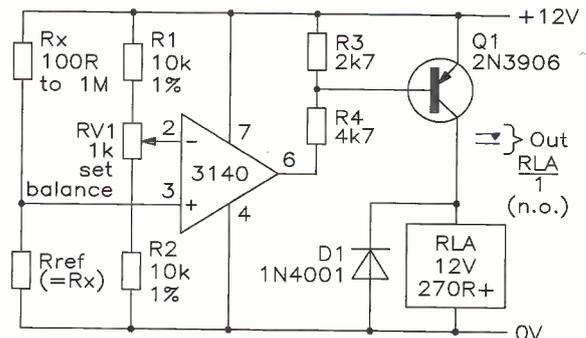


Figure 20. Precision over-resistance switch.

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.

## April 1998

- 2 to 3 April.** Knowledge Management 98, The Royal Horticultural Halls & Conference Centre, London. Tel: (01865) 388000.
- 6 April.** Space Time Adaptive Processing Colloquium, IEE, Savoy Place, London. Tel: (0171) 240 1871.
- 7 to 8 April.** Intranet EXPO, Olympia, London. Tel: (0181) 742 2828.
- 20 April.** Digital Filters: An Enabling Technology Colloquium, IEE, Savoy Place, London. Tel: (0171) 240 1871.
- 22 to 23 April.** Softworld for Information, Interactive Exhibitions, Ramada Hotel, London. Tel: (0181) 541 5040.
- 27 Apr to 1 May.** Engineering Lasers Exhibition, National Exhibition Centre, Birmingham. Tel: (01737) 768611.
- 28 to 30 April.** Infosecurity, Reed Exhibition Companies, Olympia, London. Tel: (0181) 910 791.
- 28 to 30 April.** Network Systems and Applications Management, Olympia, London. Tel: (0181) 910 7910.
- 29 to 30 April.** Windows World International Data Group, Ballsbridge, Dublin. Tel: (01784) 210 210.

## May 1998

- 6 May.** Cellular Manufacture & New Product Introduction, IEE Technical Visit, Malvern Instruments, Worcestershire. Tel: (0171) 240 1871.
- 6 to 7 May.** Data Warehouse Storage & Performance, The Commonwealth Institute, Kensington, London. Tel: (01908) 373311.
- 12 to 13 May.** Digital Mapping Show, Novotel, London. Tel: (01883) 652661.
- 12 to 14 May.** Internet World International, Olympia, London. Tel: (01865) 388000.
- 12 to 14 May.** Digital Interactive Marketing, NEC, Birmingham. Tel: (0171) 357 6161.
- 13 May.** Electric Cars Colloquium, Austin Court, IEE Midlands Engineering Centre. Tel: (0171) 240 1871.
- 20 to 21 May.** Communications in Public Safety, GMEX Centre, Manchester. Tel: (01322) 660070.

## June 1998

- 17 to 18 June.** Government Computing Show, The Royal Horticultural Hall, London. Tel: (0171) 587 1551.
- 17 to 18 June.** Business Intelligence, Olympia, London. Tel: (0181) 879 3300.

Please send details of events for inclusion in 'Diary Dates' to: News Editor, Electronics and Beyond, P.O. Box 3, Rayleigh, Essex SS6 8LR or e-mail to swaddington@cix.compulink.co.uk.

# What's On?



## Intel Everywhere

Intel's founder and chairman, Andy Grove outlined Intel's aggressive plans to dominate all segments of computing in his keynote speech to delegates attending the Intel Developers Forum in San Jose, California on February 17.

"The Intel Architecture platform is extending into more segments of computing," Grove said. "We are aggressively moving the Intel Architecture into the entry level, which we call basic computing. At the same time, we are continuing our focus and investing in moving our architecture into the most powerful segments of computing, workstations and enterprise servers."

Grove revealed Intel's strategy to expand its product line by using a common foundation, the P6 microarchitecture, across an entire family of new products designed for specific market segments. A new basic computer platform processor under development, code named Covington, is slated to begin shipping in mid '98, and will utilise the P6 microarchitecture to bring the highest level of price/performance to the basic computing market segment.

"The basis of Intel's solution for all computer segments is the P6 microarchitecture. This is the same architecture that the Pentium II processor is built upon," Grove said. He further revealed that Intel would shortly launch a new processor brand name to be associated with the basic computing segment.

## Investment Forum Answers the Need for Investment in Technology

The Federation of the Electronics Industry (FEI) held its second investment Forum in February for small fast growing technology companies aimed directly at bridging the equity gap for technology companies.

Fifty-four investors heard presentations from 32 innovative young technology firms and held face to face meetings with owners seeking equity finance to launch new products and services in business markets here and abroad.

Last month's event follows the highly successful Forum in February 1997 – following which 9 firms, out of 31 who presented, have secured funding from investors for their growth plans.

Opening the Forum at the Celtic Manor Hotel in Newport, Gwent, FEI director general Anthony Parish said, "The technology sector will represent 10 per cent of world revenue by the end of the century. It is obvious that we need to use every means to enable

promising UK companies to grasp opportunities in this global industry."

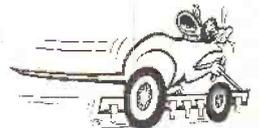
Dr Herman Hauser, founding partner in the Amadeus Venture Fund and keynote speaker at the Forum, reinforced this view by listing a catalogue of UK successes in the technology sector, and advising that the UK's £18 billion venture capital market – the second largest in the world after the US – was in danger of slipping behind in the world

rankings if it overlooks the major opportunities in infant companies.

Products from presenting firms included Internet trading systems, tokens for fast sign on to PCs, exciting new transistor technology, communications systems, applications software, advanced security systems and cheaper more efficient battery technology.

## UK Mice to Meet in Manchester

Do you think you could build a robot mouse capable of exploring and solving its maze quicker than any other competitor? Would you like to win one of the coveted Brass Cheese Trophies and cash prizes? If so, why not enter the IEE World Micromouse Championship on Saturday, 20 June 1998 at the University of Manchester.



Micromouse is a competition for 'intelligent' robotic devices, which have to find their way to the centre of a maze in the shortest possible time. Mice come in all shapes and sizes. Some have rodent faces, others flashing lights. Some even talk.

You don't have to be an expert to take the Micromouse Challenge. As well as the advanced level, there are intermediate, teenage and simplified schools competitions. The latter is designed for children aged 11 years to 16 years to further encourage learning in mechanics, electronics, computer programming and teamworking. It also provides a lead-in to the main Micromouse competition for 16 year olds upwards.

## Northern Ireland Leads the Way in Information Society

Northern Ireland is playing a leading role in the development of the Information Society, according to Keith Todd, chief executive of ICL, the IT systems and services company.

