

# ELECTRONICS

THE MAPLIN MAGAZINE

August 1996 No. 104 £2.25

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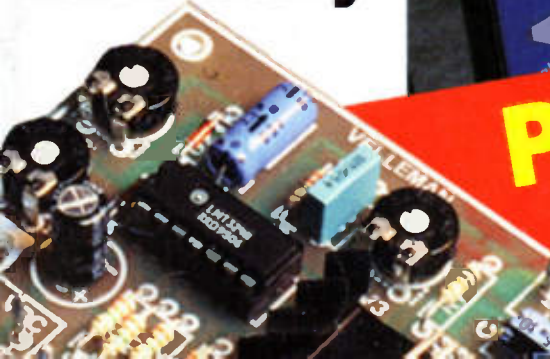


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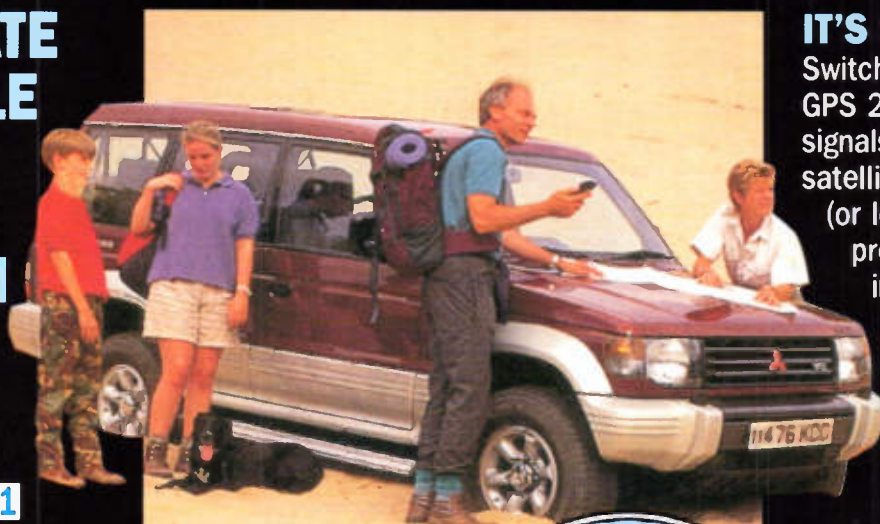
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## HOW TO ORDER



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WE BRING GPS DOWN TO EARTH

# THE MAPLIN MAGAZINE ELECTRONICS

August 1996

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# Year 2000 Computer Crisis Looms

With just three years and approximately 200 days before the next millennium, automated software is the only way to fix Year 2000 computer problems, Marc Sokol, vice president of advanced technology, told White House officials at a recent technology seminar.

Sokol said automated software tools are the only way of ensuring that information systems continue performing successfully into the next millennium. They eliminate human errors, problem delays and missed deadlines.

Without these tools, he said the millennium date change could cripple an organisation's ability to execute critical business functions, by impacting everything from insurance calculations to budgeting and electronic data transfers.

Sokol said Computer Associates has already successfully analysed and updated hundreds of millions of lines of its own code, both in its software solutions and internal applications.

The CA Discovery 2000 Solution provides a complete suite of software and services to help reduce the costs and resources associated with Year 2000 processing. Included are tools to help estimate and plan the Year 2000 initiative and services, including impact assessment, project planning, education and conversion techniques.

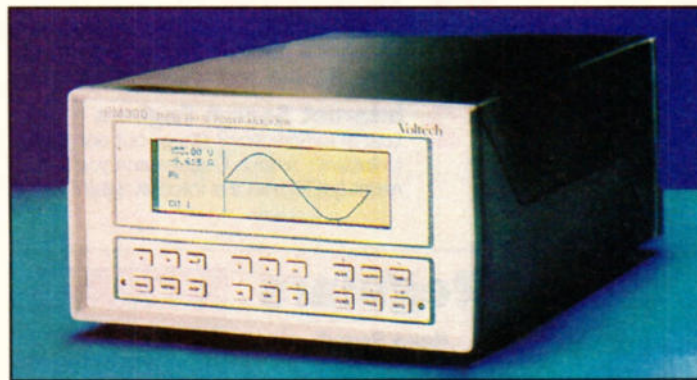
For further details, check: <http://www.cai.com>. Contact: Computer Associates, Tel: (01753) 577733.

# NEWS REPORT

## 3-Phase Power Analyser

Following the introduction of a new piece of kit from Thurlby Thadar Instruments (TTI), it is now possible to simultaneously monitor up to 10 variables of a three-phase power supply, across each phase. The Voltech PM300 can measure voltage, current, power, volt amperes, reactive power, crest factor current and voltage. The £2,100 device also includes harmonic analysis up to the 50<sup>th</sup> harmonic.

Contact: Thurlby Thadar Instruments, Tel: (01480) 412451.



## Copland Release on Hold

Apple intends to delay the delivery of its next generation Copland operating system for the Macintosh until 1997. According to an Apple spokesperson, "This will give the company time to improve Copland's integration with the Internet". For further details, check: <http://www.apple.com>.

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

## Testing Times for Teletext

Teletext is attempting to catch up with the Information Superhighway by piggybacking its service into new supply channels. Viewers involved in the Cambridge Interactive Television Trial are now able to access enhanced Teletext services.

Pages from Teletext on ITV and Channel 4 are delivered instantly via an Acom Online Media set top box via a 2M-bps ATM network. This removes the delay associated with terrestrial broadcast Teletext.

Under the remit of the Cambridge trial conducted by the Independent Television Commission, Teletext services will be enhanced to test a hyper-linked service, with links to news elements of the Internet.

For further details of the Cambridge Interactive Television trial, check: <http://www.acom.co.uk>.

Contact: Independent Television Commission, Tel: (0171) 306 7744.

## Cable Ready for to Shift Into Global Business

Until now, the cable industry has been the sleepy backwater of the information industry, but over the next ten years, it will become a major global market, according to Dr Richard Lee, lead author of the latest report to be published by industry analyst Ovum.

'Cable - The Emerging Force in Telecoms and Interactive Markets' predicts that the cable industry will become the main competitor to the incumbent telecommunication providers across the world for the provision of local telecommunication services and broadband infrastructure.

For further details, check: <http://www.ovum.com>.

Contact: Ovum, Tel: (0171) 255 2670.

## CDT Claim World First

Cambridge Display Technology (CDT) has claimed a world first, with a prototype Light Emitting Polymer (LEP) dot matrix display. The display has applications in a wide range of potential markets, ranging from replacement technology in applications such as personal digital assistants (PDAs) or advertising display boards, through to completely new products such as virtual reality headsets.

The prototype LEP dot matrix display combines the low voltage DC benefits of traditional LEDs with the large area patternability associated with non-emissive display technologies such as LCDs. The prototype display consists of a grid of pixels of density 100 per cm<sup>2</sup>, and measures 60 x 20mm.

Graphical, text and moving images are generated by driving the displays with conventional matrix display drives, consolidating the advantage the displays have due to their low cost manufacturing base.

Initially, CDT has fabricated a green dot matrix display. By engineering the properties of the light emitting polymers, they expect to demonstrate a red version very shortly. In the last year, CDT has synthesised polymers which emit light in the red, green and blue regions of the visible spectrum.

For more information on Cambridge Display Technology, check: <http://www.cityscape.co.uk/users/fq22>. Contact: Cambridge Display Technology, Tel: (01223) 276351.





## PDA Chipset

Philips Semiconductors has integrated the functionality of a personal digital assistant with fax/modem capability into a twin chip set. The PR31100 and UBC1100 give the designer a high level of device capability. By exploiting different chipset functions, designers can create various types of wired or wireless PDAs, video-telephone and Internet access terminals.

For further details, check: <http://www.semiconductors.philips.com/ps>.

Contact: Philips Semiconductors, Tel: (+31) 40 272 20 91.

## Task Buster Utility CD ROM

Task Buster from the Public Domain and Shareware Library is a CD containing over 2,300 applications for MS DOS and Windows.

According to Ron Smith, founder of the Public Domain and Shareware Library, "Sooner or later, every PC user needs a utility for tasks such as file conversion, virus cleanup, peripheral configuration, data recovery, benchmarking and file management".

Task Buster includes a search facility that allows users to scan the CD ROM. Every program is categorised and indexed, and includes a functional description.

Contact: Public Domain and Shareware Library, Tel: (01892) 663298.

## Silicon Valley Flat Panel Start-up

Hewlett-Packard and Compaq are among 27 investors in Silicon Video, a Silicon Valley start-up that plans to manufacture a prototype within the next year of a flat-panel display with full-motion colour capabilities. Silicon Video's display measures 0.25in. thick and uses cathode-ray tube technology.

Contact: Silicon Video, Tel: (+408) 257 8500.

## Apple Cuts Costs

Three months after joining Apple, new boss Gilbert Amelio has announced his rescue plan. Amelio intends to slash costs by cutting the number of PC models Apple sells by 50%. Apple will focus on its Mac OS, paring back to one operating system from six.

Meanwhile, several Taiwanese firms are gearing up to produce Macintosh clones, giving a boost to Apple efforts to build market share. Umax Group began shipping its high-end clones this month, with systems based on the 150MHz and 180MHz PowerPC chips.

IBM's recent agreement to license the Mac operating system will allow it to sub-license MacOS to two Taiwanese system makers. IBM does not plan to build the machines itself, but hopes that bundling the Mac software with its PowerPC chip will encourage other component makers to comply with the PowerPC platform. For further details, check <http://www.apple.com>.

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

## Compaq Offers Free Monitor with Each PC Sold

Compaq is aiming to capitalise on its UK market share lead over its competitors, by offering a free monitor with each business desktop PC sold.

At the same time, the company has reported new Dataquest figures, showing that Compaq's UK share of the professional desk based PC market has grown to 13.6% from 12.5% for the same period last year.

In a move to further increase this market share lead, Compaq will be offering a free Compaq monitor, worth more than £230, with each PC sold during a limited period. Compaq monitors are normally an optional extra, so this effectively represents a substantial discount on every Compaq PC system.

For further details, check: <http://www.compaq.com>.

Contact: Compaq, Tel: (0181) 332 3000.



## Game Play with Add-on Card

Mobile PC users that get hacked off with teleworking can now switch their attention to alternative PC-orientated pursuits, with the GAMEjammer PC Card from Portable Add-ons.

The PC Card incorporates sound, including a built-in speaker and joystick functionality, transforming the ordinary laptop into a fully fledged games machine.

Contact: Portable Add-ons, Tel: (01483) 241333.

## Glimpse of new Engineering Council

The Engineering Council has produced a booklet which explains its new structure and role. The 'New Engineering Council' provides a quick and easy reference to the responsibilities of the council, explaining how the Council has evolved since it was established in 1981, including the recent change relating to unification across the engineering profession.

Contact: Engineering Council, Tel: (0171) 240 7891.

## CD ROM Acceleration

A new CD ROM utility claims to reduce CD ROM access time by as much as 90%. SpeedyROM, a 32-bit utility from Quarterdeck, incorporates a caching algorithm to intelligently determine the most frequently used information and cache this to memory or hard disk.

Retailing at £35, Quarterdeck claim SpeedyROM will smooth out graphics and audio for twin-speed CD ROM applications. Benchmark tests show gains ranging from 11 to 92% for second and subsequent passes on a CD ROM with SpeedyROM active.

For further details, and to download a trial version of SpeedyROM, check: <http://www.quarterdeck.com>.

Contact: Quarterdeck, Tel: (01245) 491190.

## Contest Calls

The Radio Communications Agency has announced special call signs for clubs that wish to participate in amateur radio contests. The aim of these contests is to make contact with as many contacts as possible in a specified period.

The contest call signs are shorter than those normally issued for amateur radio, making them invaluable in such contests. The call signs will be issued to clubs on an annual basis. Applications should be made to the Radio Society of Great Britain at Contest Calls, RSGB HF Contest House, Lambda House, Cranborne Road, Potters Bar, Herts EN6 3JE.

Contact: Radio Authority, Tel: (0171) 211 0157.

## IBM Introduces Faster PowerPC

IBM has announced the availability of two new PowerPC 604 microprocessors, running at 166 and 180MHz. At the same time, Macintosh clone maker, Power Computing, announced the first personal computers using the faster chips. IBM itself has moved away from using PowerPC chips in its personal computer line, having shifted the PowerPC based systems that were part of the PC line into its RS/6000 lineup.

For further details, check: <http://www.ibm.com>.

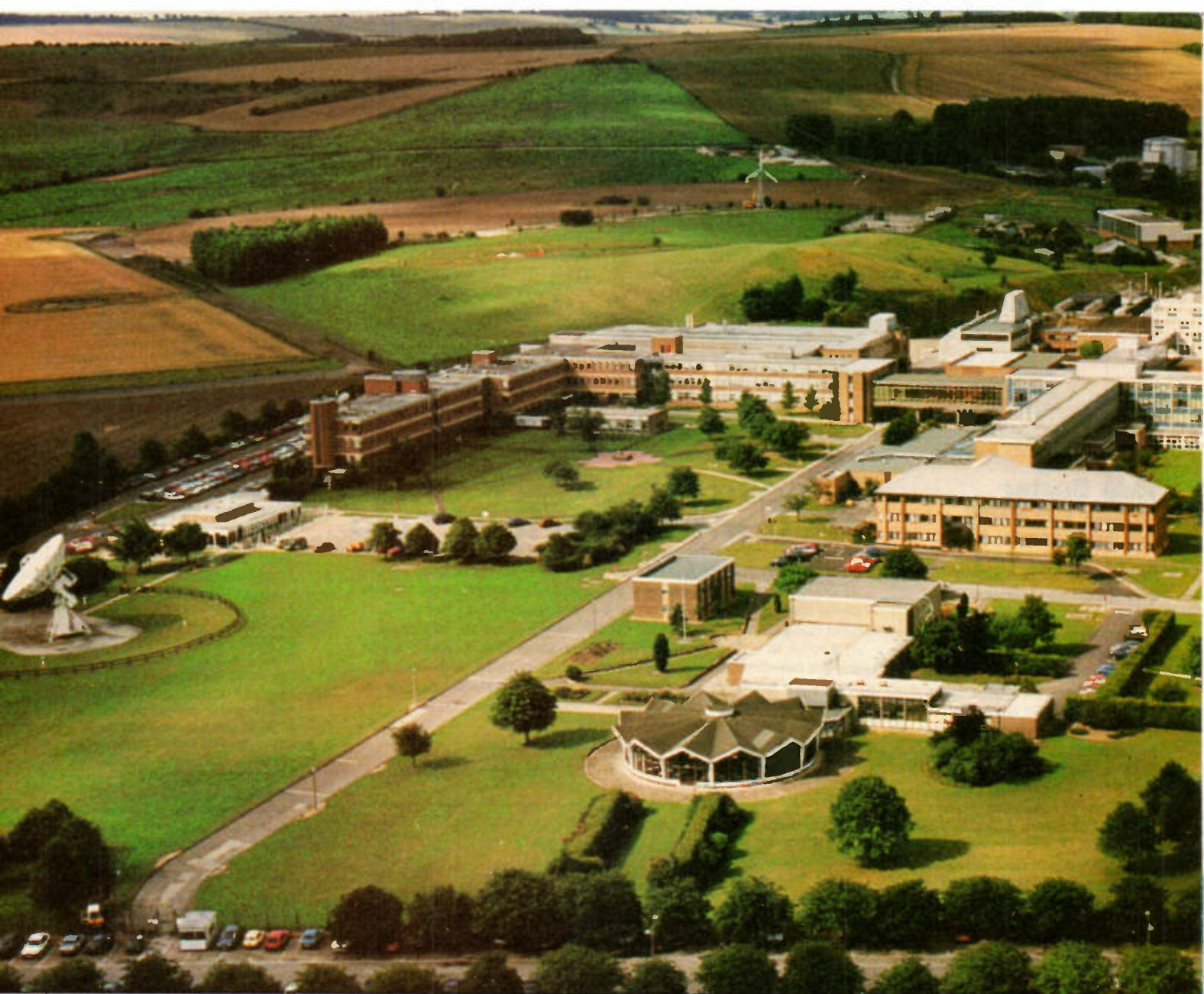
Contact: IBM, Tel: (0171) 202 3744.

## Pentium Prices Plunge

Intel has cut the price of its Pentium and Pentium Pro chips by 30%. In response, Dell has led the pack of PC manufacturers, by lowering the prices on its desktop and laptop range by as much as 20%.

For further details, check <http://www.intel.com> or <http://www.dell.com>.

Contact: Intel, Tel: (01793) 403000; Dell, Tel: (01344) 860456.



# *The Rutherford Appleton* **LABORATORY**

by Douglas Clarkson

*The Central Laboratory of the Research Councils (CLRC) was formed in April 1995 from the Daresbury Laboratory at Warrington, Cheshire and the Rutherford Appleton Laboratory at Chilton, Oxfordshire. The Chilbolton Observatory in Hampshire provides for research into radio propagation and meteorological measurements using radar systems. The concept of CLRC is to provide highest quality facilities for scientific research in the UK. Also the CLRC is being encouraged to increase its income as a direct result of its research activity, so that its dependence on state funded research is appropriately reduced.*

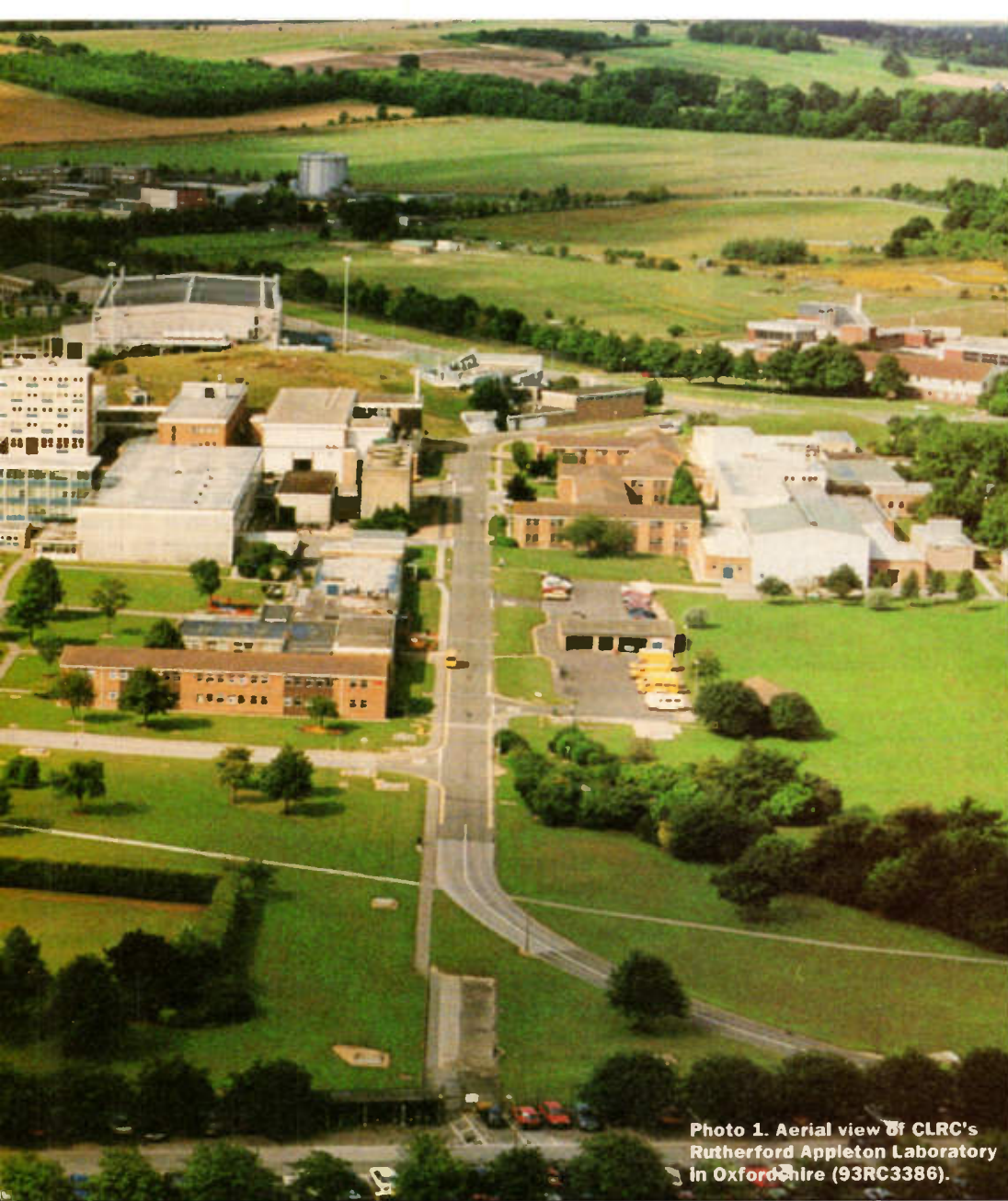


Photo 1. Aerial view of CLRC's Rutherford Appleton Laboratory in Oxfordshire (93RC3386).

ALL PHOTOS: © RUTHERFORD APPLETON LABORATORY (RAL PHOTOSERVICES)

**W**ith the trend in scientific research being one of international co-operation, it is becoming increasingly attractive for countries to develop specialist centres such as CLRC, which attracts scientists from several nations. The use of key research facilities such as ISIS and the VULCAN and SPRITE lasers by International users illustrates how the facilities at RAL are used by a wide set of researchers. Photo 1 shows the layout of the Rutherford Appleton Laboratory at Chilton, Oxfordshire.

## Space Science Department

Although the UK has no independent launch vehicle programme, a broad range of space research initiatives have already been successfully implemented at RAL. This primarily takes the form of experimental instruments for missions organised by NASA,

ESA or specific national space programmes such as those of Japan and Russia.

One of the more highly acclaimed success stories included the wealth of data received from the Along-Track Scanning Radiometer (ATSR) of the ERS-1 satellite launched as part of the ESA programme. This instrument package is able to measure surface global sea surface temperatures to an accuracy of 0.3°C, and has been of considerable use to researchers studying global climate change.

In addition, a more sophisticated ATSR system has been successfully developed for the current active ERS-2 mission. As part of NASA's Earth Observation System

(EOS), RAL is co-ordinating the development of a High Resolution Dynamics Limb Sounder (HIRDLS) designed to study infra-red emission from the atmosphere at high spatial resolution between 30 and 80km altitude. NASA's EOS Chemistry

mission spacecraft is due for launch into its 700km altitude orbit in the year 2002, and the HIRDLS module with its 21 measurement channels will provide valuable information on greenhouse gases, aerosols and the

dynamics of the atmosphere.

Work is also carried out in the Space Science Department, to improve understanding of atmospheric effects and corresponding weather patterns. A study led by workers at RAL, for example,

**Sets of atmospheric data from diverse sources have allowed researchers at RAL to develop models to predict the future behaviour of the atmosphere as it is subjected to effects of global climate change.**

has indicated that a satellite at 500km orbital altitude and with a nadir pointing millimetre radar, would be able to map details of many different types of cloud cover. With a radar pointed at 45° to nadir, speeds of particles within cloud structures could also be determined.

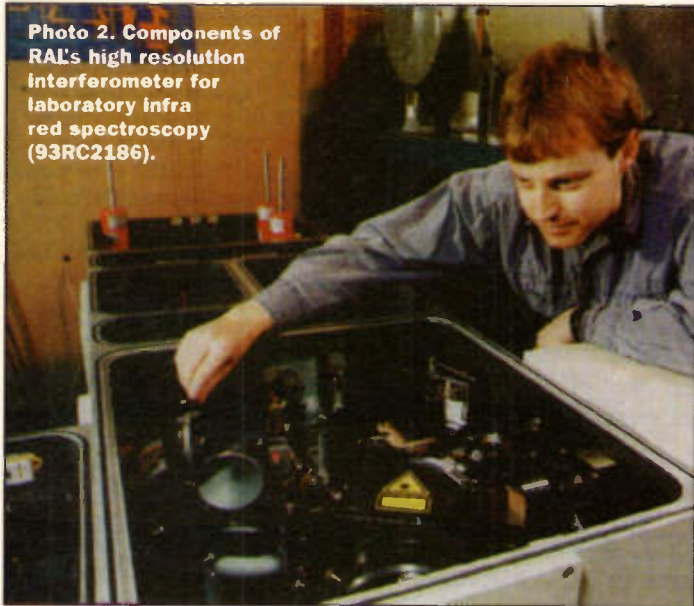
Sets of atmospheric data from diverse sources have allowed researchers at RAL to develop models to predict the future behaviour of the atmosphere as it is subjected to the uncertain effects of global climate change. The distribution of ozone has been extensively modelled as part of UGAMP (UK University Global Atmospheric Modelling Programme) and TOASTE (Transport of Ozone and Stratosphere – Troposphere Exchange). Initial assessment of these models indicates that they simulate ozone movement with a good degree of accuracy.

Inferring atmospheric data from satellites often requires a detailed knowledge of the specific spectra of a wide range of active atmospheric gases. In order, therefore, to provide a base line of knowledge of atomic and molecular spectroscopy, RAL has developed facilities for laboratory spectroscopy which comprise a very high resolution interferometer used in association with a system for simulating low density, low temperature gases. Components of this new instrument are shown in Photo 2.

RAL also plays a significant role in Infra-red Astronomy and in particular, in providing access to data of the highly successful Infra-Red Astronomical Satellite (IRAS). RAL is now providing remote access via an optical disk jukebox to many hundreds of gigabytes of data in the Space Data Centre at RAL to astronomers utilising the Starlink facility. Starlink now supports around 25 sites and provides data to over 1,600 astronomers and support staff. This access has, in particular, proved useful for astronomers planning their observing time on the recently launched Infra-Red Space Observatory (ISO). In addition, RAL has developed ISO's long wavelength spectrometer.

A key current development at RAL is the Cluster Project, which centres around the launch in mid 1996 of four separate ESA spacecraft, which together hosts 44 separate scientific experiments. RAL is one of seven global sites for receipt and processing of this multi-experiment project and in particular, to collect and analyse data from three UK-led experiments on each spacecraft.

**Photo 2. Components of RAL's high resolution interferometer for laboratory infra red spectroscopy (93RC2186).**



The work of the Space Science Department at RAL is, therefore, taking place on a broad range of projects, many of which, space does not allow reference. This excellent work at RAL, therefore, firmly secures a place for the UK in the planning and exploration of space well into the next century.

### Science Board: ISIS

The ISIS facility at RAL is, by far, the world's most powerful source of pulsed neutrons. Neutrons are electrically neutral particles, and are normally found in a stable state in the nucleus of the atom. Because they can interact directly and subtly with the atomic nucleus (in contrast with X-rays, which suffer scattering from the electron cloud), they are used at RAL to probe matter for a broad range of experiments which are primarily related to increasing understanding of behaviour of materials.

In the ISIS facility, protons are accelerated in a synchrotron to energies of 800MeV. These protons are extracted from the accelerator 50 times a second and directed into a dense Uranium target, where the high energy of the protons is taken up by the target nuclei which become unstable and shed energy in the form of neutrons in a process called spallation. The high energy neutrons are, in turn, slowed down by hydrogen-containing moderators to enable the neutrons to be used with a

range of experiments. Over 1,800 UK and overseas researchers utilise the ISIS facility for a broad range of applications based on 16 separate major scientific instruments. Photo 3 shows the main ISIS experiment hall.

Subtle clues obtained from a wide range of scattering experiments can reveal details of the internal structure of compounds such as superconductors and Buckminster Fullerene compounds of Carbon. The wide range of energies of the ISIS neutrons, which can range from  $>1\text{eV}$  to  $<1\text{meV}$ , is particularly relevant for assessing the properties of liquids, gases and glasses. The ISIS facility provides a valuable UK research tool for material science.

A key experiment is the SANDALS facility, which analyses the structure of water and aqueous solutions. Probing with neutrons allows bonding characteristics to be determined, and has already improved the understanding of the nature of hydrogen bonding in water and also, how ions are stabilised in solution. This is obviously a key area of

research, since the bulk of chemical reactions take place in aqueous solution. There is considerable scope for application of this investigative technique throughout most major areas of the life sciences and also medicine.

Recently, a valuable insight has been achieved by French researchers using the ISIS

facility in the identification of a new form of hydrogen in conventional dry cell batteries. This could, for example, lead to better understanding in battery technology and fuel cell design.

The CRISP facility for neutron reflectometry is being extensively used to study the behaviour of surfactants, colloids, polymers and complex mixtures of species at air-liquid, liquid-solid and liquid-liquid interfaces.

Researchers from Paris and Edinburgh have been able to use ISIS to measure how the structure of ice changes as it is subjected to pressures in excess of 250,000 atmospheres.

A high-performance powder diffractometer HRPD is being used to map molecular structure of a wide range of materials and compounds.

The precision of lattice constant measurements can now be undertaken to better than one part in a million. In particular, the HRPD facility is providing valuable information on pharmaceutical compounds such as dopamine. The conformation of the molecule – exactly how it is arranged in space – is of key importance in the molecule undertaking a 'lock and key' mechanism at a receptor site. The data obtained from HRPD can provide valuable insight as to why specific compounds have a specific drug interaction role.

Much of the work of ISIS is, therefore, at a fundamental level, where new information about chemical bonding and the nature of material in various phases is being determined. While there are also aspects that have a direct technical and engineering application, many of the ISIS experiments are

groundbreaking in relation to the information they provide. In particular, they tell us more about how physical structures from the nucleus to the outer chemical bonds of atoms and molecules are fabricated.

ISIS also produces an intense source of pulsed muons, by interaction of the pulsed proton beam with a thin graphite target before the main neutron target. Recent engineering developments now permit streams of muons to be directed to three separate experimental areas. It is planned to use the facilities for muon catalysed fusion studies during 1995. Photo 4 shows the muon spin relaxometer in the ISIS experimental hall. Such equipment is used to probe the magnetic properties of materials by observing muon spin interactions.

### Laser Research

RAL also includes a major high power laser facility, in the form of SPRITE and VULCAN. SPRITE is the world's brightest UV laser source, capable of producing peak power densities of  $1019\text{W}/\text{cm}^2$ . Peak powers of  $1\text{TW}$  ( $1\text{TW} = 10^{12}\text{W}$ ) at less than 300fs ( $1\text{fs} = 10^{-15}\text{s}$ ) duration have been achieved during 1993.

The VULCAN laser is based on a neodymium-glass laser operating at  $1.05\mu\text{m}$ . Pulsed operation at peak powers as high as  $35\text{TW}$  has been achieved over pulse durations varying from 800fs to 10ns. Using non-linear optical crystals, a frequency-doubled beam is available at 526nm and a frequency-tripled beam is available at 350nm. Photo 5 shows the inside of the target chamber of VULCAN.

**Over 1,800 UK and overseas researchers utilise the ISIS facility for a broad range of applications based on 16 separate major scientific instruments.**

**Photo 3. The main ISIS experimental hall (94RC5950).**





One key area of operation of high power lasers is in fusion research, where lasers are used to generate the ultra high temperatures required for such experiments. The basic approach is to use such lasers to 'implode' a fusion capsule of deuterium/tritium. The basic non-uniformity, however, of such high power lasers tends to deliver energy in a non-uniform way within the fusion capsule. One group from Imperial College has successfully developed a technique for using laser generated X-rays to smooth out the non-uniformities which tend to develop in such laser imploded fusion capsules. This development may enable fusion reactions to be initiated with laser systems of reduced power and intensity, and is a major finding for fusion research.

The Central Laser Facility is developing TITANIA as a krypton fluoride laser, based on the existing SPRITE laser. TITANIA will be excited by eight electron beams of 600keV each and with a current of 75kA. Maximum laser pulse energies are expected to be in excess of 360J and with maximum irradiance in excess of  $10^{12}$ W/cm<sup>2</sup>. TITANIA has already been extensively tested in its development location and is due to be moved to its final operating position in April 1996.

Extensive use is made of so-called chirped pulse amplification to maximise peak pulse powers, as indicated in Figure 1. While the laser pulse is generated within the lasing system of mirrors and lenses, the energy of the pulse is spread in time. Once the pulse has left the laser generation system, it is condensed in a narrower time frame to deliver much higher peak energies.

Considerable work has been undertaken at RAL on the development of X-ray lasers. One of the mechanisms of so-called 'recombination' X-ray lasers was to excite a plasma, within which the recombination of excited electrons would initiate lasing action. From theoretical studies, it was appreciated that this could be undertaken by using an ultra-short pulsed optical laser to ionise an extremely thin fibre of material. The Vulcan laser has succeeded in demonstrating 'recombination' lasing action at short wavelengths. It is anticipated that development of this technique will reach the so-called 'water window' of soft X-rays, which can then be subsequently used to probe the cellular structure of biological material. This will, in turn, open up whole new areas of fundamental scientific research.

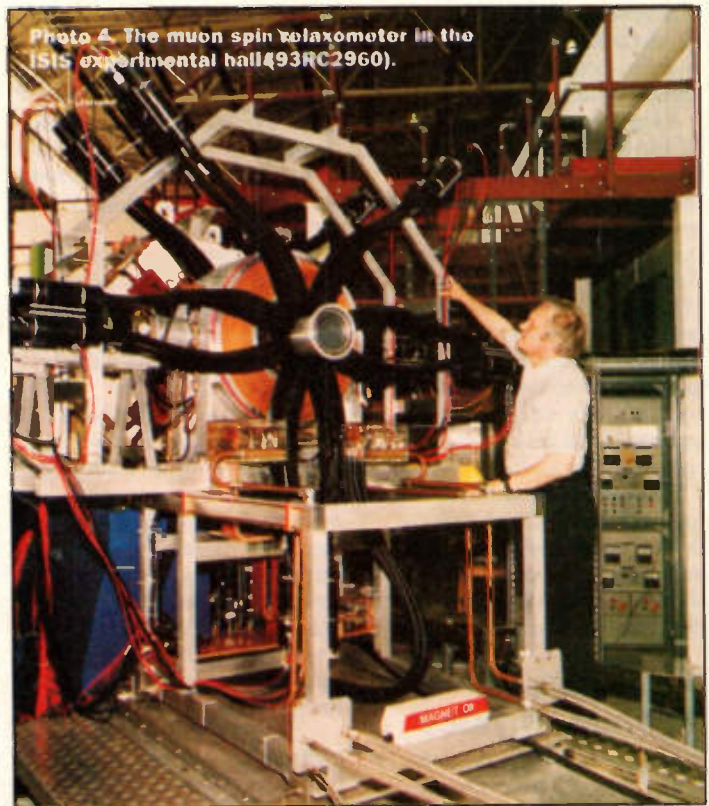
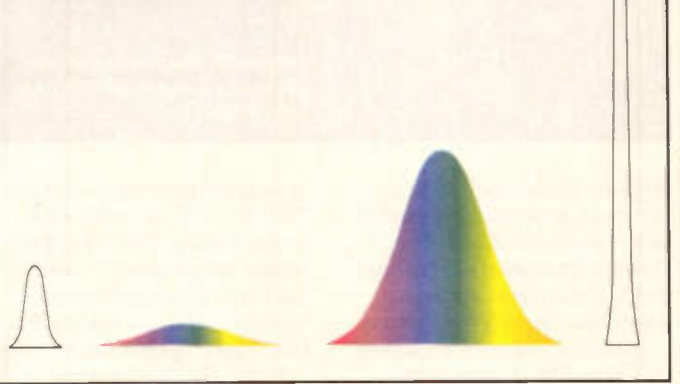
## Raman Spectroscopy

When photons interact with atoms and molecules, some photons can absorb energy or gain energy, corresponding to subtle energy interactions. This is termed the Raman effect, after its discoverer, Sir Chandrasekhara Venkata Raman, a noted Indian scientist who received the Nobel Prize for Physics in 1930. The effect is very weak however, with fewer than one photon in 100,000 contributing towards the effect. At RAL, the intense laser pulse systems are able to detect interactions which would otherwise remain undetected. Data is resolved into time-spectra space within a typical time frame of 500ps. Work undertaken at RAL using Raman spectroscopy has included studies of vitamin E and DNA, where the latter was studied in order to determine mechanisms of enzyme interactions.

## Energy Research Unit

The Energy Research Unit at RAL operates an active Wind Energy Test Site and includes five on-site wind turbines - the largest of which is a turbine with 17m diameter blades, having a rated output of 45kW. In association with various University and commercial links, RAL has successfully obtained EPSRC, DTI and European funding for basic research in wind energy technology. One major project relates to the monitoring of pressure at several points along the surface of a Windharvester

**Figure 1. Principle of Chirped Pulse Amplification: Initial energy/time pulse shapes within the laser generation system tend to 'spread' the pulse energy. Later, the pulse is time compressed, to deliver the pulse energy within a shorter time interval.**



turbine blade, with the aim of improving the design of blades in general.

Photo 6 indicates the Wind Test Site at RAL. Another major project relates to evaluation of energy storage/recovery in a flywheel interfaced to an electrical network. With current UK-installed wind power capacity of 147MW as at 31<sup>st</sup> December 1994, lagging somewhat behind Germany with 643MW, and Denmark 540MW, there is considerable scope to increase these figures. Indeed, a recent European Renewable Energy Study concluded that about 23% of Europe's total 1990 electricity demand could be met by wind power.

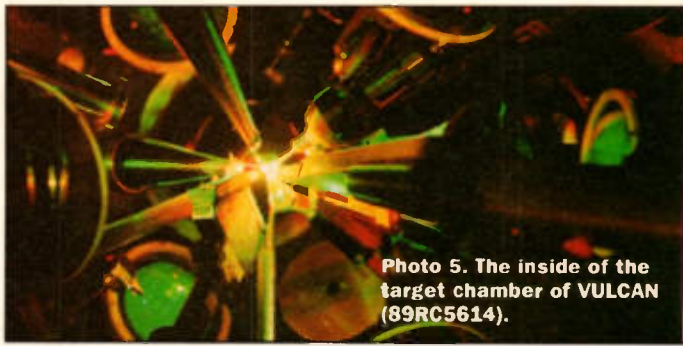
Hopefully, the basic research work undertaken at RAL will assist in UK industry becoming

more actively involved in a rapidly expanding industry within Europe and the developing world.

## Electronics Division

The Microelectronics Support Centre, part of the Electronics Division of RAL, has a key role within the UK for providing advice, training and support to a wide range of users of advanced electronic technology. The application of this technology is seen as vital for the success of a broad range of SERC science and engineering research programmes, and also will be a major factor in future competitiveness of European Industry. The interest in maintaining and developing an electronic





**Photo 5. The inside of the target chamber of VULCAN (89RC5614).**

skill base in Europe is also a European-wide initiative funded by the European Community. During 1993, support was provided to 300 Universities and more than 5,000 engineers were trained.

The Microelectronics Support Centre at RAL is expected to continue to play a leading role in developing policy and support for electronics in the future, and also facilitating technology transfer within this discipline.

A key role of the Electronics Division is Electronic Design Support. Many of the innovative data collecting and processing systems developed at RAL depend on state-of-the-art electronic design for their required levels of high performance. Electronic design support provides assistance with basic design, rule testing, mask data preparation and procurement, with also testing, evaluation and packaging of completed products.

The Electronics facility at RAL has been certified to ISO 9001 by BSI, within the scope of 'the design, assembly, test, installation, commissioning and repair of electronic systems'.

## Sub-Nuclear Particle Physics

Teams of researchers from the Particle Physics Department at RAL, in association with groups at various UK Universities, are playing a very active part in large experiments at various overseas laboratories, at CERN, Geneva, DESY in Hamburg and the Stanford Linear Accelerator Centre in the USA. In addition, smaller experiments at various underground sites are also being pursued.

In December 1994, the CERN Council approved the construction of the Large Hadron Collider (LHC). Development at CERN of the LHC is currently under way, with the UK taking an active part in the design of related experiments. The aim of the LHC is to answer many questions related to the fundamental constituents of matter, not least, the existence (or otherwise) of the elusive Higgs particles – the

postulated generators of mass. The LHC will be constructed in the existing 27km diameter tunnel that presently houses the Large Electron-Positron Collider – LEP. It is hoped that LHC will be operational by 2004.

In the LHC, two intense high energy proton beams will be collided every 25ns. Out of the collisions will emanate as many as 80,000 million particles per second. These will have to be sifted electronically on-line and 'interesting' collisions, such as those which might be a signature for the Higgs particles, recorded for further analysis.

The UK, with RAL in the lead, has been deeply involved in the definition and specification of both general-purpose detectors which are being constructed for the LHC. These two detectors, named ATLAS and CMS, are huge and highly complex, costing an estimated £250M each and containing many millions of separate electronic channels. Experience gained at RAL on radiation-resistant silicon detectors and VLSIs, as well as scintillating crystals and glasses, will be invaluable in realising these vast high-technology projects.

One of the key engineering problems is the cryogenic engineering associated with the large superconducting magnets used to bend particles emitted from the interaction zone. The End Cap Toroids of ATLAS, for example, will have the stored energy, in a magnetic field, equal to an Intercity 125 train travelling at full speed. The physical structures of these magnets must be very strong to withstand the huge forces on the current carrying conductors in the intense magnetic field. Europe, therefore, is currently centre stage for the world's biggest physics experiment.

Extensive data has been, and continues to be, obtained from the Large Electron-Positron (LEP) collider at CERN. A key result obtained from four main experiments, was the accurate determination of the mass of the Z Boson – 91.187GeV. One of the more curious effects discovered, was that of the effect of the

gravitational field of the moon and the sun in distorting the dimensions of the 27km circumference of the LEP ring, which subtly changed the reference energies of particles held within it. HERA, the electron-positron collider at DESY in Hamburg, is designed to study the structure of the proton. In operation, particles are collided with a centre of

mass energy in excess of 300GeV. The detector systems measure the types and trajectories of particles created from such high energy interactions. The principal experiments at HERA are called H1 and ZEUS, with RAL groups collaborating with UK and foreign universities on each experiment. For H1, RAL has key responsibility for the advanced Central Data Acquisition System. For ZEUS, RAL has played a key part in designing, building and now operating the Central Tracking Detector – the heart of the experiment.

An essential aspect of all such experimental work is the front end electronics, on-line sifting (triggering) and data acquisition for subsequent analysis. This requires state-of-the-art microelectronics design. RAL is a centre of excellence in this field.

Other

questions of great relevance are being tackled in different ways, but nevertheless, using very similar techniques. The SOUDAN experiment consists of a

960 tonne fine-grained tracking calorimeter and is located deep underground in Minnesota. This co-operative experiment between US researchers and a team from Oxford University and RAL is designed to set a lower limit on the lifetime of the proton. Current SOUDAN data indicates that the lifetime of the proton is in excess of 1,031 years. Such experiments are needed in order to understand why the universe has an abundance of matter over anti-matter.

**Experience gained at RAL on radiation-resistant detectors and VLSIs, as well as scintillating crystals and glasses, will be invaluable in realising these vast high-technology projects.**

## Summary

The Rutherford Appleton Laboratory, one of the two major laboratories of the Council for the Central Laboratory of the Research Councils, is playing a major role in the development of key projects within the UK's scientific research. RAL actively promotes close liaison with local schools and the CLRC publishes a range of educational posters on topics of space, particle research and the environment.

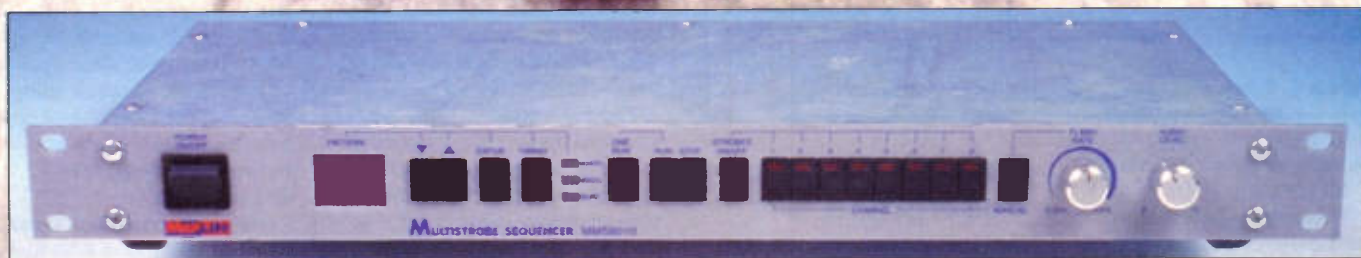
## Point of Contact

Press and Public Relations,  
Rutherford Appleton Laboratory,  
Chilton, Didcot,  
Oxfordshire OX11 0QX.  
Tel: (01235) 446482.



**Photo 6. The Wind Test Site at RAL (90RC6315).**

# PROJECT



# Multi-Strobe INTERFACE

Design by Alan Williamson  
Text by Alan Williamson and Maurice Hunt

*There are many differing makes and models of strobe lights on the market that have an external trigger input facility, but prior to the development of this project, they could not be used with the Maplin Multi-Strobe Sequencer (detailed in Issue 100 of Electronics), due to the different system protocols used. However, using the Sequencer in conjunction with this interface unit allows these previously incompatible variants of strobe lamps to be driven to full effect.*

## FEATURES

Constant current trigger output

8 Channels

Overload protected

## APPLICATIONS

Disco and party lighting

Advertising

Lighting and special effects

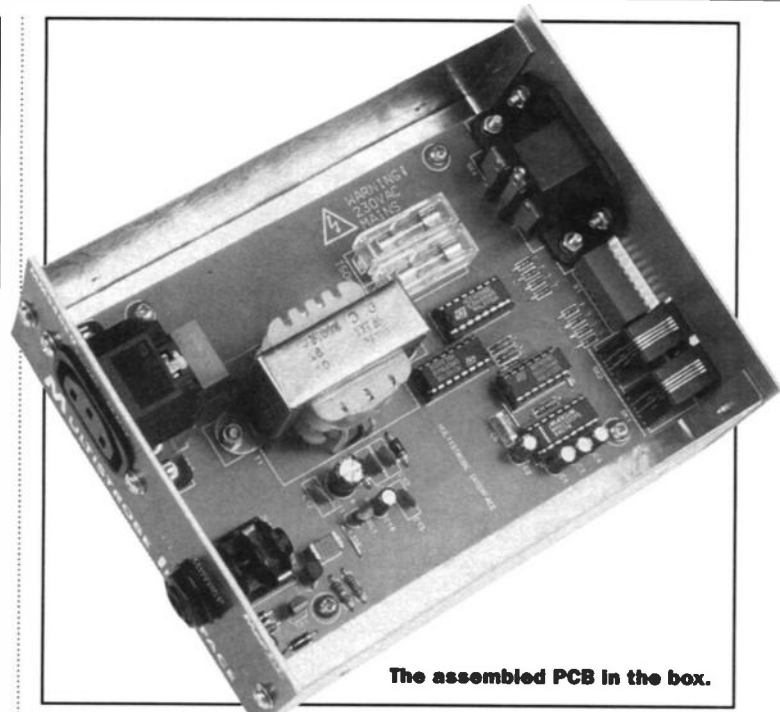
Scientific and educational uses

PROJECT RATING **3**

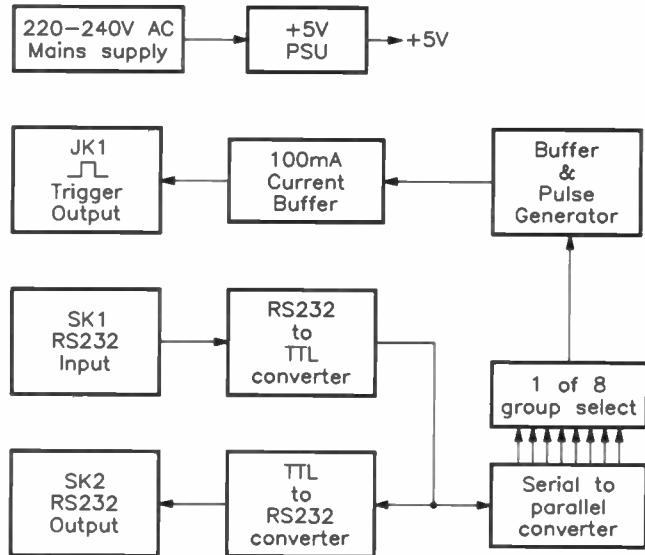
Kit Available  
Order as 95107  
Price £44.99

## SPECIFICATION

Supply voltage:	230V 50Hz AC
Power consumption:	2.5W
Maximum output load:	5A (1,150W)
Maximum trigger output current:	100mA @ 12V
Overcurrent protection:	T5A (strobe) and T50mA (circuit fuses)
Boxed unit dimensions (WDH):	125 × 155 × 58mm



**The assembled PCB in the box.**



**Figure 1. Block diagram.**

**T**he Multi-Strobe Interface kit contains all the components needed to build the project, including a robust pre-drilled metal casing, front and rear self-adhesive panel labels, high-quality fibreglass PCB and full assembly instructions.

