

THE MAPLIN MAGAZINE

ELECTRONICS

and Beyond

Transfer your old LPs onto CDs



via your computer

The Digital Economy



Information Overload



On the Way Up

Technology in the Mountains



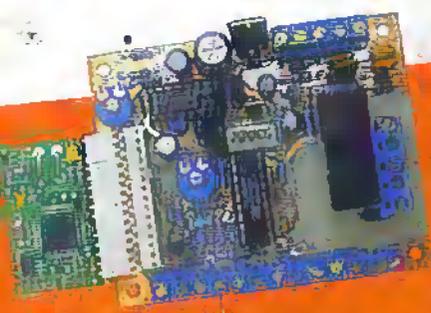
JANUARY 1998 NO. 121 £2.65

<http://www.maplin.co.uk>

Computer Printers



An insight into the way they work



PROJECTS FOR YOU TO MAKE

Touch Hybrid Board

Making your own audio CDs

SOFTWARE SHORTCUTS

An easy guide to finding out more about your everyday software



Britain's most widely circulated magazine for electronics!

projects

New Project Kits from Maplin

AUDIO LEAD CHECKER KIT

- No home or professional studio should be without one!

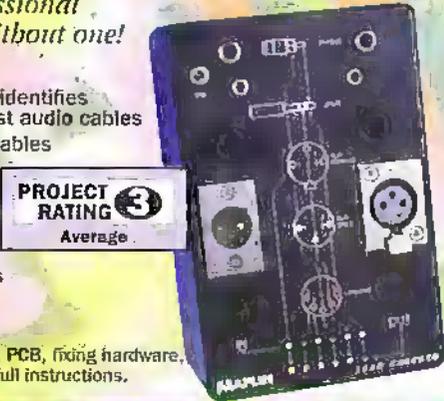
FEATURES:

- Rapidly and clearly identifies connections on most audio cables
- Will test very long cables
- Clear led readout
- Robust design

IDEAL FOR:

- PA/Sound engineers
- Gigging bands
- Fault diagnosis

Kit includes all components, PCB, fixing hardware, case, front panel label and full instructions.



PROJECT RATING 3
Average

AUDIO LEAD CHECKER KIT LU26D £19.99

Construction details: Audio Lead Checker Leaflet XZ20W/80p
Issue 114 / June 1997 Electronics & Beyond XD14Q/£2.25

PROJECT RATING 1
Simple

NATIONAL LOTTERY PREDICTOR KIT

FEATURES

- Ideal beginners project
- Simple to use - one switch operation
- Automatic switch off saves batteries
- Full source code available

APPLICATIONS

- Use to choose your lottery numbers!
- Excellent introduction to microcontrollers
- Use in other games

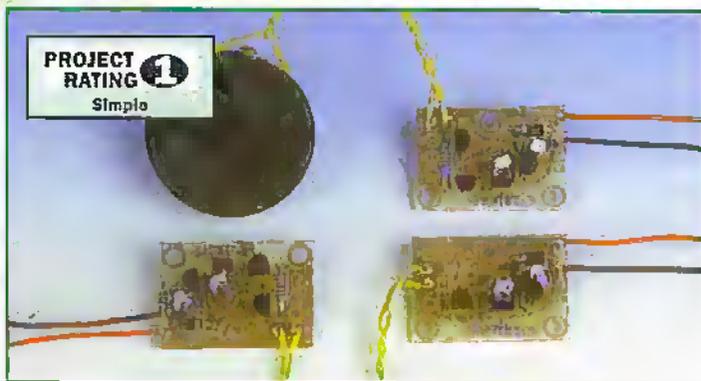
Kit includes all components, PCB, fixing hardware and full instructions. Two AAA batteries are required (not supplied).



NATIONAL LOTTERY PREDICTOR KIT LU61R £9.99

Construction details: National Lottery Predictor Leaflet XZ46A/50p
Issue 120 / December 1997 Electronics & Beyond XD20W/£2.65

MELODY GENERATOR KIT



PROJECT RATING 1
Simple

FEATURES

- Ideal beginners project
- Safe, low voltage operation
- Low current giving long battery life
- Directly drives speakers (included) or piezo sounders
- Large range of melodies supported (15 available)

APPLICATIONS

- Children's toys
- Teaching nursery rhymes
- Turn ordinary cards and gifts into novel presents

Kit includes all components, PCB, speaker, connecting wire and full instructions. One or two 1.5V batteries are required (not supplied).

MELODY GENERATOR KIT:

| | | |
|-----------------------|---------------------------|--------------------------|
| LU64U Happy Birthday | LU66W London Bridge | LU67 Old McDonald |
| LU68 Greensleeves | LU69 Love Me Tender | LU70 Jingle Bells |
| LU75 Merry Christmas | LU76 12 Days of Christmas | LU77 You Are My Sunshine |
| LU80 Just Called | LU81 Twinkle Twinkle | LU84 I'd Like To Teach |
| LU90 Willie Christmas | LU91 Warming Tone | LU92 Wedding March |

All at £4.99

Construction details: Melody Generator Leaflet XZ47B/50p
Issue 120 / December 1997 Electronics & Beyond XD20W/£2.65

PAL COLOUR ENCODER KIT

FEATURES

- PAL and NTSC compatible
- TTL compatible inputs
- 64 colour palette
- Composite video and UHF outputs
- Analogue or digital RGB inputs
- Optional S-video output

APPLICATIONS

- Colour bar generation
- RGB to composite and UHF conversion
- Computer displays

Kit includes all components, PCB, Modulator, hardware to connect the Maplin Colour Bar Generator LU50E and full instructions. A +12V DC @ 300mA, regulated supply is required (not supplied).



PROJECT RATING 3
Average

PAL COLOUR ENCODER KIT LU74R £24.99

Construction details: PAL Colour Encoder Leaflet XZ41U/80p
Issue 115 / July 1997 Electronics & Beyond XD15R

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Internet Web Site:
<http://www.maplin.co.uk>

These kits are:

- Supplied with high-quality fibre-glass PCBs - pre-tinned, with printed legend and solder resist
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- Covered by the Maplin Get-You-Working Service and 12-month warranty

Kits do not include tools or test equipment. Kits may require additional components or products, depending on application, please refer to construction details or contact the Maplin Technical Support Helpline (Tel: 01702 556001) if in doubt.

THE MAPLIN MAGAZINE ELECTRONICS

January 1998

and Beyond

Vol. 17 No. 121

Projects

- 13** **Getting Audio onto CDs**
Change your old analogue LPs to digital via your computer with this CDR recorder system.
- 30** **Circuit Maker**
Cable core identification becomes a doddle when you build this project.
- 48** **Touch Hybrid Relay Board**
Add relay output control to your touch hybrid security system.

Features

- 8** **Getting on the Internet**
Mark Brighton tries to persuade you, if you haven't done so already, to get online to the World Wide Web!
- 20** **Cold Fusion Update**
Douglas Clarkson looks into muon catalysed fusion and the RIKEN experiment at the Rutherford Appleton Laboratory.
- 24** **What's in a Name?**
In Part 11 of this series, Greg Grant investigates piezoelectricity and the use of crystals in electronics.
- 26** **Pick a Pocket**
Keith Brindley reviews the latest in Personal Digital Assistants (PDAs).
- 32** **The Latest in Printing Technology**
Reg Miles details the ongoing evolution in printer design.
- 38** **Technology in the Mountains**
Rob Sperring puts some Maplin products to the ultimate endurance test, taking them up the Peruvian Andes!

- 42** **Information Economy**
In the concluding part of this series, Stephen Waddington discusses the phenomenon of information overload.
- 56** **Radio Communications Review**
Harry Watkins kicks off a new series on radio equipment, by tuning into aerials, preamplifiers and filters.
- 62** **Communicating Through Water**
Part 2 of George Pickworth's article on pre-Hertzian wireless signal transmission describes the lake effect and polarisation.
- 66** **Security Electronics Systems**
In Part 4 of his series, Ray Marston looks at practical visible-light optoelectronic security circuits.
- 72** **New Products**
A selection of items from Maplin's New Year collection.
- 80** **Software Hints and Tips**
Ruth Hewer shows you some useful computing shortcuts in this new series.

Regulars

- 2** News Report
- 5** Back Issues
- 6** How to Subscribe
- 31** Comment
- 41** Classified Adverts
- 58** What's On & Diary Dates
- 60** Technology Watch
- 61** Clearance Sale
- 54** Research News
- 71** Air Your Views!
- 76** @Internet
- 79** In the Pipeline



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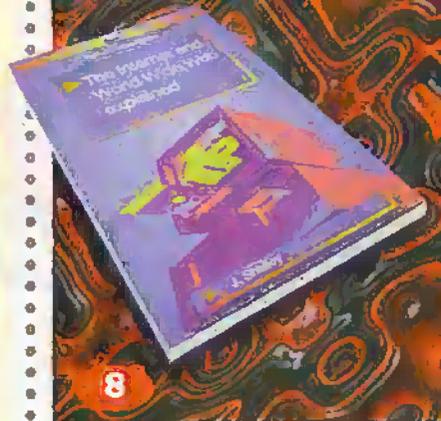
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8



26



32



72

ELECTRONICS

and Beyond

Can you imagine our world where information is being thrown at you in all directions. At present we have junk mail through the post, unsolicited phone and fax calls, junk E-mail, freebie newspapers and the roadside is littered with advertising boards and hand-outs. And still to come: Active advertising on your supermarket trolley, advertising on the floors, ceilings, water and in the air – not forgetting through audio and video without the conscious mind realising it. There will be many others I expect but are we prepared for this? I mention it because our article by Stephen Waddington looks at just one aspect of this 'information overload' namely the Internet.

Congratulations

Your luck is in Mr M T Ford of Evesham, Worcestershire, you have won the Fluke Scopemeter 123 competition. We had great difficulty feeling amongst the hundreds and hundreds of applications to produce one winner but your name was picked out of the hat. We hope you will get lots of useful measurements from this wonderful bit of kit from Fluke. The answer was of course (c) Connect and View. Our thanks go out to all the other applicants for taking an interest in the competition (probably our most successful yet) and keep reading you never know what we have to give away next!

Paul Freeman-Sear, Publishing Manager

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The Digital Economy

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PROJECTS FOR YOU TO MAKE
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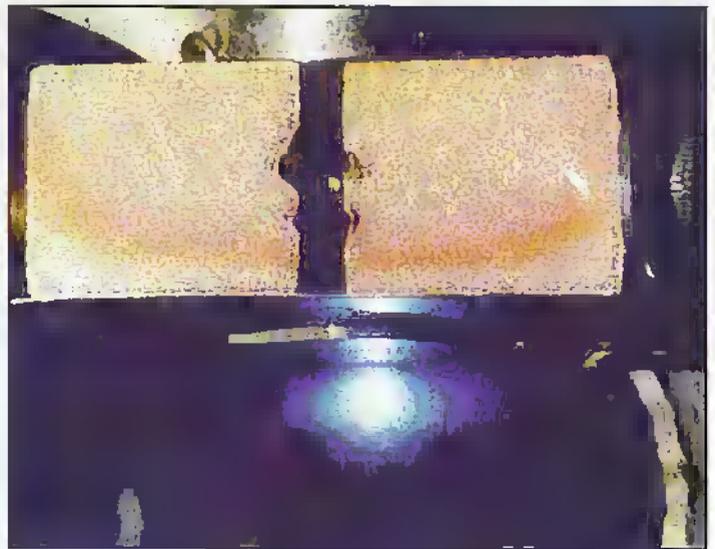
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NEWS

REPORT



Sandia Patents Extreme Ultraviolet Light Source

The realisation that atomic gas clusters could serve as part of a sort of 'light bulb' that emits extreme ultraviolet (EUV) light when laser-heated has inspired a recently patented invention at Sandia National Laboratories. This light source is enabling the research and development of EUV lithography to pattern faster, more memory-dense microchips.

Until this invention, synchrotron radiation was the most technically mature alternative for creating EUV light for research lithography systems. Advantages of creating EUV light from laser-heated clusters of xenon gas are that the EUV light that can be gathered and used is potentially brighter than that from a synchrotron – which sprays radiation out in a pinwheel pattern – and the light source takes less space.

In the Sandia invention, a small jet of xenon gas is cooled to temperatures within a few degrees of absolute zero by supersonic expansion into a vacuum. Xenon clusters, in which thousands of atoms are held together by weakly attractive Van der Waals forces, form at these low temperatures. The xenon clusters are heated to about 500,000 Kelvin with pulses of laser light, becoming a plasma. The plasma re-radiates some of this energy, producing EUV light in the process.

For further details, check: www.sandia.gov.

Contact: Sandia National Laboratories, Tel: +1 510 294 2932.



Intel Announces New Class of Flash Memory Products

Nine years of flash memory industry leadership and over 400 million units shipped have culminated for Intel Corporation in a technology that will have a revolutionary impact on the flash memory market segment. Intel today announced a new class of flash memory products, called Intel StrataFlash memory. The Intel StrataFlash memory family of products stores multiple bits of information in each cell and can be used in classic as well as emerging applications.

Speaking to *Electronics and Beyond*, Gordon Moore, Intel's chairman said, "Two bits in the space of one starts a new direction in memory technology. This will lead the way to lower cost and open up new applications".

For further details, check: www.intel.com.

Contact: Intel, Tel: (01734) 403000.