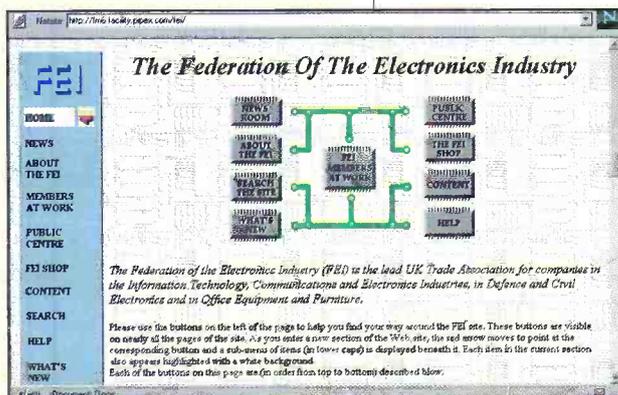
Visiting Belfast to mark the completion of ICL's £1 million investment in new office and customer facilities at its Belfast premises, Todd said, "I have been highly impressed with the initiatives taking place here in Northern Ireland. It is obvious that IT is being fully integrated into every aspect of life and that the infrastructure is in place to keep one step ahead in today's fast changing technological world."

Focusing on education, Todd added, "Having met a number of people closely involved with education in Northern Ireland, it is obvious that a well developed network of services exists.

"Excellent work has been carried out through projects such as Computerised Local Administration Systems for Schools (CLASS) and the advanced technology base in Northern Ireland schools means that they are in an ideal position to maximise emerging technologies.

"Furthermore, I believe that the education sector in the province is more aware of the benefits of the new technology than any other region in the UK, and is ideally placed to implement the National Grid for Learning. This is clearly illustrated in the content of the recently published Education Technology Strategy for Northern Ireland," added Todd.

ICL currently employs more than 550 people in Northern Ireland at its operations in Belfast. ICL is Ireland's largest outsourcing company, which has offices in Belfast and Dublin.



# Using the Maplin CD-ROM HELPFUL GUIDELINES

These notes contain additional information for users of the new Maplin Electronics CD-ROM Catalogue, released March 1998. Please read them before using your CD. You will also find extra information on the CD, in the 'Readme.Doc' or 'Readme.txt' files.

For PC users with Windows 95, right click on the 'Start' button and choose 'Explore' from the pop-up box. A window will appear showing all of your drives on the left hand side. Scroll down this list until you see the 'Maplin' CD. Double click on the small CD picture next to the word 'Maplin' and the contents of the CD will be displayed on the right hand side of the screen. Double click the 'Readme' file to read the notes.

We have worked hard to ensure that this first release Maplin CD is as good as it can possibly be, but we hope that you will be patient if you do find any problems using the CD with your machine. You are very welcome to write to us or e-mail us at the address below if you do have any comments regarding the CD or any problems in using it. Please let us know as much as you can about the type of machine that you are using, the amount of memory fitted and the type of graphics card fitted.

## Mac users

This CD does require a well specified Mac to run the Maplin catalogue program, which is very graphically intensive. Minimum recommended specification for Mac machines is 48Mb memory (RAM) or better, with at least 120Mb free hard drive capacity. Please note that older Macs such as the 475 or 530 are not recommended as they do not have sufficient graphics memory for this application and are not easily upgraded. Please check that you are able to set your graphics resolution (using 'Monitor' or 'Monitor and Sound' under 'Control Panels') to

thousands of colours at 832 x624, or better. Note that some Mac software extensions may cause conflicts with the software on this CD.

## 'Compact' installation

If you install this CD using the 'compact' installation option (recommended for faster installation, or where less than 100Mb is free on your hard drive), some of the data files used by the catalogue program will be left on the CD. The first time you run the program, you will need to show the program where the data is on your CD-ROM drive. Full instructions for doing this are on the text file on the CD, called 'Readme.doc'.

## After Installation

Please note that a special Maplin font containing various special characters used throughout this catalogue will be placed on your hard drive during installation. Use 'Start' / 'settings' / 'Control panel' / 'Fonts' and double click on the Maplin font icon to check that the font has been placed correctly. Your machine will need to be restarted in order for Windows 95 to recognise this font fully and start to use it, before running the catalogue program.

## Calculation of bulk quantity prices

Bulk quantity prices are correctly displayed with each product. However, when confirming the quantity to be ordered a display error can arise where the left most price column in the 'product detail' screen is for any quantity other than 1. Upon receipt of your confirmed order Maplin will ensure that the correct lower bulk quantity price is reinstated and you will not be disadvantaged. We apologise for any inconvenience this may cause.



## Display of information text

Some of the text files displayed on this CD have been observed to be displayed with the very bottom line partly obscured by the scrollbar at the bottom of the screen, on PC's using some types of graphics card.

## Video clips

Some early versions of Windows 95 were provided with a media player 'program' that is incapable of playing video clips supplied with this CD. After installing the newer version of the program by double clicking in the 'Amov4ie' file on the root directory of this CD and restarting the machine once installation is finished, these movie clips should play. If however, your machine does not play the clips correctly, they may still be viewed by double clicking one of the movie camera icons on the root directory of the CD.

## Disclaimer

Whilst Maplin Electronics PLC provide you with this software we cannot be held responsible for any effect it may have on your own software or hardware. We have taken as much care as possible with the construction of the CD but we cannot be responsible for any data loss.

ELECTRONICS

## Updates

Please visit our web site <http://www.maplin.co.uk> for the latest updates on this CD, or write to us at: Maplin Electronics PLC, Maplin House, 274-288 London Road Hadleigh, Benfleet, Essex SS7 2DE Our E-Mail address is: [techsales@maplin.co.uk](mailto:techsales@maplin.co.uk), or telephone Customer Services: 01702 554002

## FREQUENTLY ASKED QUESTIONS

### 1 What's the difference between a full install and a compact install?

The compact install requires far less disk space because it doesn't copy the main database file across to your hard drive. When you run it for the first time, it will show a window asking 'Open which database', showing the install directory. Use the (angled arrow) back directory button at the top of the window to move back until you see your drives listed. Then double click the icon for the CD to display the contents. This will show four folders and a file called 'Maplin' with a blue icon. Double click the icon to run the program.

### 2 When I run the program, I can't close the 'New product of the day' window.

When the program runs and the 'New product' window appears, just wait a second or two, then position the mouse pointer over the product photo and click. The window will disappear. Click on the large 'Maplin' picture behind, then on the next screen, to get to the first menu screen.

### 3 How do I exit the program without resetting the PC? The 'X' button on the toolbar doesn't work.

Use the round red buttons with 'Q' (Quit) in them. Once you have clicked past the first screens, every screen you will use has a 'Q' button. Most are in the top right of the screen.