## Circuit Description

The block diagram of the interface unit is shown in Figure 1. Referring to the circuit diagram, shown in Figure 2, FS1 (T5A) is the mains supply protection fuse

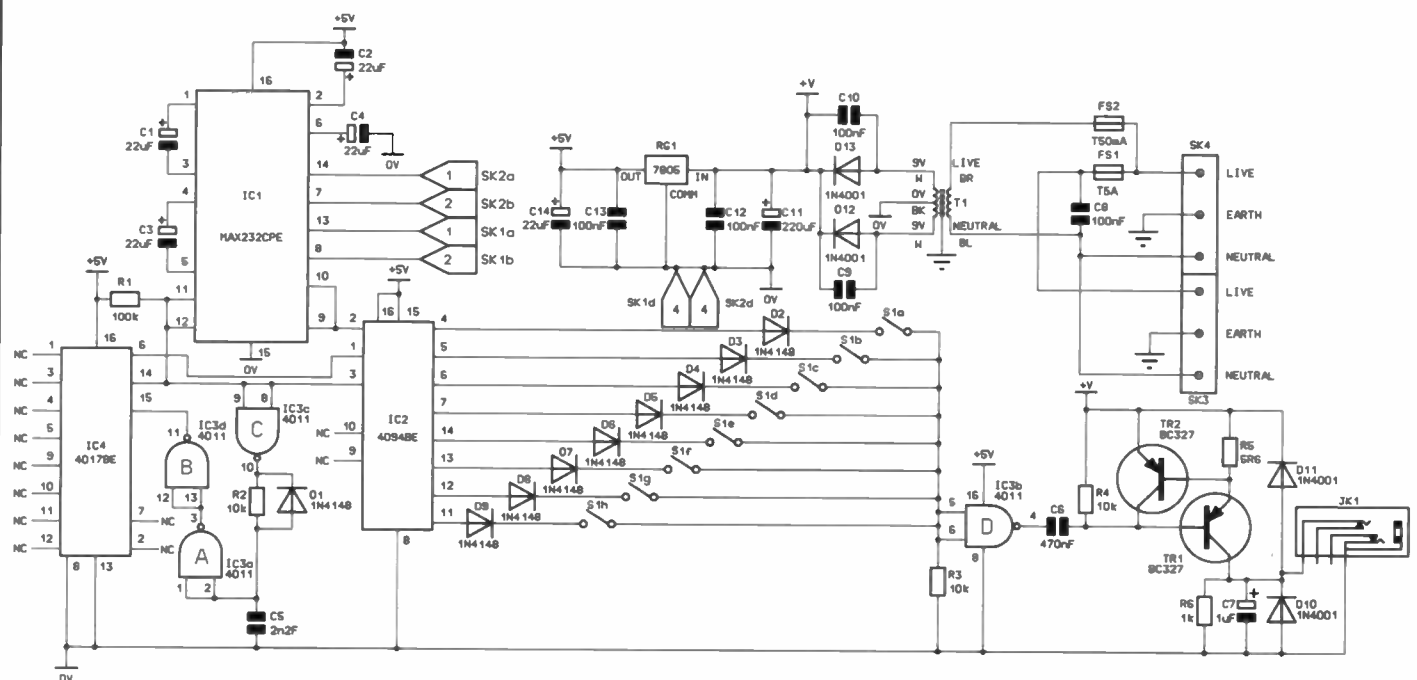
for the strobe unit (or units) and FS2 (T50mA) is the Interface circuit protection fuse.

Capacitor C8 helps to reduce noise present on the mains supply; C8 will also reduce any noise spikes being fed back onto the mains supply from the short conduction pulse of the strobe tube.

The low voltage supply is a standard linear PSU, consisting of the usual transformer T1, full wave rectifier D12 & D13 with snubbing capacitors C9 & C10, low and high frequency decoupling capacitors C11 & C12, regulator RG1, also with high and low frequency output decoupling capacitors, C13 & C14.

SK1 is the RS232 input socket; IC1 converts the RS232 clock and data signals to TTL logic levels. IC1 also acts as a line driver buffer, by converting the TTL signals back to RS232 levels, which are available at SK2. This allows 'daisy chaining' of the strobe interface units, reducing the typical 'rats nest' to a single run of cables between the sequencer and interfaces.

The TTL serial clock signal is received as a gated 8-bit frame, which is also applied to the network of IC4, a decade counter. IC3a,b,c and D1, R2 & C5 comprise a frame sync



**Figure 2. Circuit diagram.**

separator, which 'strips out' the high frequency frame data bits by slowly charging C5 via R2 and quickly discharging via D1. IC3a & b are, therefore, only allowed to change state *between* the clock frames; this resets IC4 in readiness for the next frame.

The serial data output of IC1 is converted to parallel data by IC2, an 8-bit Serial In, Parallel Out (SIPO) shift register; the data is applied to pin 2 while the clock is applied to pin 3. The 7<sup>th</sup> clock pulse applied to pin 14 of IC4 activates pin 6, which enables the 'strobe input' of IC2; the 8<sup>th</sup> clock pulse applied to the shift register will transfer and latch the 8 data bits on the output. The diodes D2 to D9 'OR' the 8 outputs of the shift register IC2 and prevent bus contention, should more than one 'Channel Select' dip switch (S1a-h) be closed.

IC3d is used as an inverter to obtain the correct logic level to drive the output stage. Capacitor C6 AC couples the output of the inverter to the output stage and also sets the pulse width. TR1, TR2 and R5 form a 100mA constant current source; the current limit value is set by R5. Output stage protection is provided by the diodes D10 & D11. R4 is used to prevent the base of TR1 floating, which would otherwise be prone to false triggering from spurious noise. The positive-going output trigger pulse is taken from the 1/4in. jack socket, JK1.

It was found necessary to add an output filter, formed by C7 & R6, as some strobe input stages can cause the constant current output stage to bounce, which could result in double triggering of the strobe unit.

## Construction

Construction is fairly straightforward. Refer to Figure 3, showing the PCB legend and track. Begin with the smallest components first, working up in size to the largest; be careful to correctly orientate the polarised devices, i.e., electrolytic capacitors, diodes, transistors, voltage regulator and ICs. The ICs should be inserted into their sockets last of all, having installed the sockets with their end notches in alignment with the printed legend.

Figure 4 shows the transformer lead preparation required prior to fitting it onto the board.

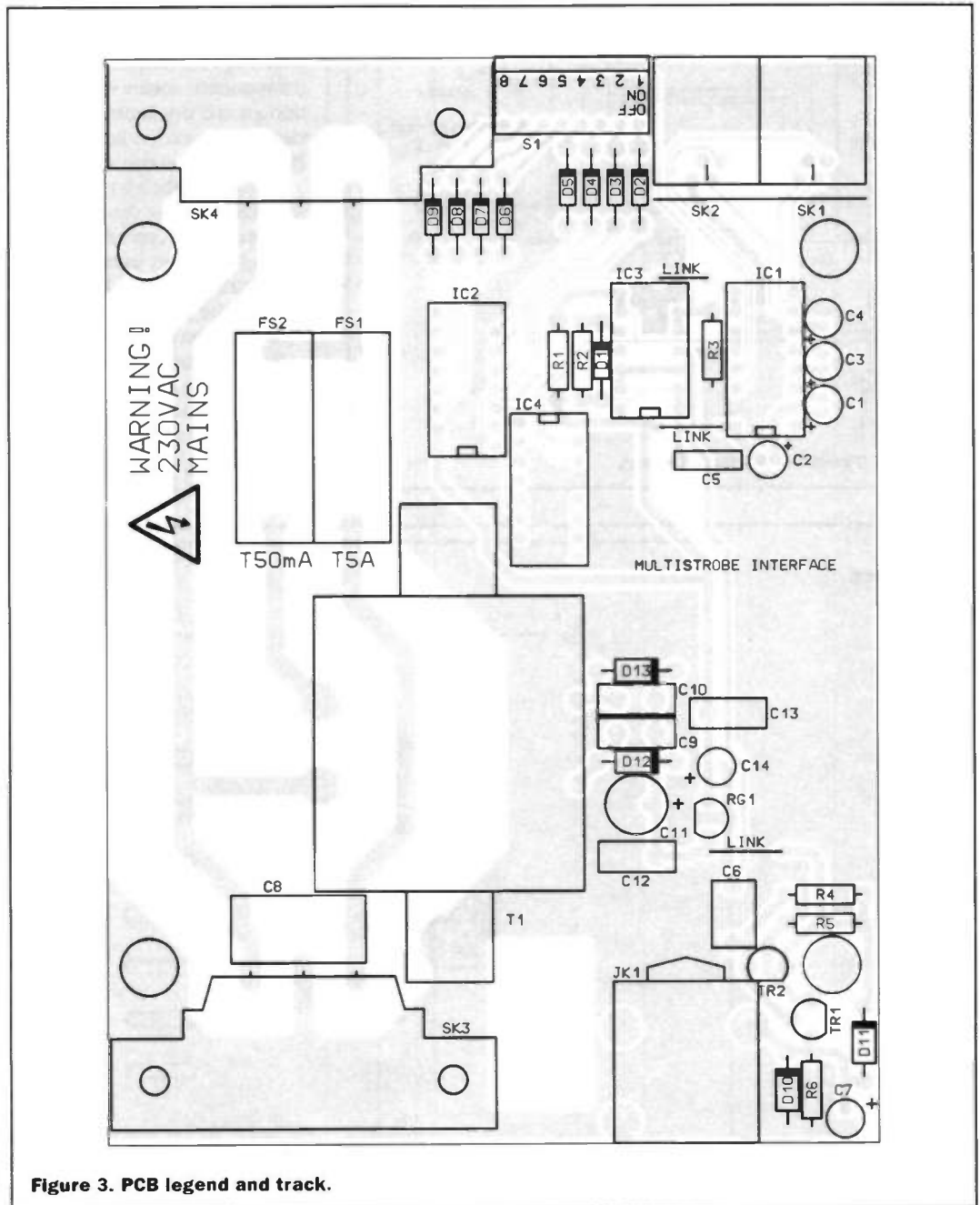
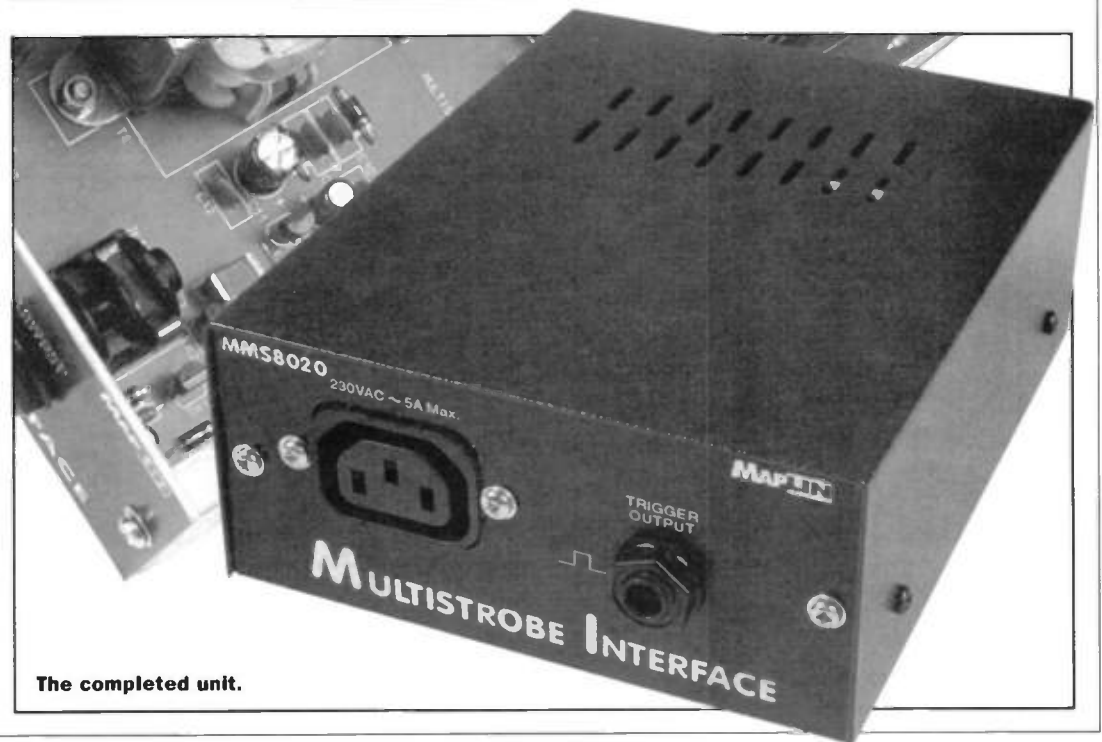


Figure 3. PCB legend and track.



The completed unit.

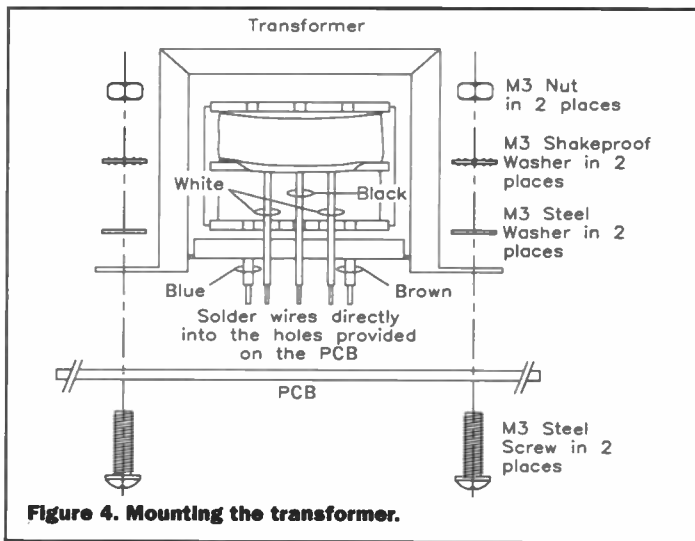


Figure 4. Mounting the transformer.

Having completed the assembly of the board, thoroughly check your work for misplaced components, solder whiskers, bridges and dry joints. Finally, clean all the excess flux off the PCB using a suitable solvent.

Attach the labels to the front and rear panels of the pre-drilled enclosure, and carefully trim around the holes using a sharp craft knife or scalpel. Drill four holes in the positions shown in Figure 5 in the lower case section.

Fit the assembled module into the enclosure as shown in Figure 6, the exploded assembly diagram. Before finally fitting the lid to the enclosure, double-check EVERYTHING!

## Testing and Use

Connect up, plug in and switch on the Sequencer, Interface and Strobe units as shown in the typical application wiring diagram, Figure 7. Set the Sequencer 'FLASH RATE' control approximately to the 3 o'clock position, push the 'MANUAL' switch, and the LED within the switch will begin to flash. Push the 'STROBES ON/OFF' switch, which should illuminate. On the rear of the interface unit, set the CHANNEL SELECT switch 1 to the ON (down) position, all other switches should be OFF (up). Push the sequencer

Figure 5. Box drilling details.

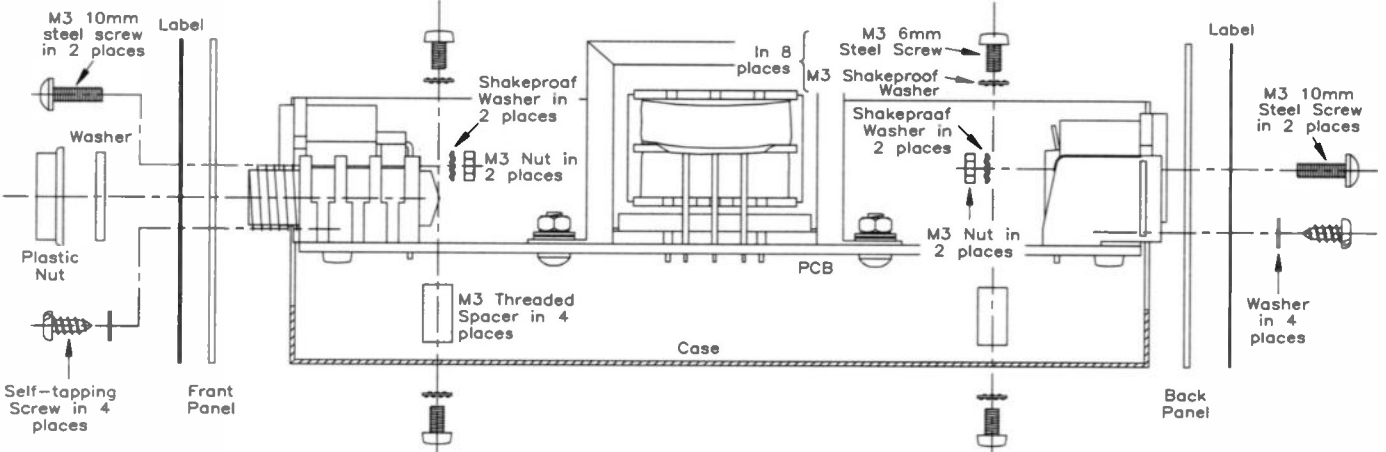
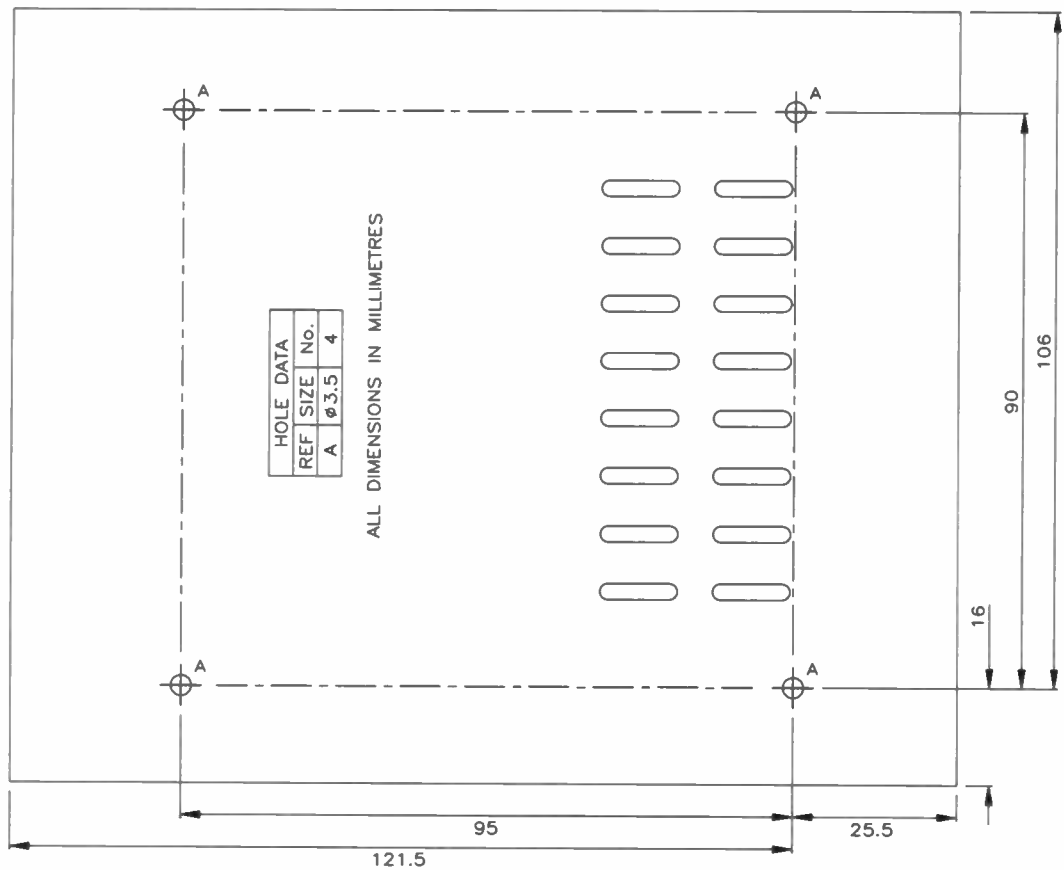


Figure 6. Exploded assembly diagram.

'CHANNEL 1' switch, the 'CHANNEL 1' switch LED and the strobe unit will flash in sympathy with the LED within the 'MANUAL' switch. De-select the interface 'CHANNEL SELECT' 1 switch and choose 'CHANNEL SELECT' 2 switch, press the sequencer 'CHANNEL' 2 switch; the strobe should flash as before. Repeat the test for each channel.

Always operate the Multi-Strobe system in accordance with the mains safety guidelines printed in the relevant articles. The Multi-Strobes were featured in Issue 92, and the Sequencer in Issue 100 of *Electronics*.



### Important Safety Note

It is important to note that mains voltage is potentially lethal. Full details of mains wiring connections are shown in this article, and every possible precaution must be taken to avoid the risk of electric shock during maintenance and use of the final unit, which should never be operated with the box lid removed. Safe construction of the unit is entirely dependent on the skill of the constructor, and adherence to the instructions given in this article. If you are in any doubt as to the correct way to proceed, consult a suitably qualified engineer.

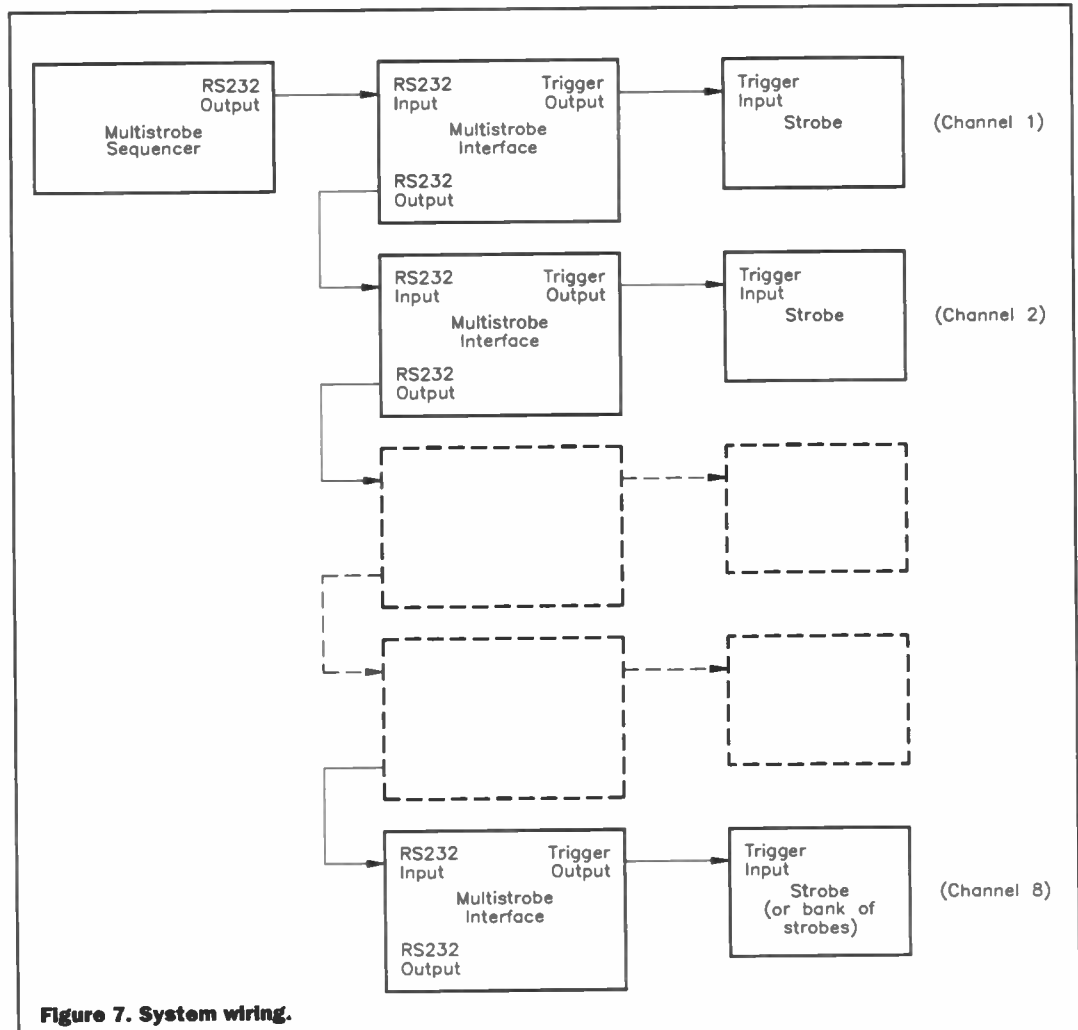


Figure 7. System wiring.

## PROJECT PARTS LIST

### RESISTORS: All 0-6W 1% Metal Film (Unless specified)

R1	100k	1	(M100K)
R2-4	10k	3	(M10K)
R5	5-6	1	(M5R6)
R6	1k	1	(M1K)

### CAPACITORS

C1-4,14	22µF 16V Radial Electrolytic	5	(AT37S)
C5	2n2F Polyester Layer	1	(WW24B)
C6	470nF Polyester Layer	1	(WW49D)
C7	1µF 63V Radial Electrolytic	1	(AT74R)
C8	100nF Metallised Film PETP	1	(JR34M)
C9,10,12,13	100nF 50V Ceramic Disc	4	(BX03D)
C11	220µF 16V Radial Electrolytic	1	(AT41U)

### SEMICONDUCTORS

D1-9	1N4148	9	(QL80B)
D10-13	1N4001	4	(QL73Q)
TR1,2	BC327	2	(QB66W)
IC1	MAX232CPE	1	(FD92A)
IC2	HCF4094BEY	1	(QW54J)
IC3	HCF4011BEY	1	(QX05F)
IC4	HCF4017BEY	1	(QX09K)
RG1	LM78L05ACZ	1	(QL26D)

### MISCELLANEOUS

JK1	Mono PCB-mounting 1/2in. Jack Socket	1	(FJ00A)
SK1,2	FCC68 PCB-mounting Socket 4C4P	2	(JW46A)
SK3	PCB-mounting Euro Socket	1	(BE23A)
SK4	PCB-mounting Europlug	1	(FE15R)
T1	250mA 9-0-9V Transformer	1	(YN15R)
FS1	5A Time Lag Glass Fuse	1	(DA02C)
FS2	50mA Time Lag Glass Fuse	1	(CZ85G)
S1	8-way Piano Type DIL Switch	1	(JW76H)
	PCB-mounting Fuseholder with Cover	2	(KU29G)
	Euro Lead	1	(MK41U)
	Steel Case Type 1105	1	(XJ25C)
	14-pin DIL Socket	1	(BL18U)

16-pin DIL Socket	3	(BL19V)
M3 Steel Nut	1 Pkt	(JD61R)
M3 Steel Washer	2 Pkt	(JD76H)
M3 Shakeproof Washer	2 Pkt	(BF44X)
M3 Threaded Spacer	1 Pkt	(FG38R)
M3 6mm Steel Screw	1 Pkt	(JY21X)
M3 10mm Steel Screw	1 Pkt	(JY22Y)
Stick-on Feet Square	1	(FD75S)
Front Panel	1	(AV82D)
Rear Panel	1	(AV83E)
PCB	1	(95108)
Panel Labels	1	(95109)
Instruction Leaflet	1	(XZ19V)
Constructors' Guide	1	(XH79L)

### OPTIONAL (Not in Kit)

Multi-Strobe Sequencer	1	(LT92A)
Strobe Connector Lead	1	(DY56L)
Coiled Mono Jack Lead	1	(RW34M)
Plastic Jack Plug	2	(HF85G)
Single-core Screened Cable Black	1m	(XR12N)

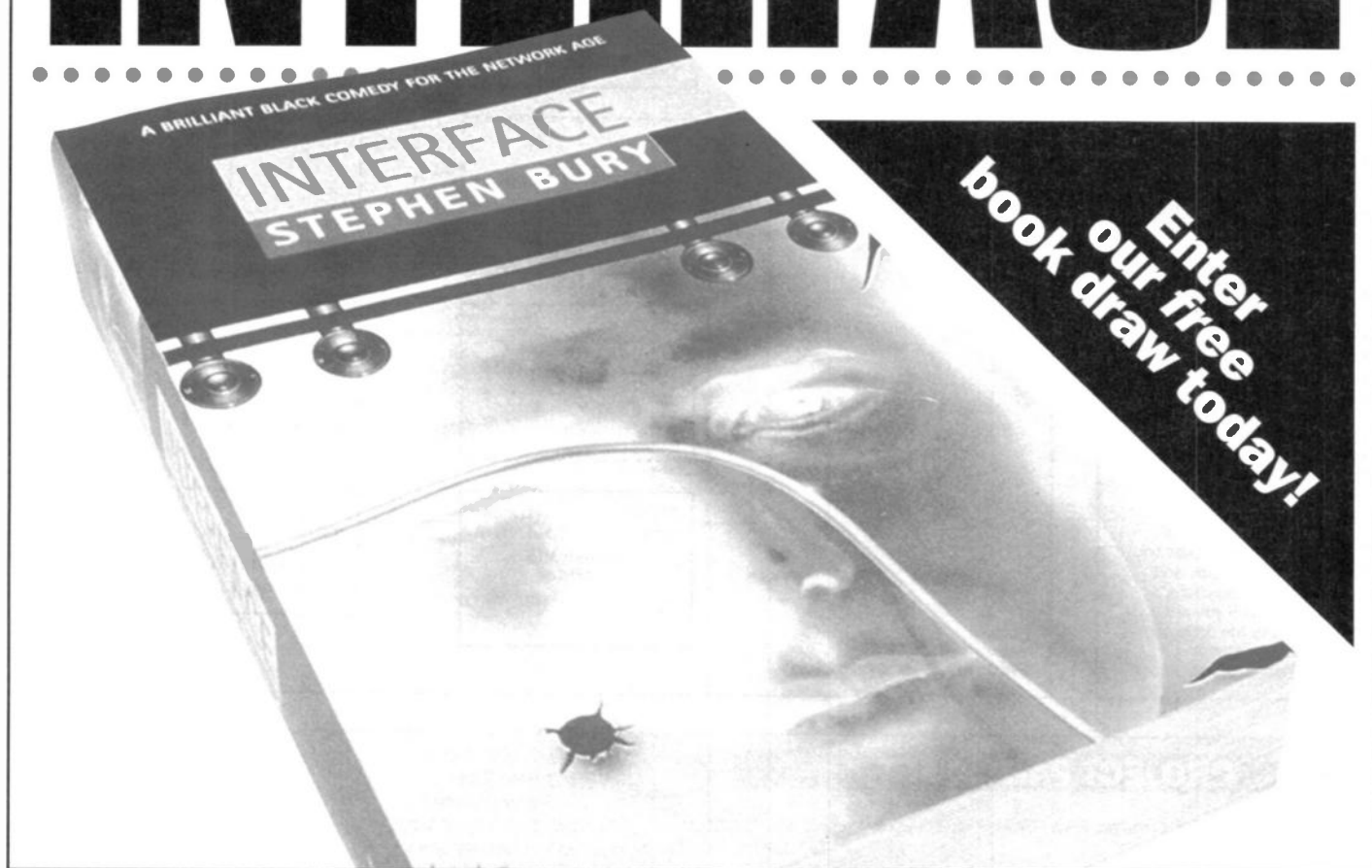
The Maplin 'Get-You-Working' Service is available for this project, see Constructors' Guide or current Maplin Catalogue for details. **The above items (excluding Optional) are available as a kit, which offers a saving over buying the parts separately. Order As 95107 (Multi-Strobe Interface) Price £44.99**

Please Note: Where 'package' quantities are stated in the Parts List (e.g., packet, strip, reel, etc.), the exact quantity required to build the project will be supplied in the kit.

The following new items (which are available in the kit) are also available separately, but are not shown in the 1996 Maplin Catalogue.

Multi-Strobe Interface PCB Order As 95108 Price £4.99  
Multi-Strobe Interface Labels Order As 95109 Price £2.29

# INTERFACE



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# Stray Signals

by Point Contact

## Tricks of Yore

A few years back, PC left his last permanent employment: he was taking early retirement (or being made redundant, whichever way you look at it). He had to make the customary farewell speech to the assembled colleagues from his immediate department, standing around in a group with others of longer acquaintance, now in other departments. In return, he was presented with a leaving gift, bought with the proceeds of a whip-round organised by one of the secretaries (bless 'em). It was a globe on a stand, complete with mains lead and plug. In daylight, it shows the continents of the world in shades of green and brown, indicating their physical topography. But when plugged in and illuminated from within, it shows the world in political format, with the various nations in different colours.

It makes a pretty accompaniment to the table lamp, the pair standing on a shelf either side of the Hi-Fi system (actually rather Medium Fi, PC having long ago opted out of the Hi-Fi rat-race, in favour of Me-Fi and knock the opposition). But a week or so back, the globe's internal bulb finally gave up the ghost, and needed replacing. But what wattage? The box the globe came in and the leaflet with it had both long disappeared, and although the voltage could faintly be made out, marked on the glass of the bulb, the wattage seemed to have worn off entirely, being not merely illegible, but actually quite invisible.

Fortunately, all was not lost; an old trick from the days of valve radios provided the answer. In those days, like any radio serviceman, PC was sometimes confronted with a valve where the type number was illegible or worn off. The trick was quite simple. One gently polished the glass with a clean dry cloth and then breathed on it lightly. If you had guessed the right place, the number could then easily be made out if viewed in a glancing light, until the condensed breath evaporated, when it reverted to invisibility. So now the globe has its proper illumination

again (25W lamp with MBC cap) – strange how tricks of yore can still come in handy today.

## Bigger Speakers

Talking of 'Fi' (Lo in this case), PC was playing with the Maplin clockwork radio he mentioned in an earlier Stray Signals. Obviously, it is not possible, in a compact case, to get a speaker large enough to provide much bass response. Nevertheless, a surprising improvement can be effected, at little or no cost, with the aid of a stout discarded box from the supermarket, made of two or three ply corrugated cardboard, such as 'tri-wall'. PC used to listen to a transistor portable radio during the lunch hour at work, with the aid of such a box perched on top of a filing cabinet in the office. The flaps where the box had been opened (to take out the tins of baked beans or whatever) were taped up, effectively increasing its depth, and the box then laid on its side. An oblong hole was cut in the bottom, of just the size to take the case of the tranny portable at a push fit. The improvement in bass response was striking, and indeed, the volume appeared increased across the whole audio range.

This dodge would doubtless benefit the Maplin clockwork radio, although an additional small hole in the side (top) of the box would be necessary to allow the telescopic aerial (which on this model is situated right at the back of the radio) to poke through. However, PC found an even more dramatic improvement was possible. A foray into the far recesses of the loft – which in the PC abode, with its long 60° pitched roof, is vaguely reminiscent of the nave of a gothic cathedral – unearthed a ten inch loudspeaker in an open back cabinet some fifteen inches square by seven deep. The loudspeaker was salvaged many years ago from a valve radiogram, and was made in the days when speakers were still built to be efficient, before anyone thought of 'improving' the bass response by making the cone so

heavy that the mid-frequency sensitivity was depressed to match that at low frequencies. The plug on the speaker lead was soon changed so it could be plugged into the external earpiece/speaker socket of the clockwork radio. The result was pure magic; suddenly double basses were in evidence, and the pizzicato cellos were a treat.

Now, this is actually rather surprising. Usually, the coupling capacitors in the signal path of a tranny portable are penny-pinchingly small, on the argument that if the set's loudspeaker cannot reproduce the bass, why pay for capacitors big enough to allow the output stage to amplify it? Perhaps some prescient designer somewhere foresaw the attachment not just of an earpiece, but of a decent size loudspeaker to the set.

## English as She is Spoke

A headline over a component review in one of the 'freebie' (controlled circulation) magazines caught my eye recently – "Industries lowest power MOSFET"! Obviously, the semi-literate editor meant "Industry's etc., etc.", but what semiconductor manufacturer would boast of having the lowest powered MOSFET? Reading on, it turned out that the item referred to the industry's lowest power-MOSFET on-resistance specification. Evidently, the benighted editor was also non-technical, it seems. So take heart, all you lads and lasses who just missed getting an F level GCSE in English; a great future awaits you as a sub-editor on a controlled circulation magazine.

Yours sincerely,

*Point Contact*

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



# Optical DISKS

by Reg Miles

*Optical discs have been largely confined to niches – audio CD excepted, but recent developments have expanded their uses and are gradually pushing them into the mainstream. Now, companies are mustering their efforts to finally push them into the mass market.*

It has been a long time in coming, for it was back in the late Sixties that companies recognised the potential of combining the recently invented laser with a new type of disc to play audio and video. MCA, Sony and Philips were experimenting with reflective discs, and Thomson with a transmissive type, in which the laser was beamed through the disc. In 1972, Philips demonstrated what it then called Video Long Play to the media, and at the end of that year, MCA followed suit. Over the next couple of years, the two agreed a joint standard for the analogue AV laser disc, and the other formats were abandoned.

Encouraged by this, Philips became the leading light and announced that VLP would be launched in 1976 or '77. Rashly, as it turned out: considerable difficulties were experienced in getting the players to work properly, as well as pressing fault-free discs. It was not until December 1978 that Philips could manage even a test launch – in Atlanta, USA. This proved successful in its small way, with around 400 players being quickly sold. However, predicted dates for a full scale launch, of what Philips had re-christened LaserVision, were not met until the UK launch in May 1982, by which time the public's imagination had been caught by the VCR. The better quality and freedom from wear were insufficient to outweigh its inability to record and the minimal software available. Even reductions in player prices went largely unheeded. Philips gradually let it fade away, concentrating on business and educational uses instead.

Philips, however, was not the only company with a commitment to the standard: Pioneer was building a small but growing market in Japan, having launched its first industrial model in 1979 and a consumer one in 1980, calling the format Laser Disc. Being NTSC, they were also suitable for the US market, and there too, the market began to grow, albeit more slowly. In 1984, Pioneer

introduced a 20cm disc giving twenty minutes per side for music videos to complement the one hour per side 30cm disc. The company then introduced a 'combi' player that accepted both disc sizes as well as audio CD and modified the laser disc standard to include CD quality digital audio in addition to FM, both of which gave further impetus to sales.

Philips felt this might be what was needed to relaunch LaserVision, and announced the result in 1987 – renamed CD Video. In addition to 30cm LP and 20cm EP, there was also a 12cm Single with six minutes of AV and another twenty minutes of CD audio. The only snag was that the greater PAL bandwidth meant there was insufficient room for both digital and FM audio together, so the latter was discarded (even so, it was still necessary to remove a lower video sideband to accommodate the digital audio, reducing horizontal resolution slightly to, about 440 lines). But again, there were delays, this time due to quality problems caused by the combination of digital audio and PAL video, which necessitated finer manufacturing tolerances for both discs and players. By the time small numbers became available, the enthusiasm aroused by the announcement had evaporated, and Philips once again gave up.

Pioneer, however, continued to develop the potential, and in 1991, launched a dual-standard, PAL/NTSC, player to give PAL users access to the large range of American titles – or Japanese. Nowadays, most players are dual-standard, and capable of playing all sizes of laser discs as well as CD-Audio.

Despite the problems faced by laser disc over the years and its still comparatively limited appeal, it did prove the technology that is still used, with variations, in all the optical disc formats that have followed.



With laser disc, the video and audio are mixed and frequency modulated onto a carrier, and this composite signal is stored on the disc in the form of microscopic pits of constant width and depth but of varying length (see Figure 1). These form a spiral track beginning at the inside and running outwards. As the low-power laser scans radially across the disc, its light is reflected by different degrees from those pits and the land (reflective surface) between, and the resulting fluctuations in intensity are converted back into electrical signals by a photodiode. The laser beam is locked onto the track by servo controlled optical systems, which also maintain focus and synchronisation.

There are two types of disc: constant angular velocity (CAV) and constant linear velocity (CLV). The former has one video frame per revolution, enabling still and variable speed forward and reverse play, as well as precise access and interactivity. It rotates at 1,500rpm, and the 30cm disc can hold up to 36 minutes of continuous motion or 54,000 stills each side. The latter can hold just over one hour of continuous motion each side; but not stills, because the speed varies from 1,500 to 570rpm and one revolution no longer equals one frame. This mattered little to the majority of consumers, but business and educational users have always favoured CAV, exploiting its properties with professional players linked to computers.

While widespread success has eluded laser disc, its audio CD offspring has become a familiar part of the music scene, both consumer and professional. Philips and Sony began developing their own versions of the Digital Audio Disc (as it was then called), with the former favouring a 10cm disc, the latter a 12cm one. When they sensibly joined forces to agree a common standard, they also agreed to adopt the larger size with its potential 80 minute capacity. CD-Digital Audio (CD-DA) was launched in the autumn of 1982 in Japan and the spring of 1983 in Europe, although not to instant success, for prices were high and there was a lot of vinyl around.

Again, the information is stored in the form of pits, but in this case, representing binary digits. The 16-bit digital samples from the analogue signal are grouped together in blocks of six right and six left channel samples for error correction calculations, and each sample is divided into an upper and lower 8-bit number called a symbol. On the disc, the single digit 1 is represented by both the leading and trailing edges of a pit (where reflected intensity changes abruptly) and the 0s by the length of each pit and the length of the land between them – the longer the pit or land, the greater the number of 0s (see Figure 2).

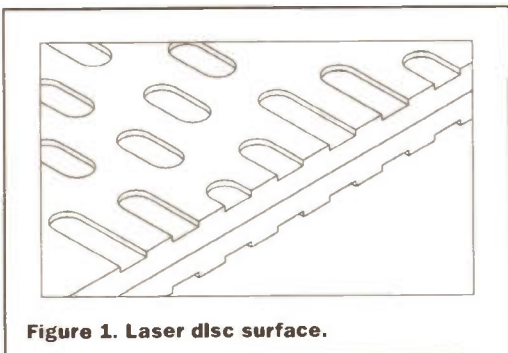


Figure 1. Laser disc surface.

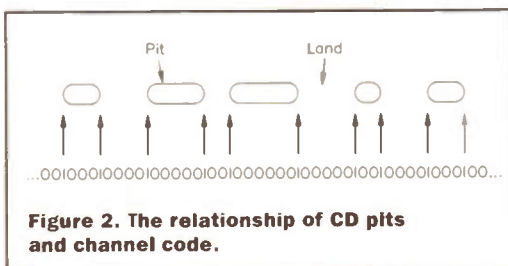
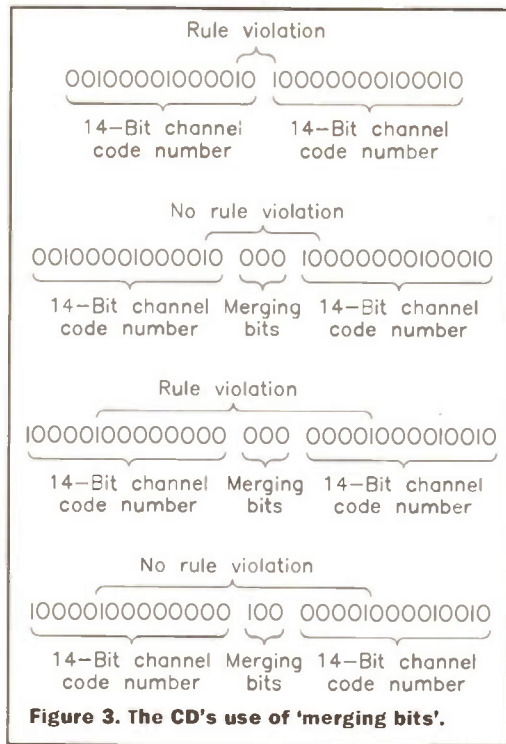


Figure 2. The relationship of CD pits and channel code.



There are nine different lengths of pits and lands: the shortest representing 1001, the longest, 100000000001. The inability of this system to represent strings of 1s is overcome by using Eight-Fourteen Modulation. This converts the 8-bit symbols into a 14-bit channel code which inserts 0s between the 1s to separate them (with 'merging bits' being added between the 14-bit symbols if the rules are violated at their junctions - see Figure 3). The nine discrete pit lengths also determine the disc's rotation speed, so that the correct number of 0s are read between the 1s. The correct speed is achieved when nine discrete frequencies compose the high frequency signal reflected back from the disc. The speed varies from 500-200rpm, giving a constant linear velocity. This produces a data transfer rate of 170k-byte/s, from a total capacity of 600M-bytes. All the many details of the format are precisely defined by the Red Book standard: a name coined because the documentation was originally kept in a red folder.

The Red Book also specifies subcodes on the disc: some of these are used for track identification and track and disc playing times, while others can be used to contain information for text, graphics and animation for TV display via a subcode output and graphics decoder. However, this CD+Graphics facility has found little use - except for karaoke in Japan.

**Panasonic notebook PC with CD-ROM.**



In 1985, Philips and Sony launched CD-ROM to provide high capacity storage for a niche market. Now, just a glance at the free discs offered by computer magazines shows how the format has suddenly gained popularity. The reason for this is multimedia and the development of ever-larger programs generally (even portable computers are becoming available with built-in drives).

It is based closely on CD-DA, and a 12cm disc can store around 650M-byte. While the more recent 8cm version has a 200M-byte capacity. Its basic specifications were defined by the Yellow Book standard. However, the file structures and drive/computer interfaces were left to the computer industry to interpret, which, not surprisingly, led to incompatibilities. These problems were tackled at a conference of developers held in the High Sierra hotel in Nevada. This High Sierra Group standard resolved many of the problems. Other standards have also been proposed, and now there is ISO9660, to which most CD-ROMs adhere.

CD-ROM has two modes: Mode 1 for text-based data, with strong error correction and a maximum data transfer rate of 150k-byte/s (single speed drive), and Mode 2, which uses less error correction. Mode 2 can, therefore, achieve a higher data transfer rate of 170k-byte/s – enabling it to carry compressed audio and video (although there was little call for that in the early days, CD-ROM was used to carry large amounts of text-based data). In 1989, Philips and Sony, with Microsoft, developed an enhanced version called CD-ROM XA (eXtended Architecture). In this case, Mode 2 is sub-divided into Form 1 for data, and Form 2 for audio and video, enabling data, audio and video to be interleaved for largely seamless playback.

CD-ROM XA was a substitute for CD-interactive (CD-i), which had been proposed as a simplified alternative to CD-ROM, only to be rejected by the computer industry. CD-i was then redirected to the consumer market. The initial development work was done by Philips and Sony, with Matsushita (Panasonic) coming in later; although Philips was, and still is, the driving force behind it.

Various problems meant that the launch of CD-i was delayed until the autumn of 1991 in the USA and the spring of 1992 in the UK. CD-i can support three levels of video: normal, with horizontal and vertical resolutions of  $384 \times 280$  lines; double, at  $768 \times 560$  and the potential for high definition. Also, there are four levels of audio quality: CD-DA, Hi-Fi, Mid-Fi, and speech, plus text, graphics and animation. The players will also accept CD-DA, CD+Graphics and Photo CD discs. To avoid compatibility problems, which would doom it to failure in the consumer market, all the specifications were precisely defined by the Green Book standard. The CD-i player is a self-contained unit, with all processing being done internally and the discs must conform to rigorous standards, so that whatever the contents – games, reference works, music, etc. – and whoever has produced it, they will all play in any player. The player merely has to be plugged into a TV, with control provided by a glorified infrared remote control or optional pointing device.

This degree of simplicity and compatibility has also tempted companies to use it for training and reference purposes, as well as making it suitable for educational uses. Professional portable players with LCD screens are now available, and a CD-i/PC card enables discs to be played on a CD-ROM drive.

The latest development is Internet and WWW access. With a standard modem and a CD-i cable connected to the CD-i player and phone, the user has only to start a disc and the software on the disc will call the service provider and make the connections to the Internet. The user can also send and receive e-mail.