TriMedia Processor Enabling New Generation of Consumer Products

Years of basic research at Phillips' labs is finally paying off with shipments of a new generation of programmable devices. The TriMedia processor has been specifically designed to handle the heavy processing demands of high quality video, sound and communications. As

complex as a Pentium, it can be used as a stand-alone processor in consumer appliances or as a co-processor in a PC.

For further details, check: www.semiconductors.philips.com.

Contact:

Phillips Semiconductors, Tel: +31 40 272 20 91.



Modular Options Add PC Card Functionality

Portable Add-ons has announced 56k-bps, GSM and ISDN modular options to its FreeSpirit range of PC Cards. Users will be able to add additional functionality to their existing FreeSpirit card by purchasing the relevant upgrade pack. The 56k-bps, GSM and ISDN are priced £269, £125 and £149, respectively.

For further details, check: www.portable.co.uk.



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

BT Wired Man Project



Almost by a process of technological osmosis, an increasing percentage of the human race are gradually becoming cyborg, claims Professor Peter Cochrane, head of research at BT Laboratories.

"Around 20% of the functional parts of a human body can already be replaced. This includes the knee, hip, ankle and elbow joints, artificial hearts, ears, and skin, and shortly, we will have; lungs, liver, pancreas and other vital organs as well. There are also now well over half of a million people walking around with electronics embedded inside them in the form of pacemakers and so on", added Professor Cochrane.

With this in mind and the fact

that many people now carry pagers, calculators, mobile phones and health monitors, researchers at BT Laboratories are now working on the 'BT Wired Man' - a study of the potential for combined communications to both the outside and inside of a human being.

Among the items being examined are pacemakers, electronic pain relief modules for the spine and knee, plus an anti-epilepsy unit that simultaneously fires pulses into the left and right hand lobes of the brain.

For further details, check: www.labs.bt.com/index.htm.

Contact: BT Laboratories, Tel: (01743) 647445.

Biological Sensor Enables E-coli Testing

Researchers at Texas Instruments have a biological sensor that could measure levels of E-coli bacteria in beef and monitor water quality substances in real time.

Potential applications for the biosensor technology include miniature sensor systems for remote environmental monitoring such as water quality control, food and beverage process control, diagnostic testing and monitoring of chemical abuse, chemical and drug research and manufacture, and affordable capable technology to detect the presence of pathogens in poultry or beef.

For further details, check: www.ti.com.

Contact: Texas Instrument, Tel: (01784) 212000.

IDT Unveils 200MHz Processor

Integrated Device Technology (IDT) has announced a 200MHz version of its IDT79RV4700 processor. According to IDT, the higher speed will enable designers to employ the processor in an expanded spectrum of embedded high-performance applications including Layer 3 local area network (LAN) switches, gigabit switches, high-end routers, wide area network (WAN) interface line cards, colour printers and Ethernet-to-ATM (asynchronous transfer mode) bridges.

For further details, check: www.idt.com.

Contact: IDT, Tel: (01372) 363339.

BT Moves Closer to High Capacity Optical Network

BT is running two pilot trunk network links using 16-channel dense wavelength division multiplexing (WDM) systems, moving the company a step closer to a high capacity all-optical network for the UK.

The two new links between Belfast and Carlisle, and Newcastle and Edinburgh, will be able to move network traffic at up to 40G-bps - sixteen times faster than existing long distance optical fibre systems.

The pilot schemes, which will operate on two of the longest and busiest routes in the UK, are expected to enter service as early as 1998. The technology will be installed on both direct and back-up routes between the locations.

For further details, check: www.bt.com.

Contact: BT, Tel: (01743) 647445.

NEWS BYTES

£1/2 Million for Digital Radio Trials

The Radio Authority has announced details of a £1/2 million field experiment with digital radio, designed to improve the planning effectiveness, efficiency for local services, the first of which will be advertised next year.

Although digital radio is an intrinsically well-proven system, the Authority wants to increase the experience available with low-power networks and scenarios, whereby a service has to cope with interference from other local services sharing the same frequency.

Contact: Radio Authority,
Tel: (0171) 430 2724.

TI Announces £15 Million University Research Fund

Texas Instruments (TI) has announced a £15 million investment to support applications for high performance digital signal processors (DSPs) at universities around the world.

The creation of this DSP University Research Fund is the latest in a series of actions to widen the company's lead in digital signal processing solutions. It complements TI's establishment of a £60 million venture capital fund and the opening of a major new research facility, both supporting future DSP applications development.

Universities interested in submitting abstracts to the TI DSP University Research Fund should begin by looking at basic criteria on TI's home page.

For further details, check:
www.ti.com.

Contact: Texas Instrument,
Tel: (01784) 212000.

European Consumer Clear Shelves of Mac OS 8

More than 200,000 copies of the new release of the Macintosh Operating System, Mac OS 8 were sold across Europe in the first two weeks following its launch, confirming that Apple is still a key platform in Europe.

The first localised version of MAC OS 8 was launched in France during the middle of September with other countries following since then. Global sales of the MAC OS 8 worldwide have reach more than 1.6 million worldwide since its introduction in the US at the end of July.

For further details, check:
www.apple.com.

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



Electronic Wallet Goes on Trial

After nearly two years of development, US-based Currency Scientific Inc. (CSI) has announced the completion of the world's first Electronic Wallet and is inviting payment industry leaders to evaluate its advanced technology for use in planned pilot tests.

The Electronic wallet provides consumers with everything necessary to perform credit, debit, cash and identification, and other financial account transactions at the point of sale, at ATMs or between consumers.

Increasing the security of all types of monetary transactions, CSI combines sophisticated Direct Sequence Spread Spectrum communications with a hybrid crypto system. Credit and debit transactions are made more secure, using cryptographic signaturing, thereby eliminating the exposure of account numbers to retail clerks and providing proof of transaction.

Additionally, the CSI Electronic Wallet can store electronic identification and personal data, such as drivers' licenses, pass key entry, insurance accounts, product preferences and frequent flyer programs.

For further details, check:
www.emoneyworld.com.

Contact: Currency Scientific,
+1 781 329 7799.

Miniature Displays Get Colour for Free

A new way of producing colour on small liquid crystal displays (LCDs) is being pioneered by screen manufacturers, MicroDisplay. The new method uses diffraction, very similar to the way a prism separates white light into its component rainbow of colours.

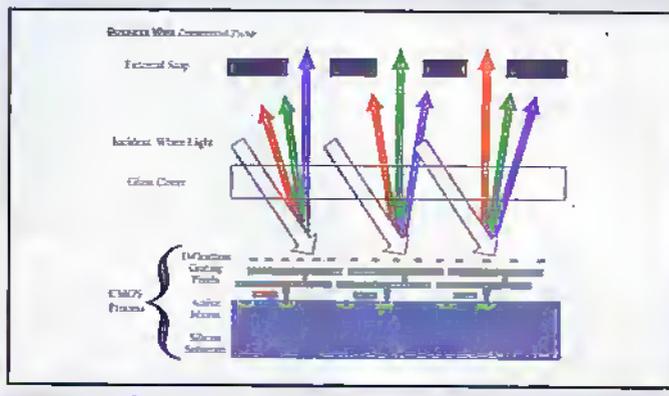
MicroDisplay's colour displays use small diffraction gratings to generate a reflective mode display with saturated colour pixels. Much like miniature prisms, the gratings diffract rainbow patterns when illuminated with white light.

MicroDisplay designs each grating to diffract a colour component (red, green, or blue) of the white light towards a particular direction. Each pixel triad on the display is composed of sets of specifically designed gratings to handle red, green, and blue light components.

The current dominant method of colour production in LCDs requires that a mosaic of red, green, and blue gel filters be placed over each pixel triad. These filters, while producing effective colour, reduce the amount of light transmitted through the display, causing the display to be darker and colours and images less distinct.

For further details, check: www.microdisplay.com.

Contact: MicroDisplay, Tel: +1 510 243 9515.



Disk Dimensions Drive Downwards



Western Digital claims to be the first disk drive manufacturer to announce a low-profile 9.1G-byte, 3.5in. Ultra SCSI hard drive. Volume production of the new drive commenced in October at Western Digital's Tuas, Singapore, manufacturing facility.

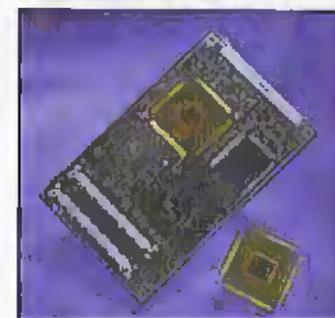
For further details, check:
www.wdc.com.

Contact: Western Digital,
Tel: (01372) 360055.

Philips Brings Answering Machines and Cordless Phones Under Digital Control

Like many consumer electronics equipment, telephone answering machines and cordless phones now feature digital keypad control of all their functions, including loudspeaker/earpiece volume, ring-tone volume and answer response time. Until now, however, designers had to add a considerable amount of peripheral circuitry around conventional telephone ICs in order to implement these features.

With the introduction today of the UBA1707 Telephone Line Interface IC, Philips Semiconductors has greatly simplified the design problem. This brand new single-chip solution not only brings the analogue functions of cordless phone base stations and telephone answering machines under full digital control, it also includes an on-chip loudspeaker amplifier, microphone amplifier and electronic hook control.



For further details, check:
www.semiconductors.philips.com.
Contact: Philips,
Tel: +31 40 272 20 91.

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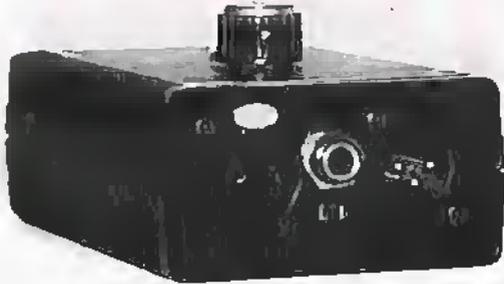
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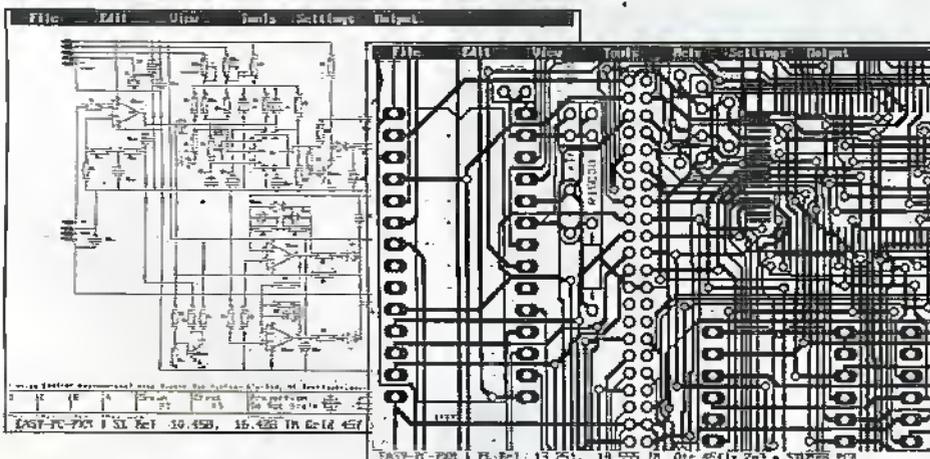
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<http://www.numberone.com>



Getting On-Line TO THE INTERNET

PART 1

by Mark Brighton

Are You Avoiding the Net?

Have you considered trying the Internet? If you have, but are a little unsure how to go about it or would like to know more about what you need to buy and fit to your computer, this series of articles will let you know exactly what is involved. This will help you to make each decision along the way with confidence. Over the next few months, we will take you through each of the steps in detail, discussing the choices, choosing and fitting the hardware and software, configuring your system and going on line for the first time.

This really is a worthwhile exercise. Far too many computers sit in the corner of a room with just a few games and a word processor installed, but an Internet connected computer can be so much more than this. The Internet gives your family a window into the world and transforms your PC into a live evolving world encyclopaedia and communicator!

You don't have to be in the least bit interested in computers to enjoy using the Internet. This takes some getting used to, especially for those of us who already have a picture in our minds as to what a computer is all about.

Connectivity is the Key

I personally first encountered home computers in the early 1980s, when a virtual torrent of new models capable of all sorts of new things were hitting the market at once. Colour displays, sound and musical effects (of a sort) and the luxury of a disk drive (5¼in. floppy with a massive 350k-bytes of storage) made these machines seem very sophisticated compared with the stark, metal cased utilitarian computers of the decade before. Computers had become more than mathematical modelling tools for academics and started to have a use in the home.

I still have an Atari 800 computer of 1979 vintage (all robust beige plastic on the outside and heavy duty cast aluminium casings inside) with matching disk drive and cassette player. Because of a forthcoming trip to Germany, I even resurrected this system just the other day to load up a cassette-based 'Conversational German' course. Whilst listening to the cheerful burring sound of data gradually streaming into the computer (occasionally rewinding and starting patiently again when it all went wrong), I had time to muse on the fact that many young PC users are probably not even

aware that there was a day, not so very long ago, when home computer buffs could only get data into (or out of) their 8-bit pride and joy by connecting it to the 'Mic' and 'Ear' jacks of a common or garden cassette player. Volume controls then had to be painstakingly adjusted until the data flowed smoothly.