### 4 My program won't run and asks me to put the CD in the drive, but it's already there.

Your CD-ROM drive letter must be higher than I:. This first version only works with CD-ROM drives up to I:, although some users will find that a compact install cures this problem. We will be putting a patch program on our web site to cure this.

### 4 Will the program work with Windows 3.1?

No, this version of the program needs Windows 95 (or a Mac) to run.

### 5 Some of the prices don't seem right.

The 'Add to order' button on the 'Enter Order' screen is incorrectly giving bulk prices, even if only one item is ordered. Don't use this button, use the button on the product detail screen instead, once you have found the product you want using 'Stock Code Search'. Sadly, there are also problems with the prices shown for items ordered in bulk, for those items where the left most quantity shown on the 'Product Detail' screen is greater than 1+ (mainly components). Please bear with us. We will correct this as soon as possible. We assure you that we will charge the correct pricing upon entering your order.

### 6 Some of the Buttons don't seem to do anything. Why is this?

Some of the buttons work in a drill down sequence, where you have to operate them in the right order. You can't use 'Product Detail' until you have chosen a product to look at and you can't choose 'Product Browse', when you haven't selected any products to browse. Use either the 'Product category search' to select a catalogue section (or part of a section, group or sub-group) by clicking and highlighting something from the four column table, or use 'Keyword search' to bring up a list of products. Then click 'Product Browse'. Click a picture on the product browse screen, or on a result list to display the product details. Clicking 'Product detail' after that will return you to the detail for the product last viewed.

### 8 When I look at the shops maps, it always shows Leeds. How do I show my local store?

Click on 'National Network' on the 'Stores and Superstores' screen. When the map comes up, click on the red spot in the region you are interested in. When the region map appears, click on the spot for the shop you wish to view. Subsequent presses of the 'Regional Network' and 'Individual Stores' buttons will go straight to the last region or store selected. If you wish to show another store in the selected region, click on the relevant spot on the 'Regional Network' screen. For stores outside that region, use the map on 'National Network' to select a new regional map.

### 9 How do I view the datasheets?

You will need to install the Adobe Reader 3.0, which is also on the CD as 'Ar32e301'. Double click from Explorer to install. Note that some machines have problems seeing the data sheets from the product detail screen (although clicking 'OK' to close the 'Can't find PDF' error message, then clicking 'Back', 'Forward' does load them!). You may choose the data sheet required from the list under 'Technical & Information' 'Data Sheets', or double click on the required filename (saved under part numbers) on the 'Datasheets' directory on the CD from Windows Explorer.

### 10 The text on the 'Product Detail' screen is unreadable. What do I do to improve it?

The installer used does not always install the special Maplin font used by the catalogue. Use Start / Settings / Control Panel / Fonts to display a list of fonts on your system. Scroll down your list of font icons and look for 'Maplin'. If it is there, double click it to display it, then restart your PC. The font should now be used. If it isn't there and a re-install doesn't put it there, we can send you a copy of the font via E-mail, or on disk, upon request.

# TECHNOLOGY WATCH



with Martin Pipe

In this edition of Technology Watch I'll concentrate on biometric validation, which is seen as the future of secure access. Traditional security systems used in banking, door controls, vehicles and other such systems identify authorised people through knowledge (PINs – Personal Identification Numbers – or passwords), possessions (such as magnetic stripe cards, keys or smart cards), or both. If somebody steals your key, or intercepts your password, they could gain access to your bank account, e-mail or car. As defined by the International Biometric Association, a biometric is a measurable physical characteristic or personal trait used to recognize the identity, or verify the claimed identity, of a person through automated means. Such characteristics include the eye's iris or a fingerprint, all of which are – in practical terms – unique to a particular person and hence can be regarded as a means of identification. In other words, gaining access can only be achieved if you are that person. These biometric characteristics cannot be stolen, and are not easy to fake.

## Validation

Biometric validation systems centre around a sensor that digitises the appropriate personal attribute during an 'enrolment' phase. A computer then analyses the data, and stores it on a smart card or a central database – perhaps both, for added security – as a profile specific to that user. Every time the user subsequently tries to gain access, the data generated by the sensor is compared with the profile. If there is a close match with the profile, then authorisation is granted. Note that an absolute match is seldom possible if verification is to be achieved within a reasonable period and so a compromise measure, in the form of tolerance limits, is built into the system. These tolerance limits are carefully calculated, perhaps via a long sequence of trial runs during the development and field trial stages. If the limits are incorrect either way, unauthorised users could be incorrectly granted access, or authorised users refused entry. This would clearly be unacceptable.

## Latest Developments

Several of the latest developments in biometrics could be seen at a trade show organised by the German company Siemens Nixdorf (<http://www.sni.de>), a major player in the banking technology sector. The banking industry has traditionally been hit heavily by fraud, and biometrics represents the latest weapon in its armoury. At the Product and Trend show, which took place in the company's home city of

Paderborn, several of Siemens Nixdorf's technology partners were demonstrating biometric validation systems. Most of these systems are designed for installation on business premises, although the third is quite cheap to produce and could end up built into smart cards, Internet commerce terminals or personal computers.

## Fingertip Sensor

This latter development, the fingertip sensor, has been developed by the semiconductors wing of parent company Siemens. Users press their fingertips on the CMOS-fabricated sensor, which consists of a 256-point by 256-point conductive matrix. The operation of Siemens' sensor relies on the variations in capacitance that are caused when the sensor's points are in close proximity to flesh. At the sensor's microscopic level, the lines that give individuals their unique fingerprint patterns appear as ridges and peaks that can span several points of the matrix. This gives you some idea of the sensor's high resolution; the points are spaced by a pitch of 50.4µm and the overall resolution in the area is stated as 500dpi. Each ridge and peak results in a slightly different capacitance between the points. The capacitance variations across the matrix are measured and digitised, providing data that allows a computer to quickly build up an accurate portrait of the fingerprint. Siemens prototype, together with its associated analogue and digital circuitry, works from a 5V supply and consumes 6mW.

## Smart Card

The company sees the sensor being integrated directly onto a smart card, although the prototype model took the form of a device that hooked up to a PC's parallel port. There is no reason why the system could not be used as a substitute for the car's ignition key, or to provide access to mobile phones. Presumably, sweat could affect the sensor's performance, and it would be interesting to learn how the associated software handles different fingertip pressures and variations in finger positioning. Unfortunately, more detailed information didn't make it to me in time despite several requests. Such factors are, however, probably software-corrected or built into those aforementioned tolerance limits.

## Iris Identification

Of the other systems demonstrated at Paderborn, the most interesting was developed by Sensor (<http://www.sensor.com>), one of Siemens Nixdorf's American partners. 'Secure', which is designed for integration into an ATM cash machine, employs a pair of digital cameras to analyse the iris of the customer's eye. Validation through iris identification is potentially more secure than fingerprint recognition; according to Sensor, the iris has over 250 measurable discriminations, against the 40 or so for a fingerprint. As with fingerprints, eyes don't change as you get older. What's more the iris, as an internal organ, is less vulnerable to damage than fingers.