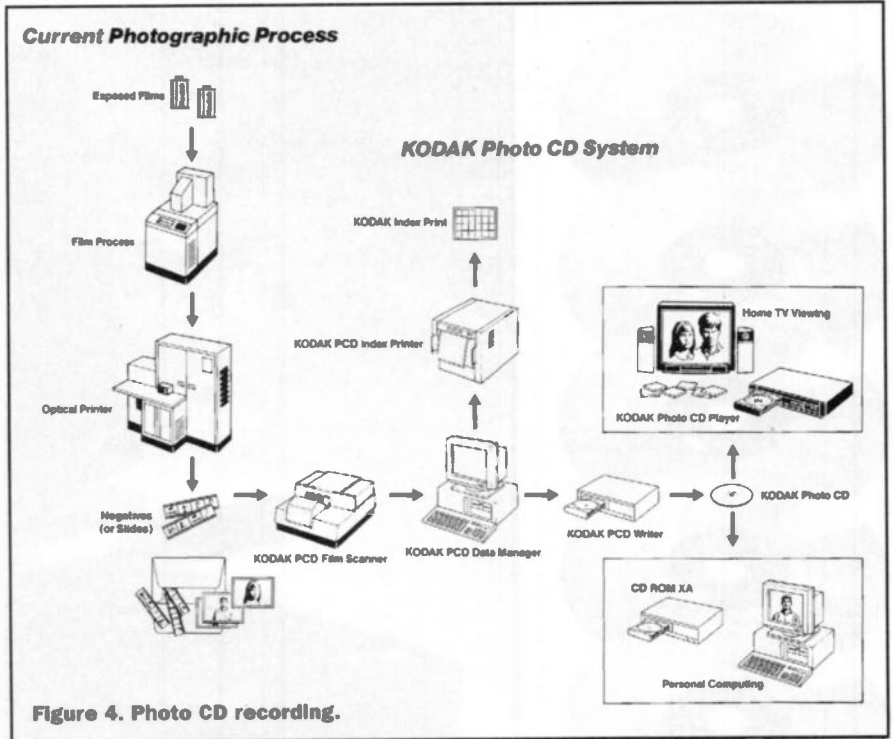


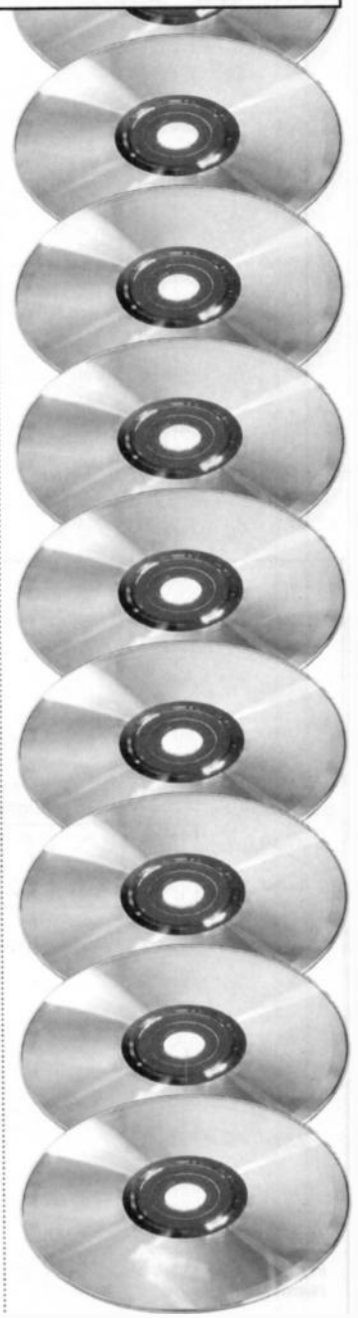
Figure 4. Photo CD recording.

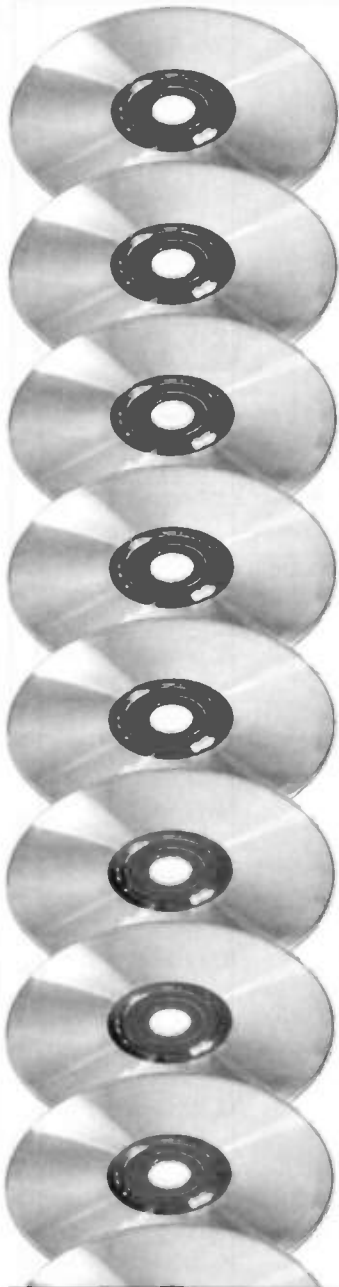
The next disc format to be launched was Photo CD in 1992 (again, after some delay). This was developed jointly by Kodak and Philips, to enable up to 100 35mm images to be transferred to disc by a photo lab – in one or more recording sessions. A Photo CD player then allows them to be viewed on TV. Figure 4 illustrates the recording process: a film scanner with three parallel arrays of CCDs captures red, green and blue images; this scanned information is then passed to the Data Manager. From there, it is enhanced, compressed, and structured into several file formats for fast video display, high definition video display and printing. It is then formatted and sent to the PCD Writer to produce the disc. This is a recordable CD (CD-R), conforming to the Orange Book standard. It has a dye-polymer coating that breaks down under the spot heat of a high power laser beam, permanently altering its refractive index and thus its reflectance, forming the equivalent of pits. An Index Printer can then produce a montage of prints for display on the disc case, as well as larger prints.

Kodak believed that Photo CD would be an ideal system for consumers, particularly as players can additionally accept CD-DA. Unfortunately, most consumers disagreed. However, it has proved attractive to professionals, particularly the picture libraries and photographers using computers to manipulate their images. The following year, Pro Photo CD was launched to take 25-100 film images – up to  $8 \times 10$ .

Photo CD images are stored in an Image Pac, comprising six different resolutions to cater for different needs. The first is for the identification prints, the second for displaying multiple images on screen, the third (known as Base) for full screen display which exceeds laser disc quality, the fourth (4Base) for HDTV with  $1,024 \times 1,536$  pixels, the fifth (16Base) with  $2,048 \times 3,072$  pixels, and Pro Photo CD (64Base) with  $4,112 \times 6,168$  pixels. Pre-mastered Photo CDs have also been launched: a Portfolio Disc intended for publishing with the addition of stereo audio, graphics, text and programmable menus, a Catalogue Disc which can hold up to 6,000 images at lower resolution, and a Medical disc.

Because Photo CD is CD-ROM XA compatible, it can be played on drives conforming to that





Goldstar CD-I player, model GPI-1200.



standard. It can also be played on CD-ROM drives that specifically state they are multisession Photo CD compatible. Multisession, because if the drive cannot cope with the lead-in and lead-out areas that bracket the data after each recording session, it will stop at the first lead-out track, believing that to be the end – as with a single-session disc.

Incidentally, professional CD recorders are available from all the major electronics companies, and these can record all or most of the CD formats, on both 12 and 8cm CD-R discs.

1992 was a good year for discs, with Sony launching the audio Mini Disc at its end, the first disc that consumers can record on themselves – a Magneto-Optical (MO) type, combining heat and magnetism to write and rewrite. The technology has been around for a few years, used for computer and video applications in disc sizes up to 30cm, but until MD, it had always been too expensive and bulky for consumer use. The breakthrough came with Sony's development of Direct Overwriting, which dispensed with the conventional two-stage erase and record process to do it in one go, with the lowest possible magnetic field strength – 8kA/m minimum. As Figure 5 illustrates, the laser at full power (4.5mW) locally heats the magnetic coating above its Curie temperature (180°C), at which it loses its magnetism. The electromagnetic overwrite head is then turned on to produce a 1 (North-South) or 0 (South-North) and as the spot cools, the magnetic field is fixed. In Figure 6, the disc is played by the laser on low power (0.6mW); the polarisation of the beam is rotated slightly by the recorded magnetism due to the Kerr effect, the direction of rotation depending on the magnetic orientation. The beam then passes through a polarisation beam splitter, which changes it into distribution ratios to be sent to one of two photodetectors. A pre-mastered version of MD is also available, and this is essentially the same as CD-DA. Sampling is the same as CD-DA in both versions – 44.1kHz, 16-bit.

MD is only 64mm in diameter, yet has a 74 minute capacity. This is due to the use of compression during recording and playback. The system exploits two psycho-acoustic effects: the threshold of audibility, below which particular frequencies cannot be heard; and masking, where soft sounds are drowned out by simultaneous loud sounds of similar frequency. When these are discarded, the data rate is reduced to one-fifth, from 170k-bytes to 34k-bytes. During playback, this has the additional advantage of providing a buffer memory to compensate for shocks knocking

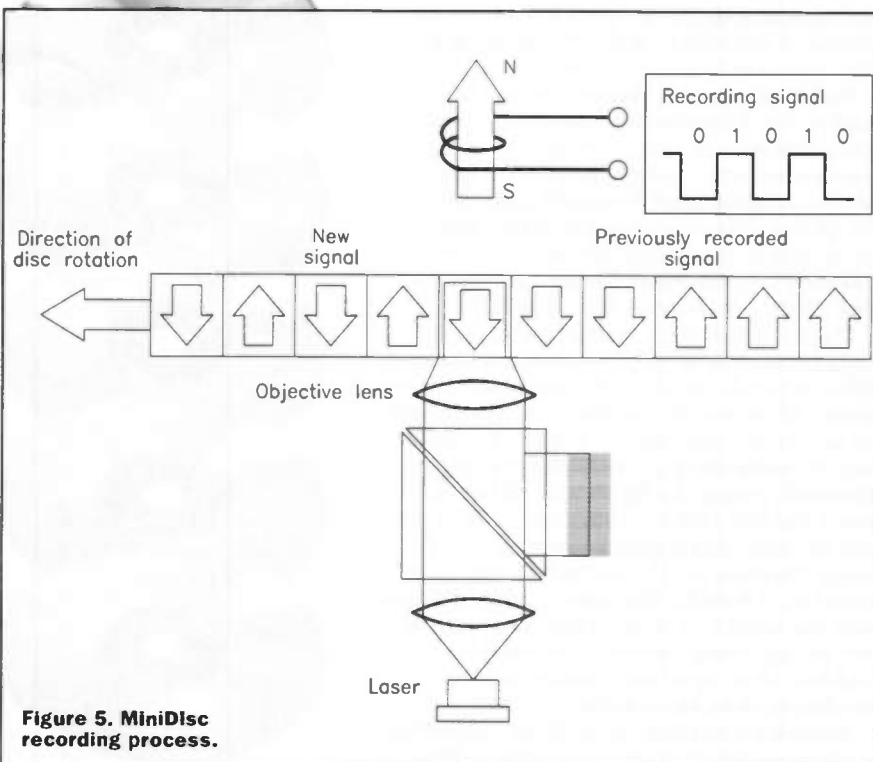
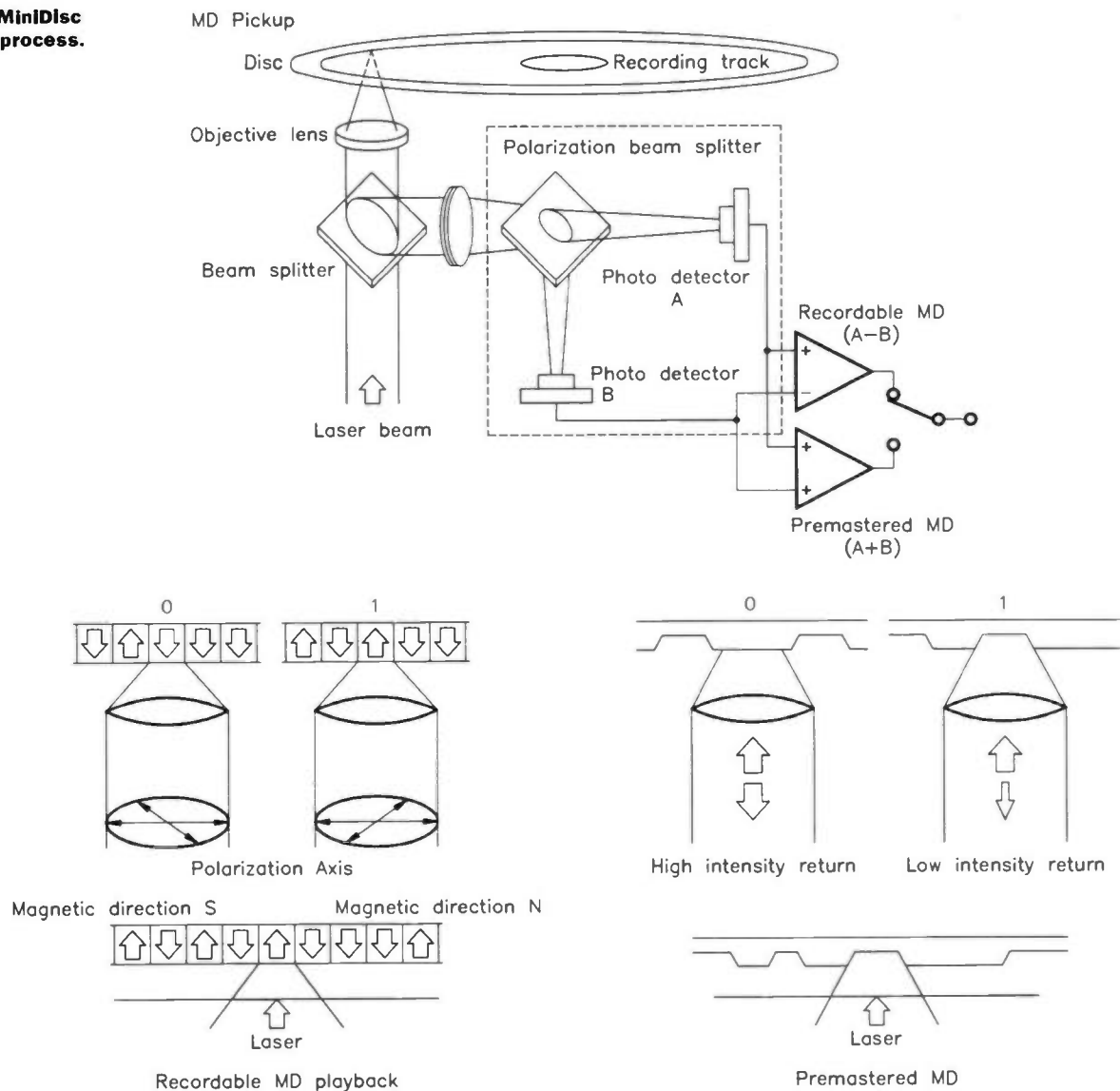


Figure 5. MiniDisc recording process.

**Figure 6. MiniDisc playback process.**



the laser and temporarily halting playback. The 170k-byte/s data stream is fed into memory at regular intervals and fed out at 34k-byte/s for processing.

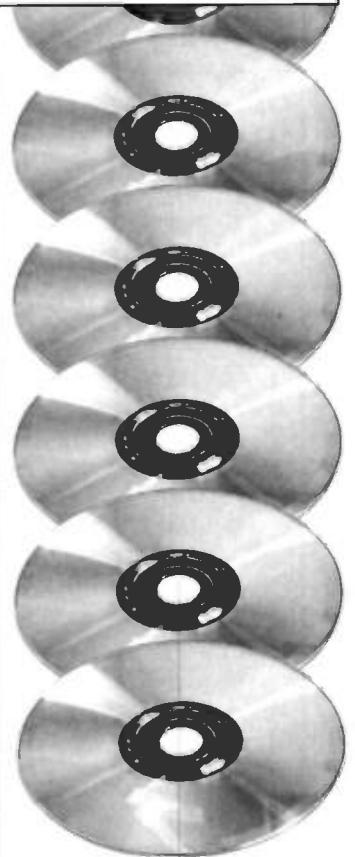
These properties, together with random access, user table of contents, track marking and a protective cartridge, have also proved attractive to professional users for acquisition, editing and playout of audio – mainly in radio.

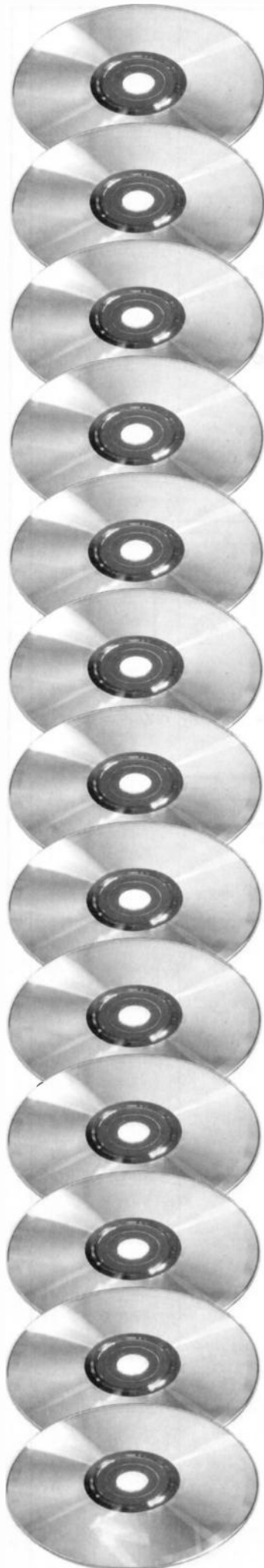
Sony has also launched an MD Data version for general computer and multimedia uses. This has a capacity of 140M-byte, and a data transfer rate of 150k-byte/s. The drive can handle three types of disc: rewritable, pre-mastered (MD-ROM), and hybrid – combining rewritable and pre-mastered sections. A new file system provides compatibility with different operating systems. The drive can also play, but not record, MD audio discs, but the MD Data discs are encoded to prevent their use in audio players.

Going on to mid 1993, JVC, Matsushita, Philips and Sony announced the Video CD standard to carry up to 74 minutes of full screen, full motion video on a 12cm disc. It was based on the White Book Karaoke CD standard already agreed by JVC and Philips that March. This employs the MPEG-1 standard for compressed audio and video, giving quality approximating to Mini Disc and VHS tape, respectively. Video CD is intended primarily for linear films and music videos, with the possibility of educational and training programmes. However, the first full motion

video (FMV) releases were on CD-i discs using the Green Book standard, for playing on a CD-i player with an FMV (or Digital Video) cartridge. CD-i and Green Book are still used for interactive FMV programmes. White Book Video CDs did not become available until 1994. These too can be played on a CD-i machine with cartridge, as well as on a Video CD player (which can additionally play CD-DA), Amiga CD32, and multimedia PCs and Mac's equipped with CD-ROM XA drives and White Book MPEG-1 decompression boards. CD-ROM discs can also carry MPEG-1 FMV – linear or interactive.

3DO machines will also be capable of playing Video CD when their FMV cartridge becomes available this year. 3DO was launched in 1994, after delays, and is similar to, but incompatible with, CD-i. Technically, it is superior, but it seems to have become trapped in the games market with its other potential applications going unrealised. But then, the 3DO company was not formed to manufacture what it had developed, only to licence the hardware and software, so it is not in a position to steer the system as Philips has done with CD-i (and 3DO is now diversifying into the development of computer products). Whether the introduction of FMV will give the system a boost remains to be seen, but the games market is very competitive with discs now commonplace – the most recent being Sony's PlayStation, launched last year.





Last year also saw the launch of Panasonic's Phasewriter Dual (PD) re-writable 12cm disc for general computer and multimedia uses. This is coated with a phase-change material, which, when heated locally by the laser at full power, changes from a crystalline to amorphous phase, altering its reflectance to give the equivalent of pits – read by the laser at low power. Re-recording is achieved by direct overwriting. The disc has a capacity of 650M-byte, and is of the constant angular velocity type, with a rotation speed of 2,026rpm. This allows a faster data transfer rate of 518-1,141k-byte/s. The PD drive/writer can also play CD-ROMs at 4× speed, although PD discs cannot be played in a CD-ROM drive.

This problem will be addressed by a new CD-Erasable standard being developed by Philips, Sony and eight other companies, with a launch expected this autumn. It too will use phase-change technology, but as well as the CD-E drive/writer being capable of playing CD-ROMs, CD-E discs will be capable of being played in CD-ROM (and CD-R) drives.

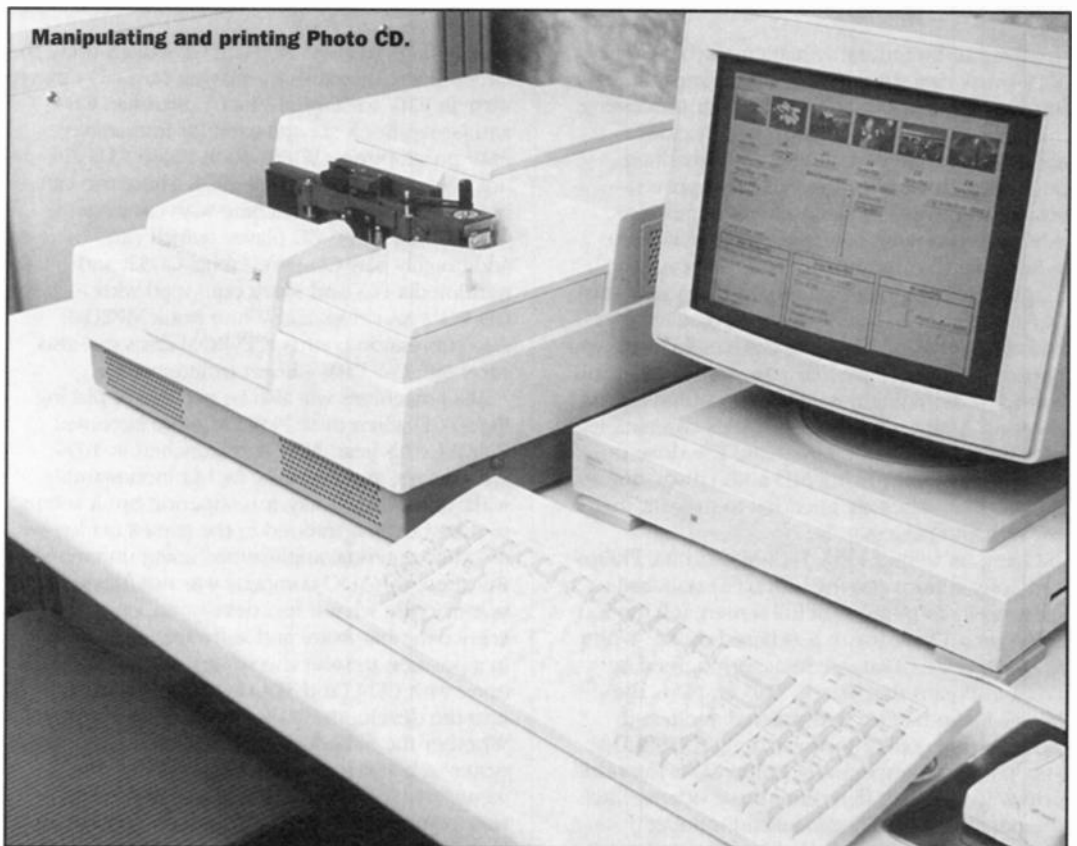
Going back to the end of 1994, there were two rival high-density, 12cm disc formats proposed for general computer, multimedia and entertainment uses: Multimedia CD by Philips and Sony, and Super Density disc by Hitachi, Matsushita, MCA, Pioneer, Thomson, Time Warner and Toshiba. Both types use red lasers with wavelengths of 635-650nm rather than the 780nm infrared lasers used currently. Combined with more efficient data coding, error correction and channel modulation, this permits the greater capacity. Over the following months, both camps picked up additional followers, although everyone knew that the two must merge in order to avoid an unseemly and internecine struggle.

In a brief midsummer interlude, Philips and Sony made time to release the Blue Book specification for an enhanced music CD (also known as CD Plus), endorsed by Apple, Microsoft and the Recording Industry Association of America. This disc can combine CD audio tracks

with CD-ROM data. Video clips, photographs, animation, text and audio can be played on multimedia computers, and audio on existing CD players (future CD players will be capable of displaying information including titles, artists, linear notes and lyrics). However, no discs have been released at the time of writing.

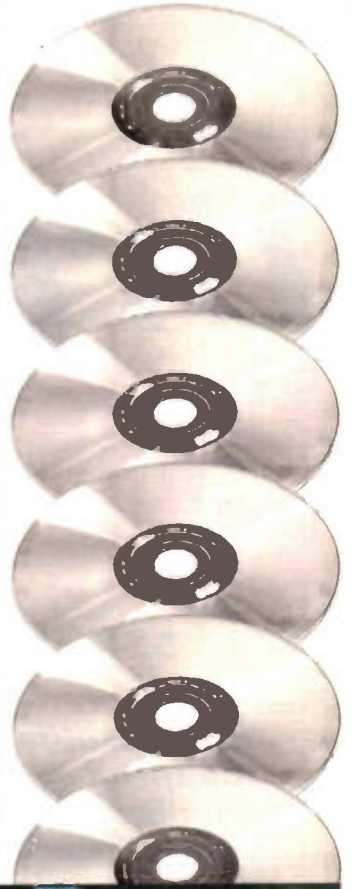
On 18 August 1995, Philips and Sony approached the rival high density camp with a proposal for a single disc standard, and on 15 September, this was agreed, together with the name, Digital Video Disc (DVD). Initially, there will be two types: DVD-Video (or -Movie) for home entertainment, and DVD-ROM, both of which will apparently be backwards compatible with CD media, thanks to a new light path. It is anticipated that both types will be launched in the USA and Japan at the end of this year or early next, followed by a European launch. DVD-ROM is expected to lead the market, partly because the drives will be cheaper than the Video players, and partly because of uncertainties in the software marketing policies of the Hollywood majors. The latter is exacerbated by the insistence on copyright protection – which has not been finalised at the time of writing, and the use of regional coding in discs that will prevent their being played in players of the wrong region (no more US titles in Britain).

The disc will be 1.2mm thick – consisting of two 0.6mm halves bonded together, with one or both sides carrying data (up to 4.7G-byte each). Subsequently, there will be a dual layer version, with one layer above the other, and the laser focusing between them. Thus, there could be discs produced with dual layers on each side – a total of 18.8G-byte! DVD-Video will use the high quality MPEG-2 compression standard for video and audio (the same standard that will be used for Digital Video Broadcasting), with the decoder also being capable of handling MPEG-1 used by CD formats. The video can be still or motion, with multiple aspect ratios. Audio can be straightforward stereo using a fixed bit-rate, multi-channel 5.1 (five channels + sub-woofer





Panasonic PD drive.



option), or 7.1 using variable bit-rate to get the most quality out of the least capacity. There will also be the option of using Dolby AC-3 5.1 (in 60Hz countries, this will be the norm, with MPEG-2 the option). The data transfer rate will be variable, but will average 4.69M-bps for MPEG streams incorporating video, audio, and error correction. The linear running time will be up to 135 minutes per single layer side – including three surround sound channels and four subtitle channels (with a maximum of 32 subtitle channels), and a dual-layer single side disc will have a 4 hour capacity. DVD-ROM will also be able to use MPEG-2, as well as carrying text-based data, graphics, etc. The file management structure will be Micro-UDF (Universal Disc Format) based on ISO9660, which will continue to be used for the existing program base. An 8cm disc is also planned for portable uses. A DVD-Audio standard has also been proposed (also known as Super Audio CD), with the first draft specifications expected to be announced this spring. Philips is also expected to propose a DVD version of CD-i for home interactive uses.

Read only discs will be followed by a DVD-E version, using phase-change technology. The possibility of a DVD-MO standard is also being explored, and Panasonic has proposed a DVD version of PD. Compatibility between read only and erasable re-writable discs is something that is, at present, occupying the time of the Technical Working Group of the computer industry and the companies of the DVD Group.

Prototype DVD-Video and DVD-ROM players have already been demonstrated at a number of shows, where representatives of the companies have made wildly different predictions for first year sales. Already, work is in progress developing new formats exploiting shorter wavelength lasers, multiple layers, and multiplexing techniques that enable different data to be stored in the same place. From its faltering start with laser disc, it seems the story of the optical disc will become a long and interesting one.



Toshiba DVD player.

# PROJECT

## Drill Speed CONTROLLER

Text by Maurice Hunt

*This versatile kit is specifically designed to control the speed of drills or any other AC mains-powered carbon-brush type motor-driven appliances over a wide control range. It may also be used to control other resistive loads, such as lamps, heating elements and similar. The unit operates on the phase cutting principle, which enables the speed of a motor to be accurately controlled without adversely affecting the torque (turning force) at low speeds. The project is ideal for use with electric drills and grinders, where a widely variable speed range enables the successful drilling/grinding of a much larger variety of materials than would be possible with a single-speed power tool.*

### FEATURES

Phase cutting operation

Built-in RF interface blocking

Wide control range

Separate inputs for circuit and load power supply

### APPLICATIONS

Electric drills

Angle grinders

Lathes

Electric polishers

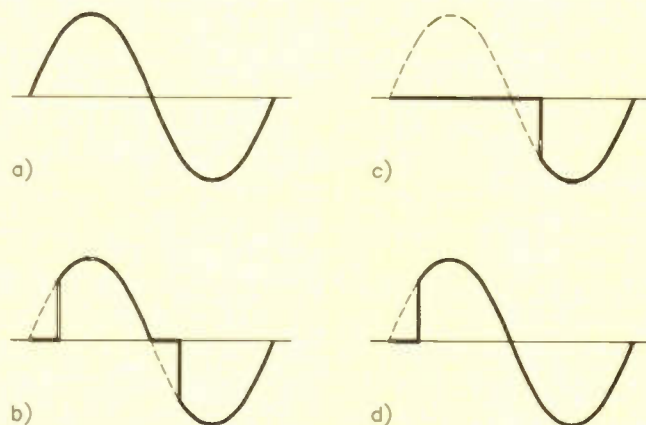
Motorised domestic mains appliances

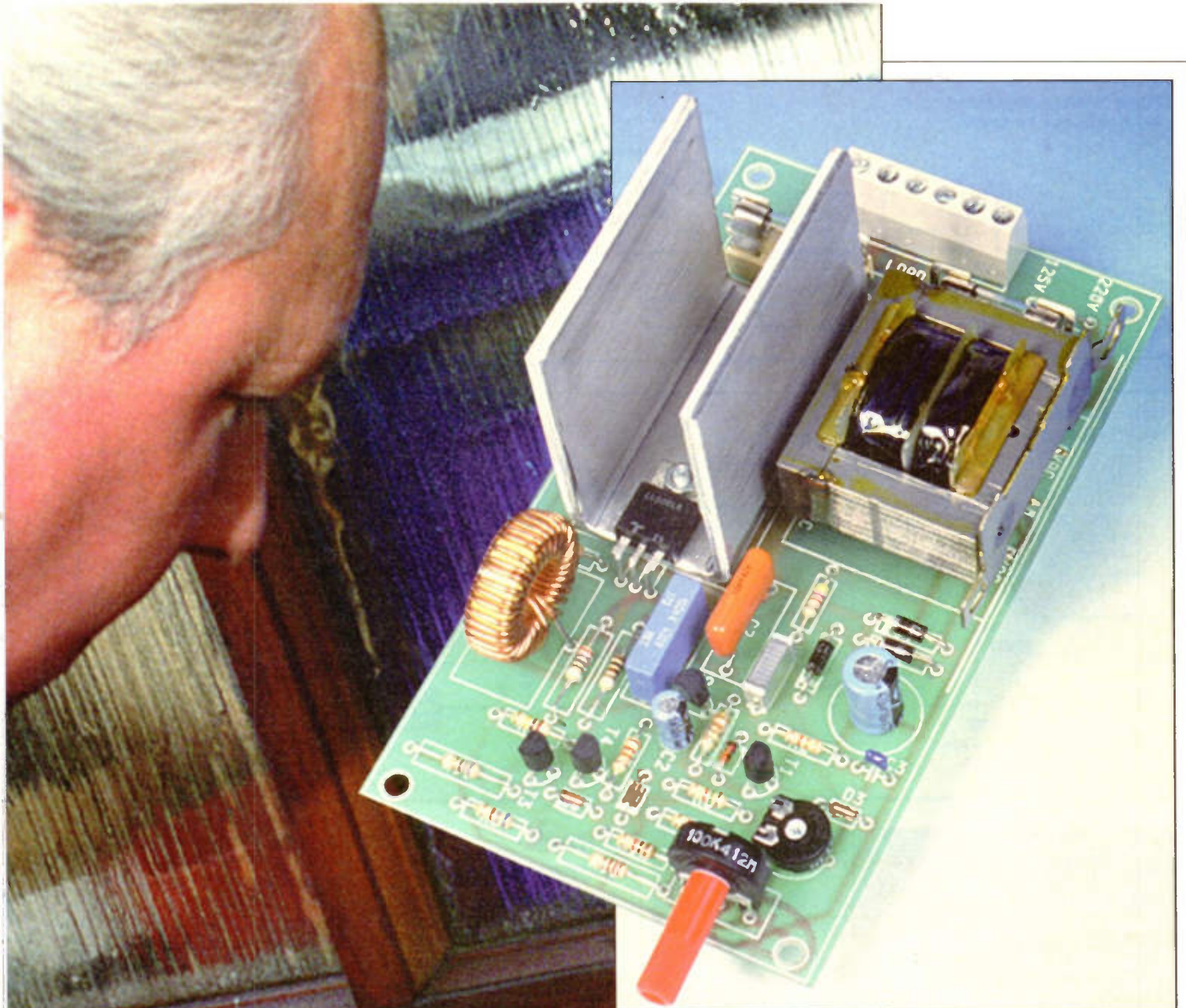
Lamps and other resistive loads

**M**ost types of electronic AC motor speed control/lamp dimmer circuits generally execute a phase-cut on every half-period of an AC cycle (as in Figure 1b), and the power can be altered by moving the moment at which the phase

cut occurs. However, although the 50Hz alternating current is still applied to the motor, at low speed levels, the motor torque will be greatly diminished. Additionally, most speed controller circuits only allow a 0 to 50% control range.

Figure 1. Phase cutting principle.





However, by passing a pulsing DC voltage to the motor at low speeds (see Figure 1c), a relatively large torque can be generated. For speeds above 50% of full speed, the torque is already large enough, and the motor can be driven with the signal shown in Figure 1d.

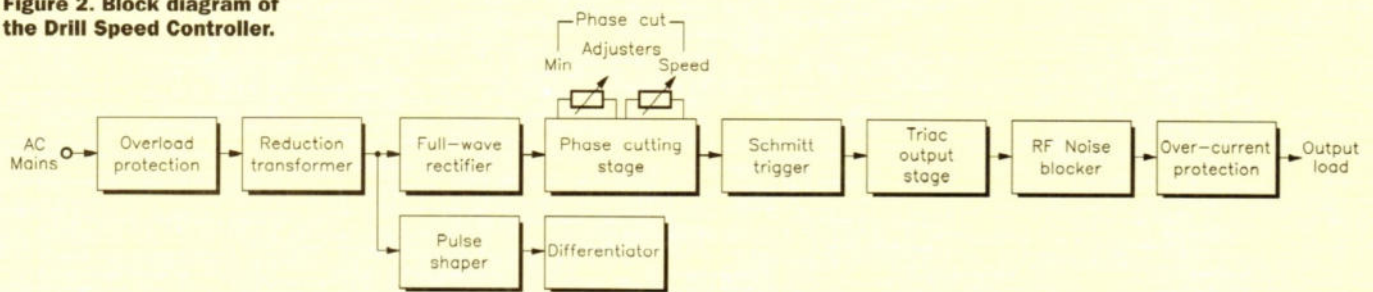
This project achieves this more effective control of the AC cycle phase-cutting, with the advantage that the torque of the motor being controlled is maintained at much lower speeds than is the case with conventional types of AC motor speed control circuit.

The kit contains everything required to create a working Drill Speed Controller unit, with the exception of an enclosure and connection cables. However, the unit is compact and straightforward to install into a casing, or it could be built into the existing housing of an appliance to be controlled, space permitting. Full assembly instructions are provided with the kit.

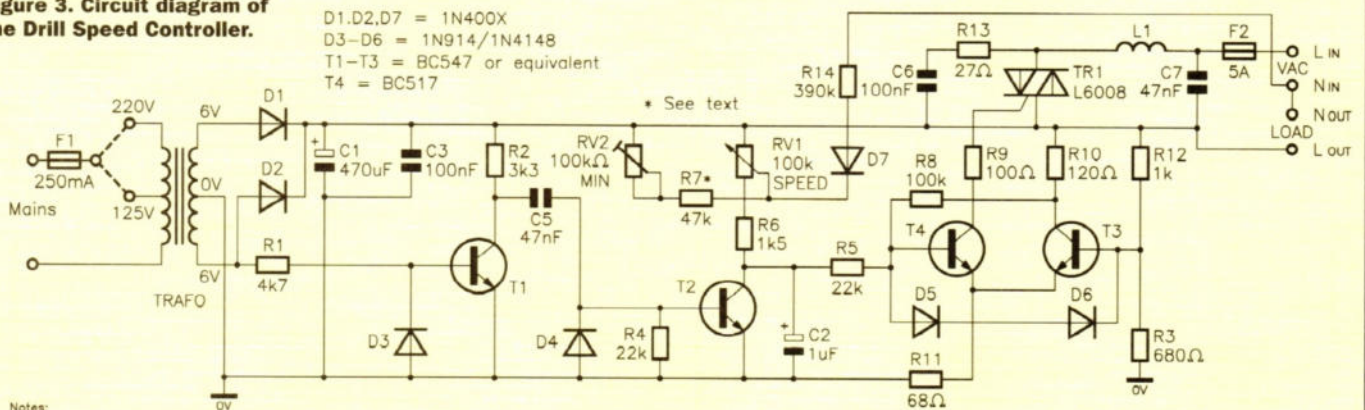
**PROJECT RATING** **2**

**Kit Available**  
Order as 95192  
Price £22.99

**Figure 2. Block diagram of the Drill Speed Controller.**



**Figure 3. Circuit diagram of the Drill Speed Controller.**



Notes:  
 1. 0V must not be connected to earth.  
 2. All parts of the circuit are Live.



## Circuit Description

Refer to the block and circuit diagrams shown in Figures 2 and 3, respectively. Power for the circuit is derived from the step-down transformer, which is full-wave rectified to produce a 6V DC level, decoupled and smoothed by capacitor C1. Fuse F1 provides overcurrent protection, while the mains voltage can be either 110 or 220V AC, selected by a link.

A square wave signal is obtained via T1 and connected to the base of T2 by means of a differentiating R-C network (R4 & C5). The result of this is that at every positive edge, T2 conducts for a while and discharges C2. This occurs after every full period of the 50Hz signal. C2 is charged itself by means of the resistance network formed by RV1, RV2, R6 & R7. The values of these components determine the moment that the phase cut occurs. T3 & T4 form a Schmitt trigger, that switches on the triac when a 3-5V level

is applied to the base of T4. T4 keeps the triac, TR1, in conduction until the beginning of the next period.

L1 and C7 are included to minimise the RF interference commonly associated with triac circuits. Additionally, an RC network (C6 & R13) is used to protect the triac from any inductive voltage peaks and prevent it from being triggered without any control signal actually being applied beforehand. Fuse F2 protects the output of the circuit from being overloaded.

## PCB Construction

The PCB is a high quality single-sided glassfibre type, with a printed legend to assist with component placement. Build up the board in order of ascending component height, and take care to correctly orientate the polarised components (semiconductors and electrolytic capacitors). Commence the assembly process by fitting the jumper link J1 if the unit is to run off

## SPECIFICATION

Operating voltage:	220 to 240V AC or 110 to 125V AC mains
Maximum output load:	5.5A
Power rating:	1,200W @ 220V, 660W @ 110V
Speed control range:	5% to 95%
PCB dimensions:	129 x 75mm

220 to 240V AC or J2 for 110 or 125V AC operation. Continue to install the resistors, followed by the diodes (D1, D2 & D7 are 1N400X types, while D3 to D6 are 1N914/1N4148 types), and preset potentiometer, RV2 – the physically smaller of the two 100k values provided.

Next, install the transistors, capacitors, fuseholders, 6-way terminal block, and potentiometer RV1. Fit the clip-on extension spindle onto RV1. Install the fuses into their holders – F1 being a 250mA, and F2 a 5A fuse. Then fit the coil, L1 (removing enamel from the ends of the coil beforehand, if necessary). Bolt the heatsink to the board using a nut and bolt through the hole nearest the F2 fuseholder. Next, pre-bend the triac leads, place them through their holes in the PCB (metal-backed side of the triac facing downwards), secure it in place against the heatsink using the other nut and bolt, and solder the leads in place. Don't overtighten the bolts, else the PCB may be damaged.

Fit the transformer, ensuring it is fitted the correct way round, that is, the 6-0-6V terminals nearest the edge of the board – the transformer mounting tabs should also face outwards. Finally, carefully check your work for mistakes. Solder whiskers, bridges or dry joints, then clean excess flux off the board using a suitable solvent.

## Testing and Use

Having installed the circuit into a suitable housing, connect the AC mains supply (110 to 125V or 220 to 240V AC, as appropriate, depending on the link setting) to the terminals marked MAINS and VAC on the 6-way terminal block, ensuring that the live connection goes to the fuse in each case. Connect an appropriate load, such as an AC motor of no higher than the specified power rating, to the board via the two terminals marked LOAD.

Rotate the control potentiometer shaft fully anticlockwise, and switch on the power, whereupon the motor being driven should rotate at low speed. All being well, rotate the control potentiometer shaft clockwise, and the motor speed should increase in response to the potentiometer setting.

The minimum motor speed can be set by means of the onboard preset potentiometer, RV2, but only do this with the mains power switched OFF beforehand, and use an insulated screwdriver. It is recommended that this project is housed in a metal box, the box must be earthed. If the load to be connected requires an earth, this must be provided. If the finished unit's output terminates in a socket, this must be suitably rated and provide provision for connection of live, neutral and earth. Note, all parts of the circuit and heat-sink are live and must not be touched when the mains supply is connected. OV must not be connected to earth. Always operate the unit in accordance with the mains safety guidelines printed in this article.



### Important Safety Note

It is important to note that mains voltage is potentially lethal. Full details of mains wiring connections are shown in this article, and every possible precaution must be taken to avoid the risk of electric shock during maintenance and use of the final unit, which should never be operated with the box lid removed. Safe construction of the unit is entirely dependent on the skill of the constructor, and adherence to the instructions given in this article. If you are in any doubt as to the correct way to proceed, consult a suitably qualified engineer.

## PROJECT PARTS LIST

### RESISTORS: All $\pm 5\%$ (Unless stated)

R1	4k7	1
R2	3k3	1
R3	680 $\Omega$	1
R4,5	22k	2
R6	1k5	1
R7	47k	1
R8	100k	1
R9	100 $\Omega$	1
R10	120 $\Omega$	1
R11	68 $\Omega$	1
R12	1k	1
R13	27 $\Omega$	1
R14	390k	1
RV1	100k Vertical Preset Potentiometer	1
RV2	100k Preset Potentiometer	1

### CAPACITORS

C1	470 $\mu$ F 16V Radial Electrolytic	1
C2	1 $\mu$ F 50V Radial Electrolytic	1
C3	100nF Resin-dipped Ceramic	1
C5	47nF Polyester Layer	1
C6	100nF 400V Polyester	1
C7	47nF 400V Metallised Polyester	1

### SEMICONDUCTORS

D1,2	1N400X	2
D3-6	1N914/1N4148	4
D7	1N400X	1
T1-3	BC547	3
T4	BC517	1
TRI1	L6008 Triac	1

### MISCELLANEOUS

TRAFO	6-0-6V 110/220V PCB-mounting Transformer	1
L1	Ringcore Coil	1
F1	T250mA 20mm Time-lag Glass Fuse	1
F2	T5A 20mm Time-lag Glass Fuse	1
	PCB-mounting Fuseholders	2
	6-way PCB-mounting Terminal Block	1
	Clip-in Plastic Potentiometer Shaft	1
	Heatsink	1
	Bolt	2
	Nut	2
	PCB	1
	Instruction Leaflet	1

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

**The above items are available in kit form only.  
Order As 95192 (Drill Speed Controller) Price £22.99**

Please Note: Some parts, which are specific to this project (e.g., PCB), are not available separately.

A comprehensive index to *Electronics* is now available from Maplin. The index covers every issue from December 1981 to October 1995. Included are details of every article, series and project published during that period. Conveniently arranged, sectionally and alphabetically, it'll take minutes instead of hours to find the exact issue number and page you need. You'll be able to rediscover a wealth of information you never knew you had! A list of all the *Corrigenda* published is also included, so you will be able to find details of changes or amendments. You'll find the index an invaluable addition to the issues of *Electronics* that you have. If your collection is incomplete, many issues are still available as back issues. The Magazine index costs just 80p NV and can be obtained (subject to availability) from Maplin Stores countrywide; by Mail Order, using the Order Coupon in this issue, or by calling the Credit Card Hotline, Telephone: (01702) 554161, Order As XU87U. You'll wonder how you ever managed without it!

# Electronics Index

**ELECTRONICS**  
The Maplin Magazine

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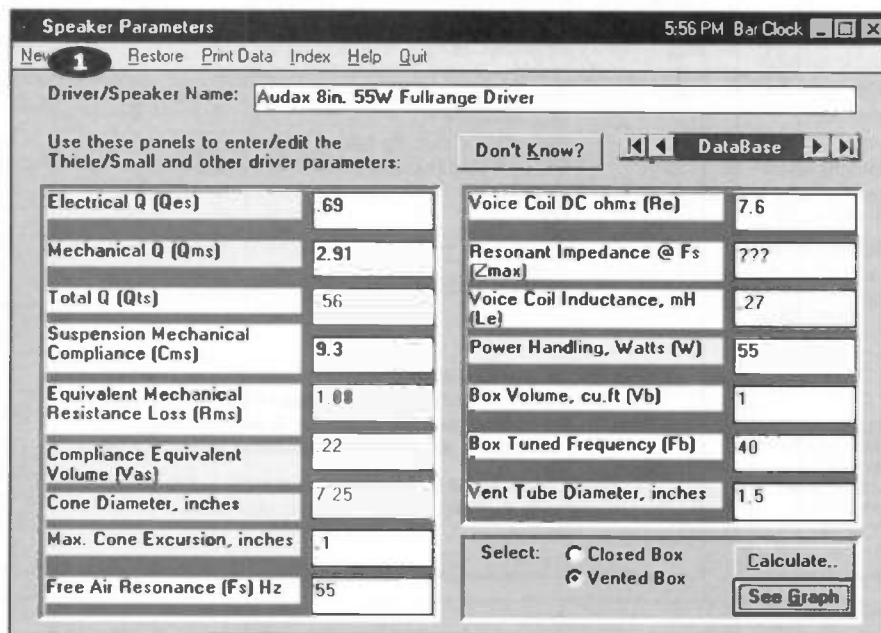
CONTENTS

Order as XU87U 80p

# Speaker DESIGN

by Robert Saunders

*A new software package that enables the home constructor to quickly produce simple DIY loudspeakers that work.*



**Photo 1.** The Speaker Parameters program with bass driver selected, in the process of adjusting a vented box.

**D**esigned to run under Microsoft Windows™ on a PC, the package comprises a 'suite' of four programs, together with a quite comprehensive help file. The suite of programs include:

- Speaker Parameters** – calculates box response.
- Drivers Library** – a large range of popular high quality drivers in a database.
- Crossovers Designer** – makes crossover circuits from supplied driver data and generates circuit diagrams.
- Cabinet Maker** – produces the most ideal panel ratios to avoid standing waves, etc., and generates a panel cutting drawing.

With 'Speaker Design', it is possible to choose suitable drivers, design and tune the cabinet, produce custom crossover circuits, generate a panel cutting plan, and have the final basic design more or less established before you so much as go anywhere near a screwdriver or a soldering iron.

To reiterate Mr John Woodgate in his excellent 'Sub-Woofer' series, as featured in *Electronics*, you can make a bass speaker by stuffing any old loudspeaker unit into any old box, but it is not likely to work very well. The driver unit's cone is inclined to move in and out rather too much, accompanied by a distinct shortage of the desired bass response. Many home constructors have attempted to build their own loudspeaker systems, and indeed, this home 'industry' possibly ranks second only to audio amplifier building.

Unfortunately, while building a loudspeaker appears to be simplicity itself, it is, in fact, far from simple and it is very easy to end up with something which just doesn't work.