My own sons were quite astonished that they would have to wait for ten to fifteen minutes for a game to load via cassette! They take their hard drives, CDROM drives and the like for granted, not to mention the dedicated games consoles with their 'instant play' cartridges.

This isn't an article about computing nostalgia, but the above serves merely to illustrate the fact that most of the advances in computing power are directly related to improvements and refinements to the connectivity of those computers. This applies both to the means by which we get data into and out of the computer and in the way the computer communicates with the real, human world.

Early home computers were limited to slow tape-based loading and saving of data, strictly one file after another, as well as very primitive sound and graphics. Later ones were fitted with disk drives, allowing multiple random file access from anywhere on the disk within seconds. This was an important factor in the overall evolution of the computer because it was the medium that allowed access to all of the extra data to fill the extended amounts of memory that were fitted to later machines.

Extra memory in turn allowed storage and manipulation of the extra data required to animate more complex colour displays and to control the new dedicated sound generators with waveform and envelope shape control, filtering and so on. The speed of the machines increased, allowing the CPU to do all the number crunching necessary to process all that extra data smoothly to produce a far more realistic result in an analogue world.

The development of the hard drive from the 10 or 20M-byte capacity found in computers at the end of the 1980s to the Gigabytes of storage available today has played its part in the greatly increased ability of the home computer (by now, predominantly the IBM PC-AT compatible series) to act as an entertainment and



Photo 1: An example taken from the software provided by CompuServe.

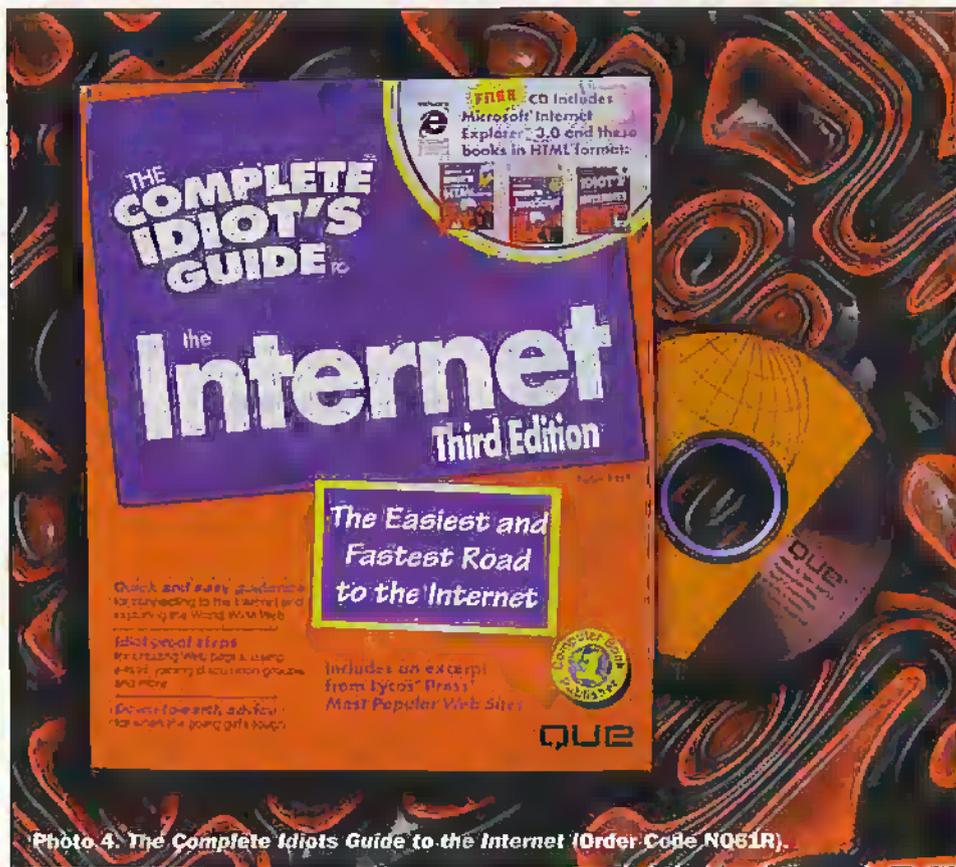


Photo 4. The Complete Idiots Guide to the Internet (Order Code NQ61R).

actually need these packages in order to use their systems to gain access to the Net. The nature of the direct access ISP contact points (sometimes called 'Points of Presence') allows you to use a standard Internet browser program once you log on (by entering your account details) to the providers host machine. Examples of well-known browsers include Netscape Navigator and Microsoft Explorer (which is included in all more recent versions of Windows 95).

Now, let's take a look at examples of these services a little more closely.

CompuServe

CompuServe, formed in 1969 when the Internet did not even exist in its present form, are the biggest service provider in the world. They have put together a package of on line services (CompuServe Interactive) tailored to be home and office friendly, avoiding technical jargon and the need for specialist software knowledge wherever possible. Just press a button to access news, weather, stock market information or a number of different home- and leisure-based areas. They run a number of virtual club/conference/exhibition sites (called forums) on almost any subject, similar to Internet Usenet groups, but with more interactivity and structure presented intuitively for the ordinary man (or woman) in the street.

CompuServe has been around for a long time and as such, they set their own standards for software and presentation a long time ago, well before the advent of Internet browsers like Mosaic, Explorer, Navigator and the like. Unfortunately, in some ways, this means that their special access program, originally called CompuServe Information Manager (CIM or WinCIM) was

not compatible with the Internet. Initially, they grafted a modified version of Mosaic to their software package when they introduced Internet hosting, but this very obviously ran as two different programs.

They have continuously changed their software to make it more friendly and

seamless, and the current version, called CompuServe 3.0, makes browsing much more simple, although it still runs a separate browser for Internet access (now Microsoft Explorer). E-mail is also offered and CompuServe are in the process of converting from the use of long unwieldy membership numbers to identify individual subscriber address to a real naming system, e.g., john_smith@compuserve.com.

CompuServe Tariff Scheme

CompuServe has traditionally run a tariff scheme charging a basic monthly charge that includes up to five hours access per month, plus extra charges for periods over the first five hours. In addition to this, the CompuServe service package is a multi-tier one, with a base of free (to subscribers) services and a higher tier of premium services for which a surcharge is levied whilst you are connected to them. Just to complicate matters, all charges are made in US Dollars and are subject to exchange rate fluctuations outside of the US.

At the time of writing, CompuServe are carrying out the conversion of their billing system to a largely flat rate service, initially in the US and Canada only. The flat rate charge is US\$24.95 per month for unlimited access, although surcharges will still apply to some services.

It is always very easy to try CompuServe out, as they often give away cover CDs on the PC magazines with a free month's trial period, trial password information and free software.

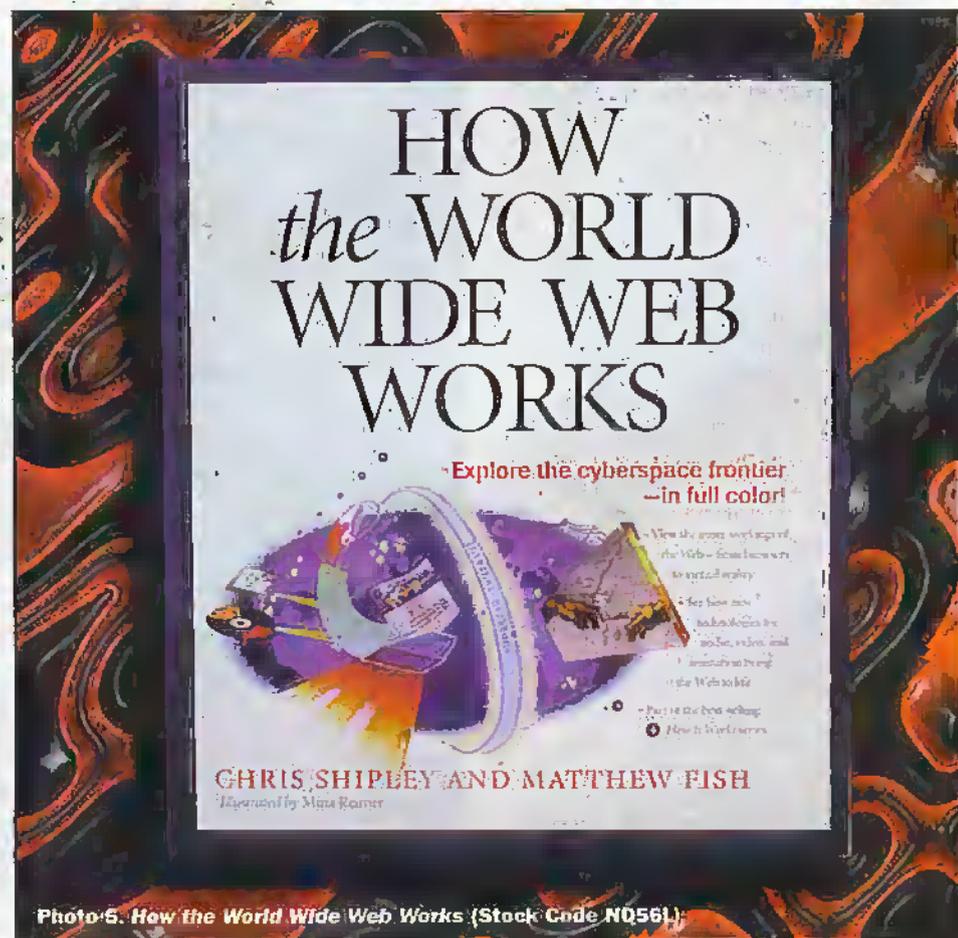


Photo 5. How the World Wide Web Works (Stock Code NQ561).

Compuserve Access Numbers

Compuserve have recently set up a Lo-Call 0845 number for nationwide access, so you no longer need to know where your local Compuserve node is, or program one of umpteen local numbers. Access is currently at speeds up to 33.6k-baud, and may be upgraded to 56k-baud in the not-too-distant future.

Demon Internet

Demon is one of the best-known Internet Service Providers. It was founded in 1992 when the Internet and its protocols were already fairly well established. They were able to start out by offering a standardised package and does not have to face the equivalent Betamax/VHS type problem that early players like Compuserve are still burdened with. They do not offer themed browsing areas, forums or a control panel for the Internet in the way that Compuserve do, but leave you to rely on third party browser software to access the search engines that already exist on the Internet (more of those in a later issue).

Having said that, Demon do offer a software package as an extra option to subscribers, which automates and simplifies the process of connecting to the Internet and using its different facilities. The package, called Turnpike, provides an easy-to-install solution for many users but can sometimes cause problems with other networking software, particularly if a cabled company network is also in use. It would seem that Turnpike does replace or modify some files required by other networking software.

A standard dial up account with Demon gives you unlimited access to the Internet. It allows you to set up your personal e-mail address and for unlimited mailboxes to be set up for members of your family, friends and so on. Access to newsgroups is provided, allowing you to view or participate in correspondence on any subject.

Should you feel like setting up your own Web site, Demon also give each subscriber 5M-byte of virtual Web space for personal or commercial use. These even include two digital audio channels (RealAudio streams) to add sound broadcasting facilities to your site. Note that the Turnpike software package available from Demon includes the Web authoring program, HoTMetal Light 3.0, from SoftQuad.

Demon Tariff Scheme

Demon charge a one-off set up fee of £12.50 and a monthly unlimited access charge of £10. There are no additional charges for access to any Internet site, but the difference between Demon and an On Line Service provider like Compuserve is that with Demon you are only (sic) gaining access to the Internet and not to specific information or forum services managed by the service provider.