Secure consists of two components. The first is an optical unit, built into the ATM, that houses the two cameras. This is interfaced to a box of electronics that does all of the analysis donkey work. During enrolment, the first camera locates the customer's face and determines the exact position of the eye. The second camera acquires a black and white image of the eye. Software, running on the identification processing unit, splits up the iris portion of this image into a complex circular grid, in order to analyse its pattern structure. Analysis involves the examination of the dark and light areas within each cell of the grid, and generates a customer-specific 512-byte identification code that is stored or compared with a previously-stored code. The process takes around two seconds.

## Multimedia Kiosk

Biometrics was one of the more interesting areas covered at the Paderborn show. Another was a new type of vandal-proof multimedia kiosk, exhibited in prototype form. One of its key components is a recessed LCD projector that casts an image downwards onto a horizontal flat surface. Derived from a computer, this image contains various option menus and a movable cursor. A camera mounted alongside the projector provides feedback to the controlling computer. It allows the motion of the user's fingers to be tracked, and the position of the cursor to be changed correspondingly. If the finger is kept still for a short period, any menu upon which the cursor lies at that point is selected. All interesting stuff, but alas the nice gent from Siemens Nixdorf could not provide any technical details on the motion tracking system, and the obviously powerful hardware required to run it.

ELECTRONICS

E-mail your comments or suggestions to Martin Pipe at [whatnet@cix.computlink.co.uk](mailto:whatnet@cix.computlink.co.uk).



# ELECTRONICS Classified



## Computers

**Spectrum +2 Computer** in perfect condition with self-learning course of four volumes in BASIC language programming £50.  
Tel: (01903) 755204.

**24 Assorted PC magazines** £5, and PC Plus Magazine issues 76 to 123 Jan 93 to Jan 97. £10  
Tel: (01692) 536323 (Norwich area).

**Electronic circuit simulator program** for PCs. Calculates gain, phase and impedances. Provides screen output and graphs for Epson, IBM and HP printers.  
Many worked examples. £10.  
Tel: (01753) 643384.

## Wanted

**Maplin 'Electronics' Magazine** copies: Vol. 3 No 11 June/Aug 84, Vol. 3 No 12 Sept/Nov 84, Vol. 4 No. 13 Dec 84/Jan 85, Vol. 4 No. 14 March/May 85, Vol. 4 No. 15 June/Aug 85. Can swap for copies I have of Vol. 5 No. 18 March/May 86, Vol. 8 No 30 Feb/March 89. Vol. 11 No. 52 April 92, Vol. 11 No 59 Nov 92. John  
Tel: (0181) 363 6983 (Enfield).

**Maplin audio/video modulator** project either assembled or unfinished kit. Alternatively, has anyone a spare Astec UM1286 modulator module they no longer need? Douglas Hunt  
Tel: (01294) 552250.

## For Sale

**For Sale** (due to bereavement) a new Magellan GPS2000 Satellite Navigator with power/data module £160 - Catalogue price over £200.  
Tel: (01305) 848823, after 6pm.

**Maplin 'Electronics' Magazine** copies: Vol. 5 No. 18 March/May 86, Vol. 8 No 30 Feb/March 89. Vol. 11 No. 52 April 92, Vol. 11 No 59 Nov 92. 50p each including p. & p.  
John Tel: (0181) 363 6983 (Enfield).

**Oscilloscopes** Scopex 4D-10 £20, 14D-10 £30 - Both 10MHz dual channel. Avo Model 8 MkIII multimeter £55. Epson dot-matrix printers LX80 and LX800, £15 each. Buyer collects. Tel (01323) 482552 (E. Sussex).

**12 Large Red LED Displays** 6 x 12in. Contain 3 x 7-segment, with 6 x 5mm LEDs per segment, over 1500 LEDs. Tel: Steve (01227) 265531.

## Club Corner

**ARS** (Aberdeen Amateur Radio Society) meets on Friday evenings in the RC Hall, 70 Cairngorm Crescent, Kincorth. For details contact: Martin, (CM0JCN), Tel: (01569) 731177.

**The British Amateur Electronics Club** (founded in 1966), for all interested in electronics. Four newsletters a year, help for members and more! UK subscription £8 a year (Junior members £4, overseas members £13.50). For further details send S.A.E. to: The Secretary, Mr. J. F. Davies, 70 Ash Road, Cuddington, Northwich, Cheshire CW8 2PB.

**Bury St. Edmunds Amateur Radio Society.** Meetings held at Culford School, 7.30pm for 8.00pm on the third Tuesday of each month, unless otherwise stated. Further details from Kevin Waterson, (G1GVI), 20 Cadogan Road, Bury St. Edmunds, Suffolk IP33 3QJ. Tel: (01284) 764804.

Placing an advertisement in this section of *Electronics and Beyond* is your chance to tell the readers of Britain's best magazine for electronics enthusiasts what you want to buy or sell, or tell them about your club's activities - **Absolutely Free of Charge!** We will publish as many advertisements as we have space for. We will print the first 30 words free, but thereafter the charge is 10p per word for each added advert per reader.

Placing an advertisement is easy! Simply write your advertisement clearly in capital letters, on a

postcard or sealed-down envelope. Then send it, with any necessary payment, to: *Electronics Classified*, P.O. Box 777, Rayleigh, Essex SS6 8LU. Advertisements will be published as soon as possible, space allowing. No responsibility is accepted for delayed publication or non-inclusion of advertisements.

Readers who have reasonable grounds to believe they have been misled as to the nature of an advertisement are advised to contact the Publisher and their local Trading Standards Office.

**Crystal Palace and District Radio Society** meets on the third Saturday of each month at All Saints Church Parish Rooms, Beulah Hill, London SE19. Details from Wilf Taylor, (G3DSC), Tel: (0181) 699 5732.

**Derby and District Amateur Radio Society** meets every Wednesday at 7.30pm, at 119 Green Lane, Derby. Further details from: Richard Buckley, (G3VGW), 20 Eden Bank, Ambergate DE56 2GG. Tel: (01773) 852475.

**Electronic Organ Constructor's Society.** Details of programme magazine, membership and details of provisional dates of regional meetings for 1998 from: Don Bray (Hon. Sec.), 34 Etherton Way, Seaford, Sussex BN25 3QB. Tel: (01323) 894909, Fax: 01323 492234.

**E.U.G.** User group for all 8-bit Acorn Micros, since 1991. Still going strong. Programming, news, information, sales. Contact: E.U.G., 25 Bertie Road, Southsea, Hants, PO4 8JX. Tel: (01705) 781168.