To quote from the suite's own help file, some of the literature that has appeared in the past doesn't help either. There are many books and magazine articles on this subject and there are a few other computer programs too. Sadly, several tend to 'fall down' in either of two respects:

1. The literature/software is so highbrow as to be incomprehensible to those who are not mathematicians or university graduates, so that the hapless audio enthusiast who does not fall into this category is totally confused.
2. In an effort to reduce the 'frightening' aspect, apparently much simplified formulae and examples are shown (these are sometimes seen in speaker mail order catalogues, for instance). Except that, in order to achieve sufficient simplification, important key considerations are left out. This so often happens with crossover networks, for example – by not taking crossover design to its full and necessary conclusion, you are, again, wasting your time.

There is the additional complication of seeing published information which is actually second or third hand.

The Speaker Design Suite proclaims to make it possible, at last, to produce loudspeaker systems which hopefully will deliver the necessary performance and fidelity that you are looking for, but you don't need to get heavily involved in too much theory. Naturally, some time and work, especially on the actual construction, will obviously be necessary to achieve this.

It should be pointed out at this stage, that the designs generated are in no way of a sophisticated or very advanced nature, just basic ported box cabinets for two-way or possibly three-way loudspeakers. Hopefully, therefore, they should not be too difficult to construct, and really it is all that most of us want, just something that does the job with a reasonable level of competence.

## Installation

Speaker Design comes on three high-density (1.44M-byte) 3.5in. disks. These must be installed onto a resident hard disk in the PC. To install, simply insert disk one and run the 'setup.exe' program on it. A rather smart, Microsoft lookalike installation program then runs for a while, while it is all loaded in – again, like Microsoft, the files are compressed on the floppies, so the setup program is essential.

As a guide, the 'README.TXT' file on floppy one states the following regarding system requirements: Minimum system = 80286 CPU, 4M-byte memory, 16 colour VGA 640 × 480 pixels, Microsoft compatible mouse, DOS 3.3 or higher, Microsoft Windows 3.1 or higher, 2M-byte of free hard disk space for extra Windows system files, and 5M-byte of free hard disk space for Speaker Design files. A 'preferred' system includes a 386 SX/DX plus 387 co-processor, or 486 DX/DX2, etc.

Note that the Drivers Database requires DOS SHARE.EXE to be installed by AUTOEXEC.BAT. If this is not already the case, then the line 'SHARE.EXE /L:200 /F:2048' must be added to AUTOEXEC.BAT. This does not apply to Windows '95.

'Readme' also advises that the Drivers Library uses Borland dBASE IV format, that Borland runtime libraries will be installed in 'C:\IDAPI', with language drivers in 'C:\IDAPLANGDRV'. The Windows system file 'WIN.INI' is checked for equivalent Borland compatibility statements.

If these are not present, then setup will modify 'WIN.INI.' If already present, i.e. another Borland database application has previously been installed, you should check compatibility of the statements that exist in 'WIN.INI' with those quoted in 'README.TXT.' If they are not compatible, the drivers database may not load. If this is the case, then back up 'WIN.INI' (make a copy with a different extension beforehand, such as .BAK), edit the original to remove all IDAPI references and re-install Speaker Design.

This sounds awfully cockeyed, but apparently, it is not unusual where two or more Borland databases are sharing the same system. Fortunately, the problem does not arise very often, provided they share the same system protocols.

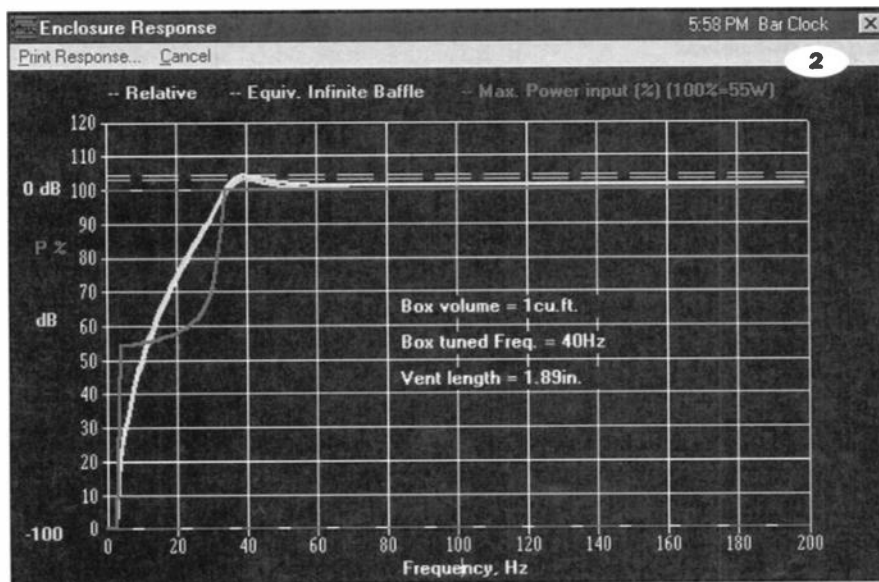
## Using The Software

Note that the Drivers Library program, 'SPKRDBS.EXE' accesses the database in whichever current directory it finds itself in, but that the Speaker Parameters program 'SPKRPARS.EXE', and 'SPKRPRPT.EXE' (the database report printer), must be able to find the database in 'C:\SPEAKERS'. You should, therefore, have followed the instructions in the setup and only install to 'C:\SPEAKERS'.

Similarly, it was found that other programs in the suite have to be run in their 'parent C:\SPEAKERS' directory, that is, the working path in the program manager must be 'C:\SPEAKERS'. This has something to do with the fact that each program needs to access something in what is defined as the default directory, else they won't run.

One of the programs in the suite is little more than a 'front-end' window, with large buttons on it that you click on to call up the desired piece of working software. This seems like a slightly unnecessary frill; each program is also individually accessible from the program manager group.

**Photo 2. Graph display sub-window for Speaker Parameters. Vent dimensions are trimmed to modify response. Note dip in power handling plot.**

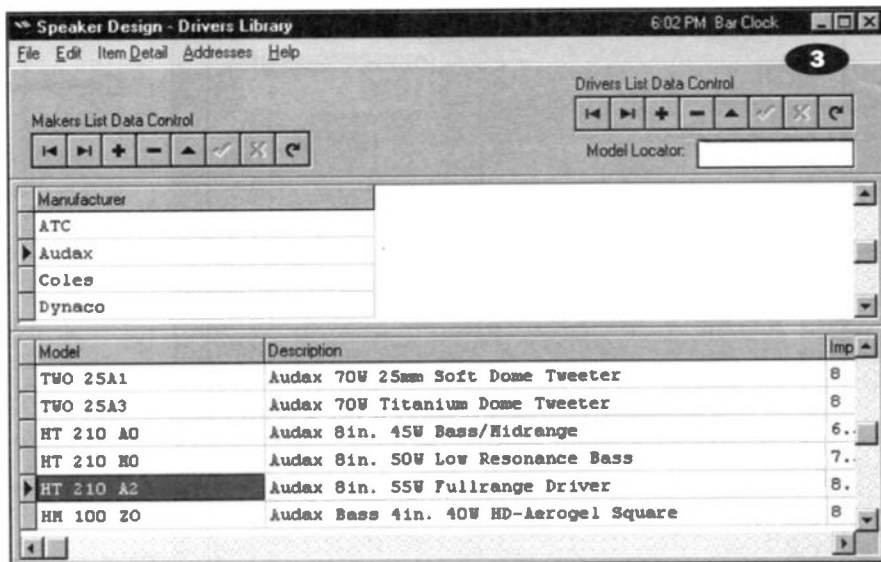


## Speaker Parameters

It seems logical to start the process with the Speaker Parameters program, which will provide the basic cabinet and bass driver. All you need to know here are the Thiele/Small parameters for the bass driver that you intend to use. The Drivers Library database contains a number of drivers, most of which have the Thiele/Small data provided.

Response is plotted on a pretty coloured graph over a range of 10 to 200Hz, showing not only relative response in decibels, but also the equivalent infinite baffle response for comparison, and, unusually, the electrical power input that the driver will safely handle while in this cabinet over the frequency range. Several drivers showed dips and falloffs of input power handling level at the bottom end, implying a risk of smouldering voice

**Photo 3. Main window of the Drivers Library. It is possible to change any record's data by directly altering information in these lists.**



**Photo 4. Initial main window of Crossovers Designer. Up to 7 different functions are possible. Option 5 (Resonance Correction) is not available until a Zobel network has been calculated (option 4).**

**Photo 5. Sub-windows of the working Crossovers Designer. Producing a third order filter simply from supplied driver impedances.**

**Photo 6. The Cabinet Maker, having worked out an initial 'bookshelf' style from the box volume produced by Speaker Parameters.**

**Photo 7. The panel cutting drawing generated by Cabinet Maker.**

coils if the full rated power of the driver was applied at this frequency! This seemed to coincide with cabinets that were made 'too large.' The plot can be printed on paper as a graph or as a table.

If your speakers are not to be found in the database and you don't possess Thiele/Small data, don't worry. The Speaker Parameters program can take you step by step through stages of electrical testing that will derive these parameters. In reality, this is a bit fiddly to do and requires some test gear; at least, a good digital multimeter or millivoltmeter and a calibrated AF signal generator, modest power amplifier and sundry items from your spares box. It also requires that a closed, unvented ('infinite baffle') test enclosure be built, but usually, if you're sensible, this can then become the final cabinet after a little modification.

## The 'Cabinet Maker' Program

Once Speaker Parameters has found the ideal cabinet volume and tuning using this data (and you may alter the criteria substantially to choose a particular cabinet size, or modify the bass response with customised venting), the Cabinet Maker will produce the optimum panel dimensions that will avoid nasty resonances and reflections within the enclosure.

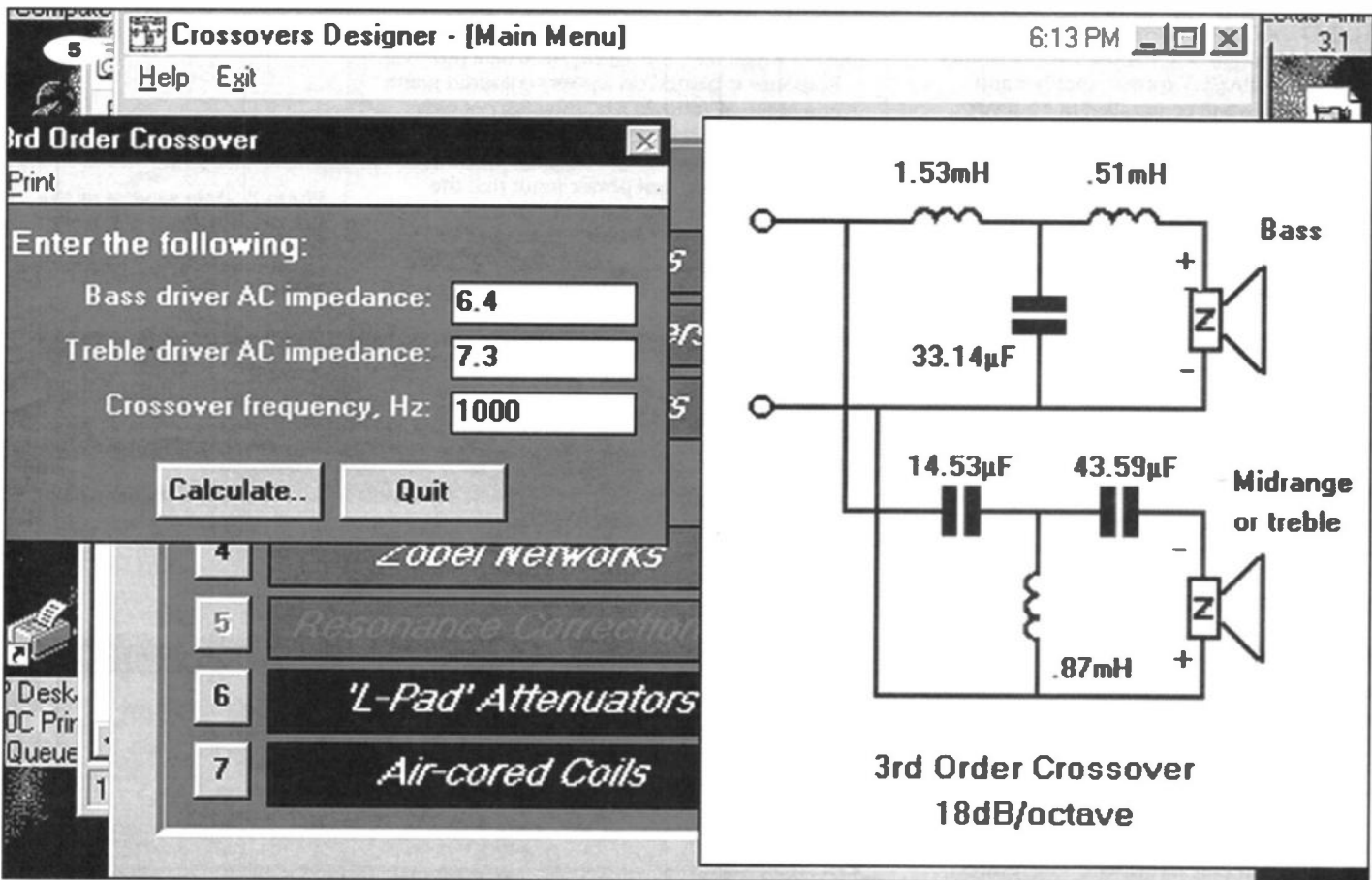
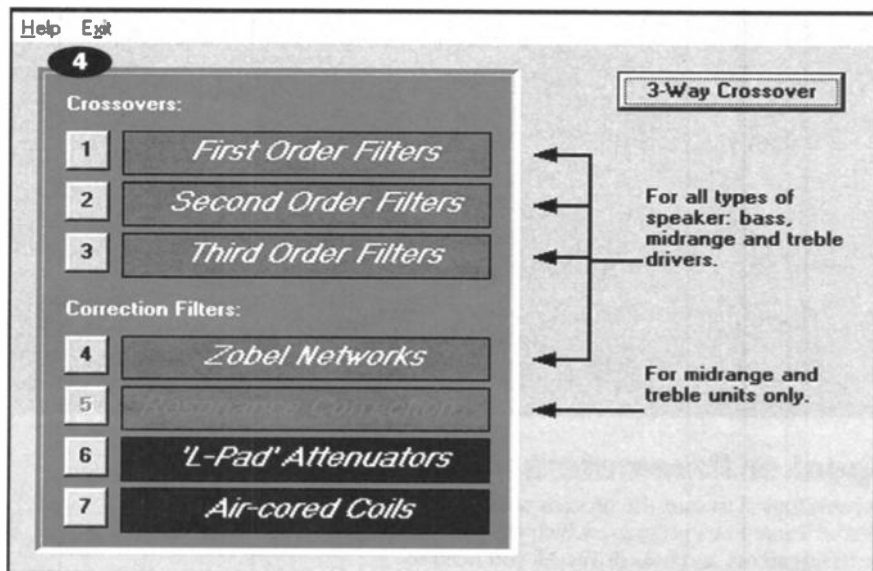
It offers three basic cabinet shapes, described as 'bookshelf', 'wall or floor-standing' and 'floor-standing', the latter being taller and thinner. These are supposed to be based on known idealised ratio protocols that minimise resonance. In addition, you are able to fine-trim the real panel dimensions before printing the plan and elevation panel cutting drawing. Usefully, these dimensions can be saved and re-called by Cabinet Maker for reprints or further modification.

## Electrical Crossovers

Having got the mechanical acoustics sorted out, the next stage is to electrically combine the drivers in the system.

The help file recommends that we avoid at all costs, ready-made crossover modules. These should be a good idea in principle, but sadly, are more trouble than they are worth.

The point being that the crossover filters should exactly match your speakers: off-the-shelf modules cannot possibly do this, unless you know for a fact that the module is by the same manufacturer as the speakers, and is matched for the specific drivers that you intend to use. Even then, such modules should be treated with deep suspicion, as they invariably have essential parts missing, such as vital Zobel networks that suppress the unwanted resonances that all midrange and treble drivers possess! In addition, their output frequency bands will not necessarily suit your speakers.





The only sort of crossover filters that will work properly, therefore, are ones that have been specially developed for your speakers, and it then follows that these are filters that you have built. The Crossovers Designer takes care of the arithmetic and generates circuit diagrams of filters precisely matched to the drivers you want to use, including all the necessary frequency correction and impedance matching. It even includes a section dedicated to making air-cored coils, as you will invariably have to wind your own to the specific values quoted. Resistors and capacitors required in the network are more easily made up by adding components in series or parallel in the familiar way.

## Drivers Database

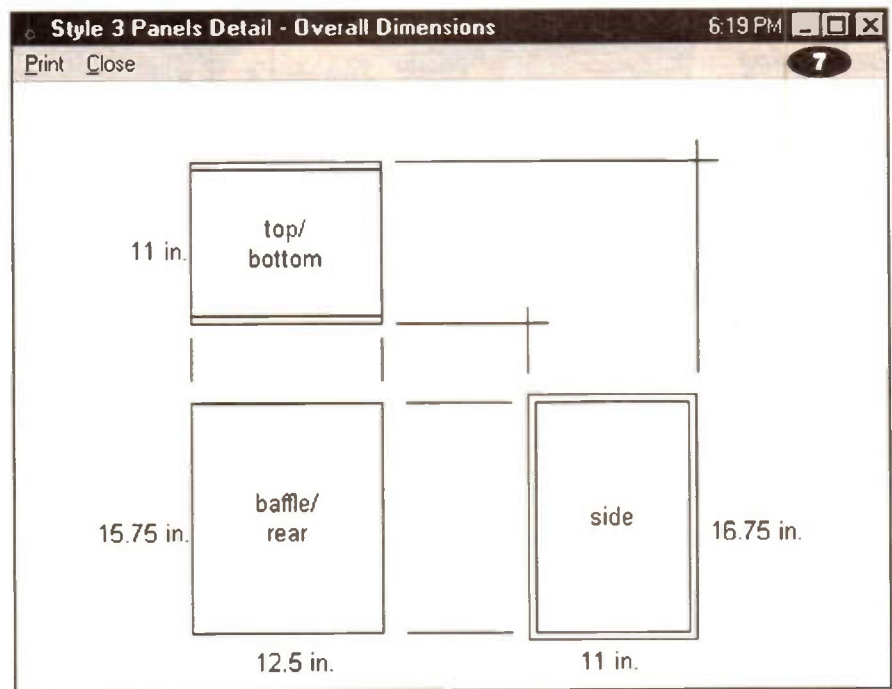
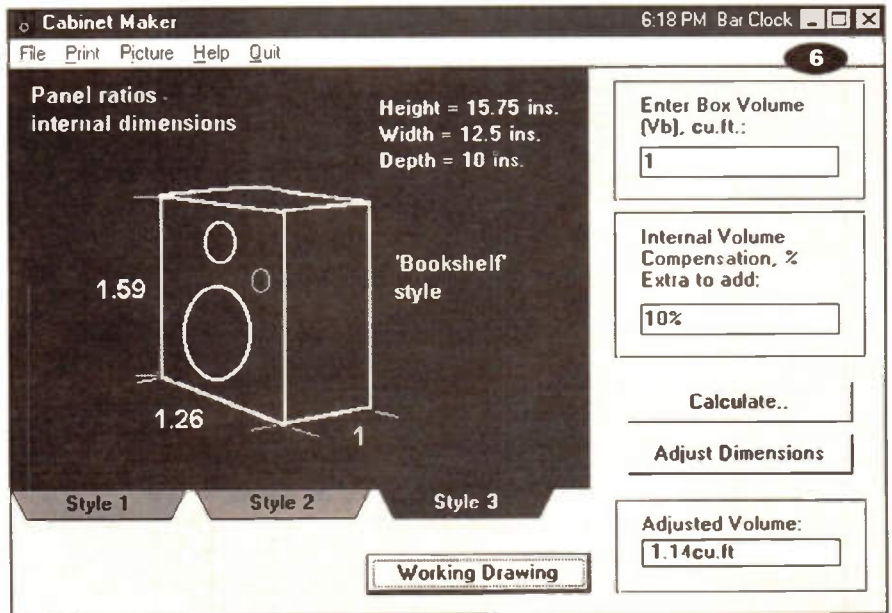
At first sight, this looks quite impressive, having several 3-D buttons and two scrolling lists. Each list operates in a fashion very similar to a spreadsheet. The upper list shows only a list of speaker manufacturers, which are ATC, Audax, Coles, Dynaco, Eminence, KEF, Morel, Peerless, RCI, Scanspeak, SEAS, and Volt. The lower list cleverly shows only those drivers in the database that are made by the manufacturer selected in the upper list.

There is a total of some 196 drivers in the database altogether, so there is plenty to choose from. Unfortunately, not all have complete Thiele Small data. Each driver can be examined in greater detail in a rather smart sub-window, on a 3-D panel that even scrolls up to reveal a memo field for notes.

The Speaker Design suite retails for £28.95. The help file is not to be ignored, as it contains lots of diagrams and helpful hints and tips, and two tutorials describing loudspeaker examples. The suite can be obtained from Three Crowns Publishing, P.O. Box 5773, Basildon, Essex SS15 5FJ.

### Please Note

Maplin Electronics plc does not have any connections with the supplier listed in this article and is, therefore, unable to answer any queries relating to the advertised product. Maplin Electronics plc does not give or imply any warranty or endorsement to the software package described. Any monies sent to the supplier listed is at the sole risk of the sender.



## ROOM WITH A VIEW

London's BT Tower is open to guests just twice a year. Among the select few who had 'lunch with a view' recently at central London's highest building were the winners of our BT contest, Ron Andrews and his wife, Pat. Following a breathtaking ride in the lift (among the fastest in Europe), they arrived at the top and there was London and its environs spread out some 160m below. With the gallery completing a full circle every 22 minutes, there was no shortage of stunning views.



Competition winners:  
Pat and Ronald Andrews.

"It was a great experience," said Ron, "seeing London from a different dimension". In Ron's case, this was certainly true, as he spends much of his working life driving around London for British Gas. Ron also stakes a claim to be one of

Maplin's longest-standing customers, remembering the early typesheet catalogue listings. Pat and Ron's visit to the top of the tower will be equally memorable.





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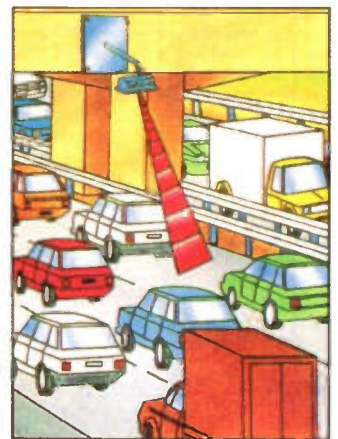
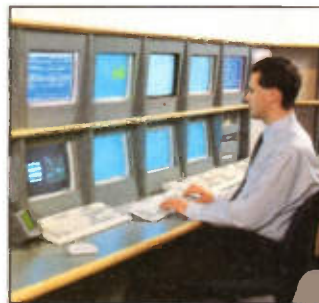
**Carriage £4.00 #**

**Desk stand, Order Code 90107, £39.99.**

**Carriage £1.60 #**

**Leather carry case, Order Code 90108, £19.99.**

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# MAPLIN

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# Maximum carriage charge per order is £6.00.  
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## Introducing the 'perfect remedy' Trafficmaster™ YQ

# REVIEW

# HF/VHF AERIAL ANALYSER

Reviewed by David Powell

*The MFJ-259 is not only aimed at aerial designers and installers, but also at the radio amateur. With many 'black box' pieces of equipment on the amateur radio market there are not many areas that the true experimenter can go into. One area that is still available, is aerial design and experimentation.*

## SPECIFICATION

Frequency Range:	1.8 to 170MHz
Impedance:	10 to 500Ω
Inputs:	SO-239 (Aerial) BNC (Counter)
Display:	LCD 2 x moving coil meters
Operating Voltage:	12V DC (Internal) 8 to 18V DC (External)
Operating Current:	200mA (External Supply)
Case Dimensions:	173 x 102 x 60mm

To get the most out of this part of the hobby, the experimenter requires at least one piece of equipment such as the MFJ-259 and although there are other types of aerial analysers on the market the MFJ-259 is proving very popular.

## Description

The MFJ-259 is really four pieces of equipment in one, a wide range oscillator, a frequency counter, a resistance and SWR Bridge.

There are six bands ranging from 1.8-4, 4-10, 10-26.2, 26.2-62.5, 62.5-113 and 113-170MHz.

## SWR Meter

The MFJ-259 measures actual SWR of any load referenced to 50Ω over a frequency range of 1.8 to 170MHz. The load must be 50Ω of pure resistance for a meter reading of 1:1.

## Resistance Meter

With a suitable load connected to the SO239 aerial input socket, resistance readings can be measured. For instance, an aerial has been designed to operate on a particular frequency with a low SWR and impedance of 50Ω. The precise SWR and resistance readings are unknown at this stage. The appropriate range is selected from one of



the six frequency ranges. With the MFJ-259 switched on and the load connected, the tuning control is rotated until the pointer on the SWR meter dips. The Tune control is rotated until the pointer indicates the minimum reading, the Resistance meter will then indicate the resistance of the load. If the design of the load is perfect then a resistance of 50Ω will be indicated.

Please note that some aerials and loads are designed not to operate at 50Ω.

## Built-in Frequency Counter

A useful tool is the built-in frequency counter. For on site work this cuts down the amount of test equipment to carry about. There is a separate BNC socket on the top of the unit (labelled Frequency Counter Input) which is selected by pressing the 'Input' button until a 'B' appears on the LCD on the right-hand-side. Connect the cable with the signal to this socket or if required simply plug in a VHF aerial such as a quarter wave

or helical (rubber duck) aerial and place near the transmitting aerial. Four different sample times of 0.01, 0.1, 1.0 and 10 seconds can be selected by simply pressing the 'Gate' button. On switch-on this is initially set up for 0.01s.

The counter displays an averaged frequency over the display time. The red LED (top right hand corner) flashes once the sample time is complete and the frequency is then displayed on the LCD.

## Use

Full operating instructions are supplied with the MFJ-259, and these also briefly cover the theory of transmission lines and aerials and common misconceptions regarding SWR, feedlines and reactive and resistive loads.

An SO-239 type socket is provided on the top of the case so that the load can be directly connected to the unit. Apart from the above uses, with a minimum or external components the MFJ-259 can also be used for the adjustment of tuners, matching amplifier networks, the testing of rf transformers, measuring inductance and capacitance, measuring the resonant frequency of tuned circuits and the testing of RF chokes.

## General

My local radio club have been using their MFJ-259 to good effect to fine tune their homebrew aerial arrays for HF. Although the initial cost in buying the MFJ-259 may seem high, money is saved in the long run especially if a number of aerials are to be manufactured at home, or persuade your radio club to purchase one for use for club members to borrow.

There is the added satisfaction of knowing that the aerial was one's own work. Another factor is that it solves having to buy an array of other pieces of test gear and lessen the possibility of causing interference to local radios and television sets. All too often a poorly tuned aerial used in conjunction with moderately high transmitting power causes someone TVI and could either damage the PA stage or in the case of the modern solid-state rigs reduce the output power.

## Further Reading

There are many books available on aerial construction, feedlines and SWR. Some books are dedicated to the subject and others have comprehensive sections included with other aspects of radio communication. Here is just a small selection of books that cover the subject for the radio amateur.

HF Antennas for All Locations 2nd Edition by Les Moxon (WS16S), Practical Antennas Handbook 2nd Edition (AN03D), Build Your Own Shortwave Antennas 2nd Edition by Andrew Yocler (YE13P), Radio Communication Handbook 6th Edition by The Radio Society of Great Britain (WS12N), The ARRL Handbook.

## Acknowledgment

Thanks to Waters & Stanton Electronics of Hockley, Essex for supplying the MFJ-259.

**MFJ-259 Aerial Analyser and Frequency Counter  
Order As 95198 Price £249.95**

# PROJECT

# Siren Sound GENERATOR

Text by Maurice Hunt

*This project is an inexpensive, compact and simple to construct general-purpose siren module, which can be used in a wide variety of applications that require a fairly loud, low voltage two-tone sound generator. The kit contains all parts needed, including the loudspeaker, on/off switch, connecting leads, solder and full assembly instructions, and is ideal for beginners to electronic project construction.*

## Circuit Description

Refer to the block and circuit diagrams, shown in Figures 1 and 2, respectively. Power for the circuit comes from a 9-12V DC source, a PP3 type battery being the ideal choice for most applications. A toggle switch is provided in the kit, which can be connected in the positive (+) lead, so that the circuit can be switched on and off. Capacitor C3 provides decoupling of the supply, necessary to prevent the varying output signal from affecting the operation of the preceding circuit stages.

### FEATURES

High power output stage

Two-tone siren sound

Compact dimensions

Easy to build

### APPLICATIONS

Toys, models and games

Alarm/warning systems

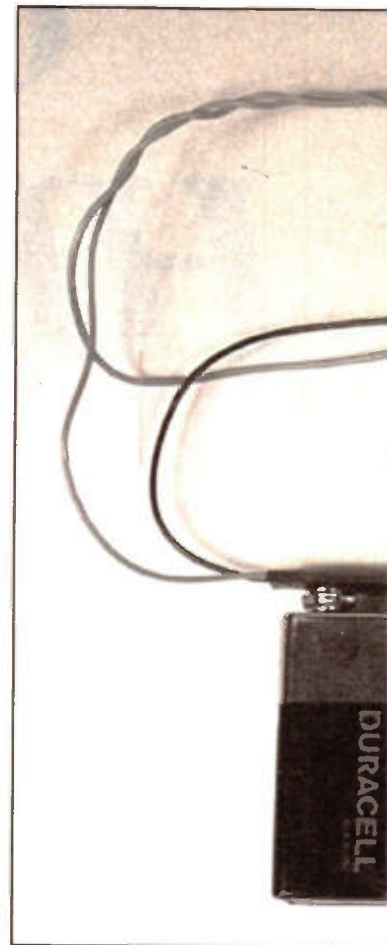
Bird/pest scarers

The siren is based around a pair of 555 timer ICs, both of which are connected in astable multivibrator (oscillator) configuration. The first, IC1, runs at around 1Hz and modulates the frequency of the second oscillator stage, IC2, which operates at an audio frequency. The result is that the output signal alternates between two frequencies, thus giving the characteristic 'hee-haw' siren sound. The frequency of oscillation of IC2's output is dependent on R3 and C2, and changing these values will alter the pitch of the siren. Changing the values of R1 and C1 would alter the rate at which the sound alternates.

The audio frequency output of IC2 is fed into the base of power transistor TR1, which amplifies it to drive the low impedance loudspeaker. R4 is included to limit the current through TR1 to a level that avoids damaging the speaker coil if the siren remains sounding for a long duration.

**PROJECT RATING** **2**

**Kit Available**  
Order as 95191  
Price £6.99



## PCB Construction

Assembly of the board is very straightforward, owing to the low component count, and an ample quantity solder is provided in the kit. However, if you are a beginner to electronic project construction, consult the Constructors' Guide prior to starting the construction process.

The PCB has the component positions marked on its printed legend, to assist with placing of the components. Assemble the board in order of ascending component height, commencing with the smaller resistors; R1 and R2 are 10k $\Omega$  (brown, black, orange), while R3 is a 100k $\Omega$  (brown, black, yellow). It is advisable to use IC sockets (not supplied, but available separately as Order Code BL17T), although you can solder the ICs directly into the board if you wish. The ICs should be fitted so that their printed legends are the same way up as that of the PCB, that is, with the end notches facing the supply terminals end (left-hand side) of the board. R4 is the larger 4.7 $\Omega$  1W resistor

(colour coded yellow, violet, gold).

The power transistor must be fitted with its metal-backed side facing the loudspeaker terminals end (right-hand side) of the PCB. If you wish to fit the supplied switch, it should be wired into the positive supply lead, i.e., with the red lead of the PP3 battery connector going to the switch and a length of red wire (supplied) going from the other switch terminal to the position marked '+' on the PCB.

Use the remaining lengths of red and black wire to connect the loudspeaker to the positions marked 'SP' on the board, noting the polarity; the speaker '+' connection should be made, using red wire, to the left-hand 'SP' hole, the black '-' lead to the right-hand hole. The connecting wires can then be twisted together for neatness.

Having checked your work for mistakes, solder whiskers, bridges and dry joints, clean excess flux residue off the board using a suitable solvent.

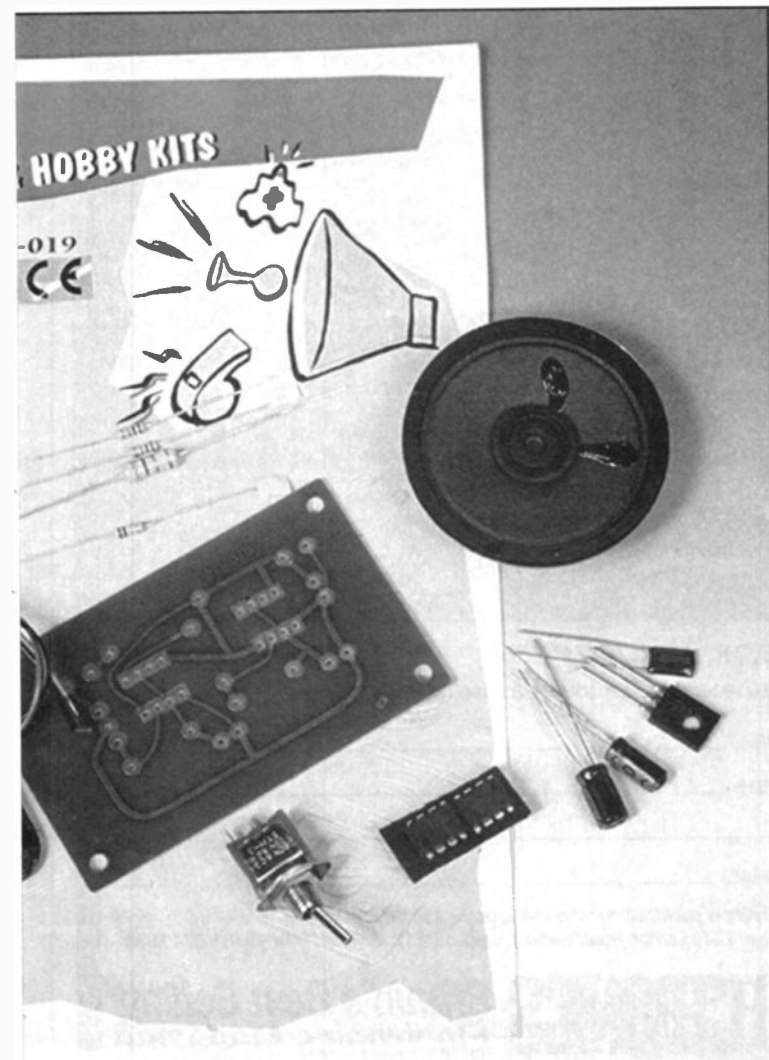
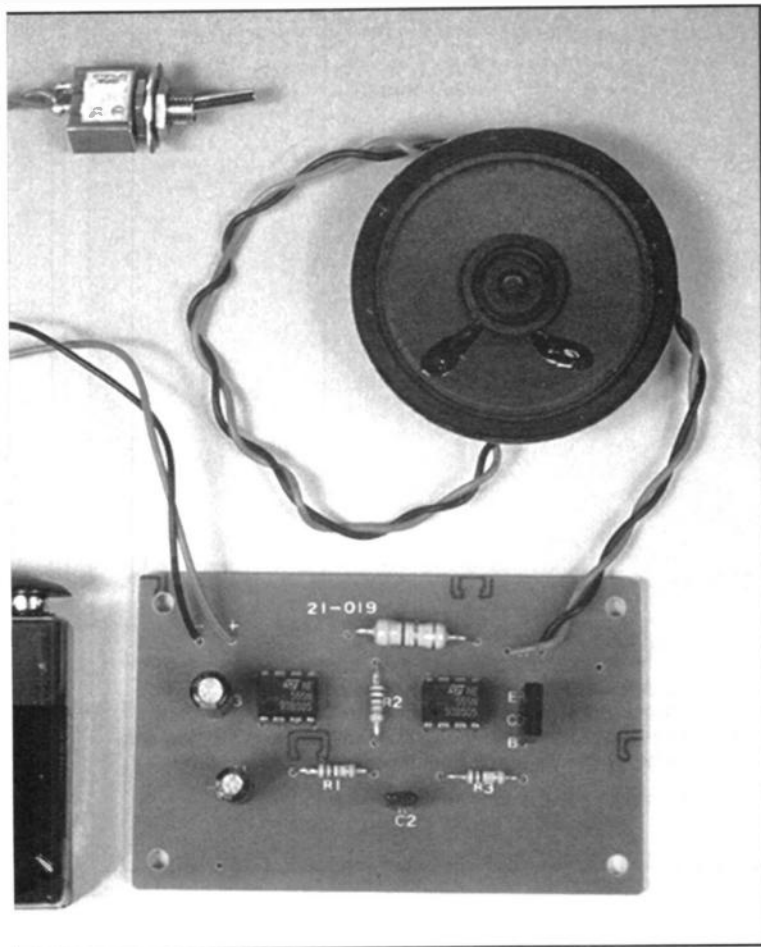


Figure 1. Block diagram.

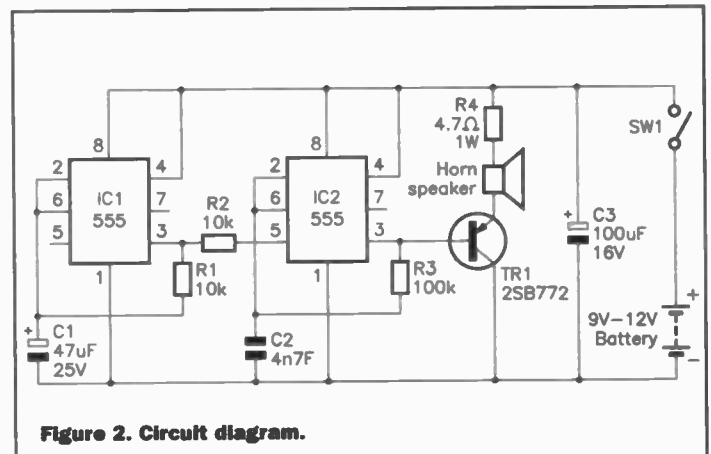
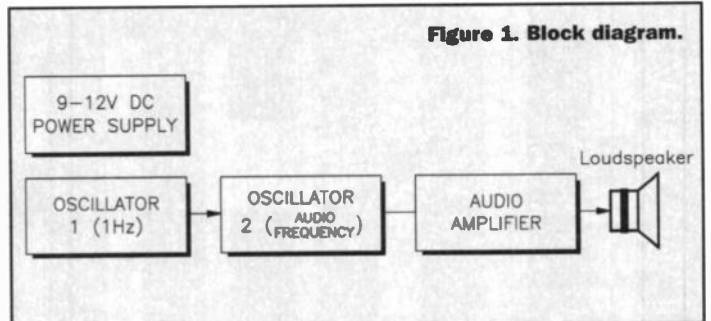


Figure 2. Circuit diagram.

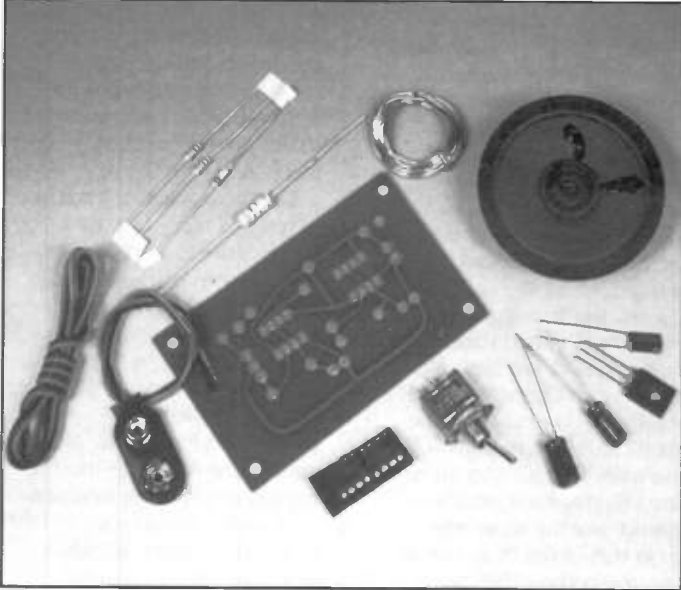
## SPECIFICATION

Operating voltage:	9-12V DC
Current consumption:	260mA (average)
Output power:	0.25W into 8 $\Omega$ speaker
PCB dimensions:	78 x 50mm

## Testing and Use

Clip a fresh PP3 battery onto the battery connector (observing correct polarity), and flick the switch to the ON position. All being well, you will hear a siren sound being emitted from the speaker, which should

alternate in pitch, roughly every second. The siren is then ready for use in your chosen application. The on/off switch could be replaced by a relay with normally open contacts for use in conjunction with an alarm system.



## PROJECT PARTS LIST

### RESISTORS: All 0.5W 5% (Unless stated)

R1,2	10k	2
R3	100k	1
R4	4 $\mu$ 7 1W	1

### CAPACITORS

C1	47 $\mu$ F 25V Radial Electrolytic	1
C2	4n7F Polyester	1
C3	100 $\mu$ F 16V Radial Electrolytic	1

### SEMICONDUCTORS

IC1,2	NE555 Timer	2
TR1	2SB772 PNP Transistor	1

### MISCELLANEOUS

8 $\Omega$ 0.25W Loudspeaker	1
SPST Toggle Switch	1
PP3 Battery Connector	1
Hook-up Wire	2 lengths
PCB	1
Instruction Leaflet	1

### OPTIONAL (Not in Kit)

8-pin DIL Socket	2	(BL17T)
9V PP3 Alkaline Battery	1	(FK67X)

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 in kit form only. Order As 95191 (Siren Sound Generator) Price £6.99**

Please Note: Some parts, which are specific to this project (e.g., PCB), are not available separately.

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# REVIEW

# In-Car ROUTEFINDER

Reviewed by Martin Pipe BSc., AMISTC

*I expect that many Electronics readers have, like myself, driven in unfamiliar territory. With a road atlas nestled in your lap, you try to figure out the next motorway junction or roundabout turning that's needed to reach your destination. Not ideal, but if you do a lot of road travelling, you don't always have time to plan the optimum route, and even if you do, there are so many factors to consider. Do you want to avoid motorways? After all, they can get congested at certain times. Do you have to visit somewhere en route, perhaps for a meeting or a collection? Even with these questions answered, planning the shortest journey isn't always as easy as one would expect.*

In the late 1980s, an answer started to appear in the form of a PC program, Autoroute. This software, recently acquired by Microsoft, became viewed as a Godsend to salespeople and other regular commercial travellers. Input your start and finish destinations, specify how you want to get there, and the software will recommend the journey that best fits your needs. It will even give you an approximate time for the journey (based on national speed limits) and calculate petrol usages, provided that you specify your vehicle's fuel economy. Autoroute also draws a map of the journey on-screen.

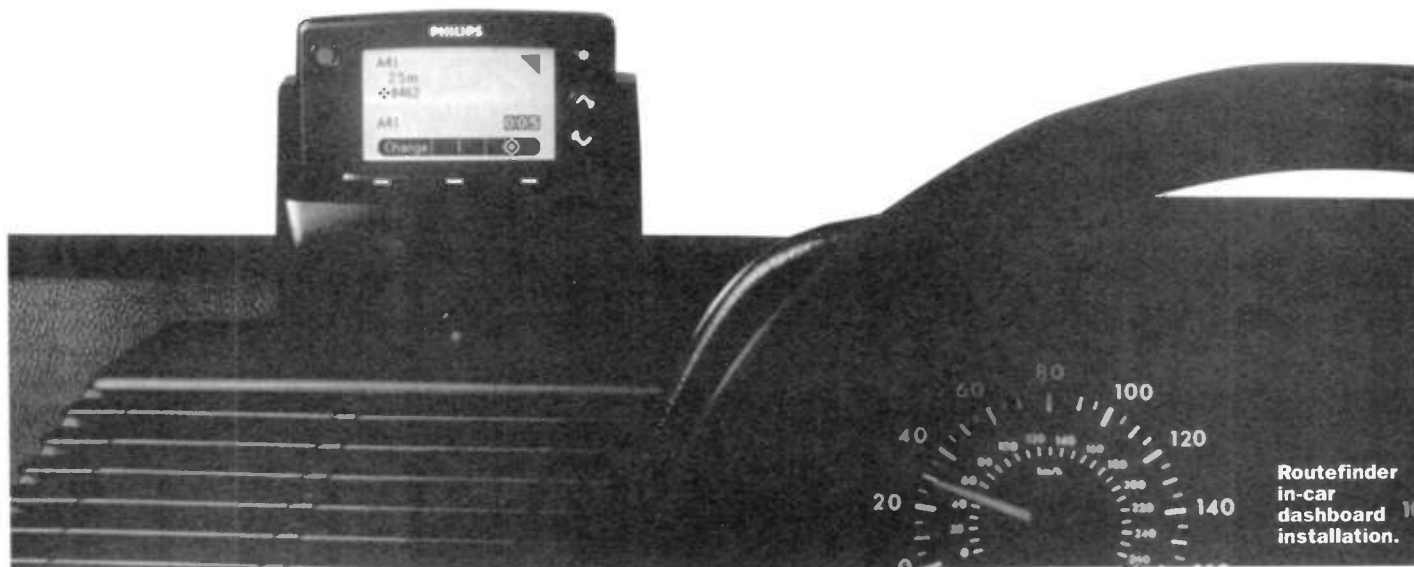
## Introducing Routefinder

For £100 less than the cost of the latest version of Autoroute for Windows, you can now have a self-contained route-finding device that fits neatly in the palm of your hand. Routefinder, which is available for just under £200 from Maplin, provides all of the Autoroute functions listed above, with one exception – there's not much room on the otherwise-detailed 160 × 100 pixel display for maps, and so they're not included. The package includes a compact and attractive display/keypad unit, a UK roads data card developed in conjunction with the AA, and even a set of alkaline batteries (an AA of a different sort). If the registration details are filled in and sent off, a protective carrying case will be posted to you.

Once you've inserted the batteries – an awkward task – and the data card, you can power up Routefinder. The legible LCD panel greets you with some snazzy Psion 3a-style graphics that invite you to determine a new journey, or recall the last calculated route. It warns you, quite sensibly, that 'watching the road is more important than watching the screen'. Display apart, the user interface comprises three large menu 'hot keys' underneath the display, a couple of up/down keys for scrolling through menu functions, and an alphanumeric keypad for entering place names and numeric values. The display has a switchable backlight (useful for night-time driving) and a rear-mounted thumbwheel for adjusting contrast level.

The first task is to set 'machine data', such as fuel measurement units and the 24-hour clock. You can then set vehicle-specific data, such as the likely percentage of maximum speed (which will vary according to road conditions and travelling times), fuel economy, caravan usage (which will affect the choice of route) and vehicle height (so that Routefinder's calculations can allow for bridges). When this is done, you can then set a 'default start place', which would normally be your home or office address.

With this data entered, you can enter your starting position (if the default doesn't apply) and your destination. Enter a place name, and you are given a list that you can scroll through – after all, there can be



Routefinder  
in-car  
dashboard  
installation.

16-bit 68000µP running at 8MHz  
64k-byte internal SRAM  
PCMCIA data card slot  
3M-byte ROM  
9,600bps RS232 serial port  
160 x 100 pixel FTN LCD  
4 x AA cell power requirement (alkaline recommended)  
14 hour battery life  
Power-saver  
-10°C to 50°C operating temperature range

**Table 1. Routefinder technical specification.**

several towns of the same name dotted around the UK. Around 38,000 place names – against Autoroute's 25,000 – are stored in the data card. Up to four stops can be specified along the way, and it is possible to change the order in which they should be visited. You can also program in four places that must be avoided. Route calculation is the next stage, and Routefinder will warn you if a route is not practical. Information provided by the unit includes a step-by-step description of the route, fuel costs, distances travelled, and an estimate of your arrival time. There are two route description modes – concise and detailed – which can be selected at the touch of a button. As you proceed along your way, the cursor keys are used to select the next step.