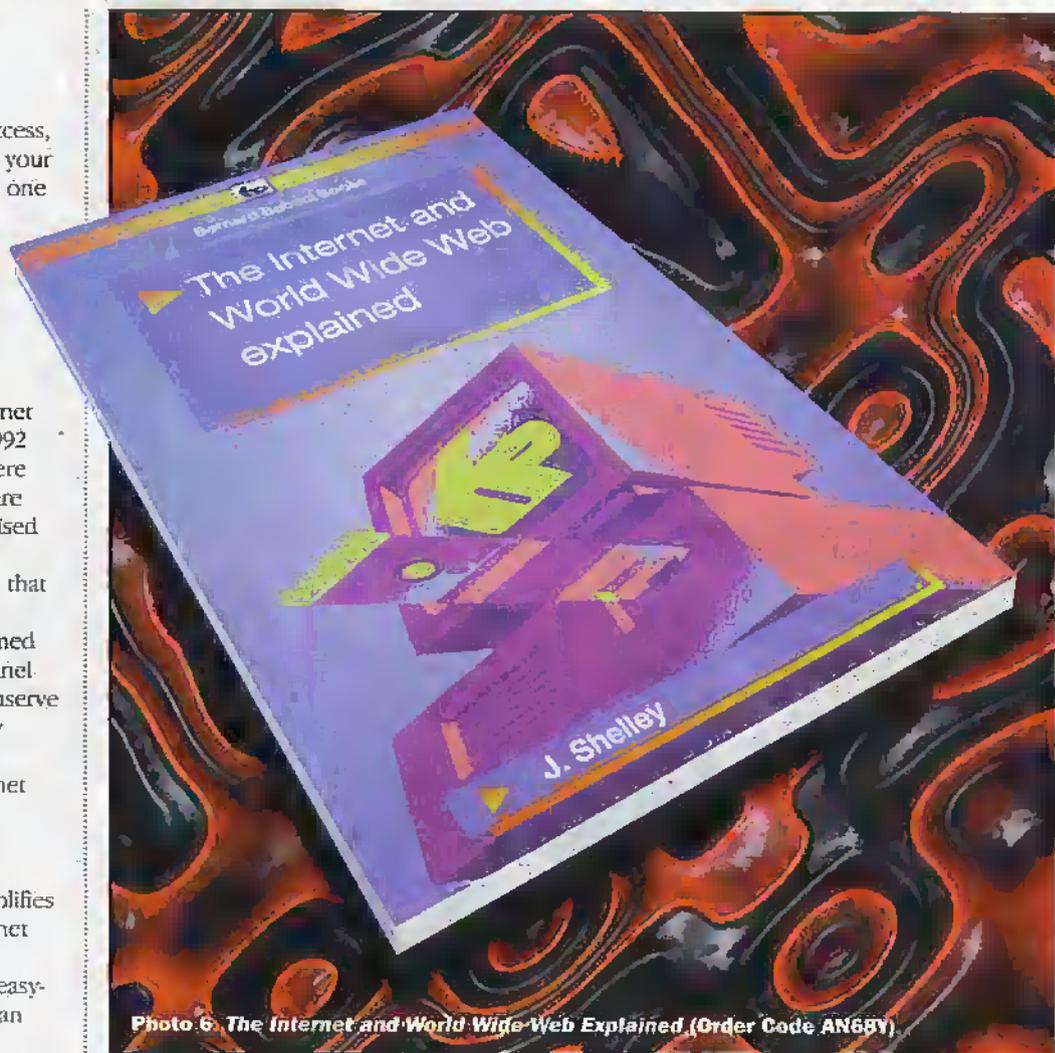


Photo 6. The Internet and World Wide Web Explained. (Order Code AN65Y)

Access Numbers

Demon have long used what they call 'virtual Points of Presence' (vPoPs), allowing you to dial one of a selection of Lo-Call 0845 numbers, depending what speed or line type you wish to access (analogue, ISDN or Orange cellular). 33.6k-baud access is now being provided on one of their access numbers and they have stated their intention to provide sufficient modems "that in the peak 15 minute period, 95% of callers obtain a connection within 5 attempts". The best known of the Internet Service Providers are to some extent becoming victims of their own success. Membership of Demon has grown in an almost parabolic curve as the Internet has become part of everyday life and there is no doubt that there are periods when it is rather more difficult to get a connection than one would wish.

Demon have announced recently that they are in the process of fitting new equipment that will allow compatibility with the coming 56k-baud technology standard.

Taking the First Step

I would not ask my readers to believe that the above has formed a complete description of all that either of these two service providers have to offer, but I hope that the information has been representative of the different types of access available. This series of articles is

concerned with nursing the beginner through the sometimes confusing process of getting on line to the Internet, with step-by-step examples, but it will still leave you with some choices to make along the way. Quite apart from Compuserve and AOL, who provide their own custom solution to Internet access, there are a growing number of ISPs all offering a very similar connection at a variety of different prices. The reader is advised to read reviews, study the advertising and ask the recommendations of anyone they know who is already on the Net before making their decision.

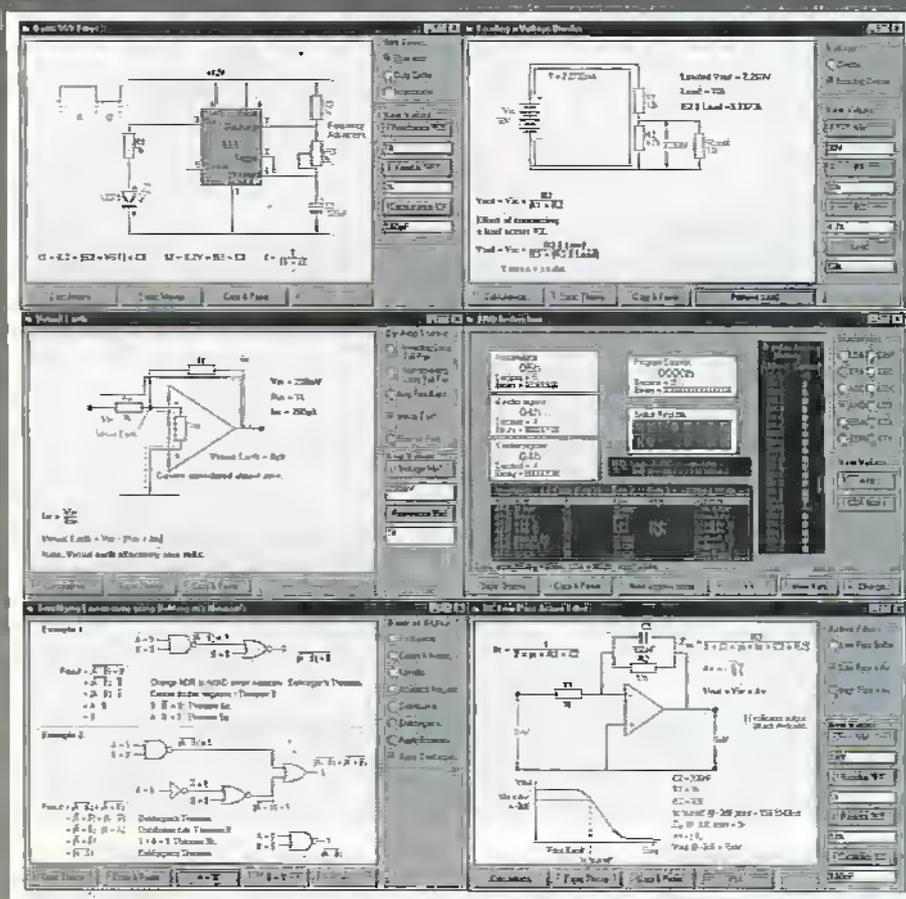
For the remainder of this series, we will use the example of a first time user who has chosen to open an account with Demon Internet, a standard ISP, although the information provided will directly apply with no changes to other ISPs and no choice as to a best or most suitable service provider should be inferred from our example. The ISPs tend to provide very easy to set up custom software and take you through the steps necessary to make a connection in any case, although the sections about choosing a modem and configuring your system for on line access should still apply. Next month's article will look at the hardware and software necessary to get on line and help you to choose a modem and Internet browser software, assuming throughout that you have decided not to purchase the service provider's software package and are intending to go it alone.

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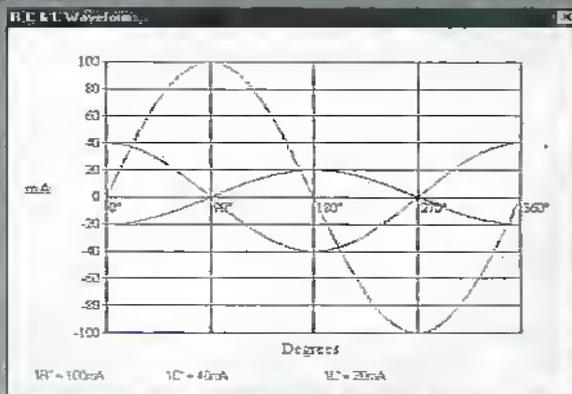
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Calculations:

$$\begin{aligned} \text{Total } R^* &= 4700 + 2500 + 100 = 7300 = 7.3k \\ V &= 3.424658E-03 \times 7300 = 25 = 25V \\ I &= \frac{25}{7300} = 3.424658E-03 = 3.4247mA \\ \text{Total } R^* &= \frac{25}{3.424658E-03} = 7300 = 7.3k \\ V1 &= 4700 \times 3.424658E-03 = 16.09589 = 16.09589V \\ V2 &= 2500 \times 3.424658E-03 = 8.561644 = 8.5616V \\ V3 &= 100 \times 3.424658E-03 = .3424658 = 342.4658mV \end{aligned}$$

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Philips CD-RW drive and disc.



Making YOUR OWN CDs

PART 1

Martin Pipe describes how you can produce audio CDs from a variety of sources.

Not so long ago, such a concept would have seemed absurd unless you had several millions of pounds to invest in a CD pressing plant. But thanks to the wonders of CD-Recordable (CD-R), making one-off CDs that contain up to 74 minutes of audio is not only affordable, but practical too. A new breed of self-contained consumer audio

recorders, from the likes of Pioneer and Philips, are beginning to appear. The most flexible approach, however, involves a computer peripheral — the CD-R writer or 'burner' — that can now be picked up for little more than the price of an audiophile CD player. The blank discs needed now sell for around £4 each — although you can pick up unbranded discs for

as little as \$1.50 each, in bulk. In terms of computer, you'll need a PC equipped with at least a 486DX2/66 processor, or a 68040 (or faster) based Mac. A gigabyte or so of spare hard disk space, for the storage of temporary audio files and/or disk images, is also recommended.

The discs that you create conform to the original Red

Book audio CD standard, and hence, can be read on the majority of CD playback hardware — including Hi-Fi systems, personal Discman-style players, computer CD-ROM drives, LaserDisc players, CD-based videogames (like PlayStation and 3DO), in-car CD players and CD-i systems. Even an old (circa 1984) and tatty Philips CD104 is able to play most of my audio CD-Rs impeccably. The only equipment that has reputedly succumbed to compatibility problems is the first generation of DVD players, most of which didn't make it to the UK. The issue doesn't affect newer generations of DVD hardware.

Applications of CD-R audio are enormous, making this the most exciting development in audio recording for years. If you're in a band, imagine being able to send a demo CD instead of a demo tape. Transcribing your favourite tape recordings, or rare and valuable vinyl records, onto CDs for general use — what a concept! DJs, in particular, may find this of value — some of their records are expensive-to-obtain 12in. imports, or special promo issues. DJ-specific CD players that offer a considerable amount of manipulative flexibility — such as Pioneer's CDJ-500 and Soundlab's dual deck (Maplin Stock Code FUB6T) — are now commonplace in clubs. CDs are much more portable than records, and are thus proving to be the format of choice as far as the mobile DJ is concerned. As somebody who used to DJ myself, I know exactly how galling it can be for prized records to go AWOL.

General-purpose mobile DJs, who cater for wedding receptions and other events, can assemble compilations of the 7in. singles that are requested most frequently. Twenty-four three-minute singles can be accommodated on a single CD-R. This saves on weight — important when you're lugging around boxes at 2am on a Sunday morning — and wear and

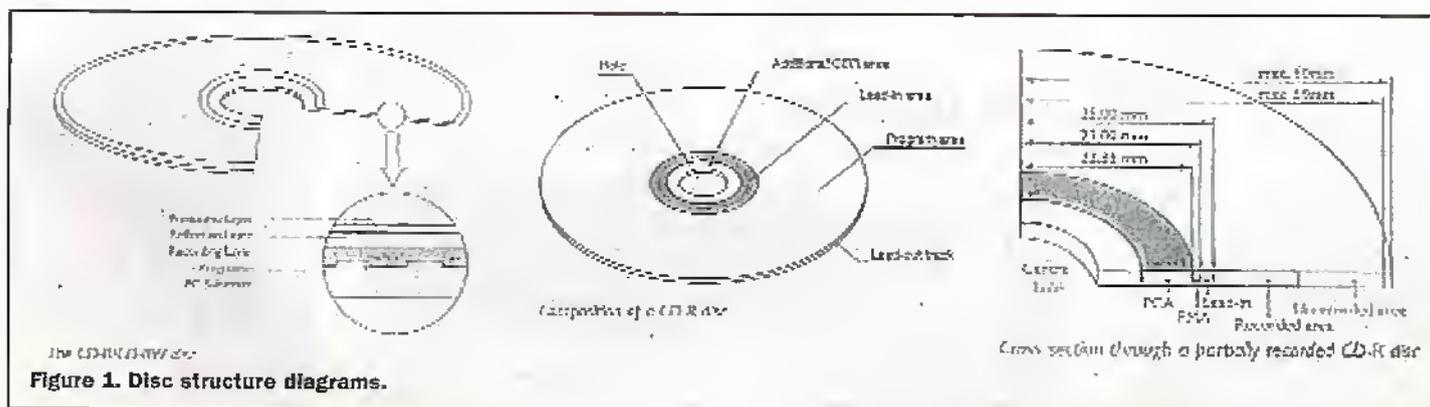
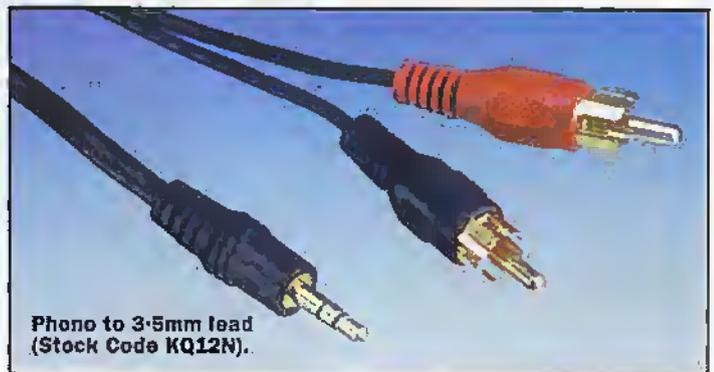


Figure 1. Disc structure diagrams.



DJ CD player (Stock Code FUB6T).