**The Lincoln Short Wave Club** meets every Wednesday night at the City Engineers' Club, Waterside South, Lincoln at 8pm. All welcome. For further details contact Pam, (G4STO) (Secretary). Tel: (01427) 788356.

**The Lincon Short Wave Club** Meetings every Wednesday from 7.45pm at Lincoln Railway Sports and Social Club, The Ropewalk London. Lincoln Hamfest 98 on Sunday 13th September. Contact: Cliff Newby

G3EBH, 25 Sudbrooke Lane, Nettleham, Lincoln, LN22RW. Tel 01522 750637. Packet BBS G3EBH @gb7dx.#26.gbr.eu.

**MERG?** 2 first class stamps (or 4 IRCs) to John Weal, 23 Chapel Street, Yaxley, PE7 3LW brings you a substantial introductory pack to the Model Electronic Railway Group - actively applying electronics and computers to the model railway operation.

**7th Northern Cross Rally** - Sunday 15th February. 1998 - Large hall venue - Thornes Park Athletics Stadium, Wakefield - Details: Pete Smith G0BQB Tel: 01924 218217.

**Preston Amateur Radio Society** meets every Thursday evening at The Lonsdale Sports and Social Club, Fulwood Hall Lane, Fulwood, (off Watling Street Road), Preston, Lancashire PR2 4DC. Tel: (01772) 794465. Secretary: Mr Eric Eastwood, (G1WCQ), 56 The Mede, Freckleton PR4 1JB, Tel: (01772) 686708.

**Science At Your Fingertips.** Want to meet friends interested in Science? Send an SAE to: Daniel Gee, S.A.Y.F., 37 South Road, Watchet, Somerset TA23 0HG, or Scott Mason, S.A.Y.F., 58 Park Avenue, Devonport, Plymouth PL1 4BR <http://homepages.enterprise.net/icedragon/says.htm>.

**SEEMUG** (South East Essex Mac User Group), meet in Southend, every second Monday of each month. For details Tel: Michael Foy (01702) 468062, or e-mail to [mac@mikefoy.demon.co.uk](mailto:mac@mikefoy.demon.co.uk).

**Southend and District Radio Society** meets at the Druid Venture Scout Centre, Southend, Essex every Thursday at 8pm. For further details, contact: P.O. Box 88, Rayleigh, Essex SS6 8NZ.

**Sudbury and District Radio Amateurs** (SafDRA) meet in Gt. Cornard, Sudbury, Suffolk at 8.00pm. New members are very welcome. Refreshments are available. For details please contact Tony, (G8LTY), Tel: (01787) 313212 before 10.00pm.

**TESUG** (The European Satellite User Group) for all satellite TV enthusiasts! Totally independent. TESUG provides the most up-to-date news available (through its monthly 'Footprint' newsletter, and a teletext service on the pan-European 'Super Channel'). It also provides a wide variety of help and information. Contact: Eric N. Wiltsher, TESUG, P.O. Box 576 Orpington, Kent BR6 9WY.

**Thanet Electronics Club.** For school age Ham Radio and Electronics enthusiasts, enters its 16th Year. Meetings held every Monday evening from 7.30pm at The Quarterdeck, Zion Place, Margate, Kent. For further details contact: Dr. Ken L. Smith, (G3JIX), Tel: (01304) 812723

**Wakefield and District Radio Society** meet at 8.00pm on Tuesdays at the Community Centre, Prospect Road, Ossett, West Yorkshire. Contact Bob Firth, (G3WWF), (QTHR), Tel: (0113) 282 5519.

**The (Wigan) Douglas Valley Amateur Radio Society** meets on the first and third Thursdays of the month from 8.00pm at the Wigan Sea Cadet HQ, Training Ship Sceptre, Brookhouse Terrace, off Warrington Lane, Wigan. Contact: D. Snape, (G4GWG), Tel: (01942) 211397 (Wigan).

**Winchester Amateur Radio Club** meets on the third Friday of each month. For full programme contact: G4AXO, Tel: (01962) 860807.

**Wirral Amateur Radio Society** meets at the Ivy Farm, Arrowe Park Road, Birkenhead every Tuesday evening, and formally on the the first and third Wednesday of every month. Details: A. Seed, (G3FOO), 31 Withert Avenue, Bebington, Wirral L63 5NE.

**Wirral and District Amateur Radio Society** meets at the Irby Cricket Club, Irby, Wirral. Organises visits, DF hunts, demonstrations and junk sales. For further details, please contact: Paul Robinson, (G0JZP) on (0151) 648 5892.

Please write your classified advert using one word per box below. Adverts of 30 words or under will be printed free of charge, but thereafter the charge is 10p per word. Please include any payment for extra words with your advert.


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# @Internet

## Hold the standards high

The International Telecommunications Union has agreed on the technical specifications for 56K modems, and the formal approval process of the new modems has already been initiated. The new 56K recommendation is called V-90, so the old terms denoting trade versions of 56K modems (K56flex, and x2) are likely to be dropped by the two competing manufacturers who are anxious to get manufacturing and selling modems to the new standard.

As the work to determine the V-90 recommendation started only in March last year, the standard has the enviable status of being the fastest modem recommendation ever. The ITU highlights this as its commitment to respond quickly to urgent market needs. It's thought that sales of modems have been falling as of late, as few users wanted to buy a modem that couldn't work once a new standard was reached. As a result, it's also expected that modem sales will increase significantly over the coming months as users rush to upgrade.

In certain cases, users of either K56 or x2 technology 56K modems may be able to upgrade their modems with a software update to enable them to comply with the new V-90 recommendation. Contact your dealers if you think this might be the case, or checkout your modem manufacturer's Web site.

## Higher

One of the nice things about the Internet is watching it develop. Sometimes things can come along that change how you use it. Occasionally, things can affect other areas of computing life too. One of these things is QuickTime, which is rapidly developing into a product that looks likely to be placed by default on every new computer within the next year or so. QuickTime is a cross-platform solution to one of the nastiest problems in computing — how to present multimedia effects on computer screen. Multimedia — in which sounds, videos, special effects and so on are played on a computer — has been around in various seedling forms for a few years. However, one of the reasons for multimedia taking a few years to come

to fruition, and be widely accepted, is the very fact that there are various forms of it around. It's been quite tricky developing multimedia product that can playback on all the wide variety of computers in existence. What's good for one PC goose is not good for a PC gander. Rather than converging, new technologies have merely diverged the requirements of multimedia computers over the years, leaving us currently with no definitive standard way of publishing multimedia products.