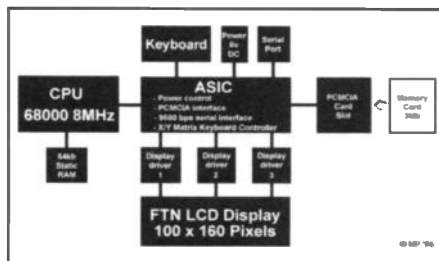
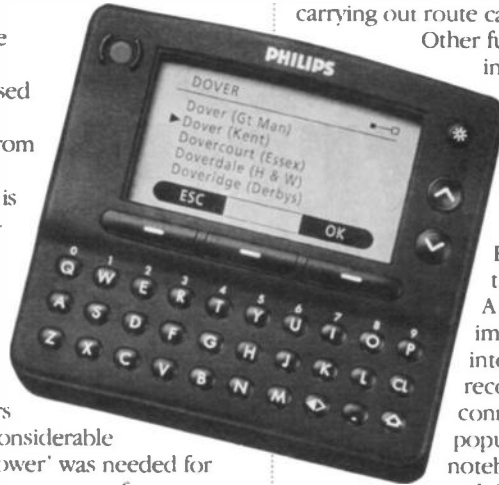
Other features include re-routing (which is useful when you hear a radio traffic report warning you of congestion ahead!) route changing (ideal for when your boss calls you to make an additional visit) and reverse route (for the return journey). Since the device requires you to tell it when you've reached a certain point – so that it can give you the next instruction – the estimated arrival time shown can be used as a guide when calling somebody that you're going to be late or early.

## The Technology

Routefinder's route-determining algorithm is, to all intents and purposes, that used by the Autoroute PC program. Developed by a gentleman by the name of Dexterous, the algorithm was originally conceived 20 or 30 years ago to route phone networks. Because route-finding is an iterative process, lots of calculations are required and so a reasonably powerful 16-bit processor is specified to keep waiting times to a minimum. Finding the best route for a 250-mile journey from Southend-on-Sea to Liverpool takes around 30 seconds with Routefinder. Autoroute, using a fast PC and masses of memory, is faster but not instantaneous.

Routefinder was originally developed by Panstar, who are responsible for a series of hand-held language translators marketed through the Innovations catalogue. Panstar's Routefinder development was bought out by Philips, which has turned it into a marketable product that sells for an attractive price. The device was turned from concept to product within a year, which is fast as development cycles go. But then again, Panstar does have considerable experience of these hand-held microprocessor-based devices.

As can be seen from Figure 1, Routefinder's core is a Motorola 68008 – basically a low-cost version of the 16-bit 68000 microprocessor used in Amigas and early Apple Macs. Its developers discovered that a considerable amount of 'horsepower' was needed for calculating the optimum route for a journey – hence the choice of a 16-bit processor over an 8-bit type. There's 64k-byte of battery-backed static RAM, which is used to hold data – such as the last route calculated – when Routefinder is powered



down.

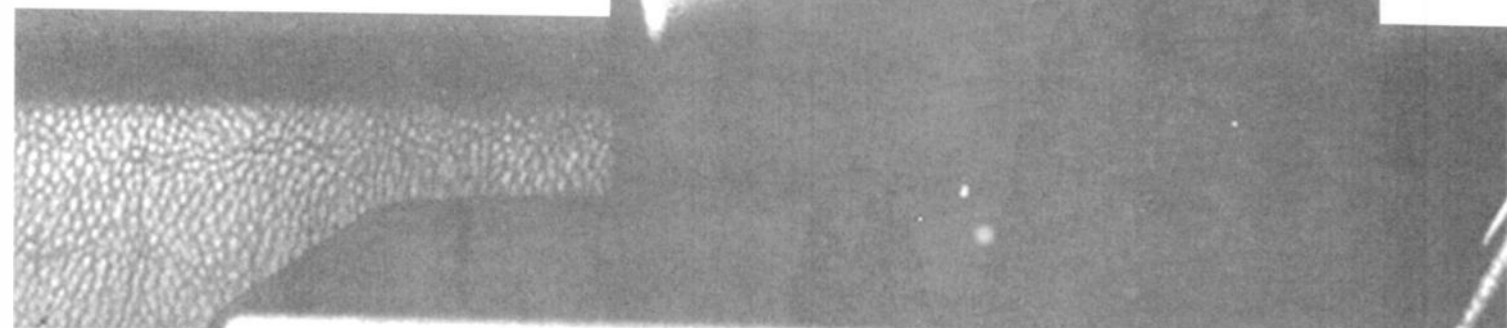
To keep the cost, power consumption and size down, a number of functions are combined in an ASIC. The first of these is power management, to maintain a long battery life – typically 14 hours with alkaline cells. This is achieved by reducing the CPL's clock speeds whenever possible. The processor, which can be clocked at speeds as low as 100kHz, only works at its top 8MHz speed when carrying out route calculations.

Other functions of the ASIC include a scanning matrix for the 37-button control keypad, control outputs for a total of three LCD driver chips, and a 68-pin PCMCIA interface for the memory card slot. A hardware implementation of the internationally-recognised PCMCIA connectivity standard – popular with PDAs and notebook computers – is used. Due to the peculiar

arrangement of the data on the card, however, you won't be able to read the card's data on your notebook PC.

## Expansion Potential

On Routefinder's base are seven recessed gold-plated contacts. Two of these contacts are for power from the optional car kit, while the rest constitute an RS232 serial port that's the final function of the ASIC. This serial port can, with the aid of an adaptor and Windows '95 communications software due for release soon, upload routes to your desktop PC so that you can print them





out. Interestingly enough, the serial port is also available on a non-standard connector at the base of the holster included with the optional car kit. Philips are thus keeping their expansion options fully open!

One such expansion option could be a phoneme-based speech synthesiser – something which the Philips boffins are taking very seriously indeed. A button on the steering wheel (or other convenient place) could be used as a ‘prompting’ device, telling Routefinder to give you the next instruction when it is needed. There would be no need, then, to take your eyes off the road! The Department of Transport would obviously welcome the introduction of such a peripheral.

Any speech unit could be mounted into a small box with a speaker (rather like the ones supplied with mobile phone car-kits), or an even smaller gadget that feeds a line-level audio output into a car audio system. Philips produce a sizeable proportion of the car stereos bought by motor manufacturers (including Ford). Perhaps ‘integrated Routefinder’ with speech could end up as an option for new vehicles. Radio integration is quite relevant – broadcasters have the potential to transmit traffic reports using an as-yet unimplemented feature (TMC) of RDS.

Such data, which could be used in route determination, is likely to be available on the same subscription basis used by today’s Trafficmaster. Apparently, the biggest problem behind the system is not a purely technical one – it’s deciding how the subscription fee should be distributed among contributors such as broadcasters and road organisations! Philips is also considering the serial port’s potential as a link to a GPS (Global Positioning by Satellite) receiver. Routefinder would then know where you are, and automatically prompt you to change course.

All of Routefinder’s operating software – even the BIOS – is on the data card. If you attempt to turn on a Routefinder with an empty slot, it will appear dead to the world. Such an approach does have advantages. Firstly, it’s easy to upgrade. Secondly, other data cards – with all kinds of applications – could be developed for the device. It certainly explains the conspicuous lack of a Routefinder logo on the unit’s casing! Such cards could include ‘Time Out’-style city guides, hotel guides, personal organisers and the language translators with which the developer is so familiar. Because there’s a serial port, the device could even be used



for a portable terminal that connects to a mobile phone for e-mails and faxes. Such ideas are currently being investigated by the Philips development team.

## Current Accessories

While all of the ideas discussed above are in an embryonic state, some accessories do exist already. The most important is a car kit, ripe for mounting in a position that’s visible from the driving position. No drilling is required, and power is taken from a cigarette lighter (even if the only smoke you’re accustomed to is the burning flux from a soldering iron, it still pays to go for the ‘cigar lighter’ option on that new car!). It consists of a holster that contains the Routefinder, together with a 6V regulator. Unfortunately, it obscures the alphanumeric keypad. This holster is attached, by means of a universal joint, to a bracket that fits to your dashboard with some unbelievably self-adhesive pads.

A desk stand for office use, which is supplied with a 9V adaptor, is also available. Accessories due to be launched shortly include the PC interface kit, and data cards

that cover roads in European countries. Periodic updates of the AA UK road atlas will also appear.

## Conclusion

Overall, Routefinder is a well-conceived product with an attractive price-tag. It does have some drawbacks – battery insertion is fingernail-unfriendly, and a machine is no substitute for local knowledge, decent signposts and common sense. It is, nevertheless, undoubtedly an excellent way of finding your way around if you don’t know the area. The peripherals mooted at are mouth-watering, and the non-specific nature of the hardware means that we can expect to see all kinds of program cards appearing in the future. Philips tell us that they are unlikely to sell for more than £40. The following Routefinder products are available from Maplin:

Philips Routefinder  
**Order As BM42V Price £199.99 H**  
Routefinder Car Kit  
**Order As CJ17T Price £32.99**

**PROJECT**

# Guitar Phantom

Designed by the Maplin Team  
Text by Tony Bricknell and Maurice Hunt

*Guitars with factory fitted active pickups generally have a battery compartment, easily accessible from the outside of the guitar. However, many guitars are bought with only 'passive' pickups and, at a later date, 'active' pickups are often retrofitted. Most retrofits involve milling out the guitar woodwork under the scratchplate to allow room for the active electronics and battery. Unfortunately, whenever you want to replace the battery (which could be as often as once a month), you need to remove the scratchplate. This may also involve de-stringing, re-stringing and re-tuning the guitar - an extremely laborious process!*



The completed kit.



## PROJECT RATING **2**

**Kit Available**  
Order as 95104  
Price £44.99

### SPECIFICATION

Operating voltage:	230V, 50Hz AC
Overcurrent protection:	F50mA 20mm 250V fuse
PCB dimensions (pre-snapped):	113 x 165mm
Boxed unit dimensions (LWH):	165 x 130 x 58mm

**T**his project comprises of a PP3 battery-sized module that fits in place of the 9V battery and negates the need to ever remove the scratchplate again! The Guitar Module is connected to the Interface Box via a lead terminated in  $\frac{1}{4}$ in. mono jack sockets, and the output of the Interface Box is applied to the amplifier input.

For guitars fitted with active pickups, the project acts as a battery eliminator, or power supply unit. If your guitar is not fitted with 'active' pickups, then this project will boost the output signals from your passive pickups, effectively turning them into 'semi-active' pickups, since it acts as a buffer amplifier to convert the high impedance pickup outputs into low impedance signal levels.

### Circuit Description

In addition to the block diagram shown in Figure 1, a circuit diagram of the Guitar Phantom PSU is detailed in Figure 2. This should help the constructor understand the operation of the unit and assist faultfinding, should this become necessary.

### FEATURES

Enables 'active' guitars to be powered via the signal cable

Turns a non-active guitar into an active guitar

Buffers the signal enabling long cable runs to be made with low signal loss

Provides a regulated 9V DC output to power active circuitry in the guitar

Short circuit protected

Guitar PCB is only the size of a PPC battery

Optional 'Power' LED can be fitted into guitar

### APPLICATIONS

Gigging bands or solo musicians

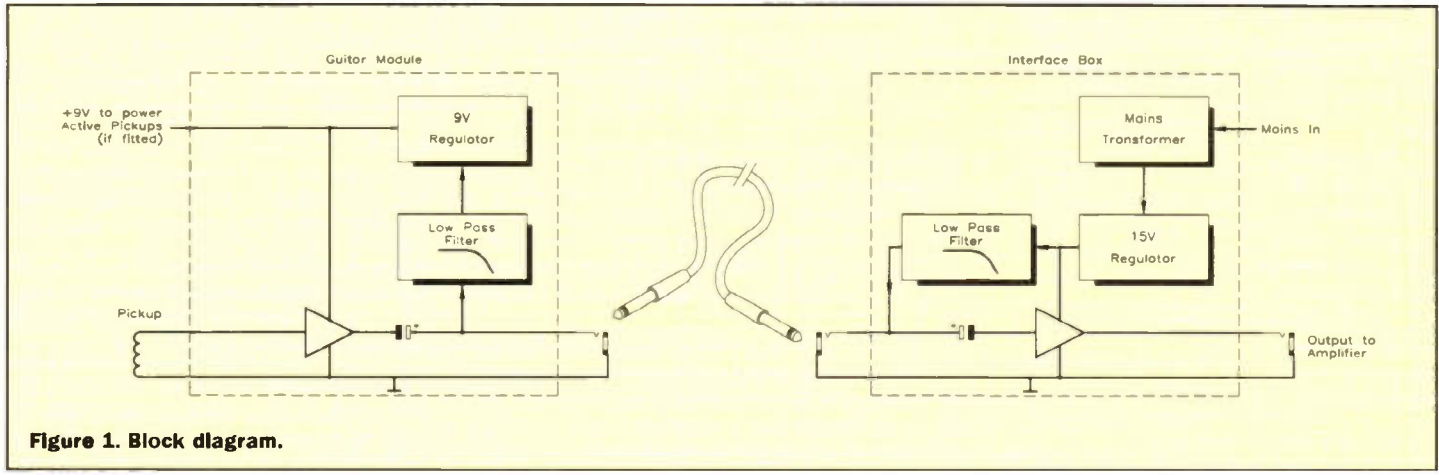


Figure 1. Block diagram.

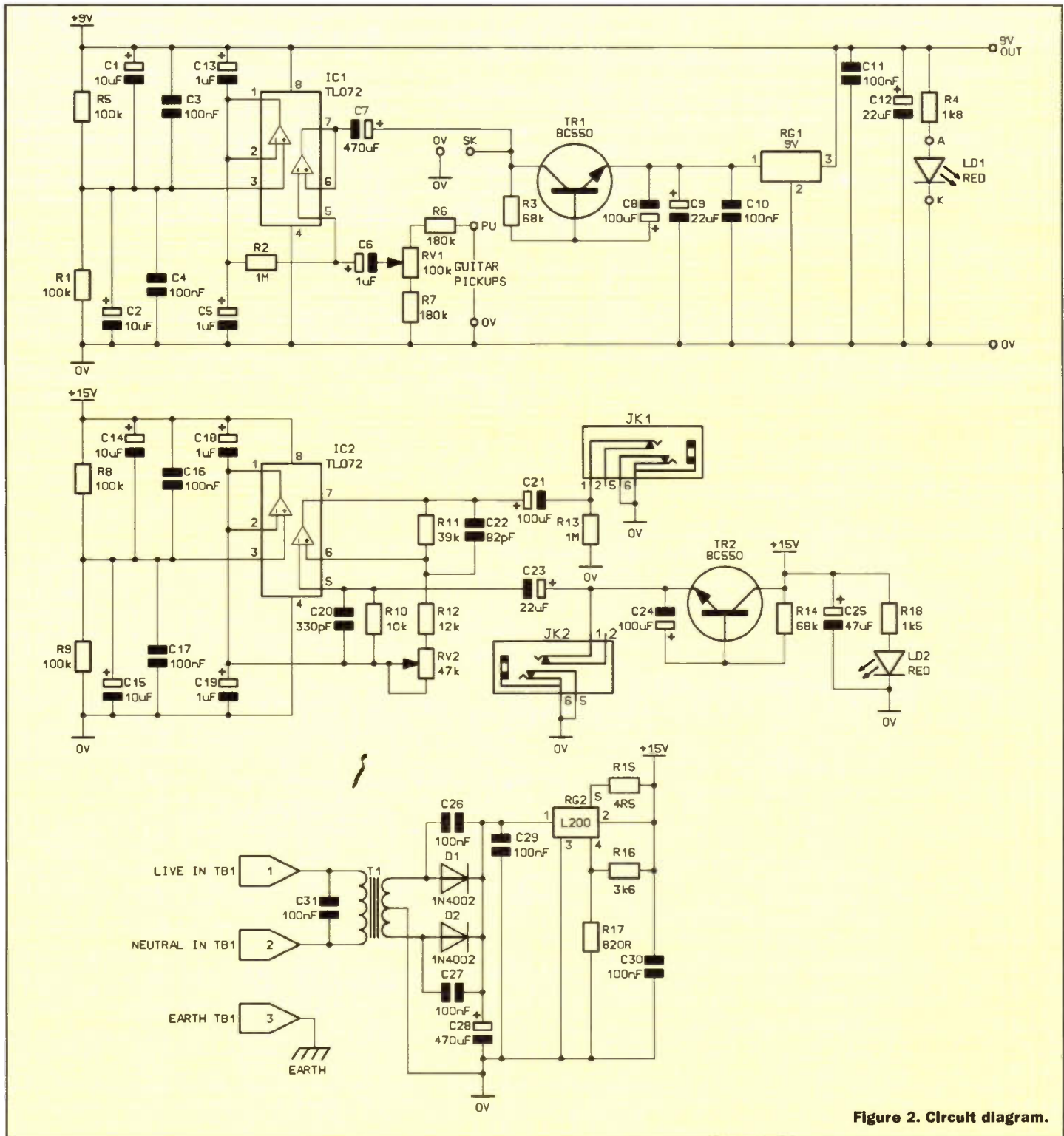


Figure 2. Circuit diagram.

Power Supply output  
from Interface Box

15V —————  
0V —————

Signal present on cable  
connecting Guitar to Interface Box

15V —————  
0V —————

Audio signal output  
from Guitar

0V —————

Direction of signal flow

15V DC

Interface  
Box

Guitar

Audio

**Figure 3. Input and output signal levels.**

The circuit is best described in two sections, namely, the 'Interface Box' and the 'Guitar Module', as follows.

### Interface Box

The 230V AC mains supply enters the unit via a fused inlet chassis plug, is stepped-down by transformer T1, and regulated to 15V by RG2. An L200 device was chosen in preference to a simple 15V regulator for RG2, as in addition to setting the output voltage, you can also set an output current limit on the device. This current limit is set to 100mA by R15, thereby protecting the unit should any connecting cable be accidentally shorted.

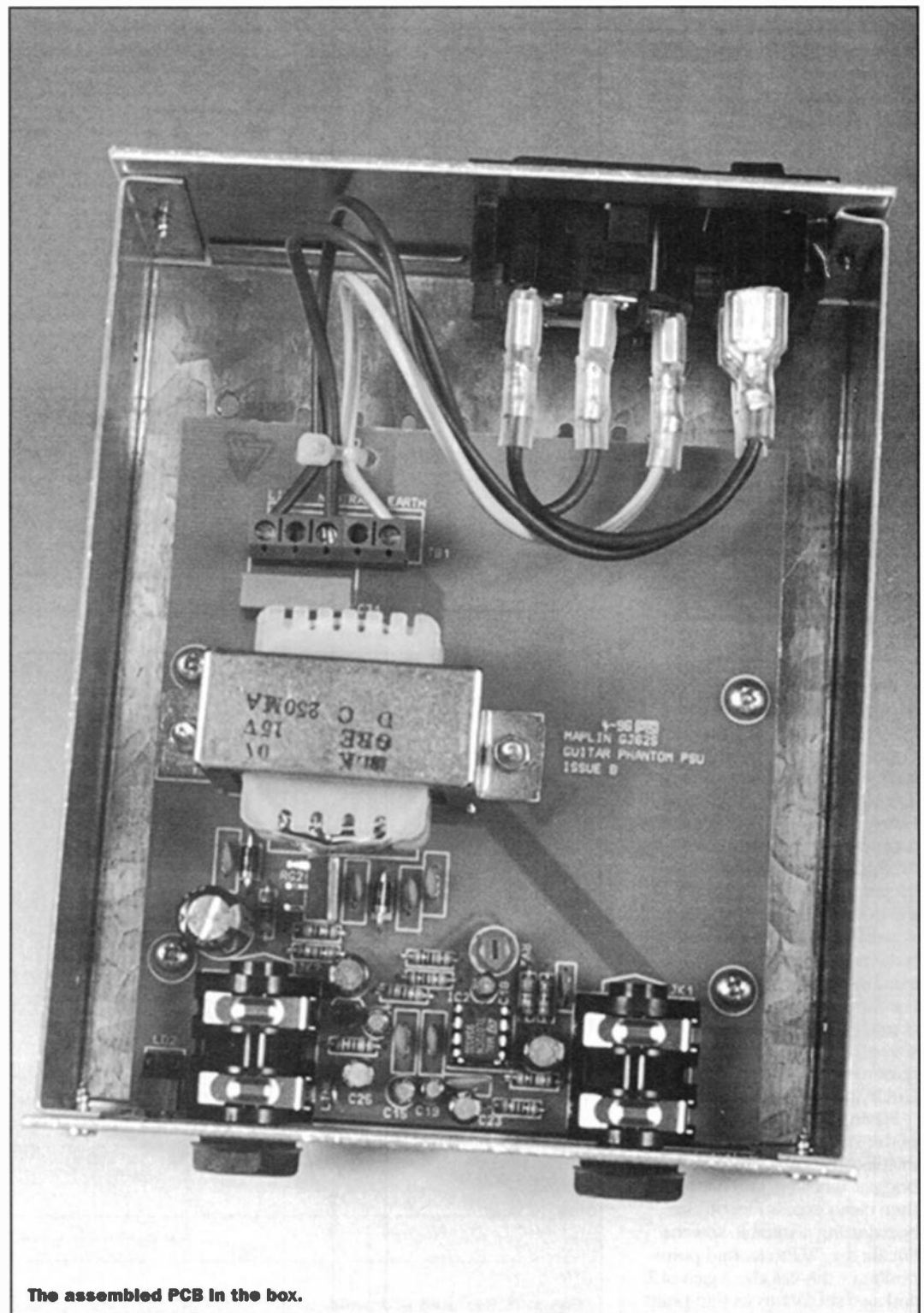
15V is fed up the audio cable to the guitar through R14, C24 and TR2, which are configured so as to simulate a large value inductor. This 'inductor' offers a high resistance to audio signals that are passed back down the cable from the guitar, but a low resistance to DC, enabling the 15V to be fed up to the guitar on the same wire as the audio – see Figure 3.

Audio signals returning from the guitar have their DC component removed by C23, and are buffered and amplified to their original level by IC2b. The final gain of IC2b is set by RV2, and using the supplied components, is adjustable from 1.66 to 3.25. IC2a, R8, R9, C14 to C19 simply provide a half supply reference for the audio path.

Finally, the audio signal has its half supply reference removed by C21 before being fed to JK1, the final audio output for the guitar amplifier.

### Guitar Module

DC entering the guitar passes through TR1, R3 and C8, which provide a low impedance path



**The assembled PCB in the box.**

for the DC, whilst blocking any AC signals that are also present at the jack socket. This DC is then smoothed and regulated to 9V by RG1. LD1 and current limiting resistor R4 simply provide a 'Power On' indicator. Audio signals from the pickups are presented across a potential divider formed by R6, R7 and RV1.

Relatively high voltages can be generated by guitar pickups, and to ensure the Guitar Phantom PSU does not overload, these signals must be attenuated *before* being fed down the cable to the Interface Box. This is achieved by the potential divider formed by R6, R7 and RV1. By varying RV1, the output of the pickups can be attenuated from 39% to 61% of its original value.

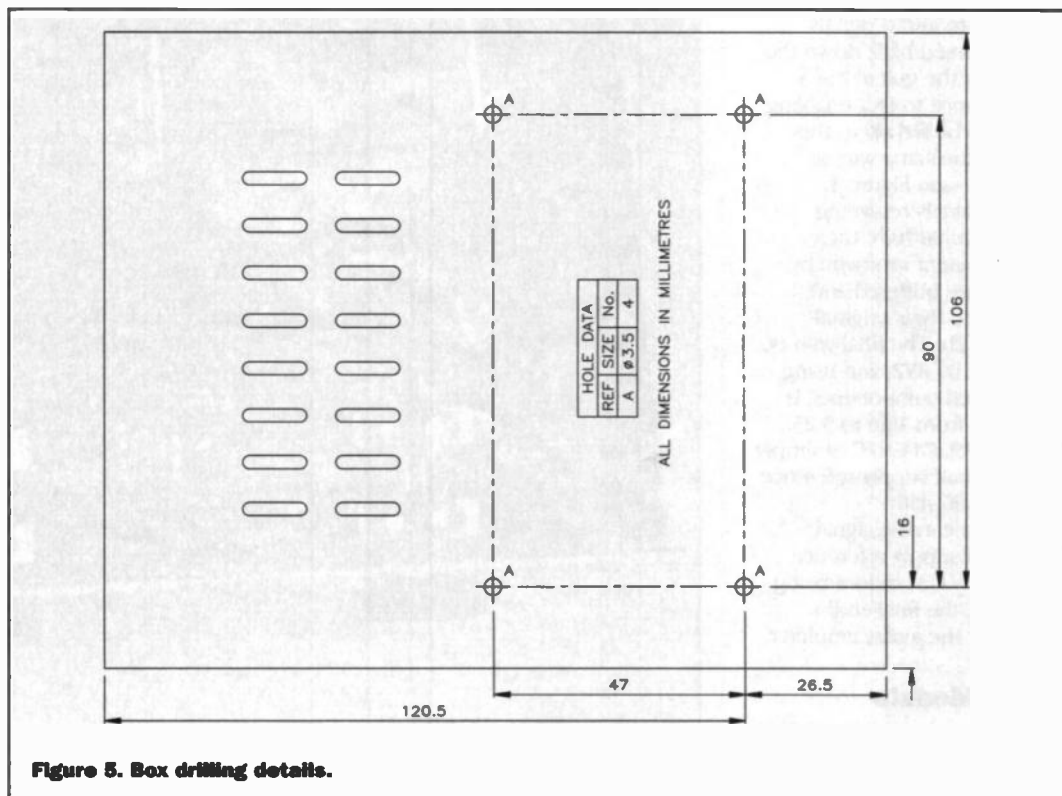
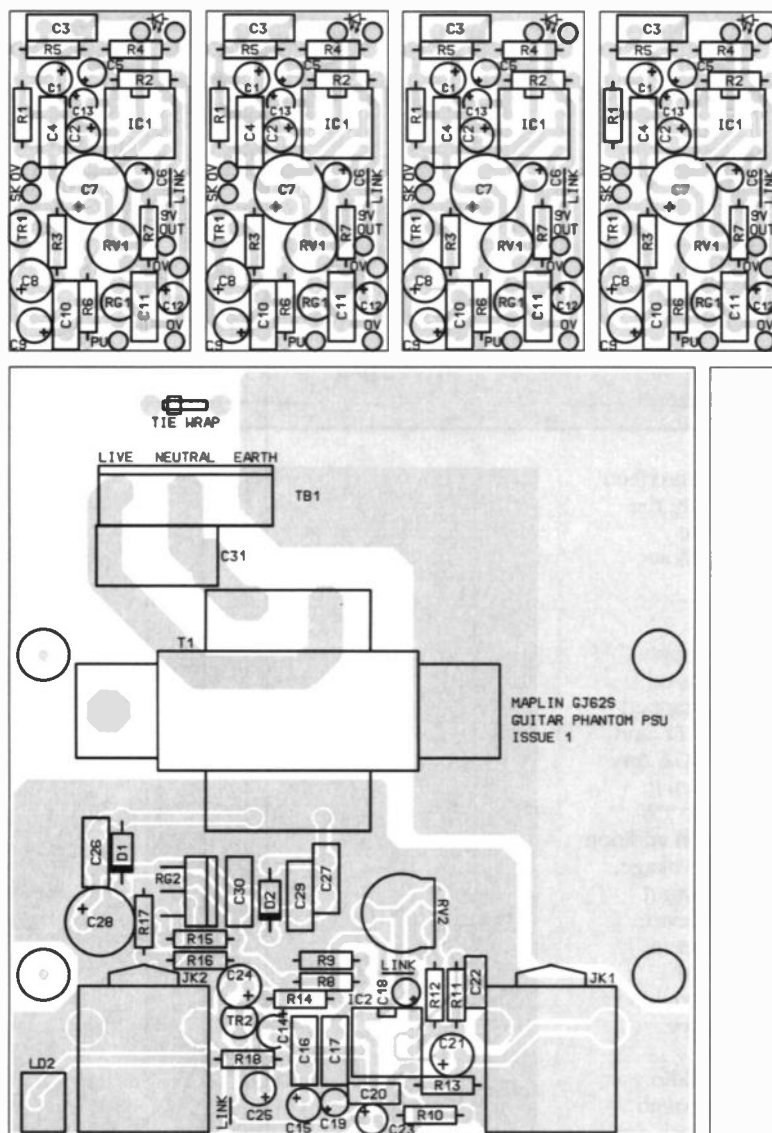
### PCB Construction

The PCB is of single-sided construction – see Figure 4, showing the legend and track. Note that it is supplied in one piece, comprising of one Interface PCB (the larger section), and four small Guitar Module PCBs, plus a throwaway piece. Enough components are provided in the kit to build one Guitar Module (and one Interface unit) – if you wish to construct more than one Guitar Module, you will need to order the relevant extra components. This enables owners of more than one guitar to be able to equip all of them (well, up to four anyway!) with Guitar Modules, which can all be used with the one Interface Box.

Remember that removal of a misplaced component can be quite difficult, so please double-check each component type, value and polarity where appropriate, before soldering! Construct the PCB in order of ascending component size. Fit the DIL holders so that their end notches align with the printed legend. The ICs should be installed into their holders last of all, taking suitable anti-static precautions. For further information on component identification and soldering techniques, please refer to the Constructors' Guide included with the kit.

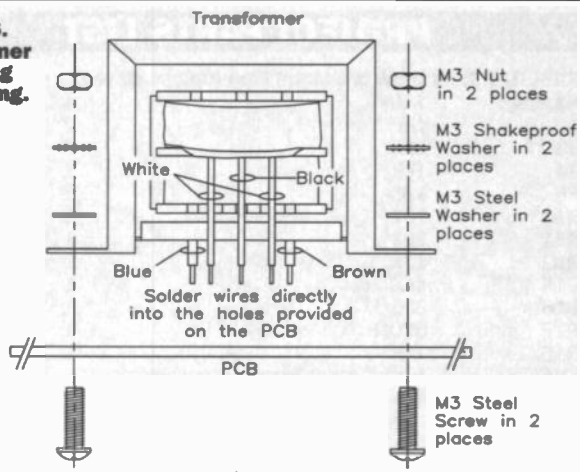
Having completed assembly of the PCB, check your work for misplaced components, solder bridges, whiskers and dry joints, then clean excess flux off the board using a suitable solvent. Finally, set RV2 to its mid-point position – this will give a gain of 2, and also set RV1 to its mid-point position (giving a gain of 0.5).

**Figure 4. PCB legend and track**



**Figure 5. Box drilling details.**

**Figure 6. Transformer mounting and wiring.**



## Box Construction

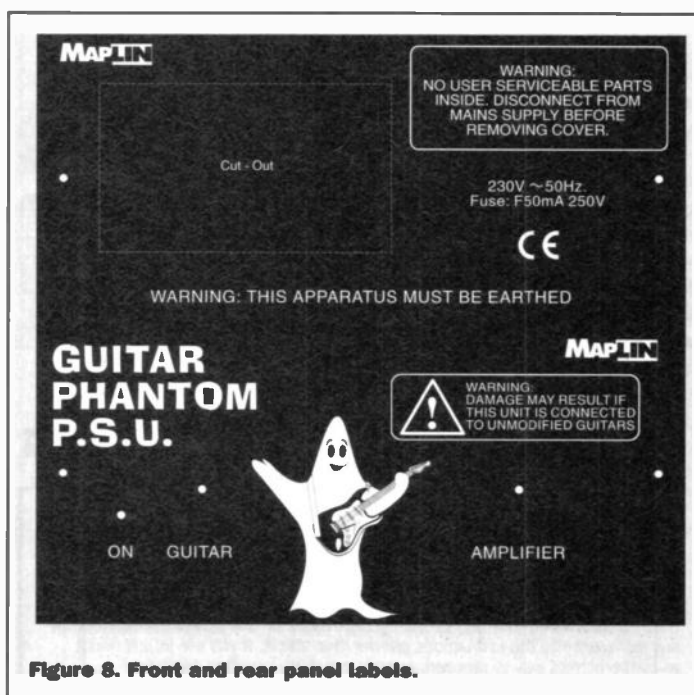
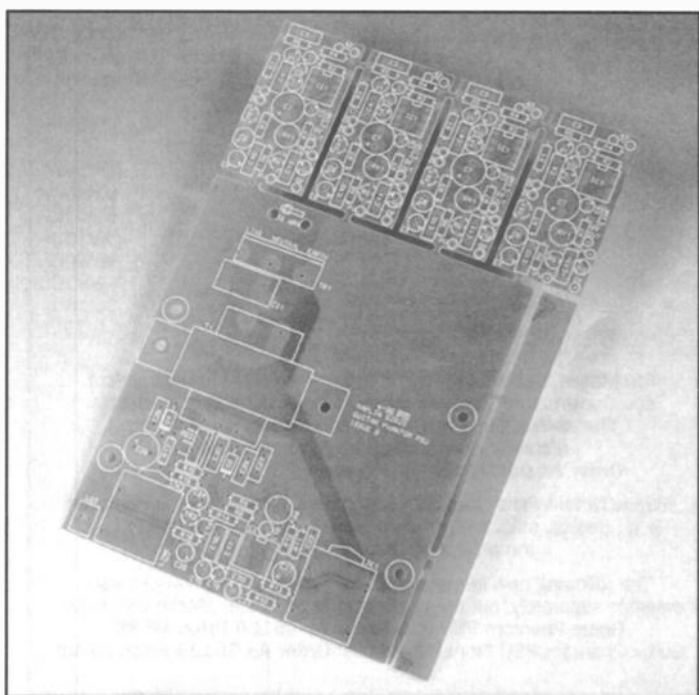
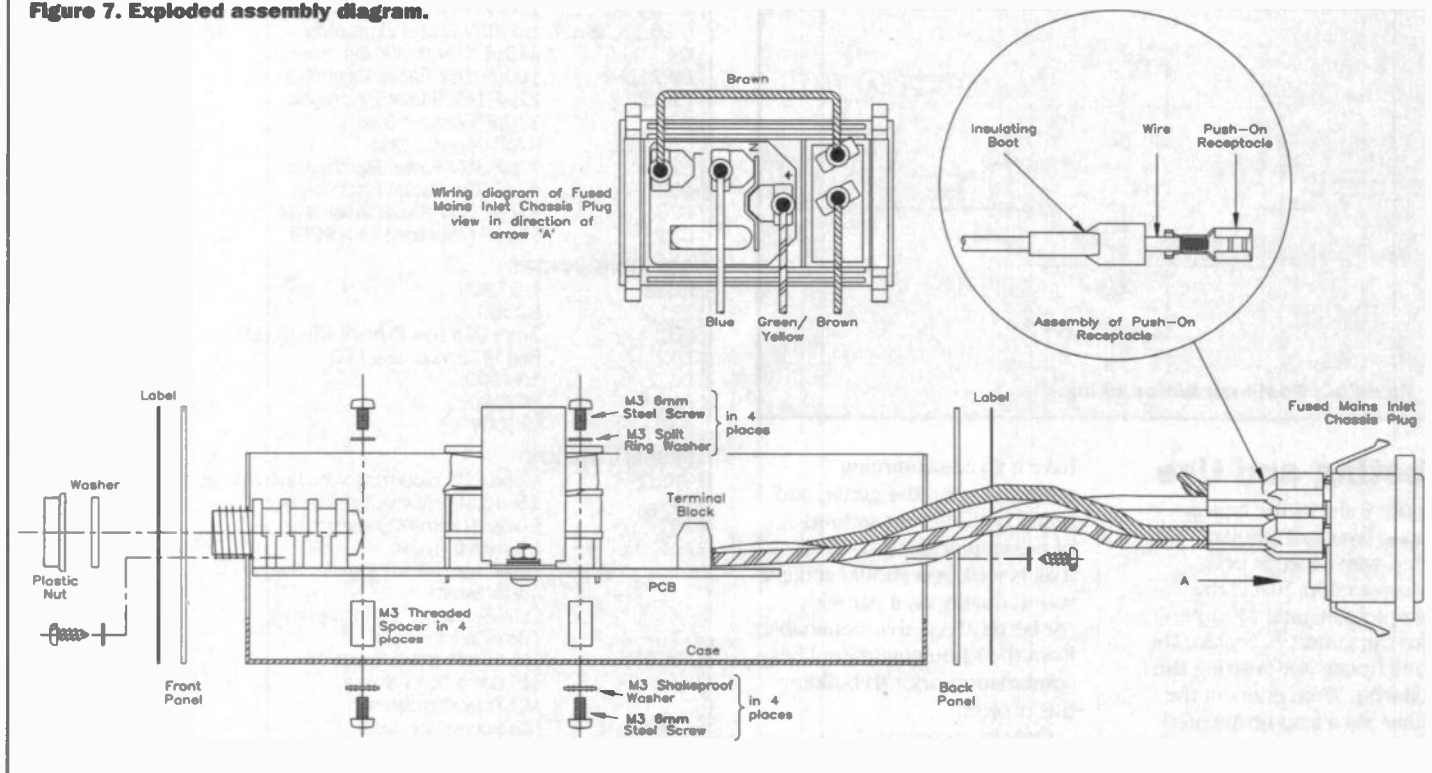
A galvanised steel box is specified for the Interface unit, which is supplied with pre-punched aluminium front and rear panels. However the base of the steel box must be drilled, in accordance with Figure 5.

Having drilled the box, chamfered the holes to remove any burrs and removed all traces of swarf, install and connect the transformer as shown in Figure 6, then install the PCB as indicated in the exploded assembly diagram, Figure 7.

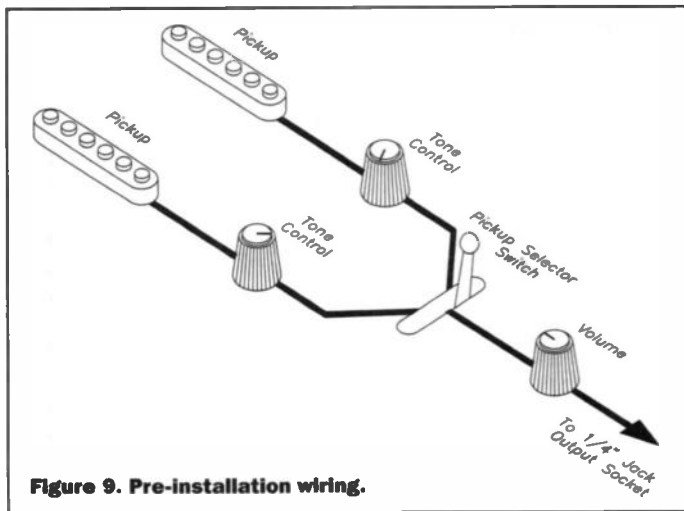
**NOTE:** Check CAREFULLY that the 'Shakeproof' and 'Split-Ring' washers are used where indicated in the assembly diagram – it is IMPERATIVE that they are fitted ONLY where indicated, to ensure that a firm, safe and secure 'earth bond' is made between the mains earth terminal and the housing.

Wipe the front and rear panels clean and apply the respective labels shown in Figure 8. Next, stick the four rubber feet onto the corners of the box base underside. Finally, fit the lid onto the box (with ventilation holes nearest the rear), fastening it using the four screws supplied with the box.

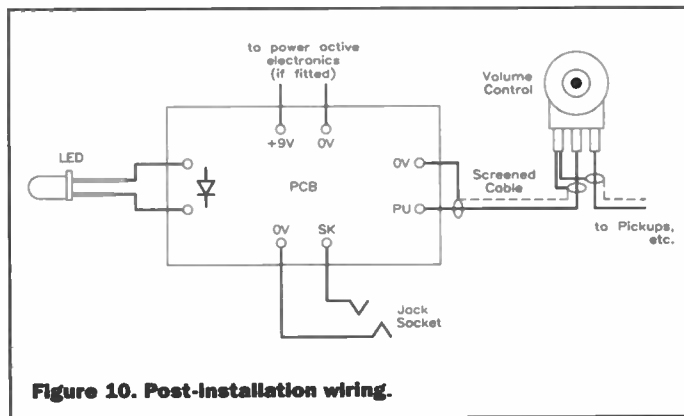
**Figure 7. Exploded assembly diagram.**



**Figure 8. Front and rear panel labels.**



**Figure 9. Pre-installation wiring.**



**Figure 10. Post-installation wiring.**

## Testing and Use

Figure 9 shows the typical wiring layout of a guitar fitted with pickups prior to conversion. Install the completed Guitar Module(s) into the guitar(s), replace the scratchplate and restring the guitar(s). Then connect the guitar, via a lead terminated in 1/4 in. mono jack plugs, to the Interface Box as indicated in the post-installation diagram, Figure 10.

Now connect the output of the Interface Box to the amplifier using a suitable lead (terminated in 1/4 in. mono jack plugs). Use the 3-pin plug-to-Eurosocket lead supplied in the kit to plug the Interface Box into a mains outlet. With this plugged into the Interface Box Euro socket, switch the unit on. The front panel LED should now be glowing. If the optional power LED has been installed into the guitar, it should also glow after a few seconds. Switch on the amplifier, and

have a go at strumming some tunes on the guitar, and trying out different settings of the volume/tone controls. If all is well, you should achieve sound quality on a par with (or better than) that obtainable from the same guitar/amplifier combination prior to building this project.

Only in exceptional circumstances will RV1 and RV2 need adjusting - RV1 attenuates the signal before it is sent down the cable, and RV2 determines the level of amplification required to boost the signal back up to its original level.

Always operate the project in accordance with the mains safety warnings printed in this article. Never operate the Interface Box with the lid removed. In the event of the fuse requiring replacement, only fit a fuse of the correct rating, as stated in the Specification table and Parts List.



### Important Safety Note

It is important to note that mains voltage is potentially lethal. Full details of mains wiring connections are shown in this article, and every possible precaution must be taken to avoid the risk of electric shock during maintenance and use of the final unit, which should never be operated with the box lid removed. Safe construction of the unit is entirely dependent on the skill of the constructor, and adherence to the instructions given in this article. If you are in any doubt as to the correct way to proceed, consult a suitably qualified engineer.

## PROJECT PARTS LIST

### RESISTORS: All 0-6W 1% Metal Film (Unless stated)

R1,5,8,9	100k	4	(M100K)
R2,13	1M	2	(M1M)
R3,14	68k	2	(M68K)
R4	1k8	1	(M1K8)
R6,7	180k	2	(M180K)
R10	10k	1	(M10K)
R11	39k	1	(M39K)
R12	12k	1	(M12K)
R15	4Ω7	1	(M4R7)
R16	3k6	1	(M3K6)
R17	820Ω	1	(M820R)
R18	1k5	1	(M1K5)
RV1	100k Cermet Preset Potentiometer	1	(WR44X)
RV2	47k Horizontal Enclosed Preset Potentiometer	1	(UH05F)

### CAPACITORS

C1,2,14,15	10μF 16V Radial Electrolytic	4	(AT98G)
C3,4,10,11,16,17,26,27,29,30	100nF 16V Radial Electrolytic	10	(YR75S)
C5,6,13,18,19	1μF 63V Radial Electrolytic	5	(AU09K)
C7	470μF 16V Radial Electrolytic	1	(AT43W)
C8,21,24	100μF 16V Radial Electrolytic	3	(AT40T)
C9,12	22μF 16V Radial Electrolytic	2	(AT99H)
C20	330pF Ceramic Disc	1	(WX62S)
C22	82pF Ceramic Disc	1	(WX55K)
C23	22μF 35V Radial Electrolytic	1	(AT56L)
C25	47μF 25V Radial Electrolytic	1	(AT47B)
C28	470μF 35V Radial Electrolytic	1	(AT62S)
C31	100nF Metallised Film PETP	1	(JR34M)

### SEMICONDUCTORS

IC1,2	TL072CN	2	(RA68Y)
TR1,2	BC550	2	(UL49D)
LD1	3mm Red Low Current (2mA) LED	1	(CZ28F)
LD2	Red PCB-mounting LED	1	(QY86T)
D1,2	1N4002	2	(QL74R)
RG1	HT7290	1	(CH49D)
RG2	L200CV	1	(YY74R)

### MISCELLANEOUS

SK1,2	Mono PCB-mounting 1/4 in. Jack Socket	2	(FJ00A)
T1	15-0-15V 250mA Transformer	1	(YN17T)
TB1	3-way 10mm PCB-mounting Terminal Block	1	(JR80B)
	Fused Mains Inlet Chassis Plug with Switch	1	(JK71N)
	Euro Socket to 13A Plug Lead	1	(MK41U)
	50mA 20mm Fuse	1	(WR93B)
	M3 10mm Steel Screw	1 Pkt	(JY22Y)
	M3 6mm Steel Screw	1 Pkt	(JY21X)
	M3 Threaded Spacer	1 Pkt	(FG38R)
	M3 Spring Washer	1 Pkt	(JD96E)
	M3 Shakeproof Washer	1 Pkt	(BF44X)
	M3 Steel Nut	1 Pkt	(JD61R)
	1mm PCB Pin	1 Pkt	(FL24B)
	8-pin DIL Socket	2	(BL17T)
	Steel Case Type 1105	1	(XJ25C)
	Stick-On Feet	1 Pkt	(FW38R)
	100mm Tie Wrap	1	(BF91Y)
	Push-On Lucar Receptacle	1 Pkt	(HF10L)
	Push-On Receptacle Covers	1 Pkt	(FE65V)
	Blue 32/0-2 Wire	1m	(XR33L)
	Brown 32/0-2 Wire	1m	(XR34M)
	Green/Yellow 32/0-2 Wire	1m	(XR38R)
	PCB	1	(GJ62S)
	Front and Rear Panel Labels	1	(KV16S)
	Front Panel	1	(AV80B)
	Rear Panel	1	(AV81C)
	Instruction Leaflet	1	(XZ18U)
	Constructors' Guide	1	(XH79L)

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

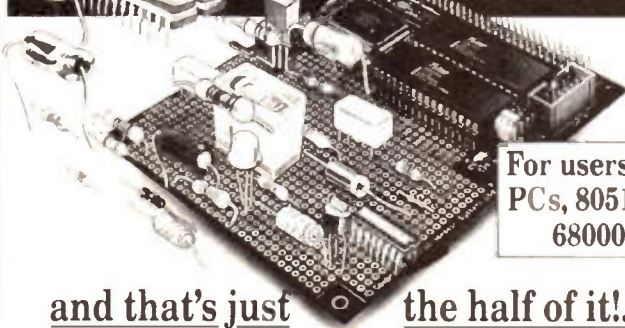
**The above items are available as a kit, which offers a saving over buying the parts separately.**  
**Order As 95104 (Guitar Phantom PSU) Price £44.99**

Please Note: Where 'package' quantities are stated in the Parts List (e.g., packet, strip, reel, etc.), the exact quantity required to build the project will be supplied in the kit.

The following new items (which are included in the kit) are also available separately, but are not shown in the 1996 Maplin Catalogue.  
**Guitar Phantom PSU PCB Order As 95105 Price £6.99**  
**Guitar Phantom PSU Front Panel Label Order As 95106 Price £2.29**



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THE MAPLIN MAGAZINE

# ELECTRONICS

**R114,00** for 6 issues  
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(All inclusive of VAT and P&P)

# The world's Toughest Race

## THE BT GLOBAL CHALLENGE

by Alan Simpson

*This is one yacht race which is, in no way, plain sailing. Challenge, commitment, excellence, enthusiasm, dedication – you name it, the round the world race provides it. Dubbed as 'the world's toughest yacht race', it can be likened to a concentrated dose of bungee-jumping, abseiling down the Matterhorn and parachuting from St. Pauls, all on the same day.*

**W**hich yacht wins will depend upon the highly trained volunteers who make up the crew of 14 on each stage of the race, plus the skill of the yacht's professional skipper. It will be the ultimate test of teamwork and seamanship for the competing crews, with each of the competing yachts having been designed, built and equipped identically. They are all 67ft. steel-built cutter-rigged sloops, distinguishable only by their sponsor's livery.

This is a race where everyone starts equal. A first-class level playing fields (or should that be seas) concept. The boats are of one design, and the crew make-up skills are as equal as possible. Whether a particular yacht is fast or slow must purely depend on the efforts of the skipper and crew, rather than any feature of the individual yacht, the depth of a sponsor's pocket or any other outside influence.

Following some two years of preparation, Sunday 29<sup>th</sup> September sees the fleet of fourteen 20.42m (67ft). yachts, each manned by amateur crews starting out from Southampton, at the start of their 30,000-mile, 10 month voyage. What is more, the teams will be competing not only with each other, but against the prevailing winds and currents of the world's oceans, in effect, sailing the 'wrong way'. Very much a case of taking the rough with the rough.