Phono to 3.5mm lead (Stock Code KQ12N).

tear on the records themselves. The 'man in the street' can also produce compilations of favourite CD tracks – with sound quality miles above that of the finest cassette decks. There are also business applications for CD-R audio – many companies use a CD player hooked up into their call-waiting systems. With CD-R, you can produce your own call-holding music, complete with announcements that give details of special offers and other news announcements.

It is possible to copy CD tracks digitally, saving them to your hard disk first as a digital audio file (.WAV for PCs, .AIFF in the Mac world). There is hence no perceptible loss of quality whatsoever. Your CD-ROM drive must, however, support digital audio extraction – and that generally means a SCSI CD-ROM drive. That said, some MS-DOS extraction utilities have been written specifically for some non-SCSI drives, such as the old dual-speed Panasonic CR-562. These can be found on the Internet – try entering the drive's model number into a search engine, like AltaVista (<http://www.altavista.digital.com>). This isn't an issue for Mac users, since the adoption of SCSI for peripheral interconnections is near-universal. All is not lost for PC users, however. If your CD-R unit is SCSI-interconnected, then this can be used to extract the audio files for temporary storage on your hard disk.

To make recordings from analogue sources, such as tapes, vinyl and the analogue outputs of digital audio equipment, you will need a sound card in your computer to digitise the audio, and store it on your hard disk as a 16-bit stereo 44.1kHz-sampled (i.e., CD-quality) file. The vast majority of PCs sold for domestic multimedia applications include a sound-card, while all Apple Macs have an audio input as standard. Some PC sound-cards, such as the 400 Turtle Beach Multisound Fiji, have a SPDIF coaxial digital input. Through this, programme material sourced from digital recording formats (such as DCC, MiniDisc and DAT) and broadcasts (DAB,



Goodmans Mini Turntable (Stock Code KS28D).

when it finally gets going) can be saved to hard disk, and from there, transferred to CD without the need for intermediate analogue conversion stages, giving potentially-better sound quality. End-to-end digital live recordings are thus possible – even for consumers and fledgling bunds! More on this next month.

Just about all CD burners are supplied with mastering software that allows captured sound files to be converted into Red Book-compliant CD audio tracks. Before burning the CD, you can apply various effects (such as trimming, noise reduction and fading) to your audio captures using an audio editing program. As far as the PC is concerned, the best such programs include GoldWave and CoolEdit 96, both of which are available as shareware on computer magazine covmounted CD-ROMs and the Internet (try <http://www.shareware.com>). The commercial package EasyCD Creator from Adaptec, which will be detailed next month, includes some surprisingly effective filters specifically for cleaning up hissy tapes and scratchy LPs. More vinyl-related issues are discussed at the end of this article.

A Bit About Data

CD-R was originally introduced as a system of producing test pressing data CDs. The first CD-R mastering equipment, which sold in 1993 for tens of thousands of pounds, was enthusiastically embraced by the video game industries and software developers – i.e., companies rich enough to afford the damned things. Now, CD-R

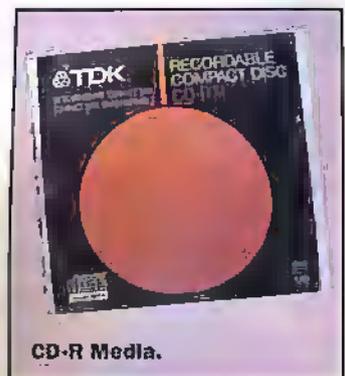
burners, capable of much better performance and small enough to fit into a computer's half-height 5.25in. drive bay, can be picked up for around £300. Most hook up to a SCSI port, although some connect via the IDE interface that's rather more common, at least, as far as IBM-compatible PCs are concerned. If you opt for a SCSI model for your PC, don't forget to budget for a host adaptor if your machine doesn't already include one for the hard disk. Decent PCI SCSI-2 models start at £100 or so. The Adaptec 2920 (Stock Code CE40T) is a good SCSI-2 card for PCs with a spare PCI slot.

Unlike the first burners, which were strictly single-speed only, the models you can buy today are capable of writing at multiple speeds. Double-speed is very common, while more expensive models tend to write at 4x speed. The HP 6020i, available from Maplin (Stock Code LR97F) is a quad speed SCSI-2 interfaceable writer that sells for less than £300! If you're on a budget, then it's worth noting that many vendors offer the excellent double-speed Philips CDD2600, which also sports a SCSI-2 interface, for less than £200. The latest high-end models will write at 6x speed – in other words, writing the disc will take a sixth of the time needed to write a disc at single speed. Of course, CD-R equipment will also read conventional audio and data CDs. That said, it's worth hanging onto your conventional CD-ROM drive, particularly if you're making audio compilations from CDs. What's more, CD-R drives tend to be rather slow (this is because the

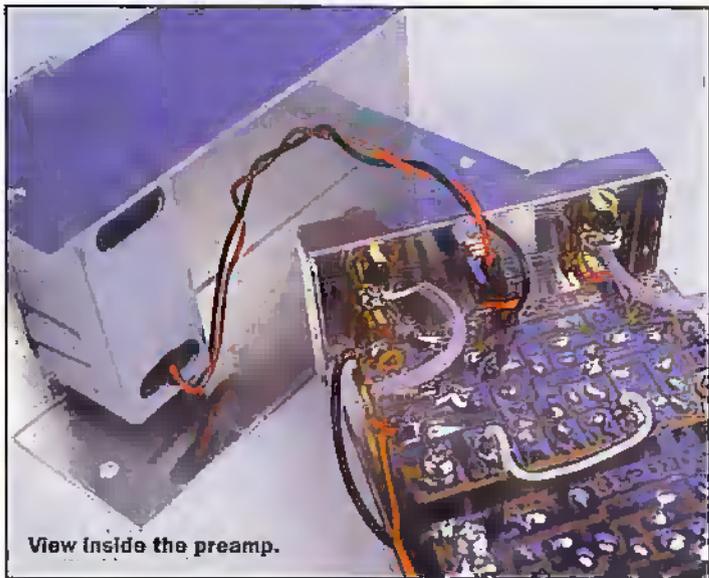
complex laser assemblies that they employ are rather heavy). While 24x CD-ROM drives are commonplace, the fastest CD-R drives currently available will only read at six-speed.

When used for data (Yellow Book), the capacity of a CD-R disc – known as a WORM (Write Once, Read Many times) medium because the contents of the disc can't be altered once it has been written and closed – is 650M-byte. Data applications of CD-R include back-up and archiving; even if you buy a drive primarily for producing audio CDs, there's no reason why you can't also use the peripheral for this eminently sensible task. Ask yourself how long it would take to reconstruct your data if it was lost through a virus infection or hard disk crash! Transfer of data between machines is another important use; just about every recent PC has a CD-ROM drive, while those with Zip, Jaz or tape drives built in tend to be relatively few in number. In addition, there is a variety of tape formats – DAT, QIC, Travan and DLT – and compression formats; just because your PC has access to a tape drive, it doesn't guarantee that the one available to your far-away colleague will be able to read your media.

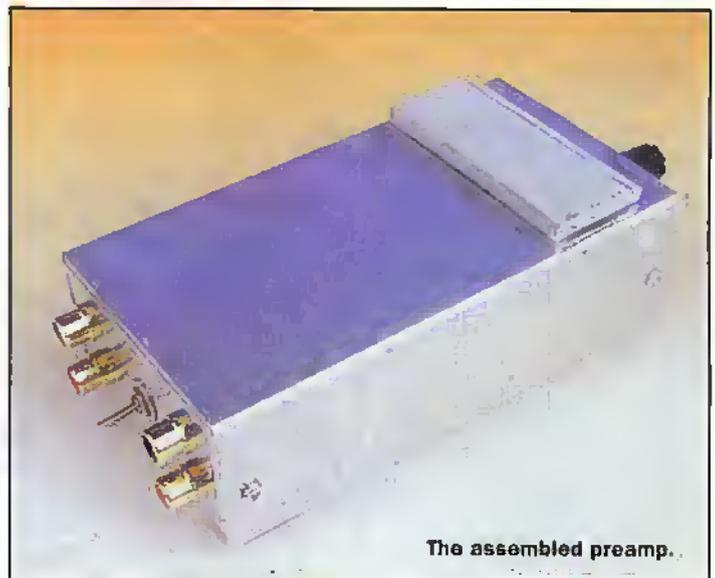
This particular issue of *Electronics and Beyond* is transferred via CD-R to the phototypesetting agency (the company that produces the final output films for the printer). Once the phototypesetter has finished with them, they're returned to the Maplin editorial office and retained for archive purposes. Until affordable CD-R



CD-R Media.



View inside the preamp.



The assembled preamp.

burst onto the scene, Maplin used to employ a removable hard disk system known as Syquest – which is rather fragile and, at 88M-byte, limited in storage capacity by modern standards. A significant argument in favour of CD-R's use as an archiving medium is that the lifetime of the media is said to be around 50 years. By this time, the information – whether audio or data – would have been transferred to another, more capacious, format – assuming, that it still has any relevance at that date!

The CD mastering programs that ship with CD-R hardware, such as Adaptec's Easy CD Pro 95 software suite, allow you to select and copy certain files from the hard disk, generally using a familiar drag and drop user interface. For cross-platform readability of the disc, the ISO9660 file format should be used. Unfortunately, ISO9660 only supports 8.3 DOS-type filenames. An alternative for Windows 95 users is the popular Microsoft-created Joliet, which allows long filenames. If the disc is to be read only by Macs, consider writing the disc in the Mac-specific HFS (Hierarchical Filing System).

Support for HFS is found – hardly surprisingly – nearly exclusively in Mac mastering software, such as Astarte (now Adaptec) Toast. All modern CD-R burning software is able to handle the track-by-track assembly of audio discs, to Red Book standards. The option to create mixed mode discs, which contain audio tracks (playable on CD-ROMs and audio equipment) as well as a data track (readable on the computer) is a feature, is usually also offered. Some packages can even handle the White Book standard – with this, you can create VideoCDs from MPEG-1 video files.

Next month, I shall describe not only how you can make

VideoCDs, but also how MPEG layer 3 (MP3) audio encoding – a system often used in broadcast studio links, since it is capable of CD-quality audio-streaming over ISDN lines – can be used to cram lots of music onto a disc. Unfortunately, you'll need a CD-ROM equipped PC to play them on, since the tracks are stored on data-mode discs as conventional (e.g., ISO9660) files. Some MPEG audio does have its advantages – a CD quality music track that would normally occupy 40M-byte as a .WAV file can be squeezed down to 5M-byte as a MP3 file – and is hence an ideal system for providing hours of uninterrupted music while you work. All of the tools needed – a WAV-to-MP3 converter, and a MP3 player application – can be found as shareware or freeware on the Internet. MP3 audio also has significant benefits for multimedia CD programmers faced with the task of cramming lots of information onto a single disc.

A recent development in CD data standards is Universal Disk Format (or UDF), which is likely to be supported by future operating systems. UDF, which is currently only available through special software supplied with CD burners (typically Adaptec's DirectCD), supports long filenames, and makes better use of the disk's capacity than older formats such as ISO9660. Through a technique known as packet writing, and an improved directory structure, UDF is able to support non-wasteful one-at-a-

time file writing. Although UDF is incompatible with ISO9660, it is possible to close CD-R (by writing a table of contents – TOC – to it) so that it can be read by conventional CD-ROM drives. UDF comes into its own with a new format, known as CD Rewritable or CD-RW.

Rewritable CDs

Equipment able to handle both CD-R and CD-RW is now becoming popular. As its name suggests, CD-RW allows you to re-use the disk – it is hence better suited than CD-R to back-up applications and the transfer of information between machines. Although the first such drives required you to re-format the disk before new information could be added – unlike floppy or hard disks, for example – the more recent models (or older ones that have had a firmware upgrade – typically available from the equipment manufacturer's Web site) allow you to selectively delete a file and fill its space with another, thanks to a feature known as 'random erase'.

Philips has recently released a domestic Hi-Fi component, the 500 CDR-570, that will record analogue or digital audio sources onto CD-Rs or CD-RW discs. Unfortunately, you have to wipe the CD-RW completely; it doesn't (unlike Sony's MiniDisc) have random erase, and hence, you can't change one song that you're tired with. Philips reckon that most people will re-record

the complete disc in one go, like they are used to with cassette tape. However, CD-RW is very unlikely to be seen as a replacement for the almost-universal cassette for some time.

This is because the format's most significant disadvantage is its incompatibility with the existing base of CD equipment – can you imagine somebody replacing all of the cassette players around the house with machines capable of playing back a new super-duper type of cassette? The surface reflectivity of the CD-RW media's coating – upon which the data is written – is very low at 15% to 25% (against CD-R's 40 to 65%, and CD's 70%); hence, there is insufficient radiation transmitted back to the CD mechanism's optical pickup. Fortunately, the audio and data CD equipment now being manufactured – known as 'multi-read' – will play CD-RW discs. CD-RW hasn't taken off quite as expected – many are waiting for DVD rewritable formats, which offer much higher capacities.