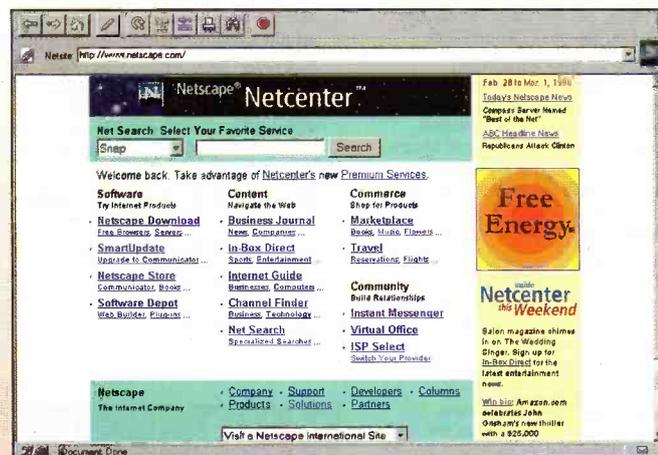
QuickTime, like other multimedia formats, is a medium in which sound, videos and effects can be manipulated. QuickTime files in the QuickTime Movie format can play on any computer equipped to play QuickTime movies — in other words, any QuickTime-capable computer can playback any QuickTime file. The latest version of QuickTime, on the other hand, plays back all other major multimedia file formats too — unlike all other individual file format players. Files of AVI, OMF, MPEG, DVD, DVB, DVcam and others are all playable with the latest version of the QuickTime architecture. Broadly speaking this means that the file format used to store multimedia is now irrelevant to a QuickTime-capable computer.

Put another way, a QuickTime-capable computer is not restricted to having to maintain a multimedia player for outmoded formats, despite having to maintain a collection of legacy files in those outmoded formats. Whatever your collection of multimedia files, and however old and outmoded they are, QuickTime will play them.

If any reader is in doubt as to the fact that QuickTime represents the future of multimedia, bear in mind that the latest version of QuickTime (version 3) has been adopted by the International Standards Organization (ISO) as the starting point for development of a unified digital media storage format for the future MPEG-4 specification.

QuickTime 3 is in final stages, and a stable pre-release edition can already be freely downloaded for Macintosh and Windows 95/NT computers, from <http://www.quicktime.apple.com/>. However, it's a large multi-megabyte download, so it might be worth waiting until it's supplied on magazine cover disks in due course. Naturally, any future multimedia products that uses QuickTime technology (the number is expected to grow rapidly now that a unified format is in the pipeline) will have the requisite QuickTime player installed along with other user files when first loaded on the computer.

## Netscape for Sale?



Analysts reckon that Netscape, which is embroiled in a fight with Microsoft over the browser market, is seeking a buyer for all or part of the company, and has held discussions with Sun Microsystems, AOL, IBM and Oracle.

These are amongst a long list of companies that would like to see Netscape succeed in its efforts to derail Microsoft's in its attempts to dominate the Web browser arena. Netscape's browser market share has fallen to 57%, down from 73% a year ago, largely due to Microsoft's success.

## Know London Better



'This is London', is an interactive online guide to London for residents and visitors, from Associated Newspapers, the publishers of the Evening Standard at [www.thisislondon.com](http://www.thisislondon.com).

'This is London' is based on six content supplements including a comprehensive entertainment section, listing guides for

London, sections on Lifestyle, Food and Drink and Things to Do, and up-to-the-minute 24-hour, seven day information on News, City and Sport.

Associated Newspaper's dedicated electronic newsroom updates and keeps the site fresh with breaking news content, 24-hours a day, seven days a week.

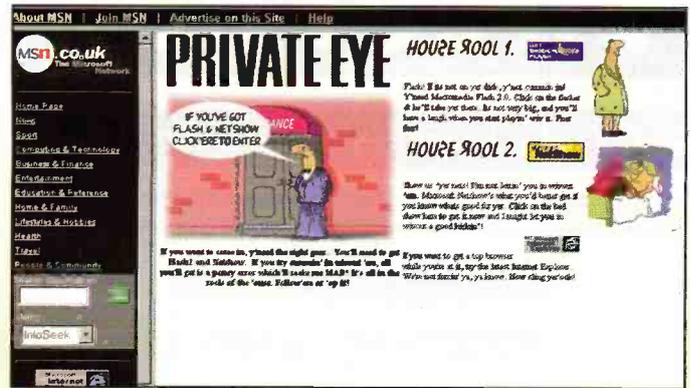
## Private Eye Hits the Web

Microsoft Network has teamed up with the usually 'techno-sceptic' Private Eye, the UK's favourite satire magazine, to pour scorn on politicians, the media and bungling sports commentators on a new interactive multimedia Web site at [www.msn.co.uk](http://www.msn.co.uk)

Without sounding like Private Eye's infamous Pseuds Corner, the site will exploit the Internet's capabilities to combine text, audio and moving illustrations, bringing many of

the Eye's most loved characters and columns to life for the first time, in full multimedia.

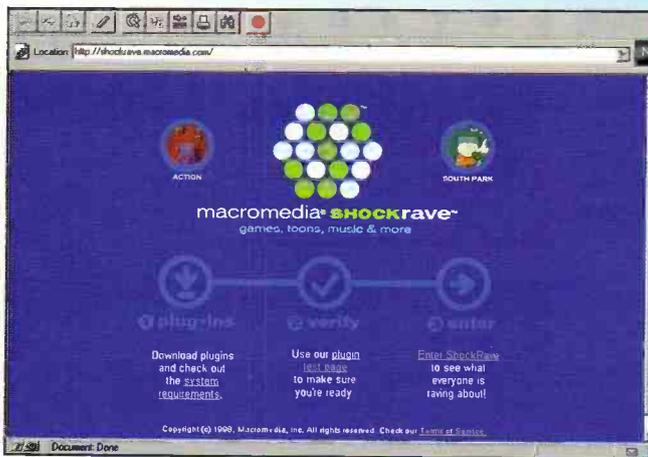
So if you've ever fancied yourself as a successor to Peter Cook, Willie Rushton, Richard Ingrams or Ian Hislop, now's your chance to pen those famous speech bubbles for the front cover. If your acidic retorts are good enough, the winning entry will be published on the Internet the following week, and you'll win the customary tinner into the bargain.



Speaking to Electronics and Beyond, Ian Hislop, editor of Private Eye, said: "It's all

incredibly exciting and cutting edge and state of the art, but I've no idea how it works."

## Dedicated Shockwave Content Site



ShockRave at [www.shockwave.com](http://www.shockwave.com) is a free online entertainment service featuring Shockwave content created by entertainment companies and software developers.

Visitors to the Web site can choose from over 45 games, puzzles, cartoons and more. Consumers will find cutting-

edge action and arcade-style entertainment as well as witty animation and mind-bending tests of concentration.

ShockRave is being sponsored by some of the industry's best-known consumer companies including 7-UP, Apple Computer, Inc. and The LifeSavers Company.