BT has, in fact, been supporting the upper end of international yachting for

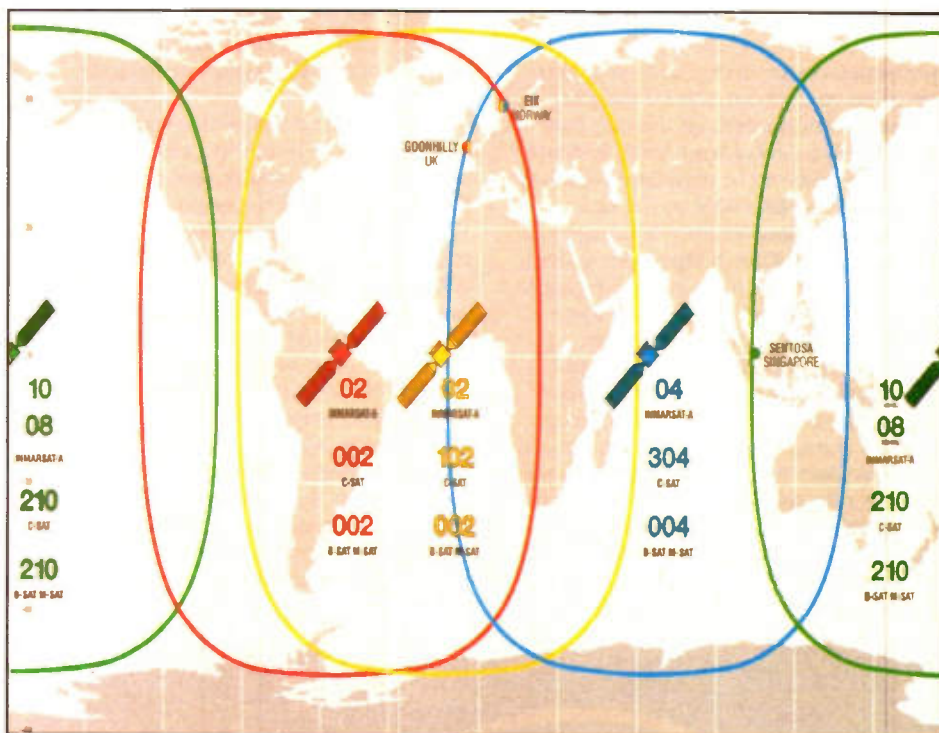
some years. Originally, the race was known as the Whitbread Race, with BT providing the electronics and communications. In 1992, the race was known as the British Steel Challenge and was the inaugural wrong-way round the world race.

This year, BT has taken the title sponsorship. The logic for BT's sponsorship is clear. Facing strong competition in the UK, the company needs to expand overseas and find new markets. Sailing the BT flag around the world allows BT to mount their own challenge, proving they are, in fact, a truly global, multi-national company.

As the BT project director Bob Semaine puts it, "the Challenge fulfils a multitude of requirements. Helping the UK man-in-the-street to become closer associated with the company; liaison with some of the world's major companies who are sponsors; focusing on business opportunities; helping BT to be identified as an innovative company with a considerable level of R&D; helping raise funds for the associated charity, Save the Children Fund. If we can communicate with the world in the southern oceans, we can operate anywhere. Indeed, there is a lot of mileage in the race. In fact, the multi-million pound sponsorship is ideal. It comes at a time when the company is developing a global alliance with America's second largest and fastest-growing long distance carrier, MCI, to provide global networking services."



BT Global Challenge yacht.



**Above: Figure 1. The yacht communications system.**

**Below: Motorola's special edition mobile phone for the BT Global Challenge.**



## Yachts Ahoy

There was a time when yachting was a matter of sailing around the Isle of Wight with a picnic basket and attractive companion. Now, it is a major ordeal. The Challenge route takes the yachts from Southampton to Rio de Janeiro, around Cape Horn and the Roaring Forties, and on to Wellington, New Zealand. It is estimated that yachts will take 40 days or so to cover the 7,000 mile distance, arriving at the year end. Following a short respite, a racing sail with the relatively short 1,250 mile distance to Sydney. The fleet then crosses the Indian Ocean to Cape Town, with the penultimate leg being the 7,000 mile race to Boston. The final 3,000 miles charge up the Atlantic should see the first yachts crossing the Southampton line on 15<sup>th</sup> July 1997.

This is a race where danger is a built-in ingredient. When cruising some of the world's roughest seas, safety is paramount. Safety equipment is regularly checked, in particular, safety harnesses, where every link in the chain is examined, as well as the specially re-designed lifejackets. Additionally, the 4,000 individual parts of the yacht are checked and double-checked. Suspect items such as the rudder support have been re-designed and hull plates strengthened. The rigging and masts, in particular, are closely examined, as just one weak link in the 6-6km of wire rigging could be a disaster. Very much a case of one slip and you're dead meat.

## Hi Tech Spans The Globe

According to BT, the essence of their sponsorship is that 'if you can communicate with someone as they sail around Cape Horn, you can communicate with them anywhere in the world'. As BT put it, 'a small yacht in a vast ocean, probably in grotty weather conditions, makes a tiny and erratic target for any communication system. BT aims to not only make contact, but to do it as and when and where required, at a moment's notice and with complete reliability.'

There is no doubt that satellite communications developed by BT have transformed ocean racing. Text, voice and even video contact can now be maintained with each yacht throughout the race (see Figure 1). Also, Global Positioning Systems (GPS) yacht plots can be transmitted regularly via Inmarsat satellites back to the race headquarters control centre in Southampton. Inmarsat C is, in effect, a super-telex system, firing typed messages to a satellite – probably from BT's Goonhilly Downs, Madeley or Docklands stations and then beaming them down to a receiver on each yacht.

The satellite link also transmits position data back from the yachts at sea, keeping everybody in touch. A special race information system calculates the latest competitive results four times a day and distributes the information to the public world-wide via phone, fax, polling and local PC (making use of the Microsoft Windows environment) for hard copy press releases, with information being

updated onto the Internet. As an aside, it is perhaps interesting (and alarming) to note that one of the BT Internet commands reads 'Deck wipe-out'.

At present, technology does not allow pictures straight from the yachts, but overhead pictures will be sent while the fleet is in the pre-determined corridors. These, as well as photos from the various ports of call, will then be transmitted by ISDN-line to press and media. During the race, the 14 identical steel yachts have to sail in two defined corridors (4 days out of Southampton and then between Tenerife and Las Palmas in the Canaries) to facilitate PR and photographic opportunities.

Meanwhile, basic radio ship-to-shore communications from one of BT's coastal radio stations, the respective skills of operators both ashore and on board, (plus a little help from atmospheric conditions) will allow the operations centre to keep in touch with the yacht skippers. On-boat

radios also feature emergency beacons and panic buttons, allowing the race organisers to pinpoint precise positions.

As a sign of job requirements, the BT call for headquarters watchkeepers states that communications experience should include Inmarsat and STD-C, and basic experience with speller codes, HF/VHF radio propagation, knowledge of Portishead and other long range services, GMDSS and HMCG. Don't all rush!

One of the leading sponsors is Motorola, who are accepting the Challenge in several ways. Each skipper will be supplied with the very latest in cellular technology – a 'Motorola Flare' mobile 'phone. In fact, Motorola have produced a special edition 'BT Global Challenge' mobile 'phone, featuring the Challenge colours and insignia. Operating on the digital GSM network, they will operate at most ports-of-call during the race.

In addition, since each skipper will be equipped with a Motorola pager, small enough to clip to a belt, alphanumeric messages can be relayed round the boat – even in screaming gales. According to Motorola's marketing manager, Steve Wyre, "Motorola likes nothing better than a challenge. We've built our reputation on it. The BT Global Challenge is a celebration of teamwork, and we're delighted to be on board."

Other sponsors (or business club members) include Toshiba, Nuclear Electric, Amdahl, Hewlett-Packard, Nortel, Oracle UK, Sun Microsystems and Tandem Computers.

Typical donations include a number of Oki LED page printers to both competitors and organisers of the Global Challenge. As well as providing a number of LED page printers to help deal with the massive administrative workload generated by the event, Oki has supplied ML280 dot matrix printers for use onboard the yachts. The 24V printers will run off the boats' standard power supplies, printing reports received by satellite and thus providing vital advance information of any irregular weather patterns. Just to make sure that sponsors remain keen, BT will award The Princess Royal Trophy to the yacht sponsor whose vessel wins the race.

## No More Heroes Anymore

Not true. Over two hundred crew volunteers, many of whom have little or no previous sailing experience, have paid nearly £20,000 each for the privilege of taking part on all legs of the race. Each yacht carries a crew of 14, one of whom is the professional skipper, who will have an ocean yacht Master certificate. One boat, in fact, will be largely crewed by disabled people, selected by the charity 'Time and Tide trust. They, like all the contestants, will leave all the comforts of home behind and become reliant on dried food ingredients.

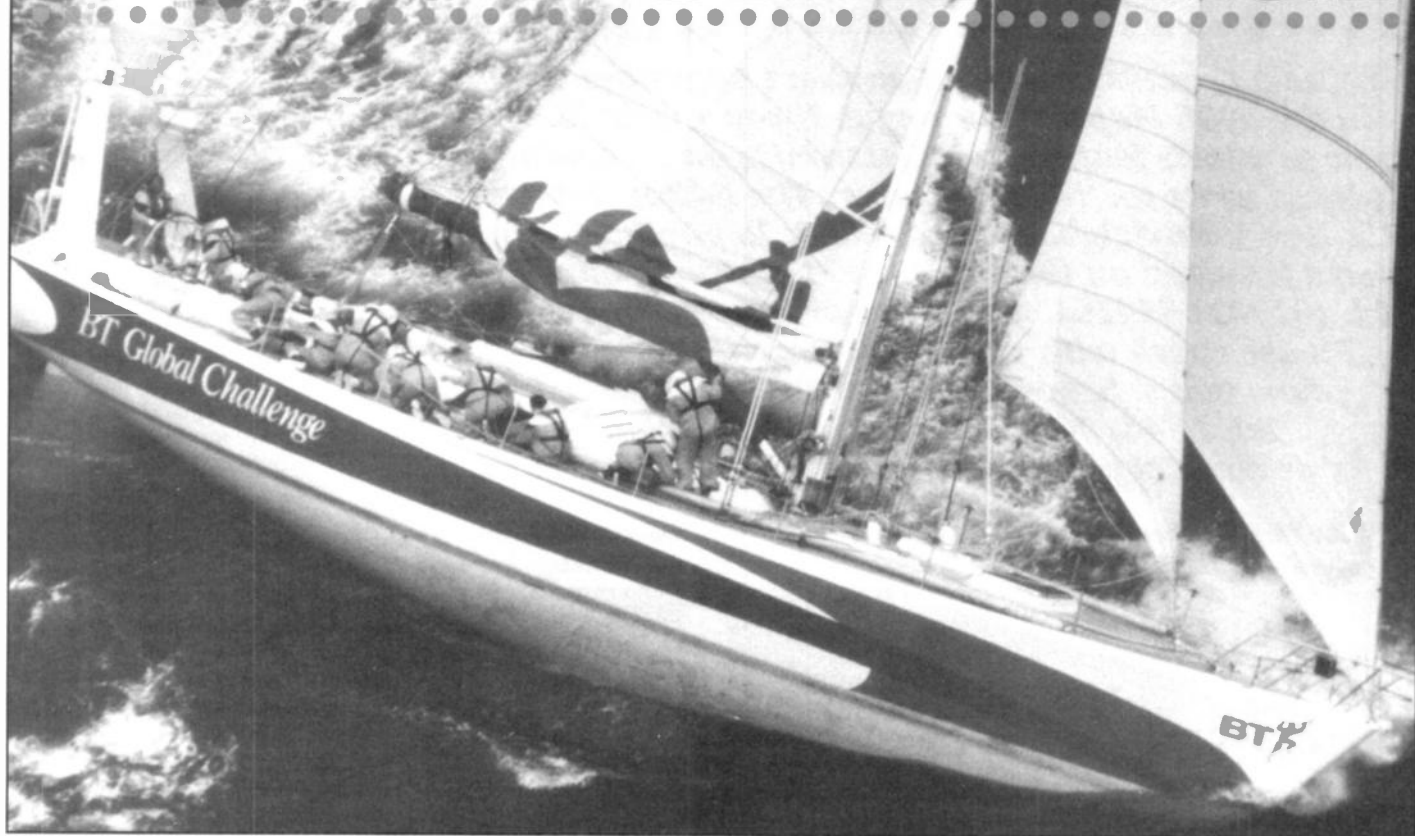
So, let's hear it for the valiant crews. But whatever the outcome, there is no doubt that the major Challenge winner will be BT themselves.

### Point of Contact

Current information about the BT Global Challenge is available via  
 Fax: Poll (0990) 321 123.  
 Internet web site: [BTGC1996-97.com](http://BTGC1996-97.com)  
 Radio communication: (0800) 378389.



# GLOBAL CHALLENGE



## EXCLUSIVE! ELECTRONICS COMPETITION

### The Challenge – Prizes Galore

Readers of *Electronics* will not have to face the ordeal of the oceans to win some highly desirable prizes. Just get all the easy to answer questions right, and you could win the first prize, that of being present at the start of the race, as a guest of BT.

The runner-up is also on to a good thing. Oki Systems (UK) Ltd, a leading manufacturer of printers and fax machines and a major supplier to the BT Global Challenge, is giving a fortunate reader their revolutionary Page Printer, the OKIPAGE 4w. Priced at £279 (including VAT), this is a four-pages-per-minute, 600dpi class, LED technology printer which has a footprint almost as small as the sheet of A4 paper it prints, and is ideal for either the home, the small office, or personal use within large departments.

### And There is More

Third prize is a stunning, limited edition Musto Motorola BT Global Challenge snug jacket. Protect yourself from the elements with this polartec, fleece lined jacket, worth about £150.

And for the lucky runners up, we have no less than 10 sets of Motorola BT Global Challenge T-shirts and baseball caps.

### How to enter

Get on board now. Just complete the coupon, correctly answering the four questions, or send your answers on a postcard or back of sealed-down envelope. Don't delay – the contest ends on 31st July 1996 and the draw will be made on 2nd August 1996.

Send your entry to:  
**BT GLOBAL CHALLENGE Competition,  
The Editor, Electronics, P.O. Box 3,  
Rayleigh, Essex SS6 8LR.**

Alternatively, fax: (01702) 556987.

**Please note that employees of Maplin Electronics, associated companies and family members are not eligible to enter. In addition, multiple entries will be disqualified. The prizes will be awarded to the first all-correct entries drawn. The editor's decision will be final. The prizes are not exchangeable for cash. Any related travel costs will not be met by the publication or the sponsors.**

Answer all the questions below, ticking one box for each question.

**1. What is the front of a boat or ship called?**

- Bow.  
 Galley.  
 Rigg.

**2. Which port will the yachts not be visiting?**

- Sydney.  
 Cannes.  
 Rio.

**3. Which company is not sponsoring The Challenge?**

- Motorola.  
 GPT.  
 Golders Green Garments.

**4. The Challenge Yacht will be linked by:**

- Royal Mail Post.  
 Satellite.  
 Cable TV.

Name \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_

Postcode \_\_\_\_\_

Daytime telephone number \_\_\_\_\_

Please tick box if you do not wish to be entered for first prize. This will not effect your entry for runner's up prizes.

# New Products from MAPLIN

*The new products featured on these pages are not shown in the 1996 Maplin Catalogue. If you would like to see new products featured in Electronics on a regular basis, please write to: 'New Products', The Editor, Electronics, P.O. Box 3, Rayleigh, Essex SS6 8LR. To purchase any of the items featured on this page, call the Credit Card Hotline, Tel: (01702) 554161, or use the order coupon on page 56. Please check with your local store if they stock these new items. Export customers call Maplin Export, Tel: (+44) 702 554155 extension 326 or 351, or contact your nearest Overseas Maplin Agent.*

## MityLite Mini System

Peli Products



This comprehensive MityLite kit includes all of the features of the basic unit (Order Code BS60Q) and adds a replacement bulb unit, a detachable 'Bugsaway' night vision lens and a keychain ring, all in a neat presentation case. Lifetime guarantee. Replacement lamp module available (Order Code EL07H). Powered by 2 x AAA batteries (Order Code JY50E, supplied).

Pack Quantity: 1 (all items)		Price each
Order Code	Description	
BS62S	Super MityLite Mini System	£16.99
EL07H	Lamp Module	£3.99

## Super MityLite

Peli Products



The technically advanced pen torch with a powerful, laser sharp high-intensity beam. Super MityLite's very powerful pre-focused Xenon lamp provides a 6,000 candlepower beam – that's 600% more light than a conventional torch. The unbreakable, corrosion-proof and submersible (to 500 feet) casing is O-ring sealed, comes with a lifetime guarantee and includes a pocket clip and keychain ring. Supplied with a free 'Litebender' that bends the beam through 90°. Replacement lamp module available (Order Code EL08J). Powered by 2 x AAA (Order Code JY50E) batteries (supplied).

Pack Quantity: 1 (all items)		Price each
Order Code	Description	
BS63T	Super MityLite	£13.99
EL08J	Lamp Module	£4.99

## Super MityLite Bonus

Peli Products

A smart plastic presentation case containing a Super MityLite pen torch (see description for BS63T) and a PeliKnife – a compact and tough penknife with a sharp, hollow-ground stainless steel blade. Lifetime guarantee. Replacement lamp module available (Order Code EL08J). Powered by 2 x AAA (Order Code JY50E) batteries (supplied).

Pack Quantity: 1 (all items)		Price each
Order Code	Description	
BS64U	Super MityLite Bonus Pack	£17.99
EL08J	Lamp Module	£4.99



## Routefinder

Philips Car Systems



Routefinder is a portable electronic route planner that provides junction-by-junction directions for the quickest route from A to B anywhere in England, Scotland and Wales.

Using the simple to follow instructions, the Routefinder can be programmed to find routes that include/exclude motorways or specific places, avoid low bridges or are most suitable for towing. If basic information about your vehicle and preferred driving speeds is entered, the Routefinder will also calculate journey time and ETA, fuel consumption and the cost of the journey.

Routefinder includes a serial port (9,600 baud) for future expansion and is supplied with a removable 3M-byte ROM card containing AA data for Great Britain. A free protective case and information on software updates and accessories will be sent when the product is registered with Philips.

Powered by 4 x AA (Order Code JY48C) batteries (supplied) or through the optional Desk or Car Kit (see below). Further accessories will become available during 1996. Please enquire for details and availability.

Dimensions: 110 x 110 x 27mm.

Pack Quantity: 1		
Order Code	Description	Price each
BM42V	Philips Routefinder	£199.99 H1
JY48C	Duracell AA	£0.89

## Philips Routefinder

Turn to page 32 for a product review.

**Use the Order Coupon on page 56 to order any of these new products from Maplin or telephone (01702) 554161.**

**MAPLIN**

## Routefinder

Philips Car Systems

This kit, which powers the Philips Routefinder from the cigar lighter socket in your vehicle, comprises a rigid, well constructed and durable 'pocket', finished in exactly the same matt black as the Routefinder itself. The Routefinder slides easily and snugly into this pocket and locks safely in place until you release the lock again by pressing the small button on the front of the unit. Routefinder can then be slid out of the unit again for hand-held, battery operation.

The kit includes the Routefinder 'pocket', with a front-mounted red indicator light to show that power is being received from the cigar lighter socket, a fused (2A slow blow) cigar lighter plug with approximately 1m of lead and a deluxe ball and socket mounting unit for the dashboard, designed to easy positioning for viewing by the driver or a passenger. Supplied with comprehensive fixing kit and full instructions.

Pack Quantity: 1

Order Code	Description	Price each
CJ17T	Routefinder Car Kit	£32.99

## Mirror Styrene

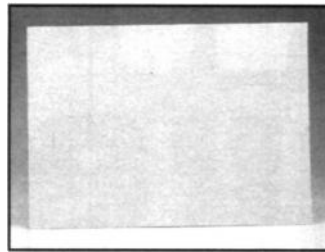
If you want to add a mirror or intricate mirrored shape to your model and want to avoid the expense and hassle of cutting glass, this sheet of cutting glass, this sheet of mirror-finish styrene will do the trick. It can easily be cut to almost any shape and the styrene ensures rigidity. Supplied in a sheet measuring approximately 280 × 196mm (11¼ × 7¾in.)

Order Code	Description	Price each
GZ78K	Mirror Styrene	£3.49

## Rigid Plastic Sheet

Plasticard

A high quality plastic sheet supplied in 22.85 × 33cm sheets, available in a range of thicknesses and three colours – white, black or clear.



Order Code	Colour	Thickness (mm)	Price each
GZ66W	White	0.25	£0.29
GZ67X	White	0.38	£0.49
GZ68Y	White	0.5	£0.49
GZ69A	White	0.76	£0.69
GZ70M	White	1.0	£0.89
GZ71N	White	1.5	£1.29
GZ72P	White	2.0	£1.59
GZ73Q	Clear	0.25	£0.69
GZ74R	Clear	0.5	£0.89
GZ75S	Clear	1.0	£1.49
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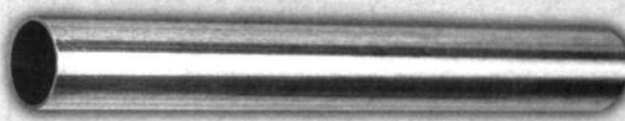
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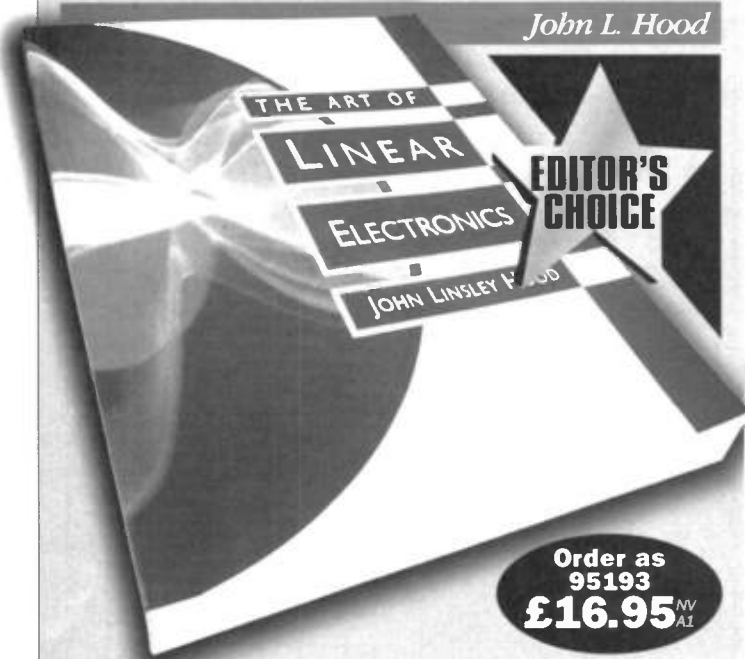


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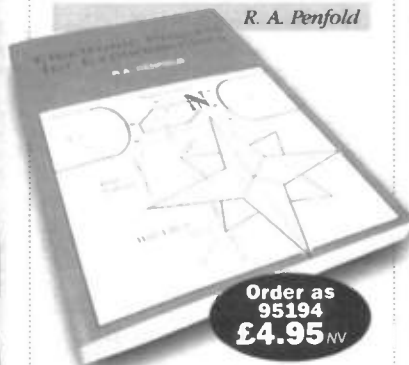
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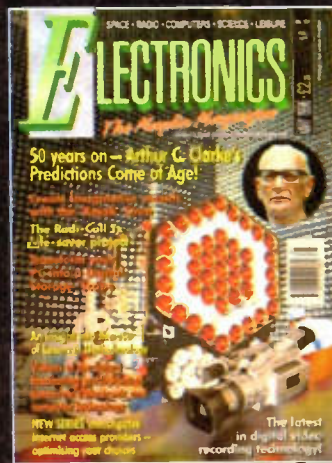


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# Lamp/LED BRIGHTNESS CONTROL CIRCUITS

Text by Ray Marston

*Ray Marston looks at practical ways of varying the brightness of filament lamps and LED devices.*

## Lamp Control Basics

Any ordinary filament lamp can be powered from AC or DC supplies, and usually consists of a coil of tungsten wire (the filament) suspended within a vacuum-filled glass envelope and connected to the outside world via a pair of metal terminals; the filament runs white hot when connected to a suitable external voltage, thus generating a bright white light. In this type of lamp, the filament's resistance has a positive temperature coefficient, causing the lamp resistance to increase with operating temperature; Figure 1 shows the typical resistance variations that occur in a 12V 12W lamp. Thus, the resistance is  $12\Omega$  when the filament is operating at its normal 'white' heat, but only  $3\Omega$  when it is cold. This 4:1 resistance variation is typical of all tungsten filament lamps, and causes them to have switch-on 'inrush' current values about four times greater than the normal 'running' values.

The brilliance of a DC-powered filament lamp can be varied in any one of three basic ways. The simplest way is to wire a rheostat and a ganged switch in series with the lamp, as in Figure 2, which shows a 12V circuit that drives a 12W lamp. Here, if RV1 has a maximum resistance value double that of the 'hot' resistance value of the lamp, RV1 will enable the lamp power dissipation (and thus its brilliance) to be varied over an approximately 12:1 range, as follows.

The operation of the Figure 2 'rheostat' circuit is fairly simple, as shown in Figure 3. When RV1 is set to the 'maximum brilliance' (zero RV1 resistance) position, the full 12V supply is applied to the lamp, which presents a resistance of  $12\Omega$  and thus has a power consumption of 12W; as shown in Figure 3 (a). When RV1 is set to the 'minimum brilliance' (maximum RV1 resistance) position, however, RV1 has a resistance of  $24\Omega$  and the lamp presents a resistance of only  $6\Omega$ , as shown in Figure 3 (b), and under this condition, only  $2\Omega 4V$  is

developed across the lamp, which thus consumes only 960mW and produces very little light output. RV1 therefore allows the lamp brilliance to be varied over a wide range.

A major disadvantage of the Figure 2 circuit is that it wastes a lot of power in RV1, which must have a substantial power rating and be capable of handling the 'cold' currents of the lamp. Figure 4 shows an alternative brilliance-control circuit, which dissipates negligible power in RV1. Here, RV1 acts as a variable potential divider which applies an input voltage to the base of emitter follower Q1, which buffers (power boosts) this voltage and applies it to the lamp. RV1 thus enables the lamp voltage (and brilliance) to be fully varied from zero to maximum. Note in this circuit, that Q1 needs a fairly large power rating and must be capable of handling the 'cold' currents of the lamp.

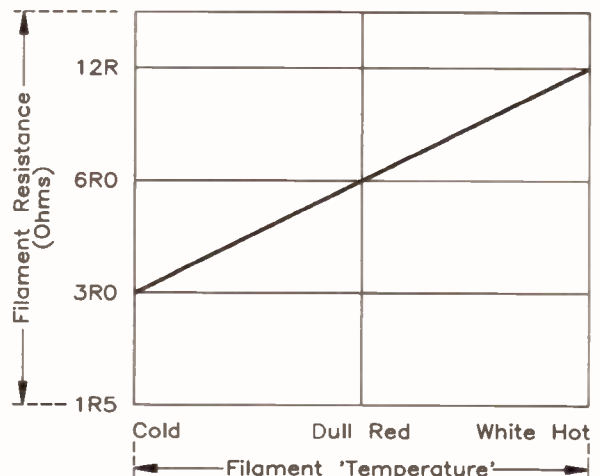
## Switched-mode Control

The third and most sophisticated way of controlling the brilliance of a DC-powered lamp is the so-called 'switched-mode' method, which is shown in basic form in Figure 5. Here, an electronic switch (SW1) is wired in series with the lamp and can be opened and closed via a pulse-generator waveform. When this pulse is high, SW1 is closed and power is fed to the lamp; when the pulse is low, SW1 is open, and zero power is fed to the lamp.

The important thing to note about the Figure 5 pulse generator is that it generates a waveform with a fixed frame width but with a variable mark-space (ON/OFF) ratio or duty cycle, thereby enabling the mean lamp voltage to be varied. Typically, the mark-space (M/S) ratio is fully variable from 1:20 to 20:1, enabling the mean lamp voltage to be varied from 5 to 95% of the supply-voltage value.

Because of the inherently long thermal time constant of a tungsten filament lamp, its brilliance responds relatively slowly to rapid changes in input power. Consequently, if the frame width of the Figure 5 waveform generator is less than roughly 100ms (i.e., the repetition frequency is greater than 10Hz), the lamp will show no sign of flicker, and the lamp brilliance can be varied by altering the M/S ratio.

**Figure 1.** Graph showing variations in filament resistance temperature for 12V, 12W lamp.



Thus, if the M/S ratio of the Figure 5 circuit is set at 20:1, the mean lamp voltage is 11.4V and the consequently 'hot' lamp consumes 10.83W. Alternatively, with the M/S ratio set at 1:20, the mean lamp voltage is only 600mV, so the lamp is virtually 'cold' and consumes a mere 120mW. The lamp power consumption can thus be varied over a 90:1 range via the M/S ratio control. Note, however, that this wide range of power control is obtained with virtually zero power loss within the system, since power is actually controlled by SW1, which is always either fully on or fully off. The 'switched-mode' control system is thus exceptionally efficient.

Figure 6 shows the practical circuit of a switched-mode DC lamp dimmer or brilliance control that is designed for use with a 12V lamp with a maximum power rating of 24W and enables the lamp's light intensity to be smoothly varied from zero to full brilliance via 100kΩ variable resistor, RV1. The circuit operates as follows.

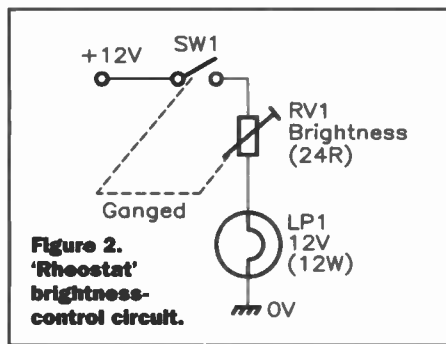
In Figure 6, IC1a and IC1b (comprising one half of a 4001B CMOS quad 2-input NOR gate) are wired as an astable multivibrator or squarewave generator, in which half of the waveform is generated via C1-D1-R1 and the right-hand part of RV1, and the other half is generated via C1-D2-R2 and the left-hand part of RV1, thus enabling the M/S ratio to be varied via RV1. Thus, when SW1 is closed, the astable operates and feeds a switching waveform to the lamp via Q1 and Q2. The astable operates at a fixed frequency of about 100Hz, but its M/S ratio is fully variable from 1:20 to 20:1 via RV1, thus enabling the mean lamp power to be varied over a 90:1 range. Note that ON/OFF switch SW1 is ganged to RV1, so that the circuit can be switched fully off by turning the RV1 brilliance control fully anticlockwise.

The Figure 6 lamp dimmer circuit can be used to control the brilliance of virtually any low power (up to 24W) filament lamps that are powered by 12V DC supplies. Note, however, that if it is used to control vehicle lights, it can only be used in ones in which the 'free' ends of the lamps go to the +ve supply line via control switches, as is normal in vehicles fitted with 'negative earth' electrical systems (in which the -ve battery terminal goes to the chassis of the vehicle).

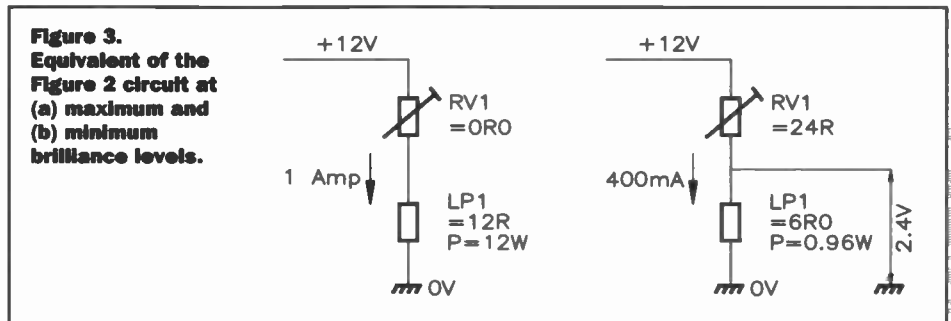
The alternative circuit of Figure 7 can be used to control the lights of vehicles in which the free end of the lamp goes to the -ve supply line via control switches, as occurs in some old vehicles fitted with 'positive earth' electrical systems. Note in both the Figure 6 and 7 circuits, that R6 & C2 are used to protect IC1 against damage from high-voltage transients that may occur on the vehicle's supply lines.

## LED Brightness Control

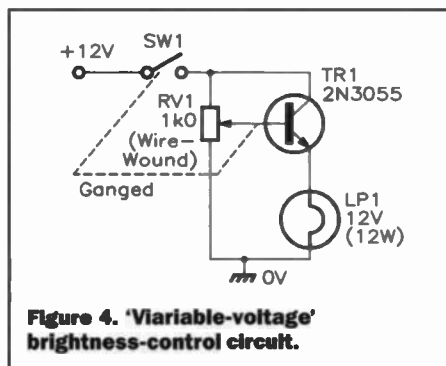
The switched-mode technique can also be used to control the brilliance of solid-state light-emitting devices such as LEDs and 7-segment LED displays. These devices, however, give an instant response to changes in input power level, so the design technique must rely on the natural integrating action of the human eye to ensure a flicker-free brightness-control action.



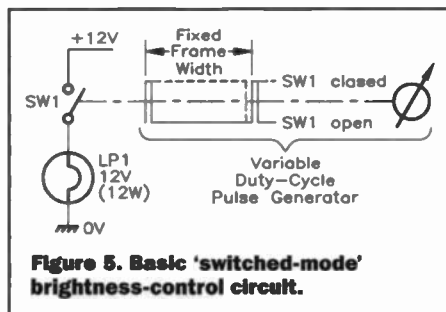
**Figure 2.** 'Rheostat' brightness-control circuit.



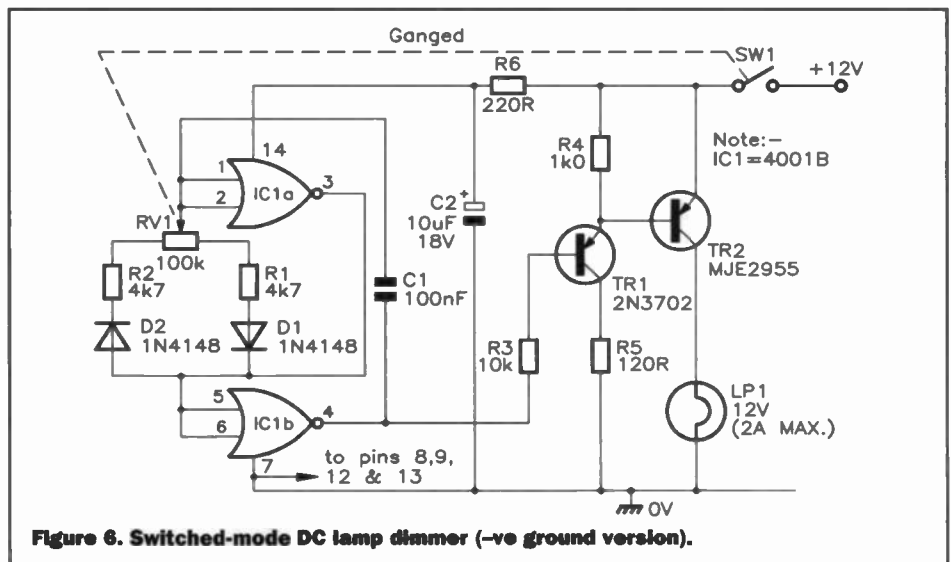
**Figure 3.** Equivalent of the Figure 2 circuit at (a) maximum and (b) minimum brilliance levels.



**Figure 4.** 'Variable-voltage' brightness-control circuit.



**Figure 5.** Basic 'switched-mode' brightness-control circuit.



**Figure 6.** Switched-mode DC lamp dimmer (-ve ground version).

The natural action of the human eye is such that it ignores the instantaneous values of rapidly repeating changes in light level if these changes occur at a frequency in excess of about 40Hz, and sees these changes in terms of the 'mean' value of light intensity instead. Thus, in LED brightness-control circuits, the variable M/S ratio generator normally operates in the range 50 to 100Hz.

Figure 8 shows a practical example of a LED brightness control circuit, designed around a single 4001B CMOS IC. Here, IC1a

& IC1b are wired as a 100Hz astable, with M/S ratio variable from 1:20 to 20:1 via RV1, and IC1c & IC1d are connected in parallel to provide a medium-current (15 to 20mA) buffered drive to the LED via current limiter, R3.

Figure 9 shows how to apply switched-mode brightness control to a common-cathode 7-segment LED display. Here, IC1a & IC1b are again wired as a 100Hz astable with variable M/S ratio, but in this case, the output waveform is fed (via R3) to the base of Q1, which functions as a medium-power switch that is wired in series with the common cathode terminal of the display.

Figure 10 shows how to modify the above circuit for use with a common-anode display. Here, IC1c is used as an inverting buffer that connects the astable output signal to the base of pnp transistor Q1.

In practice, many 7-segment LED driver ICs have a 'blanking' terminal (enabling the display to be turned on and off), which can be used to apply switched-mode brightness control to the LED display device. This terminal is usually designated 'BL' or 'BI'. The TTL 7447 and 7448 range of

decoder/driver ICs have such a terminal, as also does the CMOS 4511B latch/decoder/driver. In the latter case, the display is blanked when the BL terminal is low, and is active when the terminal is high. Figure 11 shows how to connect this IC to give brightness control via an external variable M/S ratio generator (such as is used in Figures 6 to 10).

## AC Lamp Control Basics

The brilliance of an AC-powered lamp can be controlled by using a triac and a variable phase-delay network to vary the power feed to the lamp, as shown in the basic 'phase-triggered' system of Figure 12. The triac is a bi-directional (AC) solid-state self-latching power switch that can be turned on by applying a brief trigger pulse to its gate, but which turns off again automatically at the end of each power half-cycle as its main-terminal currents fall to near-zero.

Thus, in Figure 12, the triac is triggered via a variable phase-delay network that is interposed between the AC power line and the triac gate. Hence, if the triac is triggered  $10^\circ$  after the start of each half-cycle, almost the full available mean supply voltage is fed to the lamp load. If the triac is triggered  $90^\circ$  after the start of each half cycle, only half of the mean line voltage is fed to the load. Finally, if the triac is triggered  $170^\circ$  after the start of each half-cycle (e.g.,  $10^\circ$  before the end of each half-cycle), only a very small part of the available mean line voltage is fed to the load.

The three most popular methods of obtaining variable phase-delay triggering are to use either a line-synchronised UJT (Unijunction Transistor), or a special-purpose IC, or to use a diac and an R-C network in the basic configuration shown in Figure 13. The diac is a bilateral threshold switch, which when connected across a voltage source, presents a high impedance until the applied voltage rises to about 35V. At this point, the device switches into a low-impedance state and remains there until the applied voltage falls to about 30V, at which point, it reverts back to the high-impedance mode.

Thus, in Figure 13, in each AC power-line half-cycle, the RV1 & C1 network applies a variable phase-delayed version of the power-line waveform to the triac gate via the diac. Each time that the voltage across C1 rises to 35V, the diac fires and delivers a trigger pulse to the triac gate, thus turning the triac on and simultaneously applying power to the lamp load and removing the drive from the RV1 & C1 network. The mean power to the load (integrated over a full half-cycle period) is thus fully variable from near-zero to maximum via RV1.

## RFI

Note from the Figure 12 waveforms that each time the triac is gated on, the load current transitions abruptly (in a few microseconds) from zero to a value determined by the lamp resistance and the value of instantaneous AC power-line voltage. These transitions inevitably generate radio-frequency interference (RFI); the RFI is greatest when the triac is triggered at  $90^\circ$ ,

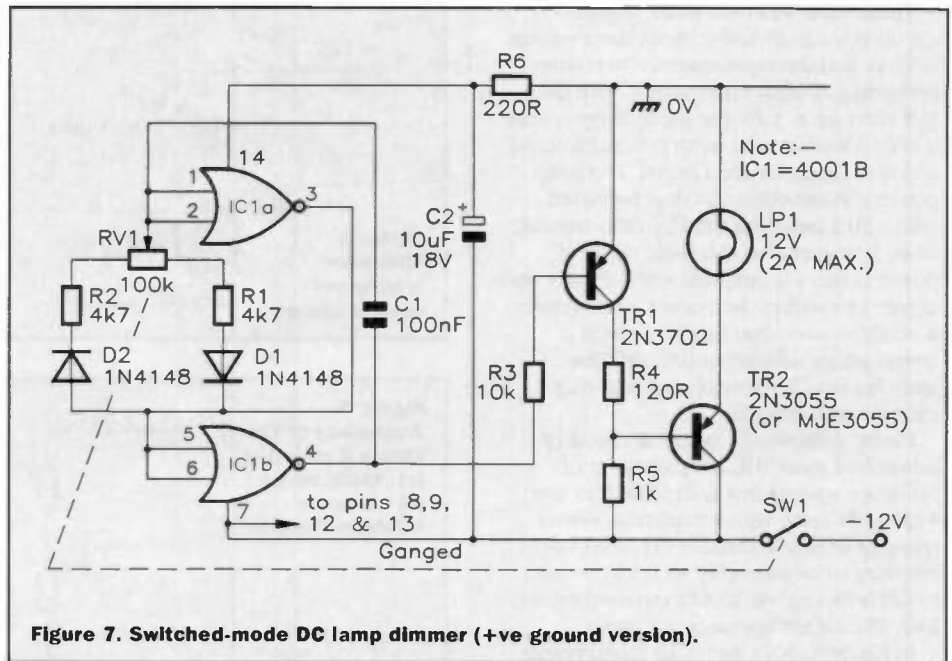


Figure 7. Switched-mode DC lamp dimmer (+ve ground version).

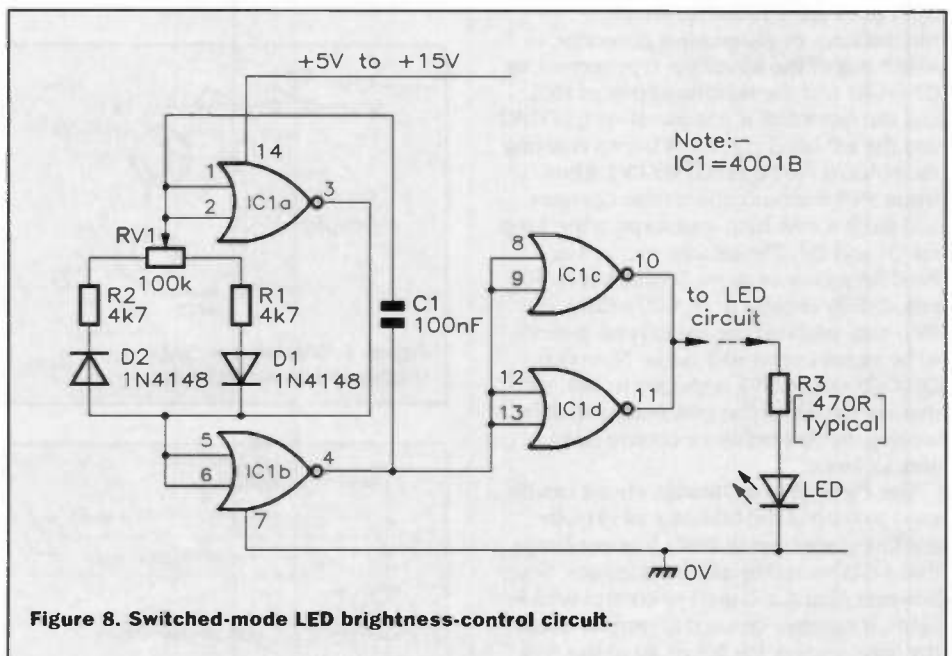


Figure 8. Switched-mode LED brightness-control circuit.

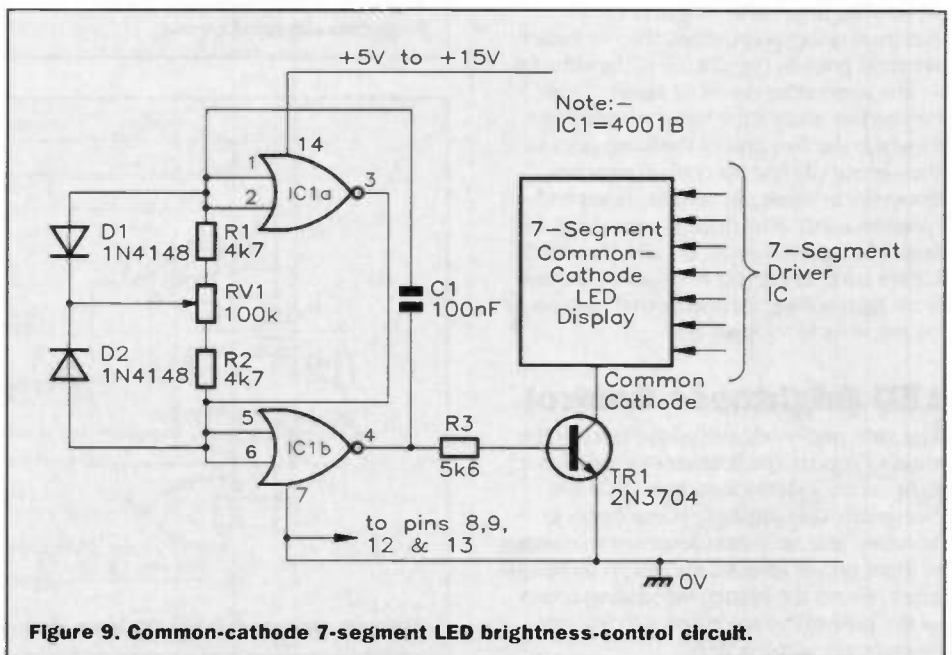


Figure 9. Common-cathode 7-segment LED brightness-control circuit.

and is least when the triac is triggered close to the 0° and 180° 'zero crossing' points of the power-line waveform.

In lamp-dimmer brightness-control circuits, where there may be considerable lengths of power cable between the triac and the lamp load, this RFI may be offensive. Consequently, in practical lamp dimmers, the circuit is usually provided with an L-C RFI-suppression network, as shown in the circuit of Figure 14; this

circuit also shows how ON/OFF switch SW1 can be ganged to brightness control potentiometer, RV1.

Note in Figure 14 (and all other triac circuits shown in this article) that the diac can be virtually any commercial type (ST2, etc), that the triac type should be chosen to suit the power-line voltage and lamp-load values, and that the values shown in brackets are applicable to 115V (rather than 230V) power-line operation.

## Backlash Reduction

The simple circuit shown in Figure 14 makes a useful lamp dimmer, but has one annoying characteristic, in that RV1 has considerable hysteresis or backlash. If, for example, the lamp finally goes fully off when RV1 is increased to 470kΩ (in the 230V circuit), it may not start to go on again until RV1 is reduced to 400kΩ, and it then suddenly burns at a fairly high brightness level. The cause of this characteristic is as follows:

The basic action of the Figure 14 circuit is such that, in the first part of each power-line half-cycle, C1 charges via RV1 & R1 and the lamp, etc., until C1 charges to 35V, at which point, the diac suddenly fires and starts to partially discharge C1 into the gate of the triac. As the triac turns on, it switches the remaining part of the half-cycle to the lamp and simultaneously removes the power-line drive from R1 & RV1. This switching action only takes 2μs or so, but in this brief period, the diac is able (in the Figure 14 circuit) to remove substantial charge (typically about 5V) from C1 and thus upsets the timing of the following half-cycle, thereby causing the annoying 'backlash' characteristic.

One easy way to reduce this backlash is to simply wire a current-limiting resistor (47 to 120Ω) in series with the diac, to reduce the amount of C1 voltage change that takes place in the 2μs triac switch-on period. Another way is to use the gate-slaving technique shown in Figure 15. This circuit is similar to that of Figure 14, except that the charge of C1 is coupled to slave capacitor C2 via the relatively high resistance of R2. C1 thus charges to a slightly higher voltage than C2, and C2 fires the diac once its voltage reaches 35V. Once the diac has fired, it reduces the C2 potential briefly to 30V, but has little influence on the voltage value of the C1 main-timing capacitor; the circuit backlash is thus reduced. The backlash can be reduced even more by wiring a current-limiting resistor in series with the diac (as described above), to reduce the magnitude of the C2 discharge voltage, as shown in Figure 16.