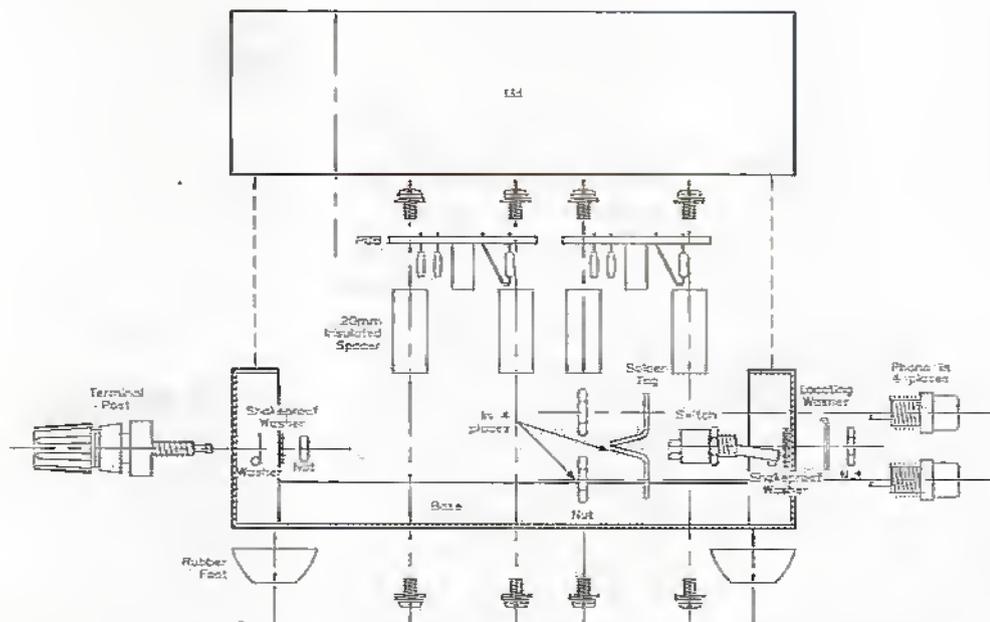
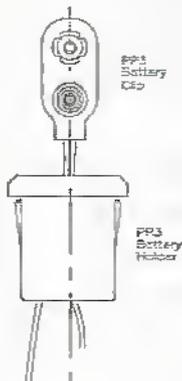
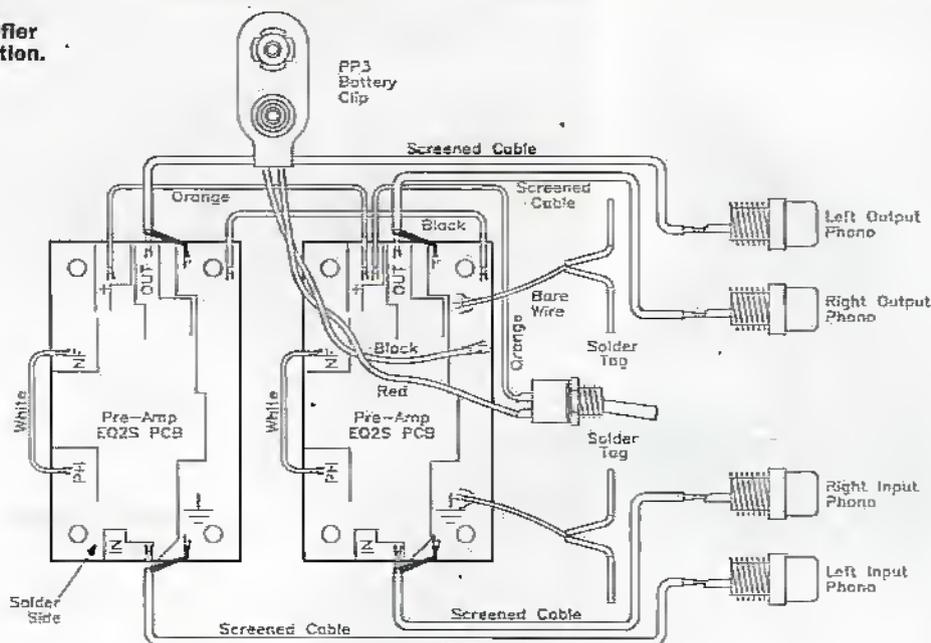
How It All Works

Although there is broad compatibility between conventional CD/CD-ROM and CD-R, the two systems are like chalk and cheese in terms of media. Conventional CDs are mass-produced ('stamped') from an injection mould that carries the negative image of a precision glass master disc. Molten polycarbonate is forced into the injection mould, forming the microscopic data-carrying pits. The information surface is then coated with a very thin layer of aluminium to provide a reflective surface. A final coating of lacquer is then applied to protect the disc. During playback, a low-power laser is used to read back the data. During playback, the



Philips consumer CD recorder.

Figure 2.
Preamplifier
construction.



infra-red radiation from the CD player's laser is reflected from the unpitted areas (lands) to the optical sensor, and scattered by the pits. The changes in level are used to regenerate the datastream's '1's and '0's (which are arranged as frames, each consisting of data, synchronisation, control and error correction information).

The master CD production

process has much in common with the way in which CD-Rs are written. A recording layer, consisting of a green organic dye, is embedded in the CD-R. A spiral of pits is burnt into this by the recorder's fast-switching laser. When this relatively high-powered laser (4 to 11mW) is pulsed on, the dye is molten, exposing a second reflective gold layer that does the same job as a mass-

produced CD's aluminium coating. These reflective pits carry the data, and can be read by regular CD playback equipment. Out of interest, writing is quite a complex process. The pulse initially is initially at a high power level to produce the required heating of the die. The power is then reduced to a level that is sufficient to maintain the dye temperature at a desired level.

CD-RW discs, which tend to be a muddy brown in colour, are rather different. They don't use the gold layer to provide the reflectivity required during read operations. The recording layer of CD-RW discs is an alloy of silver, indium, antimony and tellurium. It can be in two states or phases – hence the term 'phase change' that's often used to describe the technology that underpins CD-RW. This property is entirely responsible for the format's rewritable nature. In its original state, the alloy has a polycrystalline structure. When heated by the laser to create the pits, the alloy goes into an amorphous (non-crystalline) state that has a much lower reflectivity than the unwritten crystalline areas. It is this difference in reflectivity between the two states that forms the basis of subsequent reading operations. To erase a CD-RW disc, an annealing process is used. The layer is heated to a temperature of around 200°C. In random erase CD-RW equipment, the write and erase procedures are combined 'on the fly'.

Both CD-RW and CD-R discs have a spiral track or 'pregroove', which is pre-formed during manufacture. This servo track ensures that the recorder follows the same spiral pattern as a conventional CD, and has the same width of 0.6µm and pitch of 1.6µm. It is this spiral onto which the data is written. The servo information, which is provided by a 22.05kHz modulation of this track, is used to accurately control the burner's disc rotation speed. These steps are necessary to ensure the required levels of accuracy from cheap domestic equipment. If there was no pregroove system employed, a hyper-precision computer-controlled lathe would be required to write the discs – at an impractical cost of hundreds of thousands of pounds. These room-filling pieces of hardware are, however, used in the production of commercial CD glass masters, and indeed, the injection moulds for blank user-writable discs.

CDs, unlike LP records, are written from the centre of the disc outwards. On conventional CDs, the first track consists of the Table of Contents (TOC), which contains the track numbers of the recorded titles and their respective start and stop points (out of interest, commercial mass-produced data CDs have only one track). CD-Rs and CD-RWs have an additional track before the TOC track, which is known as the Program Calibration Area (PCA). This is used by burners to calibrate the required laser energy – which

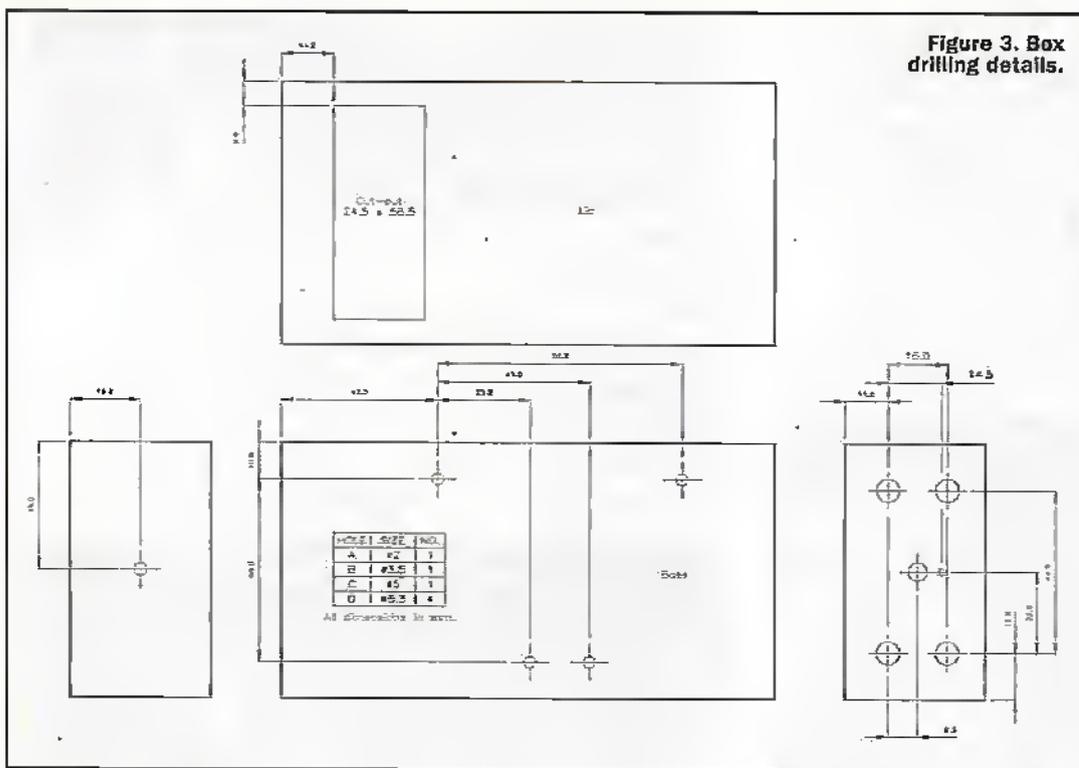


Figure 3. Box drilling details.

can differ from disc to disc, and from day to day as different ambient conditions are encountered – by carrying out a brief trial recording.

Some CD-R and CD-RW discs, designed for use with self-contained audio recorders, also have a unique identification bit written at some point in the lead-in. Discs intended for use with computer peripheral drives don't have this bit, and cannot be used with such equipment. If the machine can't detect the bit, it will spit the disc out if you try recording to it. Blank audio-only discs, are – surprise, surprise – somewhat more expensive than their general-purpose counterparts, because extra duties are apparently paid on them. Oh yes, and we wouldn't want the pricing of blank CDs to make piracy seem attractive, would we? They're optimised for single-speed writing (such as real-time recording from radio) and have extra space for the extra copyright-protection features that are only built into audio recorders.

These include the RID (Recorder Unique Identifier), a 97-bit code that is written every 100 frames. The code identifies the brand of equipment, model and even serial number. As a result, the copyright enforcers can track down the exact piece of hardware upon which a particular disc was made. Audio recorders also support SCMS (Serial Copyright Management System), an established system designed to prevent the production of multiple-generation digital copies of a copyright-protected original. You can make one digital copy –

and that's it.

SCMS consists of a copy bit that is placed every 75 frames on a copyrighted recording. On copyrighted discs (and all recordings made from analogue sources using audio CD recorders), this bit is continuously on. On a copyright-free disc, the SCMS bit is continuously off. In a first-generation copy, the SCMS bit is toggled between on and off every 5 frames. A SCMS-compliant recorder refuses to record from its digital input if it detects this toggling bit, and hence second-generation digital copies cannot be made. All of this only affects audio CD recorders, which are aimed squarely at the consumer. If somebody desperately wanted to make illegal copies of a valuable copyrighted work, they could use a computer equipped with a CD-R drive, a system that incorporates none of these protective measures.

More Vinyl Issues

For the best results with analogue sources, you should employ the stereo line input of your sound card/Mac. Unfortunately, this means that only tape, tuner or other line level sources can provide material unless extra help is brought in. The only pick-up cartridges with decent enough fidelity for vinyl-to-CD mastering are magnetic, or – if you're into audiophile esoterica – moving-coil types. High-output moving coil, and the vast majority of magnetic cartridges, produce a minute output, in the order of 2mV, which is simply too small to

drive the sound card directly.

The problem is even worse with the highest-quality moving coil cartridges, which might only deliver an output of 0.1mV.

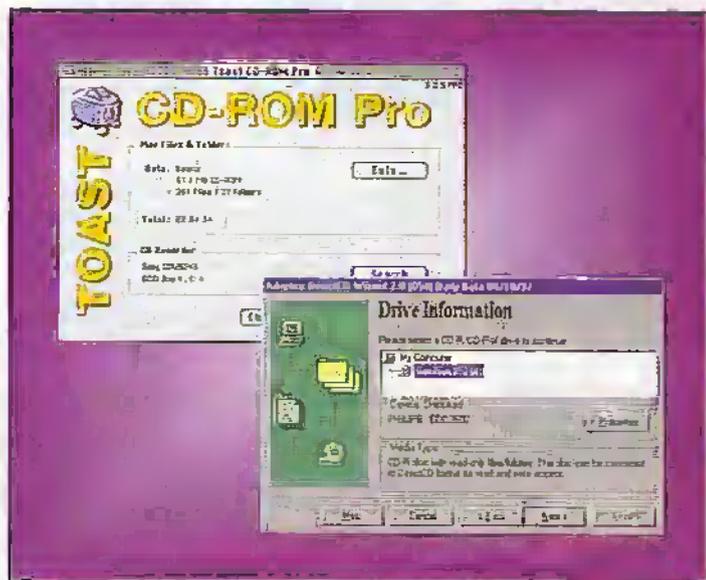
Although it would be possible to connect a turntable's signal outputs directly to the low-level microphone input that's often built in, there are distinct disadvantages. Firstly, soundcard microphone inputs are mono. Secondly, the sound quality is unlikely to be up to scratch. The equalisation applied to the microphone input is flat – with records, it needs to follow the RIAA curve (this boosts bass frequencies and reduces the treble ones, to counter the pre-emphasis that has to be applied during the mastering stage to keep groove dimensions practical!) A tinny sound is not all you'd get from your microphone input, though. High-gain mic

preamps are also likely to amplify all of the digital hash floating around your computer, resulting in horrible whining noises that spoil your recordings.