## ICL launches GamesZone

GamesZone at [www.gamezone.com](http://www.gamezone.com), is a dedicated multiplayer online games service launched this month by ICL. The service provides games from the world's leading online games companies. There is something for everyone, from strategy games such as Simutronics III from Simutronics and Kingdom of Drakkar from MPG Net, to

action games such as Descent from Engage games and Crimson Wars from Oceanline.

There is no monthly fee for the service, and users pay as they play, with charges automatically debited from their credit cards. Pay per hour is £1.80, day tickets for 24 hours unlimited play are £6.00 and weekend tickets lasting from 6pm Friday to 6am Monday 6am cost £10.00.



## AOL and CompuServe to Remain Separate

AOL said it would operate CompuServe and AOL as separate brands in Europe. While AOL will remain targeted to the consumer audience, offering the most interactive entertainment, education and information content available online, CompuServe will continue to serve its strong base of the business, professional and technical customers.

This two-brand strategy is seen as a decisive step in the efforts of the joint venture partners to bring the Internet as a new exciting mass medium to every household and

office in Europe.

The two partners also announced that they are developing a next-generation software for CompuServe. This new software will deliver cutting edge features and functionalities to CompuServe customers while retaining the service's distinctive focus on serious research.

Following the completion of the AOL/CompuServe merger, AOL is considering laying off 300 CompuServe customer-support personnel as part of its strategy to reduce overlap between the two companies once operations are combined.



AOL has announced the completion of its acquisition of CompuServe's European operations, creating the leading

pan-European Internet online business with more than 1.8 million combined customers in 33 countries.

## AltaVista Launches Free E-Mail



Digital is offering Internet users a free email with a complete range of Web-based e-mail functions, forwarding and storage is available at AltaVista Search site at [altavista.digital.com](http://altavista.digital.com).

Through its partnership with iName, AltaVista will offer a new level of functionality, not readily available through free Web-based e-mail services. The

service is seamlessly integrated into the AltaVista Search site, enabling users to directly manage all of their e-mail tasks from anywhere in the world.

The AltaVista Search Service now delivers 32 million page views per day to 18 million individual Internet users worldwide, placing the search engine second in page view popularity among search engines.

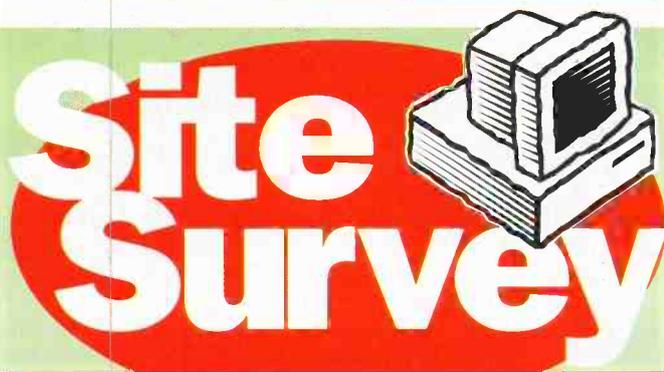
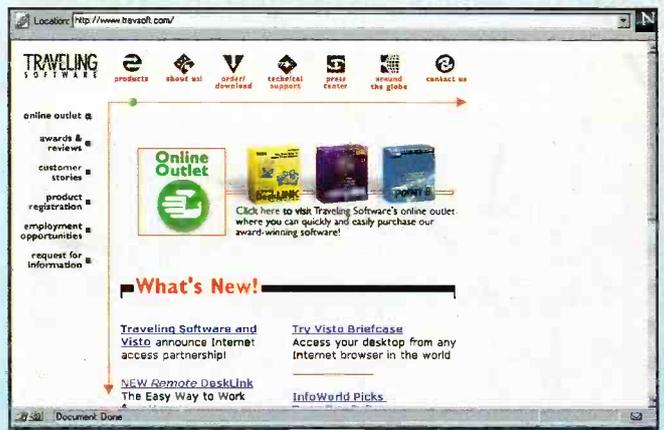
## Keeping Data on the Move

In theory transferring data files and applications between PCs should be a relatively easy task. But if you'd ever tried to swap more than a disk-full of data between two machines, you'll know its not a straight forward task.

But there could now be a solution. Travelling Software, the developer of the serial Windows application, LapLink, and Visto, the universal data access company, have joined together to develop a

solution that will see users transferring data between machines via an Internet briefcase.

Beginning in May 1998, LapLink products will include single-click access to Visto Briefcase. Travelling Software will also offer the Visto Briefcase on its Web site at [www.travsoft.com](http://www.travsoft.com) so that anyone with Internet access can take advantage of this offer. Beyond this, the two companies are working on a tightly integrated Web-based file transfer solution.



## The month's destinations

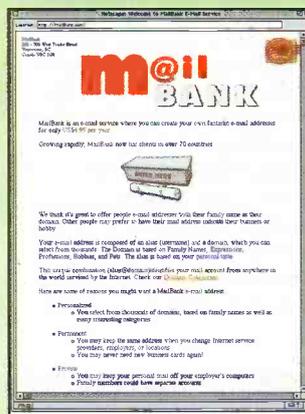


Hoots mon. For all things North of the Border take a look at the [scotland.org](http://www.scotland.org) site at <http://www.scotland.org> where you'll find literally thousands upon thousands of

links all to do with bonny Scotland.

Type your surname into the address line of your Web browser in the form `<http://www.yoursurname.com>` and there's a good chance you'll find a Website with that domain name. In many instances the Website has been set up by an

enterprising company in the USA, with the express purpose of attracting you. For a nominal sum (\$19.95 setup, and \$4.95 per each year of use) you can have an email



your surname as your domain name doesn't interest you, there's a searchable index of general domain names maintained by MailBank too. Checkout the company's main site, at <http://MailBank.com> for details.

Worldwide road maps about at <http://www.lycos.com/roadmap.html> where you can type in the name of a city or town, postcode, country or whatever, and get a zoomable road map of the area you want. It's pretty cool, though — being specifically for car drivers — it doesn't go down to street level.

address of the form `<yourusername@yoursurname.com>`. Then from anywhere

on the Internet you can access your mail (you can even have it forwarded to another email address) by password logon to your mailbox. If having



# in the pipeline

# ELECTRONICS and Beyond

Don't miss another great assortment of entertaining and easy-to-make projects and essential electronics information aimed at the novice constructor.

Issue 126 on sale  
Friday 1st May

## Projects

**Bench Power Supply  
Using a PLC as an Alarm  
Part 2 of the On-Screen  
Video Level Meter  
IBUS - Analogue Output Module  
Building & Upgrading PCs -  
Part 3, assembling your PC**

## Features

**Imaging Devices  
Sound Card Technology  
Radioactivity -  
A Century of Controversy  
Electronics in Agriculture  
Driverless Tractors Part 2**

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## Project Ratings

Projects presented in this issue are rated on a 1 to 5 for ease or difficulty of construction to help you decide whether it is within your construction capabilities before you undertake the project. The ratings are as follows:



**PROJECT RATING 1** Simple to build and understand and suitable for absolute beginners. Basic of tools required (e.g., soldering, side cutters, pliers, wire strippers, and screwdriver). Test gear not required and no setting-up needed.