## UJT Triggering

A lamp dimmer with absolutely zero backlash can be made by using a power-line-synchronised variable-delay unijunction transistor (UJT) circuit to trigger the lamp-driving triac in each AC half-cycle. Figure 17 shows such a circuit. Here, the UJT is powered from a 12V DC supply

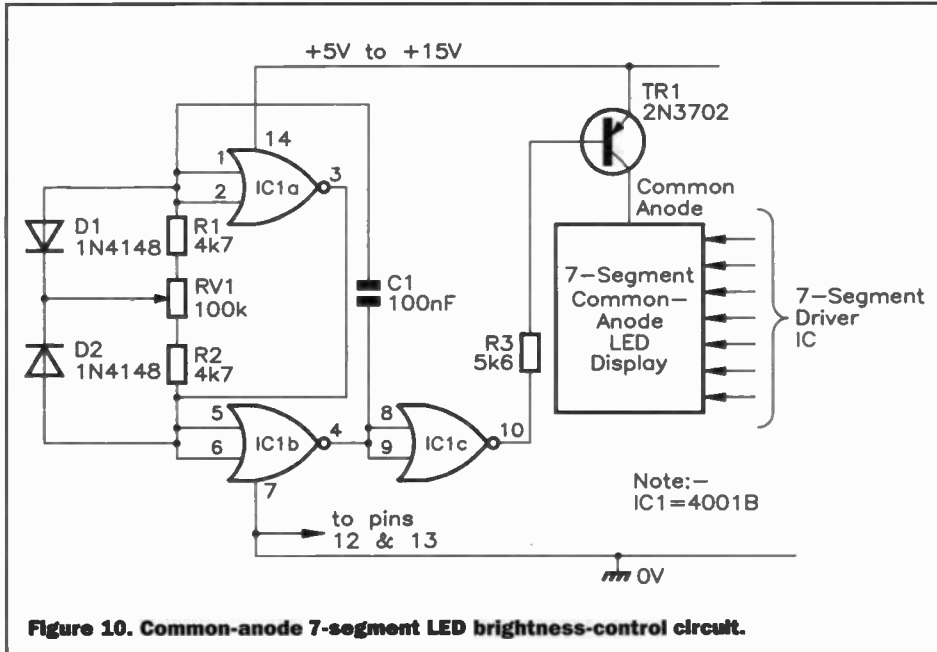


Figure 10. Common-anode 7-segment LED brightness-control circuit.

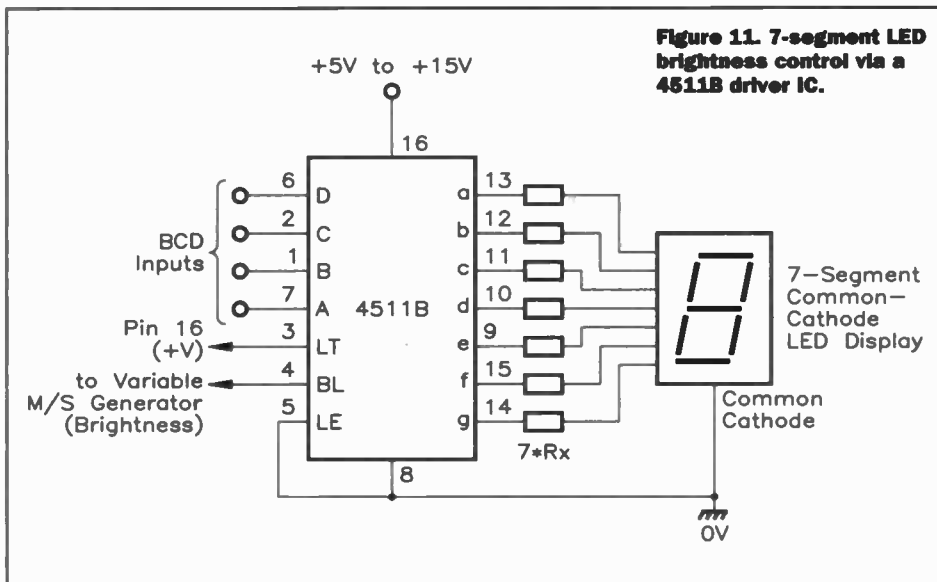


Figure 11. 7-segment LED brightness control via a 4511B driver IC.

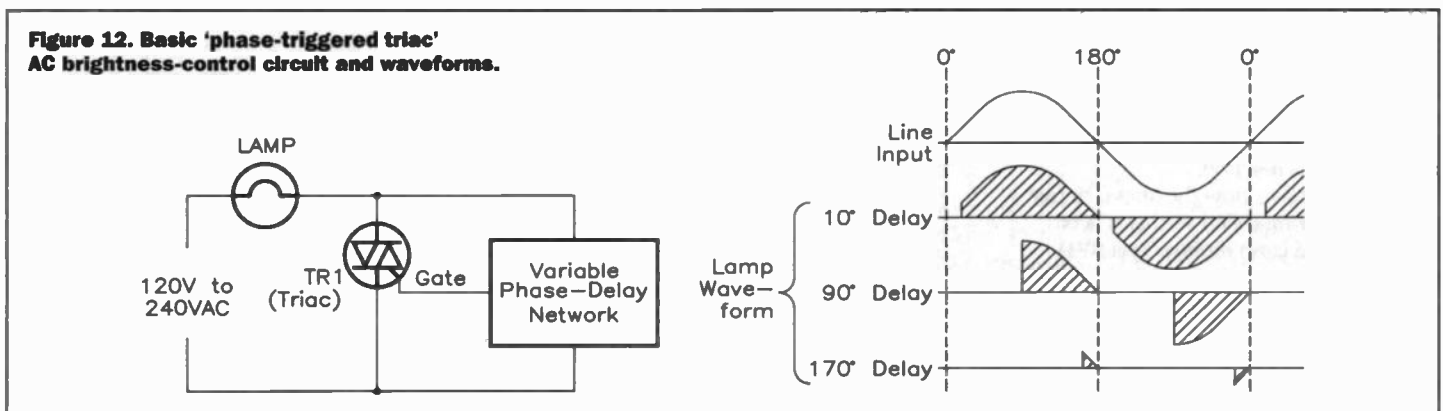
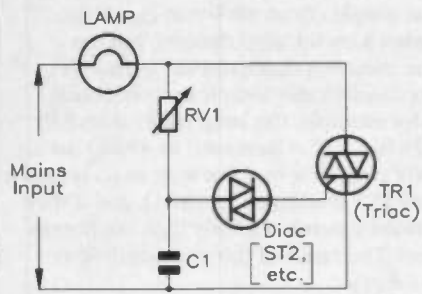


Figure 12. Basic 'phase-triggered triac' AC brightness-control circuit and waveforms.



**Figure 13. Basic 'diac-type' variable phase-delay lamp dimmer circuit.**

derived from the AC power line via R1-D1-ZD1 and C1. The UJT is synchronised to the AC power-line via the Q2-Q3-Q4 zero-crossing detector network. Operation is such that Q4 is turned on (applying power to the UJT circuit) via Q2 or Q3 at all times other than when the instantaneous power-line voltage is close to the zero-crossover point at the end or the start of each power-line half-cycle.

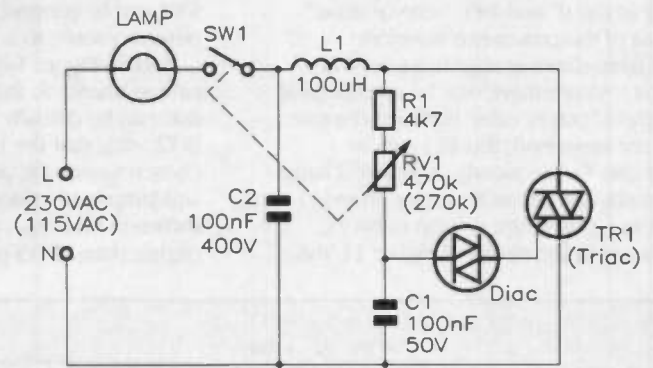
Thus, shortly after the start of each half-cycle, power is applied to the UJT circuit via Q4, initiating the start of the UJT timing cycle. A short time later (determined by R5-RV1-C2), the UJT (Q5) delivers a trigger pulse to the triac gate, driving the triac on and connecting power to the lamp load for the remaining part of the half-cycle. The triac and the UJT circuit automatically reset at the end of each half-cycle, and a new sequence then begins.

The Figure 17 circuit generates absolutely zero control backlash, and can be usefully modified for use in a variety of non-standard applications. Figure 18, for example, shows a circuit that can be fitted in place of the existing UJT network to modify Figure 17 so that it acts as a slow-start lamp dimmer that simply causes the lamp brilliance to rise slowly from zero to maximum when first turned on, taking about two seconds to reach full brilliance. The circuit is intended to eliminate high turn-on inrush currents and to thus extend the lamp life. Circuit operation is as follows:

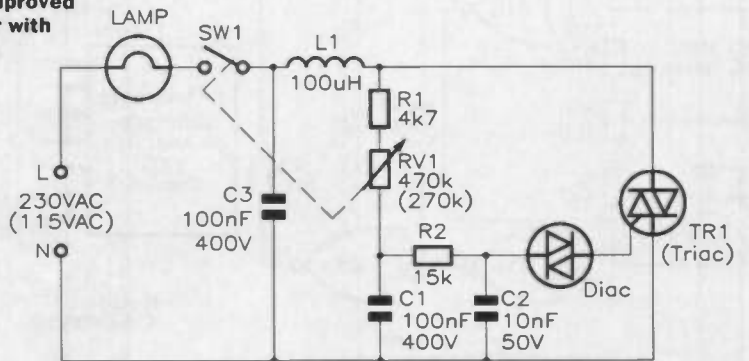
When power is first applied to the circuit, C4 is fully discharged and acts like a short circuit, so C2 charges via high-value resistor R8 only; the UJT thus generates a long delay under this condition, so the triac is triggered late in each half-cycle and the lamp burns at low brilliance. As time passes, C4 slowly charges up via R9, enabling the C2 charge to be supplemented via R9 & D3, thereby progressively reducing the UJT time constant and increasing the lamp brilliance until, when C4 is fully charged (after roughly two seconds), full brilliance is reached.

Figure 19 shows how the above circuit can be further modified so that it acts as a combined lamp dimmer (via RV1) and a slow-start circuit. Note in these two circuits, that diode D2 prevents C4 from discharging into the UJT each time Q5 fires, and D4 automatically discharges C4 via R10 and thus resets the network when the circuit is turned off.

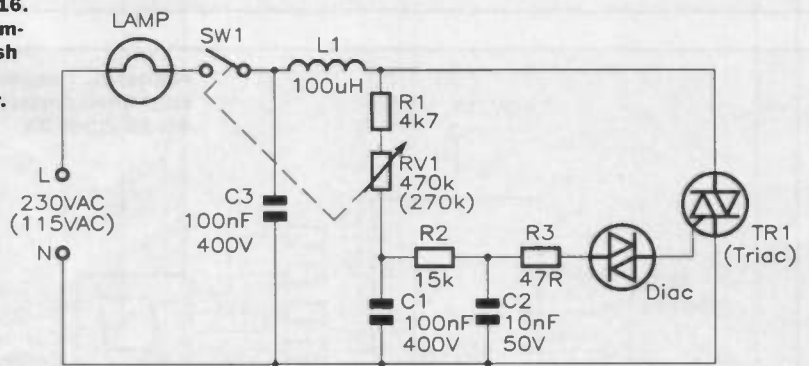
**Figure 14. Practical circuit of a simple lamp dimmer with RFI suppression.**



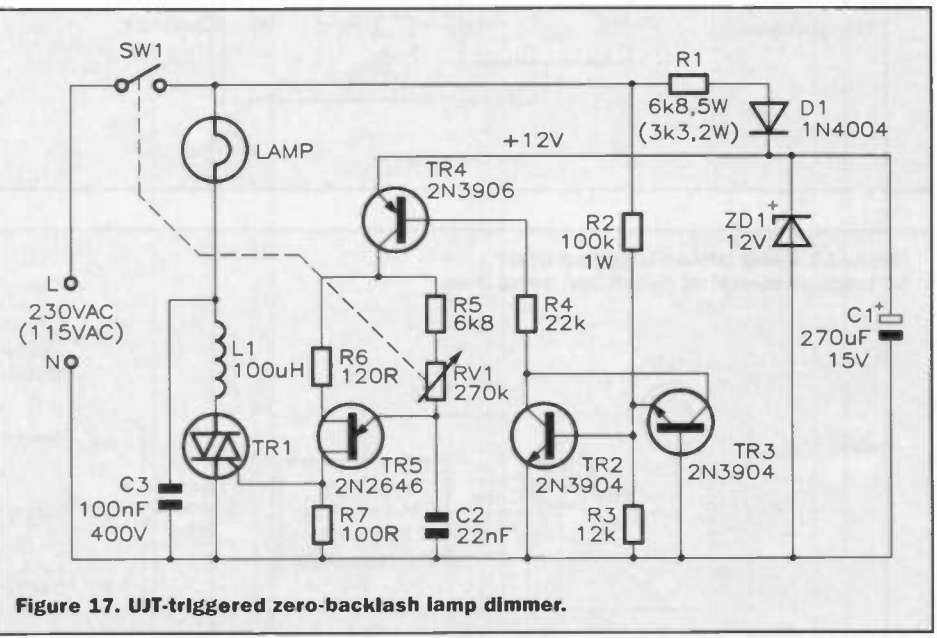
**Figure 15. Improved lamp dimmer with gate slaving.**



**Figure 16. Minimum-backlash lamp dimmer.**



**Figure 17. UJT-triggered zero-backlash lamp dimmer.**





## IC-controlled Lamp Dimmer Circuits

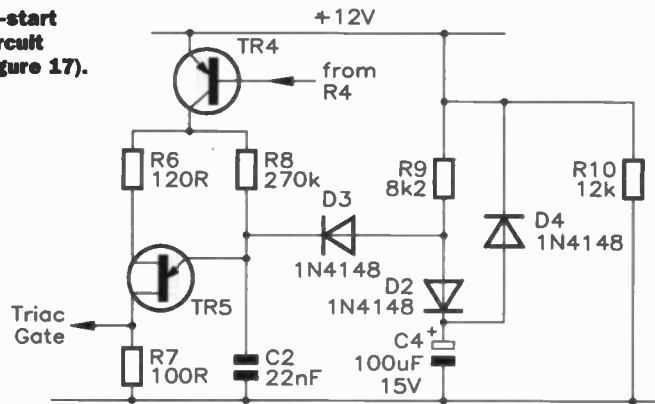
Many modern lamp dimmers have their triac driven via a dedicated 'smart' IC that can turn the lamp on or off or control its brilliance, the IC taking its 'action commands' via a touch-sensitive pad or push-button input switch, etc. Siemens are the leading producers of this type of IC; their first really successful model was the S566B, which incorporated touch-conditioning circuitry. Its action was such that a very brief input touch or push made the lamp change state (from OFF to a remembered ON state, or vice-versa). A sustained (greater than 400ms) 'dimming' input touch or push made the IC go into a ramping mode, in which the lamp power slowly ramped up and down (between 3 and 97% of maximum) until the input was released. The prevailing power level was then held and 'remembered'; the ramp direction reversed on alternate 'dimming' touches.

Over the years, the S566B has been replaced by a succession of improved Siemens IC designs, their latest product (introduced in 1990) being the SLB 0586, as used in the Pattress Mounting Dimmer Switch project (see Issue 103 of *Electronics*). This 8-pin IC draws a mean current of about 0.45mA from a 5-6V DC supply, and allows the user to select any of three alternative dimming modes via the pin 2 PROGRAMME input terminal. Figure 20 shows the IC's basic application circuit, using a single touch-sensitive control input (made from a simple 'button' pad or strip of conductive material). The IC is powered (between pins 1 and 7) from a 5V6 DC supply derived from the AC line via R2-C2-ZD1-D1-C3, and has its EXTENSION IN input disabled by shorting pin 6 to pin 7. Its pin 5 SENSOR IN input works on the inductive pick-up principle, in which the human body picks up radiated AC power-line signals, which are detected when the touch pad is contacted. The conductive touch pad must be placed close to the IC, to avoid unwanted pick-up. The operator is safely protected from the AC power-line voltage via R7 & R8; for correct operation, the AC power line must be connected as shown, with the live or 'hot' lead to pin-1 of the IC, and the neutral line to the lamp.

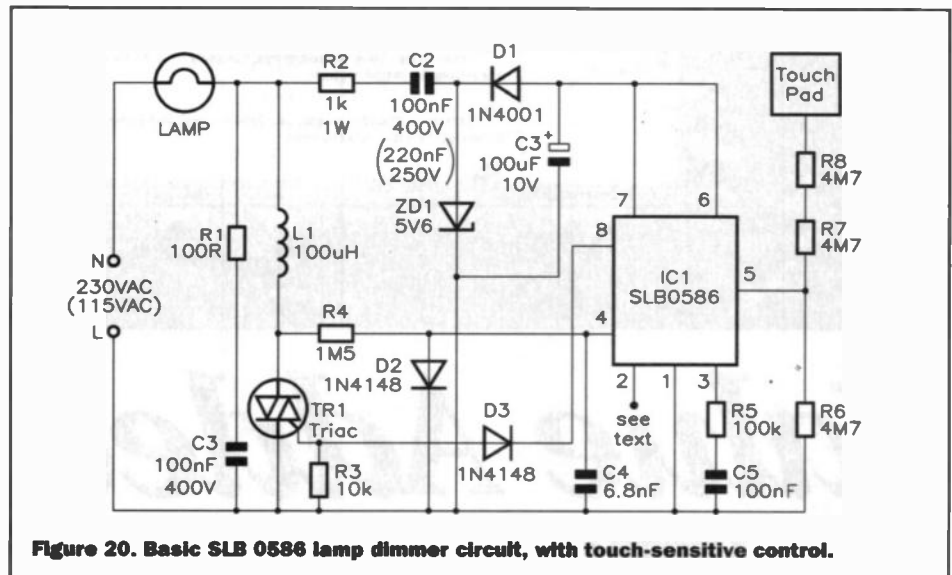
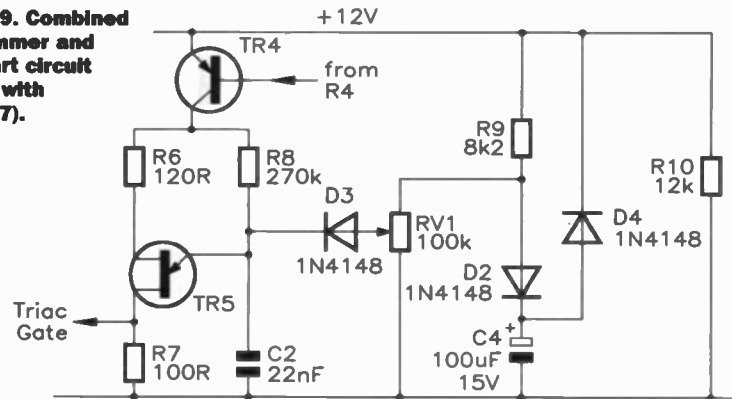
The Figure 20 lamp dimmer circuit can be set to any one of three basic operating modes by means of the pin 2 PROGRAMME terminal. If pin 2 is left open, the circuit gives exactly the same ON/OFF and ramping control action as already described for the S566B. If, on the other hand, pin 2 is shorted to pin 7, the lamp always goes to maximum brightness when switched ON. In dimming operations, the lamp starts at minimum brightness and then slowly ramps up and down until the sensor is released; the ramping direction does not reverse on successive dimming operations. Finally, if pin 2 is shorted to pin 1, the lamp operation is like that just described, except that the ramping direction reverses on successive dimming operations.

The basic Figure 20 circuit can be modified in a number of ways. If, for example, multi-input operation is required, this can be obtained by wiring any desired number of push-button control switches in parallel and

**Figure 18. Slow-start lamp-control circuit (for use with Figure 17).**



**Figure 19. Combined lamp dimmer and slow-start circuit (for use with Figure 17).**



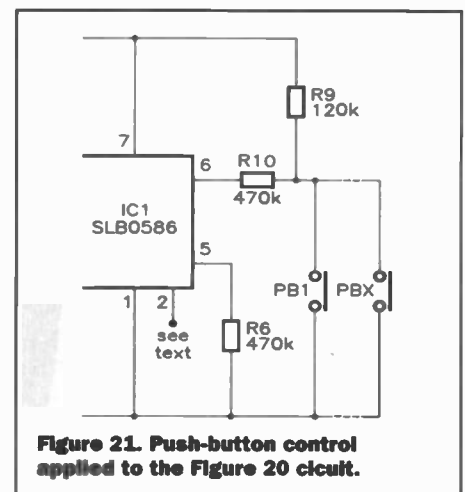
**Figure 20. Basic SLB 0586 lamp dimmer circuit, with touch-sensitive control.**

modifying the circuit as shown in Figure 21. Here, the pin 6 to pin 7 connection is broken and replaced by the R9 & R10 divider. The push-button control switches are connected between the R9 & R10 junction and pin 1 of the IC. If the 'touch control' facility is not needed, R7 & R8 can be eliminated and R6 can be reduced to 470kΩ.



### Important Safety Note

It is important to note that mains voltage is potentially lethal. Every possible precaution must be taken to avoid the risk of electric shock. It is always recommended that any mains related circuit should be enclosed in a case and protected by a suitably rated fuse. If you have any doubt on mains related matters, are in any doubt as to the correct way to proceed, consult a suitably qualified engineer.



**Figure 21. Push-button control applied to the Figure 20 circuit.**



**Talking Point**

The Talking Point area lets users chat and discuss.

**EOL Index**

The front page to Europe Online, organised to appear similar to a traditional online service. Users can point and click with Netscape Navigator to access the areas and forums of their choice.

**Chat Rooms**

Users are guided through the chatting and discussing procedures with a series of friendly and helpful pages.

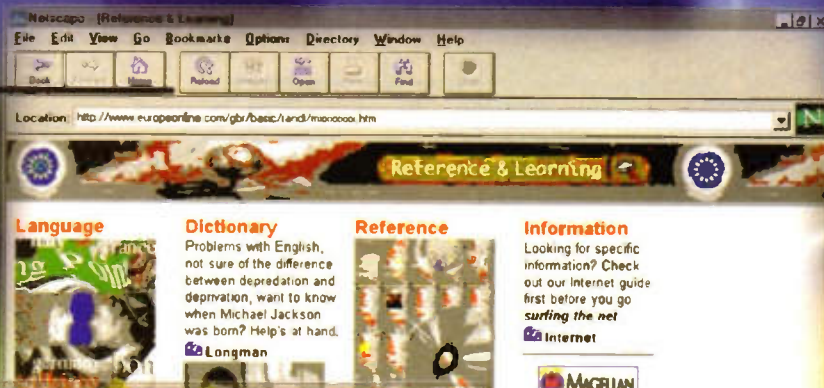
# Value Added INTERNET SERVICES

by Keith Brindley

*In this final part of this series, Keith Brindley looks at three Internet services. First, there's a new Internet service provider which warrants examination because it features significant user services. Second, we need to take a look at AOL and its graphical on-line service (which is probably the best in the world). Finally, we consider the important changes to the Microsoft Network (MSN) which have taken place over just the last few weeks.*

## Reference and Learning

Areas within Europe Online can be fun or educational. The Reference and Learning page is both.



## Marketplace GUS

Great Universal Stores has its own area within Europe Online. Buy what you want from the comfort of your computer chair.



## Marketplace Index

If you want to buy or sell anything, chances are you can do it in the Market Place area.

Throughout this series, we have seen how service providers are of two basic types. First is the provider who gives you a local phone number for your computer to dial-up the provider's computer and get Internet access from. This method can be likened to being a socket to the Internet, into which you can plug your computer. The service provider sometimes gives you the software to control the data communications between your computer and the Internet, sometimes you have to locate that yourself, sometimes (where the software is already built-in – as in a Macintosh computer, say), you merely need to enter the relevant information your computer needs to get connected to the provider's computer. Examples of these (which we have looked at over the last few issues) are Demon, Pipex Dial, Worldscope, IBM Global Network and so on.

The trouble with this type of Internet access can be that once you are on-line, you could be flying blind. Unless the Internet access provider gives you the software and the instructions how to use it, you have to locate it all yourself. This is no problem to an experienced user, as all software can

usually be downloaded from the Internet to your computer, ready to use. But, as you should have worked out, when you first use the Internet, you are not at all experienced, and locating the sites to download the software from isn't all that easy to a new user. Nevertheless, for most users of the Internet, this is the way they become accustomed to using it. It's a 'suck-it-and-see' method of getting Internet access, which while not the best for the new user, is arguably the most efficient in the long run.

The second type of service provider is the on-line service. This takes the form of a graphical interface, where you point and click with your computer's mouse to get to the areas in the service which interest you. This sort of service is a good bet if you're new to computers, say, or if the Internet proper doesn't particularly interest you (or, worse, scares you). Examples of on-line services are bulletin board services (we have looked at some based on the FirstClass system), CompuServe, AOL and MSN. We are taking a look at the last two of these in this issue.

Both of these methods (plug-and-socket and on-line) have their pros and cons which we've considered over the last few months.

However, in between these two extremes lie several new services which are hybrids of the two. Some plug-and-socket Internet providers realise that to attract users, they have to give something more than just the plug-and-socket capability. So, they've taken the concept that users have World Wide Web access through them too and turned it around so that users can have a quasi-on-line service. This is a simple matter of generating a World Wide Web site which users can access as they want. We saw the UK Online service which uses this very principle.

The beauty about such a service is that it can be local. UK Online's World Wide Web site has very specific information for the UK, and its many regions. Users are allowed and, indeed, encouraged to send in titbits of information which the staff at UK Online add to the site, and the result is a dynamic and user-friendly experience. You simply don't get this sort of thing with the basic plug-and-socket Internet providers.

A brand-new service built along these lines is Europe Online which, like UK Online (although no relation, despite similar naming), has a World Wide Web site specific to the UK. Content is localised and gives a very user-friendly environment.

### AOL Menu

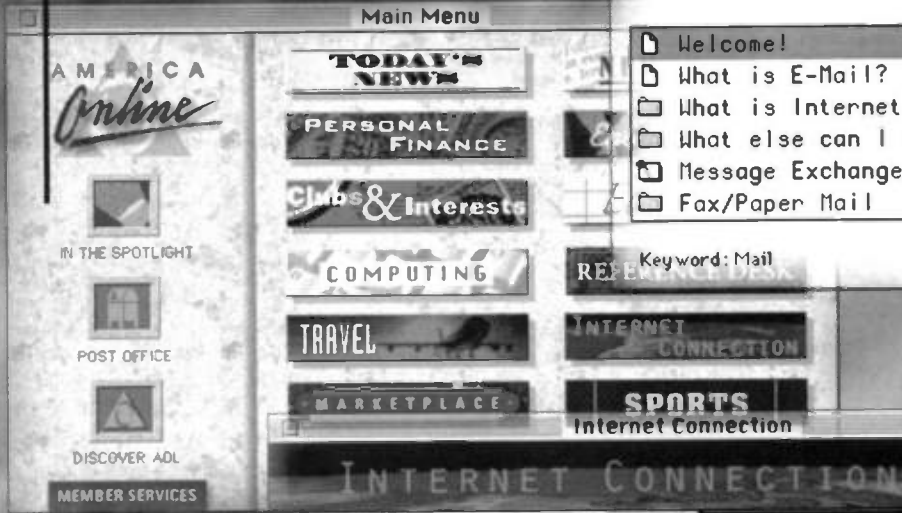
AOL's main entrance point for users, showing the many areas users can access with a simple point and click of the mouse.

### Post Office

Integral to AOL is the Post Office, where you send and receive mail.

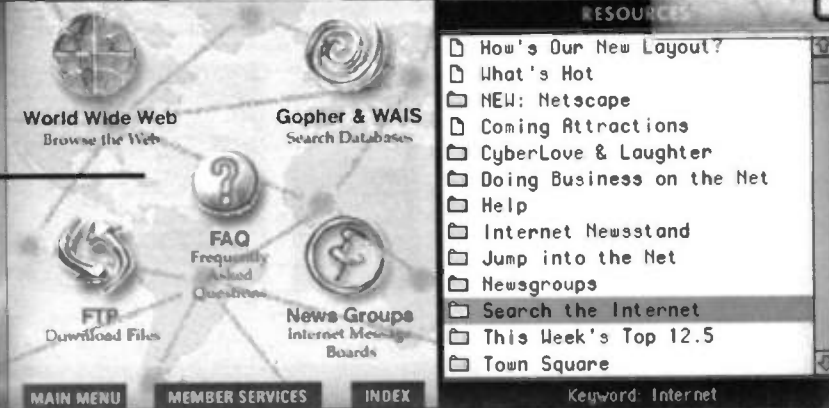


### Main Menu



### Internet Connection

Accessing the Internet from within AOL is as easy as clicking the Internet Connection button on the main menu. From here, the World (Wide Web, that is) is your oyster.



### Keyword dialog box

The keyword dialogue, where you can type in the keyword of the area or forum you want, to get straight there.

### Clubs and Interests

In any area within AOL you'll find further buttons to access other areas and forums, or scrolling lists or areas, forums and things to do.

One point of note for Europe Online is that its charges are based more on the usual on-line services method of paying by the hour than the typical Internet service provider of paying a flat-rate fee which covers any amount of usage. A charge of £3.95 a month gets you on-line and with up to 3 hours' usage. Above this, and you're charged £1.85 an hour. This is a good choice, therefore, if you use the Internet for e-mail and only a small amount of other services. Bear in mind, though, that if you surf the Internet for hours on end, charges will soon add up.

The Europe Online installation software comes complete with Netscape Navigator version 2, and all connection software. Navigator is used for e-mail and newsgroup access. It's currently available for Windows only, but a Macintosh version is expected shortly. Meanwhile, Mac users can access the network in the standard in-built way: using whichever World Wide Web browser, e-mail and news programs they have installed.

At the moment, being a new service, full UK coverage is not available at local call rates. Some 70% of the population has

local call access, and remaining UK access will be available soon. At the moment, Belfast, Birmingham, Bristol, Glasgow, London, Manchester and Newcastle have points of presence, and others are to follow.

## AOL

The biggest (and in my opinion, the best) of the on-line services is AOL. AOL is actually a recent start-up service in the UK, although it's been operational for years in the US, and with nearly 6 million users world-wide (admittedly, most in the States), it is a huge service. Virtually any information you want can be found on AOL, and just about every shareware program you could ever hope for is downloadable.

Like CompuServe, AOL is built around a hierarchical graphical interface, in which you step from one area to the next by clicking on icons with your mouse pointer. Like CompuServe, too, you can rapidly step to areas you want with shortcuts called keywords (just like the GO prompt in CompuServe), and AOL has conferences and forums you can enter and contribute to.

An account with AOL gives you up to five mailboxes. You can more or less decide the mailbox names for yourself (depending on whether someone else already has that name), and those names are the names other users use to refer to you in on-line conferences or forums. The names are also used to address e-mail, so that a name such as maplin which would be used by other AOL users, is extended to maplin@aol.com for e-mail purposes. Of course, the five names need not all be allocated to just one person – it's an ideal system for a family, say, with up to five members of a family each having their own e-mail address. As each name has its own password, e-mail can be secure from other family members.

In the UK, AOL client software is available for Windows users (a free disk was on the cover of the May 1996 issue of Electronics), but, at the time of writing, there is no UK Macintosh client. The problem is one of localisation, and the Windows client was simply the first to be localised for UK use. Localisation is the process in which the country's telephone access points are listed in the client and details of various special forums and conferences are included.

**Clubs & Interests**

**Clubs & Interests**

Yoodoo and Secret Societies -- Find out more here!

Get the latest on the Israeli elections!

What's Hot Hobby Central People & Communities

Religion & Beliefs The Health Channel

ALPHABETICAL LISTING OF CONTENT

Sign on a Friend

Chat: Clubs & Interests

Search Clubs & Interests

AARP Online

Alumni Hall

American Woodworker

ASTRONET

Keyword: CLUBS

**Web Instructions**

Within AOL's own World Wide Web pages, accessed from AOL's Web browser, there are clear and simple instructions how to create your own home pages.

AOL Web Tools

Home Back Forward Reload Load Images Stop Load Original

Current URL: http://members.aol.com/Tools/ToolsIndex.html

Link URL:

Page complete Image: 536 of 9499 bytes

**AOL's Web Publishing Tools**

AOL has developed a whole set of tools to help you get your own web page on the Internet. If you are a complete beginner, or if you are a seasoned veteran of Internet Surfing, we here at the Surf Shack are dedicated to helping you find all the resources you will need!

To go to one of these areas just click on the blue heading of where you want to go and that screen will pop right up! You don't need to exit this page (your browser) at all to go to these areas, when you're done reading all the cool and helpful information in an area just close it and this page will still be there for you to continue to the next area that will help you learn how to make the best web page ever! :) Be sure to add this web page to your "Favorite Places" so you'll be able to quickly find us the next time!

Personal Publisher

**PERSONAL PUBLISHER**

Keyword: HOME

MY PLACE

Connected to members.aol.com

Keyword: MyPlace

If you already know how to write web pages in HTML, then this is the place on AOL for you. As a member, you have 2 megabytes of space (per screen name) on AOL's server for you to post your web page. If you upload an HTML document here, it will be available on the web right away. The URL will be: `http://members.aol.com/<your screen name>/<file name.html>`

You will find a list of instructions in "MyPlace" to help you along.

Desktop and Web Publishing

**Computing**

**COMPUTING**

Consumer Electronics The Web

Print & Broadcast Software Center

Family Computing Company Connection

In The Spotlight Click Here

Computing Channel

Check for Active Auditorium - The

What's HOT in Mac

Search Computing

The Web

Face Off

Consumer Electron

New Product Show

The Help Forum

Keyword: Con

**Computing**

Within the Computing Forum, you'll find lots of areas and forums of interest to you and your computer. Note the keyword often given at the bottom of the window. To access this area next time - simply call up the keyword dialog box and type in the keyword.

If you're a Mac user and don't want to wait for UK localisation of the Mac client (expected by the middle of this year), there is a temporary way round the situation. You need first to have access to the US AOL client (which you can download from the AOL FTP site). Then it's a simple matter of getting your username and password from AOL in the UK in the usual way, and logging in using the US client on your Mac. The only thing you'll need is the local telephone access number, which you can get from the Windows client if you have a PC, or direct from AOL UK. Various parts of AOL's UK system won't be accessible on your Mac in the same way it is on a PC due to the lack of localisation of the client, but that's nothing to worry about on the whole. Screenshots of AOL featured here were all taken on a Mac to prove this.

One of the current niceties about the AOL network in the UK is its speed. Not bogged down with too many users at the moment (unlike some Internet providers around), it has extremely fast transfer rates. This will change, no doubt, as users take up with AOL, but, for the moment, it's a big advantage if you intend downloading things off AOL or the Internet, or uploading to FTP sites.

Talking about the Internet, included with the on-line client is a World Wide Web browser, which, while it's not as fully featured as the likes of Netscape Navigator, is pretty good nevertheless. With the browser, and other in-built Internet software giving users FTP and Gopher capability, AOL represents a good way to access the Internet and to have a proper on-line service at the same time. Unlike CompuServe, this is all from a single telephone number and simultaneously at that. You can be using the on-line service one click of a mouse button, then surfing the World Wide Web the next, and downloading files by FTP the very next.

Each of the five mailboxes or names you have on a single AOL account is automatically allocated an FTP site in which you can store up to 2M-byte of files for download or access by yourself or others. This is useful in two ways. First, by hot-linking between the sites, you can have a total of 10M-byte of on-line storage. Second, if you can create your own HTML files, you can create your own World Wide Web home pages (again, up to five of them - one for each name). So, not only can you have a

World Wide Web home page of your own, the rest of the family can too.

Costs of AOL are comparable with other on-line services, at £5.95 for your first five hours a month, then \$1.85 per hour after this. All secondary schools within the UK have been offered a free account with AOL, so it may be worth mentioning this if you have a relationship with any school.

**MSN**

The last of the Internet service providers we're going to concentrate on is Microsoft's very own Microsoft Network (MSN). I've purposefully saved it until last not because it's the best, but because it has been in a state of flux over the last few months, and I wanted to wait until it had incorporated some very important changes to its services. It started life as a full on-line service, like CompuServe and AOL, but is an ordinary on-line service in the true sense of the term no longer.

MSN has undergone a major transition over the last few weeks to a full-blown Internet service based on proper TCP/IP communication techniques. Users of MSN can choose to stay on the existing on-line



**Categories**

Categories shows the main areas available within MSN.

**Forums directory**

The MSN Directory lists all forums available.

network, or can opt to upgrade to the Internet service – probably worthwhile, if only for the fact that you get true Internet access.

Part of the upgrade procedure is installation of the latest version of Microsoft's Internet Explorer, which is a well-featured World Wide Web browser. If you have Windows '95 (and, as you'll see soon, that's currently the only way you can access MSN) and have installed the Microsoft Plus package to give you Internet potential, then you'll already have an early version of Internet Explorer. However, the latest version is required for Internet access via MSN, so downloading that will be your first job when you sign on. With Internet Explorer, you can surf the Internet to your heart's content, while you can access MSN from the Internet access point too, rather than via the usual dial-up means.

Repositioning MSN to an Internet service rather than an on-line service marks a significant turning point in how the computer software industry views the various services. Microsoft was not alone in thinking that the way forward for computer and personal communications was with

on-line services. However, that was before the explosion in the Internet and its myriad services. Now, most on-line services (MSN, AOL and CompuServe included) are moving towards the Internet as the communications tool, but are continuing to provide services over and above basic Internet plug-and-socket abilities. The best of both worlds, I suppose.

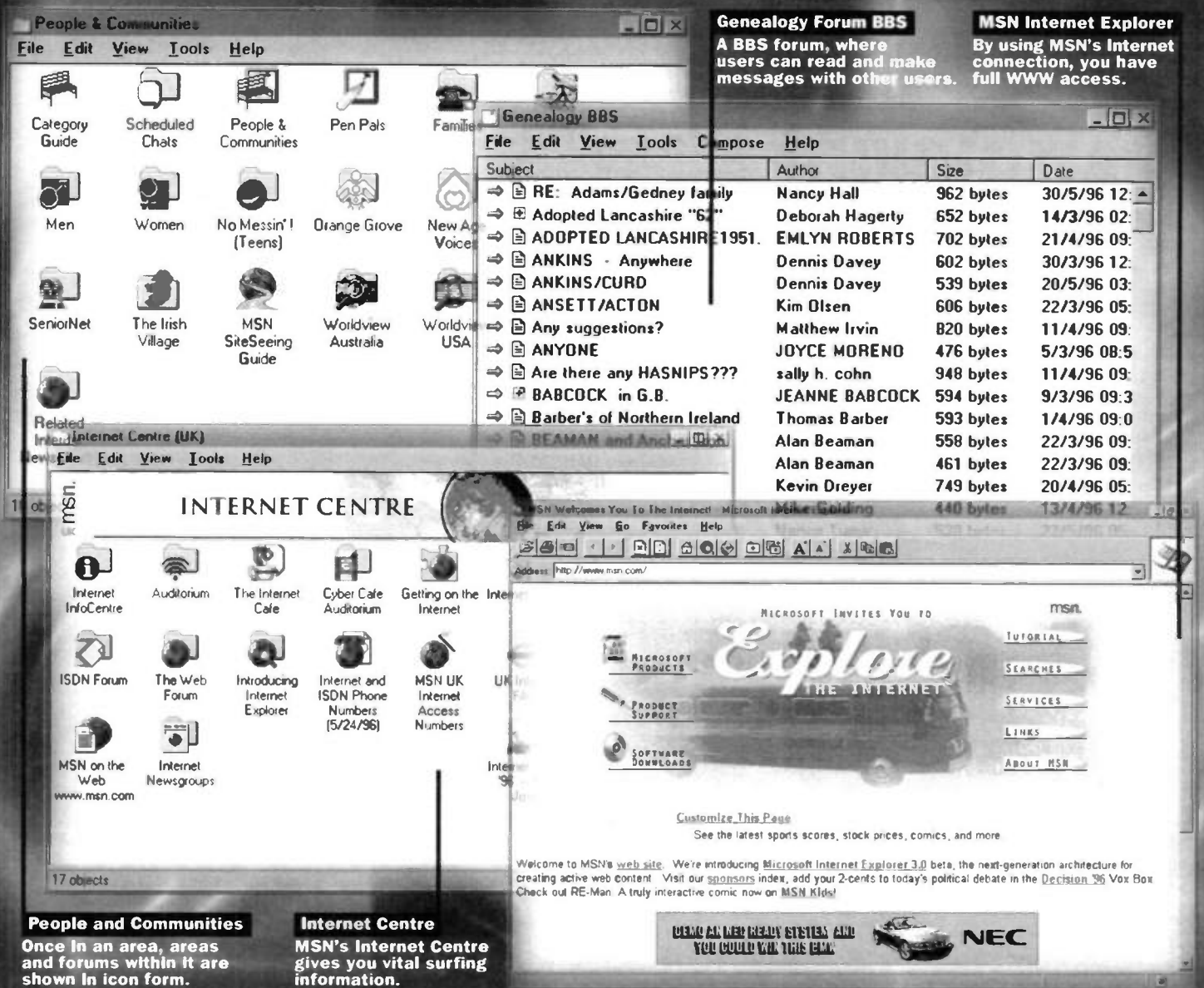
As I have already mentioned, at the moment, MSN is accessible only from a PC running Windows '95. From within Windows '95, you can access it both directly as an on-line service and as an Internet service provider – you make that choice when you log in. Microsoft recently started up a new network of dial-up access points around the UK, so that most people have local call access to either method.

In the long term, Microsoft intends to change all MSN content to Internet form (that is, it will be produced in HTML format suitable for a World Wide Web browser to be able to access). When this takes place, it will be accessible by anyone, from any computer in the world, who has standard Internet access. In the meantime though, rule out MSN unless you have Windows '95.

Eventually, all MSN content will only be accessible in HTML format, but for the moment, there's an overlap between being an on-line service and an Internet service, in much the same way that there is currently an overlap between the two methods for AOL and CompuServe too.

Costs for access to MSN will reflect all this state of flux. For users wishing to access MSN direct, charges are £4.95 for the first three hours, then £1.95 per hour after that. Alternatively, you can get unlimited access to MSN for £14.95 per month, or £149.95 per year. If you already have Internet access, you'll eventually be able to access MSN from your own World Wide Web browser (theoretically, from any computer) once MSN has moved across to HTML format. A lower price will reflect this.

Like AOL, MSN has offered a free account to schools (all schools – not just secondary schools), but, of course, schools need to be running Windows '95 to take advantage of this at the moment. However, not many schools currently have the hardware to be able to run Windows '95, so will probably have to wait for Windows 3.1 or Macintosh versions of MSN, and/or Internet accessibility.



**People and Communities**  
Once in an area, areas and forums within it are shown in icon form.

**Internet Centre**  
MSN's Internet Centre gives you vital surfing information.

## In the End . . .

Finally, to round up this series of value-added Internet services, I'm going to try to bring all the various aspects of all the various services together so that readers can make an informed choice over the access method which suits them best. Bear in mind that you have to decide what you want from Internet access. If you only want e-mail capability, then your access method can be far simpler (and cheaper) than if you want full-blown World Wide Web browsing ability.

Talking of which, if e-mail's your prime goal, then maybe you don't want Internet access at all. Instead, there are hundreds of bulletin board services around, which can provide e-mail services. We looked at the FirstClass system, in which local bulletin boards log onto the Internet at cheap-rate times to transfer messages to and from bulletin board users and other Internet users. This is the most cost-effective method, and has a strongly localised flavour. Usually, users are within the local area, so information on the bulletin board is most likely for that area alone.

MSN (being available only for Windows '95 users) is obviously biased strongly

towards Windows '95 itself. As a result, it's not everyone's cup of tea (even those who use Windows '95) and so might not suit what you want from a service. As an example of this – particularly relevant to UK users – while it has localised versions for countries around the world (like CompuServe and AOL), it's strongly biased towards the US.

As a result, none of these services might be the one UK customers (particularly UK home customers) would want to buy into. On the other hand, these are graphical services which are easy to use and allow vast quantities of information, programs, files and so on to be available to all users.

Having said all that, it could well be the basic plug-and-socket Internet service providers which will prove to be the most popular method still. The basic Internet service providers (Demon, Pipex Dial, Worldscope, BT Internet and many, many others), while having only bare-bones features once you're actually plugged into the Internet, are still good value for money, all things considered.

Finally, one excellent way to get a value-added Internet service with strong UK content is to use an Internet service provider which features and supplies the sorts of things you

want. The likes of UK Online and Europe On-line could be highly recommended here. They are true Internet services, with well thought out content, biased towards the UK in a way that neither the basic Internet providers nor the US-based on-line Internet services can hope to achieve.

In the end, of course, the choice is yours. I hope, though, that this series has shed some light on the kinds of things which are out there. The Internet is huge – much too huge to be able to quantify in a series of feature articles in a magazine. However, the areas of the Internet I've showed you here are varied enough so that I hope you can see the various methods of obtaining Internet access and, better still, see how best to get what you want.

As for me? What service do I use? A conventional Internet service provider, an on-line service, or an Internet service provider with an online service included? Well, I use several services, actually. They're all useful in their own ways, and they all give me various features which no single Internet service provider has yet included in a single service. It's horses for courses really, and I'm glad you are choosing which one service to use and not me! Good luck.

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**Brighton** 65 London Road.  
**Bristol** 302 Gloucester Road, Horfield.  
**Cardiff** 29-31 City Road, Roath.  
**Chatham** 2 Luton Road.  
**Cheetham Hill** 169 Cheetham Hill Road, Cheetham Hill.  
**Coventry** 12 Bishop Street.  
**Dudley** Unit 7, Sterling Park, Pedmore Road, Brierley Hill.  
**Edgware** 146-148 Burnt Oak, Broadway.  
**Edinburgh** 126 Dalry Road, Dalry.  
**Forest Hill** 107-113 Stanstead Road.

**Glasgow** 264-266 Great Western Road.  
**Hammersmith** 120-122 King Street.  
**Ilford** 302-304 Green Lane.  
**Leeds** Carpet World Building, 3 Regent Street.  
**Leicester** Office World Building, Burton Street.  
**Liverpool** Edge Lane, Fairfield.  
**Manchester** 8 Oxford Road.  
**Middlesbrough** Unit 1, The Forbes Building, 309-321 Linthorpe Road.  
**Milton Keynes** Unit 2, Office World Building, Snowdon Drive, Winterhill.  
**Newcastle-upon-Tyne** Unit 4, Allison Court, (The Metro Centre) Gateshead.  
**Northampton** 139 St. James Road.  
**Nottingham** 86-88 Lower Parliament Street.  
**Portsmouth** 98-100 Kingston Road.  
**Preston** Unit 1, Corporation Street.  
**Reading** 129-131 Oxford Road.  
**Sheffield** 413 Langsett Road, Hillsborough.  
**Slough** 216-218 Farnham Road.  
**Southampton** 46-48 Bevois Valley Road.  
**Southend-on-Sea** 282-284 London Road.  
**Stockport** 259-261 Wellington Road South.  
**Stoke-on-Trent** 39-45 London Road.



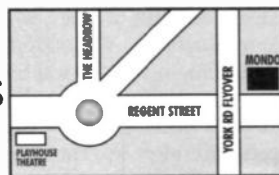
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THE WORLD OF ELECTRONICS AND BEYOND



## Diary Dates

Every possible effort has been made to ensure that information presented here is correct prior to publication. To avoid disappointment due to late changes or amendments, please contact event organisations to confirm details.

### June 1996

**24 June.** Repeater Management Group Chairman, Geof Dover G4AFJ, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

**26-27 June.** Electrical Engineering Exhibition, Airport Skean Dhu, Aberdeen. Tel: (01732) 359990.

**30 June.** Radio Rally, Longleat, Wiltshire. Tel: (01707) 659015.

### July 1996

**6 July.** Summer Social Event, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

**7 July.** Southend & District Radio Society Radio and Computer Boot Sale, Druid Venture Scout Unit, 191 Eastern Avenue, Southend. Tel: (01702) 304439.

**8 July.** 160m Direction Finding Contest, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

**8 July-30 September.** Science Museum Superhighway UK Tour, Explons, Northern Ireland. Tel: (0171) 938 8192.

**11 July.** Telecommunications Technology Seminar, Carrera Showroom, Tottenham Court Road, London. Tel: (0171) 830 0486.

**22 July.** Construction Competition, Stratford-upon-Avon and District Radio Society, Stratford-upon-Avon. Tel: (01789) 295257.