Many Hi-Fi systems and amplifiers have a tape output, where the boosted and equalised phono signal can be found. This output can be hooked up to the sound card's line input, using a phono-to-stereo 3.5mm adaptor lead (such as Maplin's KQ12N). If you no longer have a turntable, but want to transcribe an old record collection that you might still have, or take advantage of the vinyl bargains that often crop up at boot sales, a unique and cost-effective product worthy of consideration is the Goxlman's Mini Turntable (Stock Code KS26D). This product, which was enthusiastically reviewed by the Hi-Fi press, has a built-in preamp to boost and equalise the tiny signal from its magnetic cartridge.

A turntable worth considering by DJ types is the SoundLab DLP-3R (Stock Code BE59P). This quartz-locked direct-drive deck is closely styled on the industry-standard Technics SL1200, but is rather more affordable. It features quick start, and a slider that affords 8% of pitch control adjustment. With a Stanton 500 cartridge, it's capable of 'doing the business' with dance records. The ability to vary the pitch is also useful if you want to maximise the CD-R's 74 minute disc capacity. That said, audio editing programs offer time-stretching and time-compression facilities to do the same job. Such processes are undertaken off-line, and can take several minutes, depending on the length of the track and the speed of your computer.

If you want a deck capable of working at 78rpm, and hence capable of transcribing old shellac discs, your best option is to examine the second-hand market. A good deck for this



application is the Goldring GL75, a massive construction that is no stranger to car boot sales. The GL75 is continuously variable in speed from under 16rpm to over 78rpm. Note that the deck's cartridge will need to be equipped with a stylus capable of tracking 78rpm discs – specialist Hi-Fi dealers are the best people to consult on such matters. Note that used equipment purchases aren't relegated to those with a shellac fetish – a second-hand deck is also worth considering if you're on a limited budget.

Preamplifier

If your Hi-Fi system doesn't have a phono input, then you'll need a preamp. Constructing one isn't difficult, and we present a design – capable of working with magnetic cartridges – for you here. Even if you have no intention of getting into audio CD mastering, this preamp will add a phono input to your shiny new midi system, making it compatible with the sounds of yesteryear – delivered via the format of yesteryear! Just build it up – a two-hour job – connect it to a spare auxiliary input, plug in the turntable and go! To keep things simple, the design uses two Maplin EQ2S preamplifier

modules – one for each channel.

These self-contained two-transistor circuits are, dependent on configuration, capable of operating in three equalisation curves – flat (i.e., microphone), RIAA (magnetic phono cartridge) or NAB (tape head). Although it's not implemented here, a three-position switch could be incorporated to select the desired curve – in this case, though, we've hardwired both preamplifiers for RIAA. Note that the EQ2S, in microphone mode, is considerably quieter than a typical soundcard's microphone pre-amplifier.

Each module only draws about 1mA at 9V during operation; as a result, an alkaline PP3 battery (which has a capacity of around 500mAh) will provide many hours of continuous operation. The two preamplifier modules are built into an aluminium case, in order to prevent pick-up of noise. Note that the solder side of each circuit board faces upwards to simplify wiring. For ease of replacement, the PP3 battery is held in a snap-shut holder. Internal signal connections are made with screened cable, earthed at the preamplifier module-end only. 16/0.2 wire is

used for other interconnections, including earthing and preamplifier option selection. External connections to and from the preamplifier are made via gold-plated phono sockets. A binding post for connecting the turntable's ground terminal, in the case of hum (earth loop) is also provided. Drilling details for the metal case are given in Figure 3.

Next month, we look at the mechanics of how to put your system together, and how excellent-quality audio CDs can be mastered, plus a discussion of how you can put your home videos onto a CD.

Copyright Warning

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

PREAMPLIFIER PARTS LIST

| | | |
|------------------------------------|-------|---------|
| EQ2S Mono Preamplifier Module | 2 | (LB97F) |
| Box AB7 | 1 | (LF08J) |
| PP3 Battery Holder | 1 | (XX33L) |
| Gold Phono Socket Black | 2 | (FT95D) |
| Gold Phono Socket Red | 2 | (DE77J) |
| M3 Insulated Spacer | 1 Pkt | (FS38R) |
| SPST Ultra Miniature Toggle Switch | 1 | (FH97F) |
| Grounding Post | 1 | (JL99H) |
| Miniature Screened Cable | 1m | (XR15R) |
| 16/0.2 Wire White | 1 Pkt | (FA35O) |
| 2Phono/2Phono Lead | 1 | (BV85G) |
| Alkaline PP3 Battery | 1 | (FK67X) |

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The above items are not available as a kit.

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| 2 | - | LT96 | Sound Generator Kit2 | £7.99 | 749 |
| 3 | 1 | LK63 | Live Wire Det Kit | £6.99 | 785 |
| 4 | 2 | LP56 | Mosfet Amp Kit | £21.99 | 706 |
| 5 | 20 | LP28 | Beginners AM Radio | £10.99 | 765 |
| 6 | 6 | LP77 | Lights On Reminder | £6.99 | 716 |
| 7 | 12 | LM55 | TDA7000 MKII Kit | £24.99 | 765 |
| 8 | 8 | LP69 | L200 Kit | £7.99 | 762 |
| 9 | 3 | LP16 | TDA7052 Kit | £6.99 | 703 |
| 10 | 5 | LP30 | 1/300 Timer | £8.99 | 726 |
| 11 | 7 | LK42 | Car Batt Monitor | £12.99 | 714 |
| 12 | 9 | LT34 | 555 Proto Card | £7.99 | 729 |
| 13 | 14 | LP66 | Courtesy Light Ext | £4.99 | 716 |
| 14 | 18 | LT31 | SSM 2017 Pre-Amp | £16.99 | 709 |
| 15 | 10 | LU29 | PIC 16C84 Programmer | £19.99 | 731 |
| 16 | 11 | LM76 | LM386 Kit | £4.99 | 703 |
| 17 | - | LP83 | LED Xmas Tree | £15.99 | 0 |
| 18 | - | LP12 | IBM Expansion Kit | £27.99 | 376 |
| 19 | 16 | LP03 | TDA2822 Stereo Pwr Amp | £10.99 | 703 |
| 20 | - | LW36 | 8W Amp Kit | £9.99 | 704 |

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TOP 20

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| 2 | 8 | YU07 | Small Temp Mod Ext | £10.99 | 753 |
| 3 | 13 | FP64 | Min/Max Temp Module | £11.99 | 754 |
| 4 | 7 | FE33 | Temperature Module | £9.99 | 753 |
| 5 | 6 | WC20 | UHF Modulator 6MHz | £10.99 | 791 |
| 6 | 5 | FS13 | Counter Module | £9.99 | 755 |
| 7 | 9 | GW01 | DVM Meter Module | £12.99 | 756 |
| 8 | 3 | AM27 | 418MHz Tx | £13.99 | 770 |
| 9 | 4 | AM28 | 418MHz Rx | £25.99 | 770 |
| 10 | 12 | MK68 | EM2 MSF Rcvr Module | £16.99 | 727 |
| 11 | 10 | RJ89 | W/Less Clock Module | £24.99 | 728 |
| 12 | 17 | NV10 | TDCM622-1TimeDateVGM | £49.99 | 790 |
| 13 | 11 | YT99 | Temp Mod Wide Range | £13.99 | 754 |
| 14 | - | AM03 | 150W MOSFET Amp Assm | £29.99 | 706 |
| 15 | 2 | YU05 | Small Clock Module | £8.99 | 728 |
| 16 | 16 | LB97 | Pre-Amp EQ2S | £12.49 | 709 |
| 17 | 15 | CK41 | Touch Hybrid & Mstr | £23.49 | 954 |
| 18 | 14 | AM11 | Expansion Card Assm | £34.99 | 376 |
| 19 | 18 | YU67 | Alarm Clock Module | £4.99 | 728 |
| 20 | - | AM26 | Relay Module | £6.99 | 714 |

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Muon Catalysed FUSION

THE RIKEN EXPERIMENT AT THE RUTHERFORD APPLETON LABORATORY

by Douglas Clarkson

For many years particle physicists have been interested in the characteristics of particles called muons. Once known as pi mesons, these particles came to light primarily as a result of Cosmic Ray investigations. Muons are produced as a result of a collision with a highly energetic particle such as a proton with the Earth's atmosphere. Initially, pions are produced which in turn decay to muons. They are 207 times more massive than the electron.

In a similar process, pions can be produced by targeting high energy protons onto a graphite target. This is the principle used at the RIKEN experiment at the ISIS facility at the Rutherford Appleton Laboratories (RAL) at Chilton, Didcot. This facility provides the most intense pulsed muon beam in the world.

Although the main theme will be the investigation of muon catalysed fusion, some brief details of the baseline proton synchrotron facility - ISIS, will be briefly presented.

The Nature of ISIS

ISIS is shown diagrammatically in Figure 1. Negatively charged Hydrogen atoms are initially injected to energies of 70MeV via a linear accelerator using four accelerating radio frequency cavities. After passing the third cavity, electrons are stripped off by using an alumina foil 25µm thick. On entering the synchrotron complex, a series of radio frequency generators accelerate the protons during several circuits of the synchrotron ring. During

acceleration, the RF frequency is increased to optimise the net accelerating effect of the ring. At an energy of 800MeV - protons are released towards the main experimental area. Around 25 million million protons are generated in each pulse. Two bunches of protons separated in time by a few hundred nanoseconds are produced in each main cycle.

Photo 1 shows the synchrotron accelerating facility. The protons are steered by ten massive bending magnets so that between these the protons travel in a

straight line. The magnets operate at room temperature and use water to cool the field coils. The inner core of the synchrotron is an evacuated metal pipe. Within this cavity, the cross-section of the proton beam is, on average, around 5cm in diameter, though this varies considerably around the circuit.

The synchrotron cavity presents a complex problem in relation to radiation protection. Radiation tends to be generated from peripheral protons colliding with the containment systems, with levels tending to be highest around the area of initial beam injection into the synchrotron facility from the linear accelerator. Areas with raised levels are carefully delineated by safety barriers with extensive use made of portable radiation monitors on long extension arms.

The main function of ISIS is as a source of pulsed neutrons. The protons are made to collide with a heavy metal target such as tantalum or depleted uranium. In the energetic collision process, fragments are chipped off the large heavy metal nuclei. The very energetic neutrons must be slowed down in order to be of use in the range of experiments. A range of moderators used include water at ambient temperature, liquid methane (100K) and liquid hydrogen at 20K.

The muon particles of particular interest to the RIKEN experiment are generated by use of a thin intermediate graphite target before the main neutron spallation target.

Photo 2 shows a section of the ISIS experimental hall. The main spallation target is below the large red overhead crane in the centre. The RIKEN experimental area is shown in the foreground and extends on the right towards the edge of the experimental hall.

When experiments are active, most beam line conduits are typically covered by concrete protective blocks to reduce levels of radiation.

Pions initially travel along a 6m long section with a 12cm cross section. The

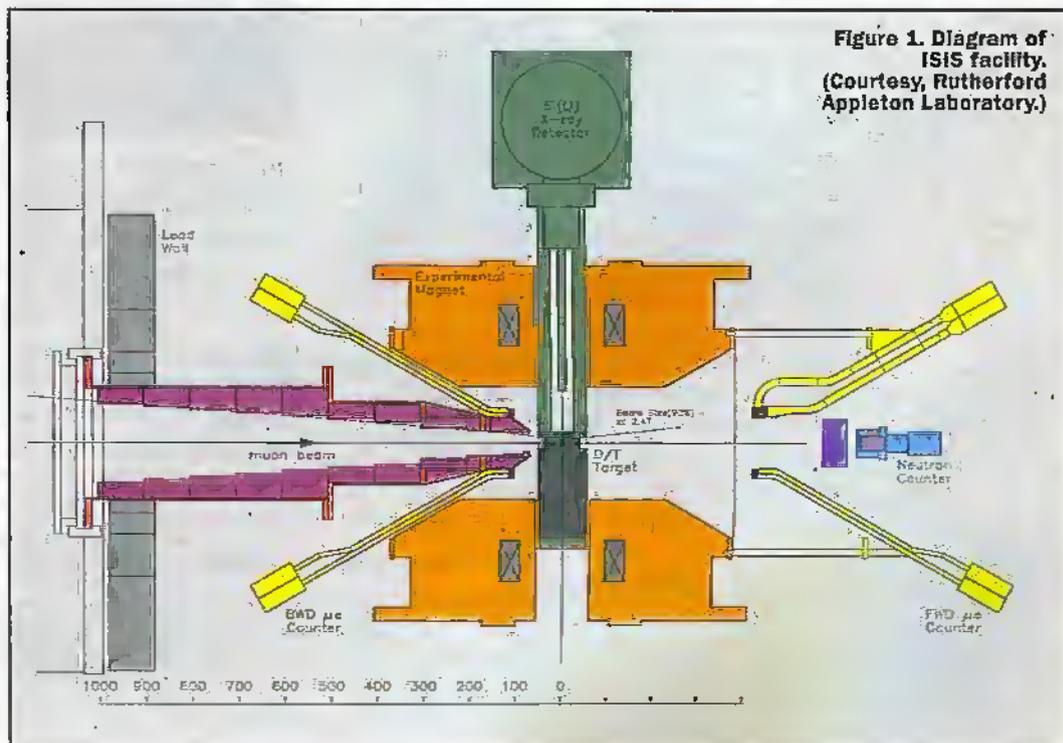


Figure 1. Diagram of ISIS facility. (Courtesy, Rutherford Appleton Laboratory.)