**PROJECT RATING 2** Easy to build, but not suitable for absolute beginners. Some test gear (e.g. multimeter) may be required, and may also need setting-up or testing.



**PROJECT RATING 3** Average. Some skill in construction or more extensive setting-up required.



**PROJECT RATING 4** Advanced. Fairly high level of skill in construction, specialised test gear or setting-up may be required.



**PROJECT RATING 5** Complex. High level of skill in construction, specialised test gear may be required. Construction may involve complex wiring. Recommended for skilled constructors only.

## Ordering Information

Kits, components and products stocked at Maplin can be easily obtained in a number of ways:

1 Visit your local Maplin store, where you will find a wide range of electronic products. If you do not know where your nearest store is, telephone (01702) 554002. To avoid disappointment when intending to purchase products from a Maplin store, customers are advised to check availability before travelling any distance; 2 Write your order on the form printed in this issue and send it to Maplin Electronics PLC, P.O. Box 777, Rayleigh, Essex, SS6 8LU. Payment can be made using Cheque, Postal Order, or Credit Card; 3 Telephone your order, call the Maplin Electronics Credit Card Hotline on (01702) 554000; 4 If you have a personal computer equipped with a MODEM, dial up Maplin's 24-hour on-line database and ordering service, CashTel. CashTel supports 300-, 1200- and 2400-baud MODEMs using CCITT tones. The format is 8 data bits, 1 stop bit, no parity, full duplex with Xon/Xoff handshaking. All existing customers with a Maplin customer number can access the system by simply dialling (01702) 552941. If you do not have a customer number, telephone (01702) 554002 and we will happily

issue you with one. Payment can be made by credit card; 5 If you have a tone dial (DTMF) telephone or a pocket tone dialler, you can access our computer system and place your orders directly onto the Maplin computer 24 hours a day by simply dialling (01702) 556751. You will need a Maplin customer number and a personal identification number (PIN) to access the system; 6 Overseas customers can place orders through Maplin Export, P.O. Box 777, Rayleigh, Essex SS6 8LU, England; telephone +44 1702 554000 Ext. 376, 327 or 351; Fax +44 1702 554001. Full details of all the methods of ordering from Maplin can be found in the current Maplin Catalogue.

## Internet

You can contact Maplin Electronics via e-mail at <recipient@maplin.co.uk> or visit the Maplin web site at <http://www.maplin.co.uk>.

## Prices

Prices of products and services available from Maplin shown in this issue, include VAT at 17.5% (except items marked NV which are rated at 0%). Prices are valid until 26th May (errors and omissions excluded). Prices shown do not include mail order postage and handling charges. Please add £2.95 to all UK orders under £30.00. Orders over £30.00 and MPS Account Holding customers are exempt from carriage charges.

## Technical Enquires

If you have a technical enquiry relating to Maplin projects, components and products featured in *Electronics and Beyond*, the Technical Sales Dept. may be able to help. You can obtain help in several ways; 1 Over the phone, telephone (01702) 556001 between 9.00am and 5.30pm Monday to Friday, except public holidays; 2 By sending a facsimile, Fax (01702) 554001; 3 Or by writing to Technical Sales, Maplin Electronics PLC, P.O. Box 777, Rayleigh, Essex, SS6 8LU. Don't forget to include a stamped self-addressed envelope if you want a written reply! Technical Sales are unable to answer enquires relating to third-party products or components which are not stocked by Maplin.

## Maplin 'Get You Working' Service

If you get completely stuck with your project and you are unable to get it working, take advantage of the Maplin 'Get You Working' Service. This service is available for all Maplin kits and projects with the exception of: 'Data Files'; projects not built on Maplin ready etched PCBs; projects built with the majority of components not supplied by Maplin; Circuit Maker ideas; Mini-Circuits or other similar 'building block' and 'application' circuits. To take advantage of the service return the complete kit to: Returns Department, Maplin Electronics PLC., P.O. Box 777, Rayleigh, Essex, SS6 8LU. Enclose a cheque or Postal Order for the servicing cost (minimum £17) as indicated in the current Maplin Catalogue. If the fault is due to any error on our part, the project will be repaired free of charge. If the fault is due to any error on your part, you will be charged the standard servicing cost, plus parts.

# MAPLIN ELECTRONICS

## RETAIL CAREER OPPORTUNITIES

Perhaps you are one of the loyal customers that has seen Maplin develop into a major supplier to some of the best known industrial and commercial businesses in the U.K. and overseas. Or maybe you have just discovered our "state of the art" CD ROM catalogue with over 17000 exciting products. Either way, you instinctively feel that we are the Company for you.

The good news is that we have employment opportunities available within our 48 retail stores at various locations throughout the U.K.

You maybe an experienced retailer looking to further your career in a hi-tech environment, or perhaps you have an active interest in our futuristic products and would like the opportunity to offer advice and generate sales. Whatever the reason for your application, we will provide training and the opportunity for you to develop to your full potential as a Sales Assistant or Retail Manager.

For full details or to apply, please send your C.V. together with a covering letter to:

Vicki Morris, Recruitment Administrator, Human Resources Department, Maplin Electronics, Valley Road, Off Station Road, Wombwell, Barnsley, S73 0BS

Fax Number: 01226 754861

Internet Site © <http://www.maplin.co.uk>

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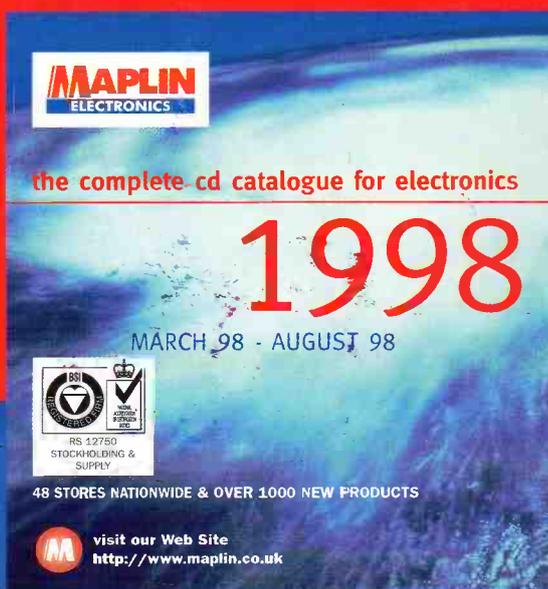
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