**25 July.** Internet Technology Seminar, Carrera Showroom, Tottenham Court Road, London. Tel: (0171) 830 0486.

### August 1996

**4 August.** RSGB National Mobile Rally, Woburn, Beds. Tel: (01707) 659015.

**18 August.** Radio Rally, Manchester. Tel: (01707) 659015.

**18 August.** Radio Rally, Great Eastern, Kings Lynn. Tel: (01707) 659015.

### September 1996

**1 September.** Radio Rally, Telford, Shropshire. Tel: (01707) 659015.

**4-5 September.** Internet, Wembley Centre, London. Tel: (01923) 261663.

**7-10 September.** British Music Fair '96, Earls Court, London. Tel: (0171) 370 8229.

**8-11 September.** PLASA '96, Earls Court, London. Tel: (0171) 370 8229.

**8-11 September.** Presentation Technology, Earls Court, London. Tel: (0171) 370 8229.

**18-19 September.** EMC UK, Olympia, London. Tel: (01981) 590481.

**21 September.** Radio Rally, Scottish Convention, Glasgow. Tel: (01707) 659015.

**24-29 September.** LIVE, Earls Court, London. Tel: (0181) 742 2828.

**25-26 September.** Digital Signal Processing, Sheraton Skyline Hotel, London. Tel: (0181) 614 8042.

### October 1996

**4-6 October.** RSGB International HF Convention, Windsor. Tel: (01707) 659015.

**7 October-16 December.** Science Museum Superhighway UK Tour, Kelvingrove Museum, Glasgow. Tel: (0171) 938 8192.

Please send details of events for inclusion in 'Diary Dates' to: News Editor, *Electronics*, P.O. Box 3, Rayleigh, Essex SS6 8LR or e-mail to swaddington@cix.compulink.co.uk.

# What's On?

## Lead Manufacturers Set Guidelines for Network Computer at Internet World

Internet World, held at London's Olympia from 21 to 23 May, proved to be a great disappointment for exhibitors and visitors alike. The event completely lacked the business profile and technology edge of its sister show in the US, which took place three weeks earlier. The majority of exhibitors claimed that the show failed to attract business level Internet users.

The one major announcement made on the first day of Internet World, was ironically followed by a press event in the US a day earlier. Apple, IBM, Netscape, Oracle and Sun joined forces to announce guidelines for the much hyped network computer (NC).

NC Reference Profile 1 will provide a common set of standard features and functions across a broad range of scalable devices. It is architecturally neutral in terms of microprocessor, and is intended to facilitate the growth of the network computing industry while protecting investments made by customers, content providers, system providers, service providers and application providers, through industry-wide compatibility.

"We believe that such a platform-neutral architecture opens broad opportunities for moving personal computing into a new era, characterised by the convergence of communications and multimedia, especially in the form of the Internet", said Gil Amelio, chairman and CEO of Apple. "As a pioneer in developing next-generation computing devices, as demonstrated by the Pippin and Newton, we are excited to contribute our expertise to this industry-wide effort to define network computing guidelines".

"Netscape warmly welcomes this announcement, because it will help ensure these standards are incorporated in forthcoming devices", said Marc Andreessen, vice president of technology at Netscape. "These open standards give customers freedom of choice and help drive innovation, which together make the Internet the hot bed of activity it is today".

NCs complying with the planned NC Reference Profiles may take many forms - from desktops

to laptops to video phones, pagers and even conventional PCs. All these devices may be linked to the Internet or Intranet and run basic applications such as Web browsers, e-mail applications, word processors, spreadsheets and presentation packages. In addition, NCs may function as multimedia machines by supporting video e-mail, 16-bit CD-quality sound and digital videos.

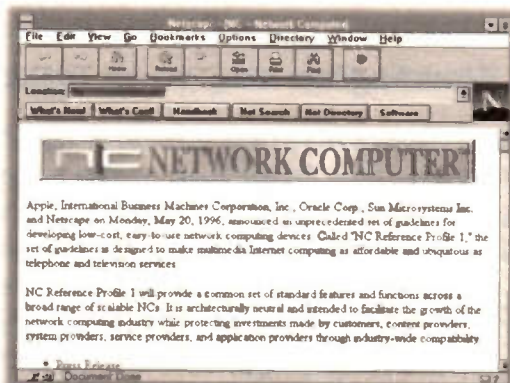
The NC Reference Profile 1 (see table) sets guidelines for standard functionality, but it does not impose limitations. Vendors interested in adding more functionality to their NC implementations

may do so because the Reference Profile does not limit designs to a specific set of features.

The NC Reference Profile 1 covers general hardware guide lines, Internet protocols, World Wide Web standards, e-mail protocols, common multimedia formats, boot protocols and security features.

NC Reference Profile 1 will be made available

for public comment and review in July 1996 and is expected to be finalised by August 1996. The draft version can be viewed on the Web at <http://www.nc.ihost.com>. Future versions of the NC Reference Profile will be determined and published by the participants in this announcement, with the involvement of other interested parties in response to changing technologies and market requirements.



### Hardware

- ◆ Screen resolution of 640 3 480 (VGA) or equivalent
- ◆ Pointing device (mouse or track ball)
- ◆ Text Input capabilities
- ◆ Audio output

### Software

- ◆ Web: HTML; HTTP; and Java Application Environment
- ◆ E-mail: SMTP; IMAP4; and POP3
- ◆ Data formats: JPEG; GIF; WAV; and AU
- ◆ Security Features (Optional): ISO 7816 SmartCards; and EMV (Europay/MasterCard/Visa) specification

### Communications Protocols

- ◆ Internet Standards: Transmission Control Protocol (TCP); and File Transfer Protocol (FTP)
- ◆ Distributed Networking: SMTP
- ◆ Storage (Optional): NFS

### Network Computer Reference Profile.

## Radio and Computer Boot Sale

Southend & District Radio Society Radio & Computer Boot Sale, at the Druid Venture Scout Unit, 191 Eastern Avenue, Southend-on-Sea, Essex on the 7th July 1996 opening time 10.00am. Bring & Buy under cover, admission 25p, refreshments, Talk in on S22.

Opposite: The club house used by the Southend and District Radio Society.



# Lost in Cyberspace?

# INTERNET SEARCH ENGINES

by Stephen Waddington BEng (Hons.), MIEEE, AMIEE, MITSC

*Internet provider, CompuServe, claims that there are now 3 million Web sites on the Internet, with a growth of 50,000 per week. Meanwhile, Digital reckons that there are around 22 million individual Web pages in Cyberspace. Whichever way you cut the statistics, the proportions of the Internet are truly intergalactic. It would take more than two decades to visit every page on the Internet, and this is assuming that it takes only 30 seconds to load and read each page. In reality, a recent study by CMP Interactive Media claims Internet users spend up to 15 minutes loading and browsing a Web site, before moving on.*

**W**hile the Internet brings a tremendous amount of data to the desktop of the individual user, it has little value in information terms without structure and order. The business user looking for information on a particular organisation needs to get access to relevant Web sites in a matter of minutes, and can ill afford to spend hours switching from site to site.

The good news is that there is a large growth in tools to help Internet users navigate around Cyberspace. Here lies a great irony. While the Internet has grown from an anarchic academic base, where freedom of expression and creativity are king, as it has become commercialised, business has begun to impose structure and order.

While the scale of the Internet is massive in human terms, it is not infinite. Therefore, while the Internet remains largely unstructured, it should be possible, given sufficient computing power, to analyse, catalogue and index every Web site. Search engines are an attempt to achieve this ideal.

## Different Flavours

There are, essentially, two discrete types of Web search engines accessible over the Internet. The key difference between them lies in the way Web details are collected by the search engine.

The first is a standard database type directory of Web addresses and basic descriptions. This format is no more than a basic index, and relies on the creators of Web sites registering the site's domain name and description with the directory. Users of the search engine can search on basic terms and can receive details of all relevant sites contained within the directory.

The second type of search engine is based on an entirely different model. Here, the search engine uses a query tool or data collector, more usually termed agent, to visit Web sites across the Internet and retrieve the domain name and details of the site's contents. This information is then sorted and stored for analysis by users of the search engine. By basic definition, this type of search engine is more comprehensive.

## Directory Enquiries

There are literally hundreds of directory-type services on the Internet. These range from basic topic-specific services, to more broad-based directories such as the Yahoo, which cover a wide range of topics. A small selection of examples are outlined here:

- ◆ The WWW Virtual Library Project at <http://www.w3.org/hypertext/DataSources/bySubject/Overview.html>, is the father of all Web sites, beginning life like the Web itself, at the European Laboratory for Particle Physics (CERN) in 1991. The project was initially intended to be used a method of tracking the growth of the Web, and was not made available on the Web until 1993.

Like the reference section in a conventional library, the Virtual Library contains lists of Web sites organised by subject. To get a site registered, modified or removed from the library, e-mail: [www-request@w3.org](mailto:www-request@w3.org).



Access Business Online BizWiz Web!

Options Directory Window Help

Open Print Find

Net Search Net Directory Software

Access Business Online

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Executive Job Network Capital Sources Legal & Regulatory Training &

Netscape - [TradeWave Ga

Go Bookmarks Options Directory

Reload Images Open Print

inet.net/

's Cool! Handbook Net Search

Netscape - [Starting Point]

File Edit View Go Bookmarks Options Directory Window Help

Back Forward Home Reload Images Open Print Find

Location: <http://www.stpl.com/>

What's New! What's Cool! Handbook Net Search Net Directory Software

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[Corporation](#). In addition, Galaxy [gu](#)

Netscape - [The Open Text Index]

Options Directory Window Help

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Netscape - [What's New Tool!]

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Location: <http://newtoo.manifest.com/>

What's New! What's Cool! Handbook Net Search Net Directory Software

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Today's announcements are separated into multiple pages of 50 URLs. At the bottom of each page are links to next and previous pages. You may also view [All Today's Announcements](#) on one page (Warning: Ave file size 400k +)

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in the World Wide Web Search Now

Infoseek Guide is best viewed with

NETSCAPE Now! Now!

infoseek Guide TRAVELOCITY™

TWO SITES THAT GET YOU WHERE YOU'RE GOING.

Document Done



GNN select }

Photo 1. GNN Select.

The site is maintained by volunteers, with each of the three hundred or so subject areas maintained by a single individual. The library always welcomes new maintainers to start and moderate new subject areas. For further details, e-mail: [vlb@w3.org](mailto:vlb@w3.org).

◆ Global Network Navigator (GNN) Select, shown in Photo 1 at <http://www.gnn.com/wic/wics/index.html>, is an exclusive hand-picked collection of the best sites the Internet has to offer. GNN itself is a beta Web-based service, operated by America Online. The service is currently restricted to the US, and is intended to be a service solely for novice Internet users. Each of the 2,500 sites listed in GNN Select has been reviewed and categorized by subject by the GNN Select editorial team. Subject areas range from Daily News to Personal Culture.

◆ The World Wide Web Yellow pages shown in Photo 2, like its telephone counterpart, is in fact, a book published yearly by Macmillan. Unlike the conventional version of the Yellow Pages, the book is not restricted purely to business, and lists over 10,000 sites which have all been checked out by its editorial team.

A version of the World Wide Web Yellow pages is also available on the Internet, at <http://www.mcp.com/nrp/wwwyp/index.html>. This includes all the content from the book, in addition to entries which did not make it into the book, and new sites that have only recently come online.

If you want to get listed in the Yellow Pages, complete the form at <http://www.mcp.com/nrp/wwwyp/submit.html>. This will not guarantee you a listing in the book, but will get you online.

Undoubtedly, the most sophisticated directory type Web search engine is Yahoo (Yet Another Hierarchical Officious Oracle), located at <http://www.yahoo.com>. Yahoo, shown in Photo 3 classifies sites in a hierarchical subject oriented format. Internet users can either browse sites by subject classification, or search on keywords. Yahoo also carries editorial listings of recommended sites under headings such as 'What's Cool', 'News', and 'Random'.



Photo 2. The Internet Yellow Pages.



Photo 3. Yahoo!



Photo 4. Yahoo!

Like so many West Coast innovations, Yahoo grew from an idea, quickly developed into a hobby, and of late, has become a full time passion and business opportunity for its creators, David Filo and Jerry Yang.

Stanford PhD students, Filo and Yang started the guide in April 1994 as a way of keeping track of their personal interests on the Web. Before long, they found that their home-brewed lists were becoming

too long and unwieldy. Throughout 1994, Yahoo was developed into a customised database, and moved onto a Stanford server to allow public access from the Internet. Meanwhile, Filo and Yang refined their code to efficiently locate, identify and edit material stored on the Internet.

The popularity of Yahoo spread quickly, and before long, the servers at Stanford became choked by demand. In February 1995, Marc Andreessen, co-founder of Netscape, invited Filo and Yang to move their files over to larger computers housed at Netscape. Today, Yahoo contains organised information on tens of thousands of computers linked to the Web and continues to receive more than 100,000 accesses per day.

Yahoo floated on the US stock exchange at the beginning of April. The initial share price of \$13 per share put the value of the company at almost \$40 million – 2.6 million shares were offered in the initial flotation. At the time of going to press, Yahoo stock was priced at \$30 per share, more than doubling the value of the company to \$78 million, and demonstrating the potential which the financial markets are forecasting for the Internet.

## Internet Robotics

So far, we have considered only search engines which rely on the creators of new Web sites submitting new URLs to a directory, although the more commercial directories such as Yahoo do not rely entirely on URL submissions to track new sites. They also use text-analysis type robots to trawl newsgroups and wire services for details of new sites, bringing us onto the second type of Web search engines.

These rely far more heavily on software robots to generate and maintain its indexes. A robot is a piece of software code that, under the direction of its

programmer, automatically traverses the Web's hypertext structure by retrieving a document, and recursively retrieving all documents to which it is cross-referenced or hyper-linked.

Web robots are sometimes referred to as Web Wanderers, Web Crawlers, or Spiders. These names are a bit misleading, as they give the impression the software itself moves between sites like a virus. This

not the case, a robot simply visits a site by requesting and downloading documents.

## Robot Exclusion

If you want to avoid having your site registered with a search engine, it is possible to insert a piece of code called robot.txt at the head of your home page to ward off robots. Think of it as the equivalent of a Doberman – it's a way of telling Internet robots to keep out. Details of robot exclusion code can be found at <http://www.info.webcrawler.com/mak/projects/robots/norobots.html>.

## Query Interface

While directory-type search engines rely on the user to browse around a series of options, usually organised by subject type, more complex search engines require the user to enter a specific query. Photo 4 shows the query interface for the Lycos search engine at <http://www.lycos.com>. Like the majority of interfaces, this is based on the form and requires the user to enter key search words. As we shall see, the more complex search engines allow complex queries involving boolean operators, and case-sensitive alphanumeric strings.

## The Next Dimension

There are more than a dozen robot-based search engines available on the Internet, as outlined in Table 1. These range from basic services, such as WebCrawler, which records and indexes sites on the basis of the title of the home page, and Digital's powerful Alta Vista, which claims to be able to index every single word on a Web site. The scope of search capabilities also varies greatly. WebCrawler allows basic text searches, while Alta Vista is able to handle alphanumeric searches based on boolean operators. As the two extremes of search engine capability, we will examine both technologies in detail.

## WebCrawler

WebCrawler at <http://www.webcrawler.com> has a very similar heritage to Yahoo, beginning life in a university computer research laboratory. In early 1994, about the time when Filo and Yang first started development on Yahoo, students in the faculty of Computer Science and Engineering at Berkeley gathered at an informal workshop to discuss the early popularity of the Internet, and with it, the World Wide Web.

Workshops at Berkeley typically offer students a forum to develop and discuss ideas in small project groups. WebCrawler was research student, Brian Pinkerton's project, and began as a small PC-based, single user application to find information on the Web.

Fellow students persuaded Pinkerton to build the Web interface further. In its first release on the Web in April 1994, the WebCrawler's database

contained documents from just over 6,000 different servers on the Web. WebCrawler quickly became an Internet favourite, receiving an average of 15,000 queries per day.

The Web continued its exponential growth, and before long, WebCrawler required commercial resources to service the number of queries per day. In February 1995, major changes to the service were necessary to accommodate the new load. By March, the daytime load was so high that the service became very sluggish and was usable only at night.

WebCrawler was sold to America Online (AOL) to become a commercially operated and supported engine. It moved from Berkeley to its new home in San Francisco on March 29, 1995. Today, WebCrawler is used by over two million people each week, who on average, make more than three million queries per day.

## How WebCrawler Works

WebCrawler has two different user based functions. It builds indices for documents it finds on the Web – the broad, content-based indexes available for searching, and it acts as an agent, searching for documents of particular interest to the user.

WebCrawler works by starting with a known set of documents (even if it is just one) identifying new places to explore by looking at the outbound links from that document, and then visiting those links. Robotic agents are used to retrieve documents. They use

CERN's Web library to retrieve a specific URL, then return that document to the database for indexing and storage. WebCrawler typically runs with five to ten agents at once.

WebCrawler was the first full-text search engine on the Internet. Several competitors emerged within a year of WebCrawler's debut, many of which are shown in Table 1. They all improved on WebCrawler's basic functionality, though they did nothing revolutionary.

**WebCrawler is used by over two million people each week, who on average, make more than three million queries per day.**

Search Engine	URL Address
Alta Vista	<a href="http://www.altavista.digital.com">http://www.altavista.digital.com</a>
BizWiz*	<a href="http://www.bizwiz.com/bizwiz">http://www.bizwiz.com/bizwiz</a>
Galaxy*	<a href="http://www.galaxy.einet.net">http://www.galaxy.einet.net</a>
Infoseek*	<a href="http://www.infoseek.com">http://www.infoseek.com</a>
Lycos	<a href="http://www.lycos.com">http://www.lycos.com</a>
Open Text*	<a href="http://www.opentext.com:8080">http://www.opentext.com:8080</a>
Starting Point*	<a href="http://www.stpt.com">http://www.stpt.com</a>
WebCrawler	<a href="http://www.webcrawler.com">http://www.webcrawler.com</a>
What's New Too*	<a href="http://www.newtoo.manifest.com">http://www.newtoo.manifest.com</a>
Yahoo	<a href="http://www.yahoo.com">http://www.yahoo.com</a>

\* See screen captures on page 73.

**Table 1. List of Web search engines.**

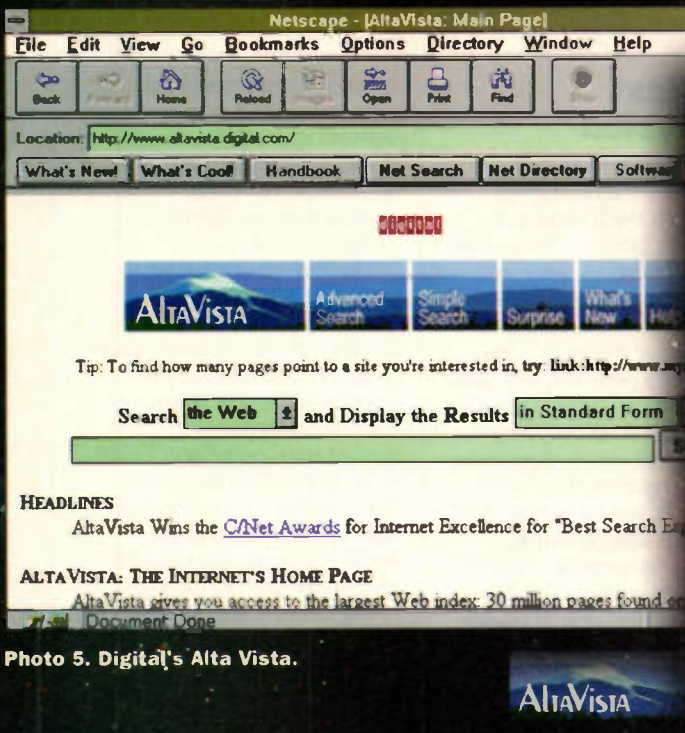


Photo 5. Digital's Alta Vista.

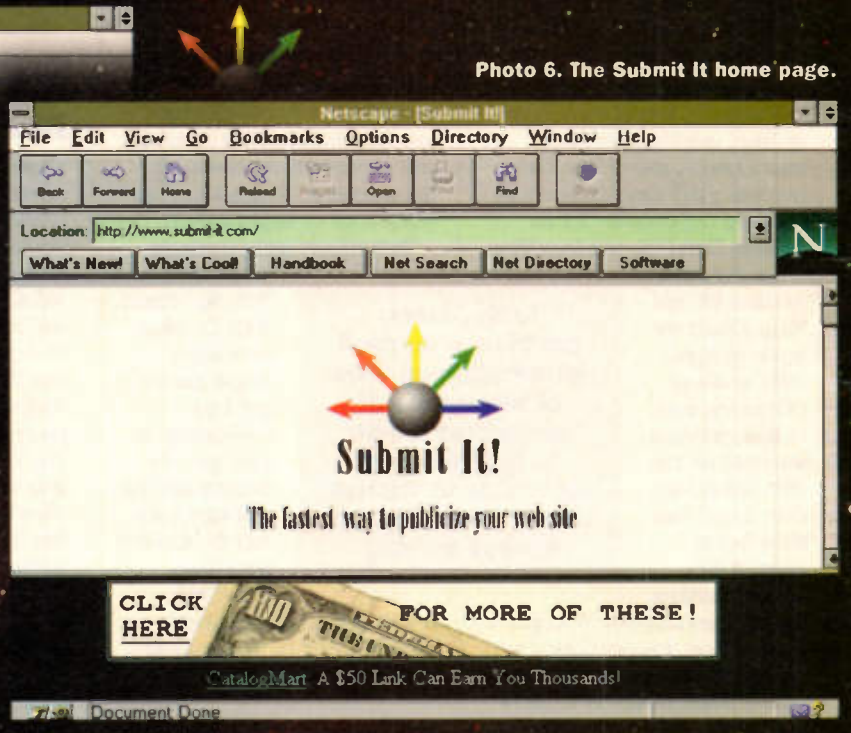


Photo 6. The Submit It home page.

## Alta Vista

That was, until Digital introduced its Alta Vista search engine on the Web in December 1995, at <http://www.altavista.digital.com>. In fact, the Alta Vista Search Service emerged from Digital's Palo Alto, California research laboratories in the spring of 1995.

At the front end, Alta Vista, shown in Photo 5, looks like any of the other search engine interfaces, however, it is in the back engine where the differences lie. Digital claims to be using the world's most sophisticated indexing software to compile and continually update a complete index, to date, of the entire Internet. At the last count, in early May, 1996, the Alta Vista Search Service database contained 11 billion words indexed from over 22 million Web pages.

## Software

Alta Vista consists of the query tool, a super spider robot and an indexer. The Alta Vista super spider, dubbed Scooter, works at a rate of 3 million Web pages per day, returning the complete contents of these pages to the Alta Vista server for indexing. Scooter simultaneously accesses and fetches thousands of Web pages at a time, but it imposes minimal load on a Web server to avoid inconveniencing the site in any way. To accomplish this, Scooter waits after performing a fetch before it retrieves another page from the same site. By invoking a delay that is a function of the

duration of the fetch, Scooter accesses slower systems much less frequently than fast ones.

Once Scooter has fetched the contents of a Web page and its URL back to the Alta Vista server, it is indexed into a relational database. Digital's indexing software can index a gigabyte of text per hour, producing links to every word on every Web page brought back by Scooter. This is the key software that allows Web users to enter a simple single word or more complex boolean query and instantly retrieve a listing of relevant Web pages.

One of the most useful features of Digital's indexing software from the user's perspective, is its ranking system. This is an important feature of a system that can easily locate thousands of documents which match a query. The ranking system scores each document that is located according to the words specified in the query. Documents having a higher score are presented first, and those having a lower score last. This allows the user to focus immediately on documents which are more likely to be of interest.

## Hardware

The Alta Vista Search Service software is optimised for Digital's 64-bit Alpha technology. To process inquiries from the Alta Vista

Search Service, Digital currently use a trio of AlphaStation's, two 250 4/266 systems and one AlphaStation 500/33, each with 256M-byte of RAM and 4G-byte of hard disk. Running on the AlphaStation systems is a custom multi-threaded Web server, which sends queries to the indexing software. With just these relatively small systems, Digital can easily handle millions of hits per day to the Alta Vista Search Service. The search queries are forwarded to the index

**Digital can easily handle millions of hits per day to the Alta Vista Search Service.**

servers – about 90% search the Web and 10% the newsgroups. The cornerstone of Alta Vista's

performance are three AlphaServer 8400 5/300 systems, each with 10 processors, 6G-byte of RAM, and 210G-byte hard disk in a RAID array. Each holds a complete copy of the Web index (currently 40G-byte in size) and is able to provide response times of less than a second. Scooter runs on a DEC3000/900 AlphaStation with 1G-byte RAM and a 48G-byte RAID array, to ensure data integrity. The sole job of this computer is crawling the Web, fetching content and sending it to the indexing system. The index is built on an AlphaServer 4100, with two processors and 1G-byte of memory. The completed index is periodically copied to the index servers.

## Getting Registered

We have looked in detail at many of the search methodologies available on the Internet, but have not yet considered how to register a Web site with a search engine. Web site designers have typically had to register new sites with each search engine in turn. This is a relatively simple task, if somewhat laborious. As a general rule, each search engine provides an option to submit a new URL from its home page.

However, it is no longer necessary to submit your URL to every service on an individual basis. There is now a service which automates the whole process. Submit-it at <http://www.submit-it.com>, shown in Photo 6, is a free service which forwards details of new Web sites entered by users on its home page, to all major search engines and Web directories. A check list is provided on the home page for reference.

Changes to URLs are a different story. If you change your Web address, details must be forwarded to each individual search engine. Otherwise, there is the danger that your details will be wiped from the search engine the next time links are checked using a validation robot.

If you submit a new URL to a search engine, do not expect it to appear immediately. It can take up to six weeks for details of new Web pages to be included in some of the more popular engines, as many of the search engines are struggling to keep pace with the growth of new sites.

# NEXT ISSUE

## 4 to 1 Mono Audio Mixer project

A very straightforward but nevertheless useful unit that enables four audio inputs to be mixed into one output with unity gain, for feeding into an amplifier.

### ±15V Regulator

A general purpose building block project, making the ideal basis for a versatile power supply.

## Sound to Light

A 3-channel mains powered sound-to-light unit that features independently controlled, optically isolated outputs that react to bass, medium and treble parts of the music spectrum.

Projects galore and lots, lots more...

**SUN GAZING:**  
The SOHO Mission by Douglas Clarkson details the Solar and Heliospheric Observatory mission of the European Space Agency/NASA.

**Issue 105 on sale Friday 2nd August**

## Liquid Level Controller

Avoid unnecessary wastage of water and expensive flood/leakage damage by using this project to indicate (conductive) liquid levels remotely by means of coloured LEDs.

## PIC 16C84 Programmer

An inexpensive unit that connects to any IBM-compatible PC and enables the popular range of PIC 16C84 microcontrollers to be programmed, using appropriate software.

## Electronic Filter Circuits

A new three-part series by Ray Marston, taking an in-depth look at modern filter designs.

### 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.

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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) 552922. 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 3, Rayleigh, Essex, SS6 8LR. Payment can be made using Cheque, Postal Order, or Credit Card; 3 Telephone your order, call the Maplin Electronics Credit Card Hotline on (01702) 554161; 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) 552911 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 3, Rayleigh, Essex SS6 8LR, England; telephone +44 1702 554000 Ext. 376, 327 or 351; Fax +44 1702 553935. Full details of all the methods of ordering from Maplin can be found in the current Maplin Catalogue.

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### 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 31st August 1996 (errors and omissions excluded). Prices shown do not include mail order postage and handling charges, which are levied at the current rates as indicated on the Order Coupon in this issue.

### Technical Enquiries

If you have a technical enquiry relating to Maplin projects, components and products featured in Electronics, the Technical Sales Department 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) 553955; 3 Or by writing to Technical Sales, Maplin Electronics plc., P.O. Box 3, Rayleigh, Essex, SS6 8LR. Don't forget to include a stamped self-addressed envelope if you want a written reply! Technical Sales are unable to answer enquiries relating to third-party products or components which are not stocked by Maplin.

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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 3, Rayleigh, Essex, SS6 8LR. 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.

**ELECTRONICS**

**W**e've been looking at the various methods of creating HTML documents over the last few months. This month, it's the turn of Quarterdeck's WebAuthor – a plug-in addition to Microsoft's Word for Windows 6 or higher.

WebAuthor creates an extra option in Word's Tools menu, which allows the conversion from Word's standard document format to the necessary HTML format required by Web browsers.

## TSB Takes Lead in PC Banking

TSB Bank has become the first major high street bank to offer PC-based home banking to all customers, with the launch of a 24-hour service, available over CompuServe.

TSB's PC Banking provides an on-screen statement, plus the ability to pay bills and transfer funds between accounts. The service also provides a historical record of all transactions made since joining PC Banking. Customers can also correspond with TSB via e-mail and if they have a TSB Trustcard, buy discounted goods and services using points collected in TSB's incentive scheme, TSB Plus. PC Banking is accessed via CompuServe. TSB customers who sign up for PC Banking will also have access to CompuServe's information, entertainment, communication and home shopping services.

41% of UK's CompuServe users said they were likely to consider switching to a bank which offered an online service, in a survey conducted by TSB and CompuServe last year.

## Eavesdrop on NASA

Forget eavesdropping on the royal family's explicit mobile calls, using Real Audio to download sound files via Netscape Navigator, you can now tune into the air-to-ground audio loop between the Space Shuttle Endeavour and Earth.

The broadcast is supplemented with commentary from NASA Television. More information is available from the NASA Shuttle Web Mission Audio Page, at <http://shuttle.nasa.gov/sts-77/sounds/>.

To read about other missions, take off to the NASA Shuttle Web page, at <http://shuttle.nasa.gov> or the Office of Space Flight Home Page, at <http://www.osf.hq.nasa.gov>.

This has certain advantages over standalone HTML authoring packages such as some of those we've seen before in @Internet. First, you create your Web page document initially within Word, as a standard word-processed document. So, the document can be typed, edited, spell-checked and arranged in the usual ways familiar to most word processor users. Second, not only can new documents be converted to HTML format, but

also old ones from your archive of previously word-processed documents. On the other hand, there is one small snag (which is more a problem of the restricted formats available in HTML itself), in that Word's in-built formatting features can't be used to format the document – only WebAuthor's formatting features.

Overall, WebAuthor is a simple and versatile method of publishing Web pages if you already have Microsoft Word for Windows.

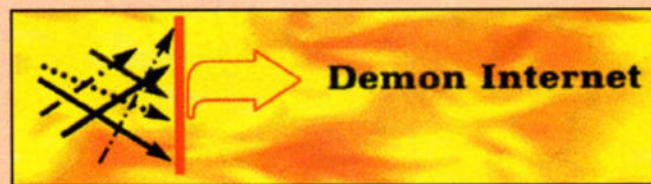
## Remote Repair

Very soon, heavy industrial manufacturing equipment may be linked via the Internet for monitoring and repair services. Each piece of equipment would contain a built-in data recorder that would transmit information on operating conditions to the original manufacturer, which could then use the data to send a replacement part or even send a command that restarts the device.

The idea is being championed by Richard Post, head of US company, Applied Science and Technology, who says all the hardware and software is available now, and all that's missing is a security system that prohibits the information flow from being reversed and used for sabotage or industrial espionage.

Post's comments follow a disaster recovery trial in May by SGS-Thomson. The complete IT system within SGS-Thomson's manufacturing plant in Maur, Malaysia, was recovered remotely via a single ISDN line by Computer Disaster Recovery (CDR) in Belgium. CDR is equipped to bring any one of SGS-Thomson's six manufacturing plants back online in the event of a computer failure.

Contact: Computer Disaster Recovery, Tel: (0171) 784 7445.



## Direct Line to Demon

Demon Internet has teamed up with Orange, to provide Internet users direct dial capability into the Internet, without the need for a modem. Users are able to access their Demon account using a Nokia Orange phone, an Orange Fax/Data card and a laptop computer.

In this way, users can access their Demon Internet account in a matter of seconds. Normally, a standard dial-up account requires a users' modem to 'handshake' with the modems at Demon Internet's Network Operations Centre.

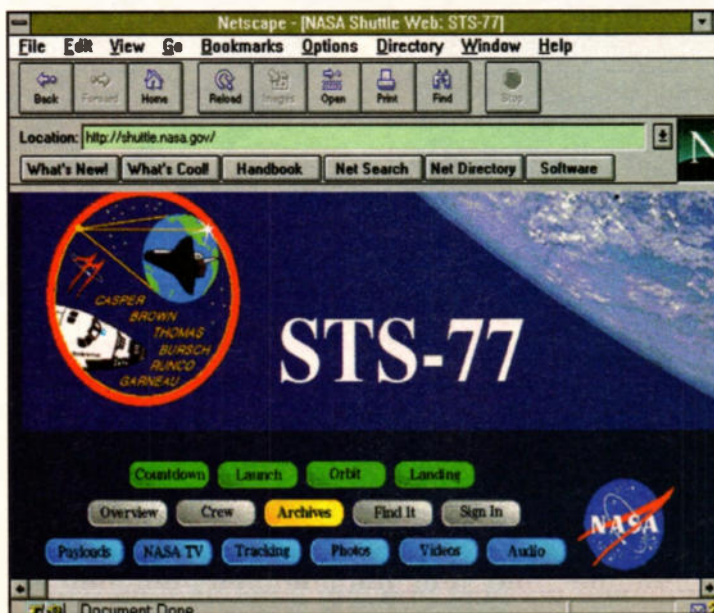
Instead, this agreement with Orange allows users with a Nokia Orange phone to simply dial the Orange Internet Direct number and get through. The service operates using an Orange (0973) 100 666 number, giving users the additional benefit of very competitive Orange-to-Orange call rates.

For further details check: <http://www.demon.co.uk>.

Contact: Demon Internet, Tel: (0181) 371 1000.

# @INTERNET

*The latest news for site surfers*



## Twist and Shake

In the last six weeks, tornadoes have struck both southern China and Arkansas, US. In China, 2,000 people were left homeless, while in Fort Smith, Arkansas, four died and 700 homes sustained heavy damage.

For an introduction to the weather phenomenon that needs no introduction, visit the Tornado Page at <http://cc.usu.edu:80/~kforstyh/tornado.html>, or the home page of the UK's Tornado and Storm Research Organisation, at <http://www.zetnet.co.uk:80/oigs/torro/>.

For storm chaser information and pictures of tornadoes, go to the Bears Cage homepage at <http://www.ionet.net/~tomado1/>.



## In Control at Last

When you first get on the Internet, one of the pleasures of surfing the World Wide Web is the power of bookmarks (or favourites, or hot lists, depending on your Web browser terminology). However, the pleasure turns out to be a pain after a relatively short time. Once you've been surfing awhile, you'll find you have more bookmarks than you know what to do with. Everywhere you surf, you find hot links and pick up more of them. Every newspaper, magazine, and e-mail message you receive usually brings more of them. Pretty soon, you find that you've so many that the things become unmanageable. There's not a Web browser available yet which has been able to tackle this problem decently, and it's to third-party utilities that many people turn.

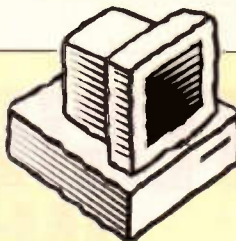
One such utility is CyberFinder, from Aladdin Systems (available only for Mac users). It has a brilliant concept, which extends the Mac desktop metaphor to the extent that any bookmarks (of any type - e-mail, ftp, http, gopher and so on) can be maintained logically, and what's more, extremely simply.

A typical example of its use is while you're reading an e-mail message from someone. The sender of the message mentions a URL. You select the URL by highlighting it, then press a CyberFinder keyboard shortcut which grabs the URL. Grabbed URLs are placed automatically in your specified location. If your e-mail program is drag-aware, you can grab the URL by simply dragging to the desktop with the shift key held down. Later, you can access the URL by double-clicking it. This launches a linked application, say, your Web browser or your e-mail program, and accesses the URL site or creates a new mail message to that person. Alternatively, you can launch a bookmark on-the-fly with a different keyboard shortcut, which launches the browser (or any other linked program) as you first select the URL.

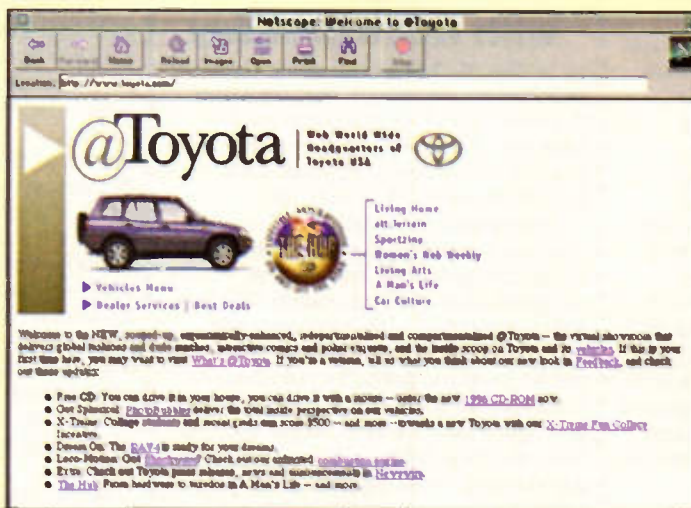
If this was all, that would be enough. However, Cyberfinder lets you open your Web browser's bookmark hot list as a Finder-style window, allowing you to group, drag and organise bookmarks just like standard desktop files. Back in your browser, the re-organised bookmarks are immediately available - beats Navigator's and Internet Explorer's limited URL maintenance features hands down.

You can download a 15-day free trial version of CyberFinder from Aladdin's Website at <http://www.aladdinsys.com>, or from Aladdin's AOL forum. Thoroughly recommended.

# Site Survey



## The month's destinations



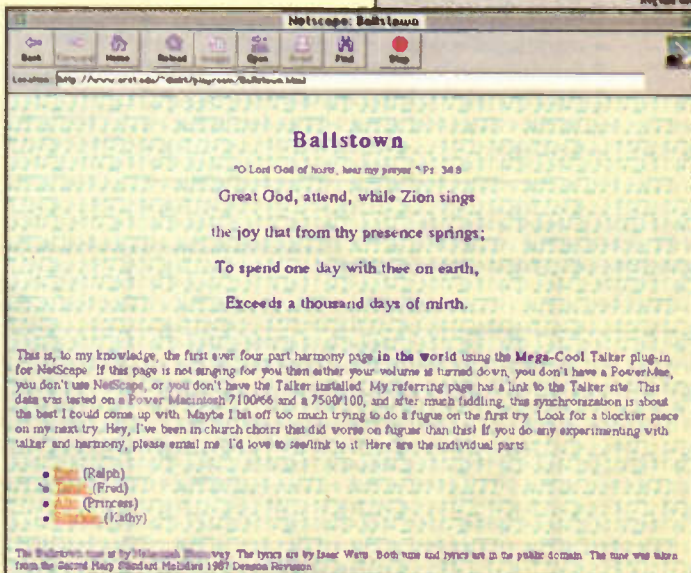
Above: Toyota's US site.



Above: Toyota's PhotoBubbles movies of vehicles.

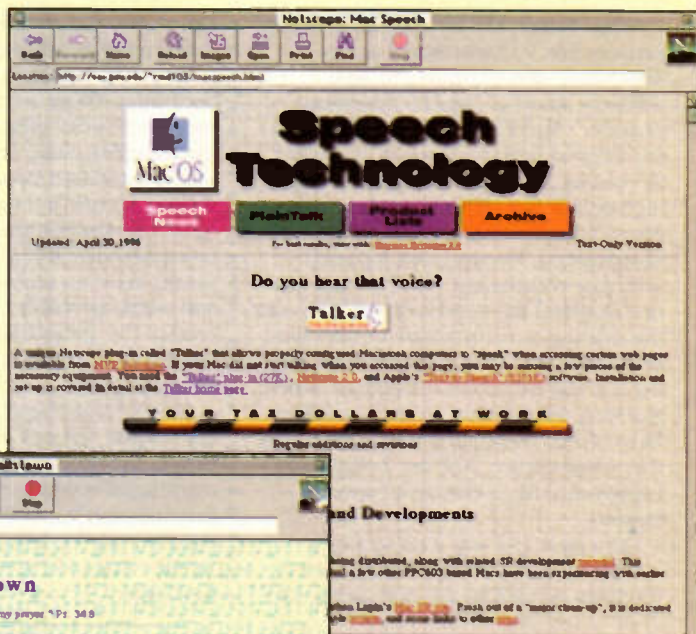
Right: Apple's information site about speech recognition for System 7.5.

Below: internet site with vocal and musical songs to play.



Check out Toyota's US site at <http://www.toyota.com> for details of its PhotoBubbles movies of its vehicles. You'll need to download a PhotoBubbles viewer first (available for Windows 3.x and '95, and Mac - details on the home page), but the download time is worth it. PhotoBubbles movies give an in-car experience on your own computer screen which shouldn't be missed.

The rest of this month's Site Survey is taken up with news of Mac speech technology. Since System 7.5, all Mac users have had the in-built capability of speech recognition and text-to-speech conversion. In other words, bog-standard Macs can be controlled directly by spoken word, and can generate spoken word from text files. See <http://cac.psu.edu/~rmd103/macspeech.html> for details. One of the latest applications of the Mac's speech abilities is a plug-in for Netscape Navigator (version 2 or later is required) called Talker, which lets Web sites you surf take advantage of text-to-speech conversion - the sites can be literally read out to users. Check <http://www.mvpsolutions.com/PlugInSite/Talker.html> for details and to download the plug-in. Great stuff.



There's more. Taken one step further, some enterprising site authors have created sites which actually sing, using the Mac's variety of voices. The Talker site already listed gives details of many sites using Talker, but try <http://www.orst.edu/~dickt/playroom/Songs.html> once you've got Talker installed. Then, listen in wonderment to four-part vocal musical harmony over a standard Internet dial-up connection.

# TECHNOLOGY WATCH



## with Keith Brindley

Despite the early appearance that digital television would find its way soon to the square-eyed masses via British Sky Broadcasting's satellite channels, things have taken a delay and we now look set to have to wait for a while yet. Now, 1998 is slated as being the year British Sky Broadcasting's digital satellite services may start.

For many eager hot bird twitchers, this will probably come as something of let down. After all, the technology is in place. The necessary Astra satellites which could be used in the digital services are in orbit and operational (Astra 1F was launched a couple of months back). The uplink which would be used by the services is in place and works. Finally, the satellite receivers which could be used have been designed and built (and, indeed, are in operation in other parts of the world where digital satellite television has already taken off).

So, what's the hold-up? Well, it appears that the hold-up is primarily a financial concern. Apart from being technically far superior to conventional satellite television, with better pictures and better sound, the end user is guaranteed little more than is already available.

When British Sky Broadcasting satellite services first started (simply as Sky Television), the situation was little different. Another satellite television provider (British Satellite Broadcasting—the original BSB) had already launched its own satellite and was broadcasting a high quality five channel service using a quasi-digital form of television broadcasting, known as multiplexed analogue component (MAC). While no-one doubted the superiority of MAC over the existing terrestrial form of television broadcasting (phase alternation by line – PAL), it was expensive in contrast. When Sky took the decision to use a satellite form of PAL, most people thought it was the wrong choice. Not me, I might add – I applauded Sky's choice for several reasons.

For a start, PAL was a proven technology. It was a safe bet. Second, the receivers needed by the end user could

be produced cheaply and easily. Finally, it deferred the decision to start up a true digital TV broadcasting system until a later time – a time when the choice over the best system could be made with knowledge rather than a gamble.

In hindsight, with BSB's merger with Sky into the current company, British Sky Broadcasting and the subsequent dropping of all MAC programming, it has become painfully obvious even to the MAC proponents that the great British public – and Joe public for that matter – couldn't care less for high quality pictures and digital quality sound. In the end, Joe and Josephine Public only want choice at a good price. High quality is great if it doesn't cost any more than what we already have.

Back to the future, and we can see that British Sky Broadcasting's decision to defer a start to any digital satellite services is very, very similar to what it was way back then. There are millions of happy satellite viewers, pleased as punch with their satellite pictures and sound. What would these users do if they were offered digital pictures and digital sound, remembering that they would need to buy a new digital receiver (currently priced between around £300 and £600) and would probably have to pay more to receive the programmes too? They would, quite naturally, say no thanks. Wouldn't you?

On the other hand, the choice not to start digital services doesn't mean that British Sky Broadcasting isn't looking to start digital services at all. British Sky Broadcasting has only recently taken rights to use 14 digital transponders of a satellite due to be launched at the end of next year.

## Faster CDs

Pioneer has announced a 10-speed CD-ROM drive, capable of a data rate of 1.5M-bps. It achieves this speed by combining techniques used conventionally in both CD-ROM and hard disk drives.

CD-ROM drives traditionally use a technique called constant linear velocity in which the speed of the disc part actually under the read head remains the same, wherever the head is. For this to occur, the actual disc speed has to change depending on the head position. As a result, though, the data being read off the disc is at a constant rate.

In a hard disk, constant angular velocity is used, which means that the disk turns at the same speed wherever the head is positioned. As a result, the rate at which data is read off a hard disk varies according to head position. When the head is at the outside edge, data is read off faster than when the head is at the inside edge of the disk.

By combining the two techniques, so that data is read off under constant angular velocity over the outside portion of the disc, and under constant linear velocity over the inside portion, the average rate is extended to the 10-speed equivalent.

What the new system implies is that data to be stored on a CD-ROM should be filtered according to a strict procedure, and stored on the disc to ensure users can get most benefit of the potential higher speed. Larger files, say, applications, which need to be accessed in a contiguous part requiring high data rates for fastest recovery, should be stored on the outside portion of a disc. On the other hand, smaller files, which need a fast access time but don't require particularly high data rates, should be stored on the inside of a disc.

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

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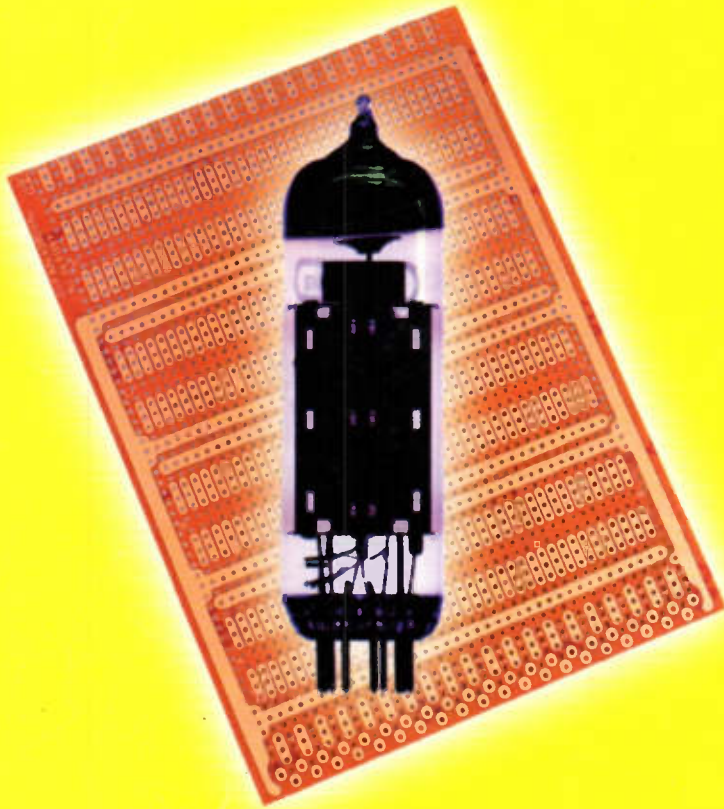
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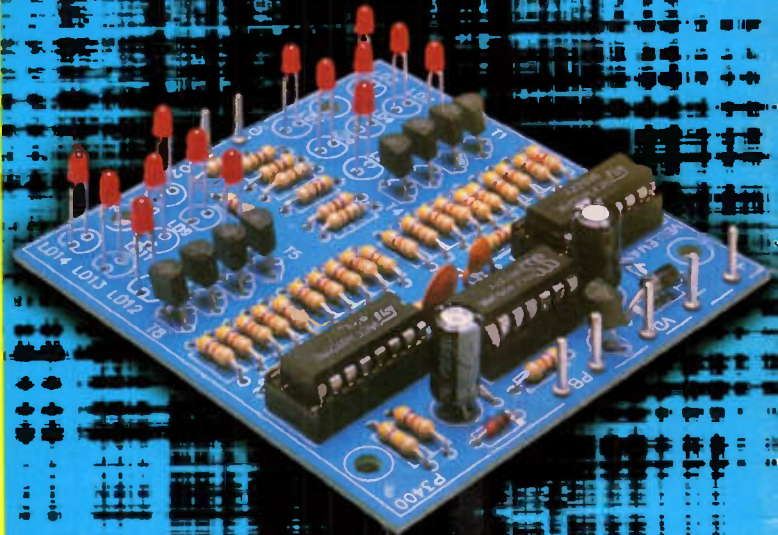
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