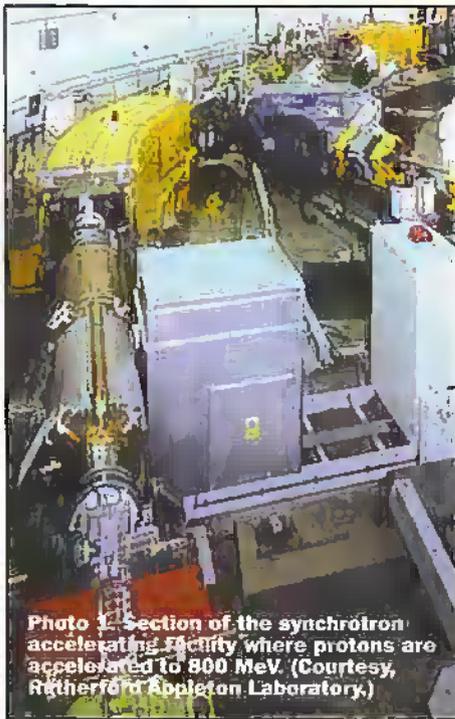


Photo 1. Section of the synchrotron accelerating facility where protons are accelerated to 800 MeV. (Courtesy, Rutherford Appleton Laboratory.)



Photo 2. Section of the ISIS experimental hall. The RIKEN experimental area is shown in the foreground and extends also to the right picture.

pions decay along this length to muons and take up spiral paths due to the use of containment by a magnetic field. The relative lifetime of the muons in our frame of reference, around $2.2\mu\text{s}$, is modified by the energy of the particles according to special relativistic effects.

Muon Interactions

A normal hydrogen atom has an effective atomic cross-section of $0.53 \times 10^{-28}\text{cm}^2$. This size is determined by the coulombic field of the electron in orbit round the single proton nucleus. It is possible for the negatively charged muon to replace an electron in hydrogen or its isotope such as Deuterium or Tritium. When this takes place, the atom physically collapses in size to around $260 \times 10^{-28}\text{cm}^2$. In achieving this size, moreover, the collapsed system behaves like a neutral particle, i.e., it has no

intrinsic coulombic repulsion with respect to other nuclei. The [p μ] (proton/muon), [d μ] (deuterium/muon) or [t μ] (tritium/muon) species can quite readily approach the nucleus of other atoms.

The actual fusion process takes place with the formation of a so-called muonic molecule such as [pp μ] (proton/proton/muon) or [dt μ] (deuterium/tritium/muon).

The fusion reaction is characterised by the release of a 14MeV neutron. It is the conversion of this neutron to thermal energy which may one day be utilised as a useful product of the fusion reactions. Figure 2 summarises the main processes of the muon catalysed fusion pathways of the RIKEN experiment.

Muon Catalysed Fusion: A Brief History

The phenomenon of muon catalysed fusion has been something of a revelation to physicists. Initial observations by Luis Alvarez in 1956 of muon catalysed fusions taking place in water containing Hydrogen (single proton in nucleus) and Deuterium (proton and neutron in nucleus) had, even then, raised the prospect of using this fusion pathway as a viable power source.

In practice, however, the fusion of the [p μ] molecule takes on average $3\mu\text{s}$ to occur - longer, in fact, than the mean muon lifetime of $2.2\mu\text{s}$.

Reaction in pure Deuterium is not

Figure 2. Main processes of the muon catalysed fusion pathways of the RIKEN experiment. (Courtesy, Rutherford Appleton Laboratory.)

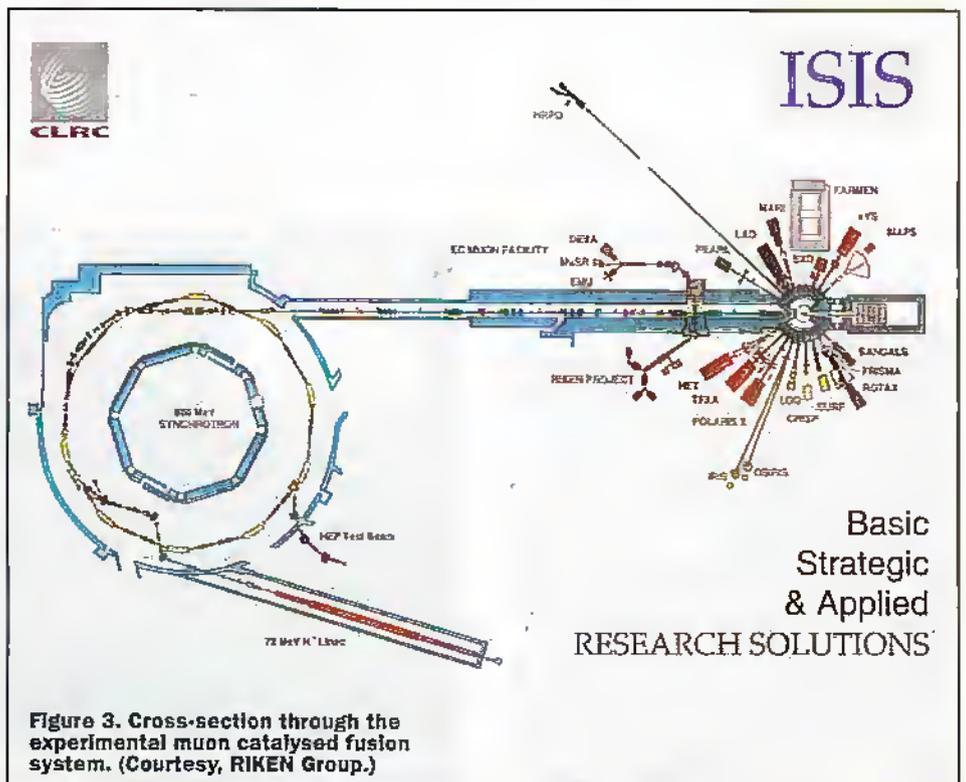
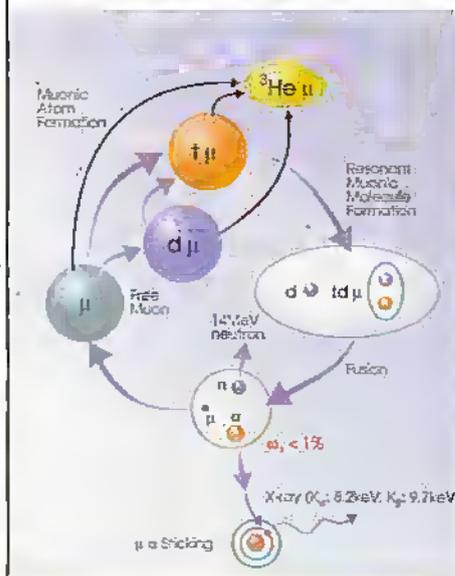


Figure 3. Cross-section through the experimental muon catalysed fusion system. (Courtesy, RIKEN Group.)

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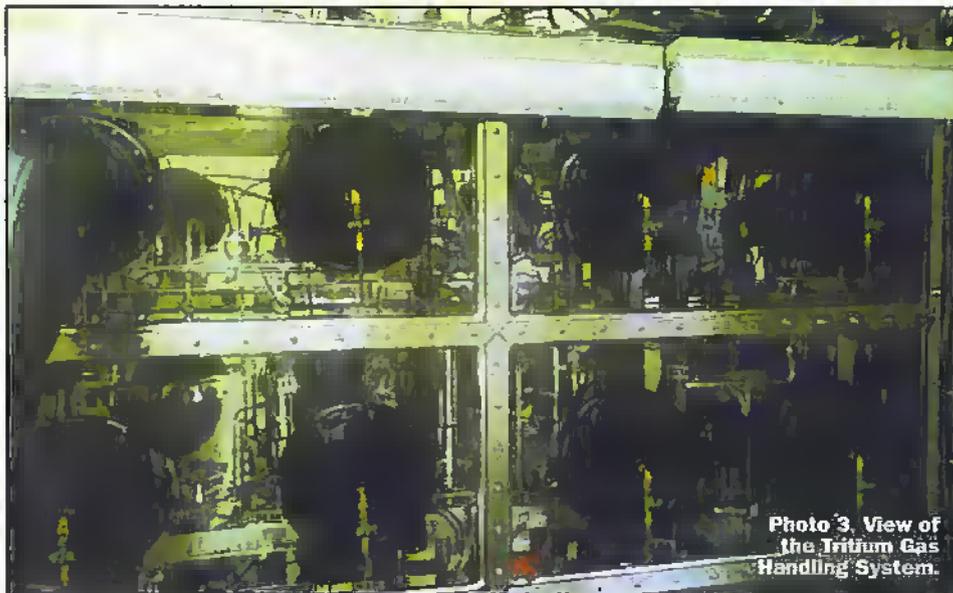


Photo 3. View of the Tritium Gas Handling System.



Photo 4. View of the superconducting magnet for concentrating of incident muon beam.

promising, either. The rate of formation of the [ddu] molecule is again relatively slow from a [dd] molecule and a [du] species.

The key component for useful muon catalysed fusion is to use Deuterium-Tritium mixtures. Initial observations were made by Bystriksy, in Russia in 1979, that the [dtu] molecule could form in a relatively short time compared to the muon lifetime. Independent verification of this was achieved in 1982 at the Los Alamos Meson Physics Facility (LAMPF).

It is worth pointing out, however, that various aspects of this work could, at one time, have had a highly classified status. The Los Alamos laboratory is highly focused on nuclear weapons technology. Tritium is a key component in the detonation of 'hydrogen' bomb.

The resonance process appears to depend on the availability of intact molecules to form resonant muonic molecules. While the rate of [dtu] formation increases with temperature, at higher and higher temperatures the molecules will dissociate – leading to an anticipated rapid fall in the reaction rate.

The [dtu] molecule can be formed by the collision of [tu + dd] or a [tu+dt] – with the reaction involving [dd] molecule taking place more readily – though the exact details of the muon molecule formation scenarios are not entirely resolved.

The [dtu] molecule forms very readily – around 1,000 times faster than the [pdu] or [ddu] species. The number of fusions achieved per muon has increased from 20 in 1982, 80 in 1983 and 150 in 1984 at the Los Alamos facility. The focus of attention remains in trying to enhance understanding of the processes involved in muon catalysed fusion.

Muon Event Sequence

There is a subtle difference between the chain reaction of a fission reactor and the sequence of events of muon catalysed fusion. In the fission reaction, there is the production of excess neutrons so that an uncontrolled increase in fission events is possible. In the muon catalysed fusion, an individual muon can initiate a sequence of

catalysed fusions, with a muon being released from each fusion with the potential to induce another fusion event. There are problems, however, in increasing the number of muon catalysed fusions that take place. One basic problem is that of so-called alpha sticking, where an alpha particle absorbs the muon.

The lifetime of the muon is estimated to be around 2.2 μ s, though it only takes around 1ns for each fusion event to take place. The fusion is limited by the duration of the lifetime of the muon. In theory, if alpha sticking did not take place, then around 2,000 fusions could take place before the muon decayed. In terms of the muon target, the beam is heavily collimated to remove muons from surrounding structures and not present scattered radiation. While the main muon beam may contain around 10,000 muons per pulse, only around 100 enter the small calorimeter volume containing the Deuterium/Tritium target.

To date at the RIKEN experiment, 150 fusions per muon have been detected with another 50 fusions accounted for in losses through various mechanisms. A total value of around 200 is considered par for the course for the present conditions, based on alpha sticking. The missing 50 fusions may be due to [dtu] and [rtu] interactions.

The Global Picture

Another muon facility exists in PSI in Zurich, Switzerland, at the KEK or High Energy Accelerator Research Organisation laboratory at Ibaraki in Japan and the TRIUMF Laboratories in Vancouver. Muon research work which had been ongoing at Los Alamos, has now stopped. A significant amount of hardware has been developed in Japan and shipped to the UK for installation at the RIKEN site facility at ISIS. As time goes by, the RIKEN experiment is attracting more and more interest – both as a means of developing associated theories and anticipating any future potential as a method of commercially viable power generation.

Real 'Cold Fusion'

In a famous review article by Steve Earl Jones published in Nature in 1986, the low temperature dependence of the reaction prompted the author to state in relation to muon catalysed fusion, "The term 'cold fusion' is, therefore, quite appropriate for the process". Being published before the 'cold fusion' controversy broke, Jones was clearly defining the muon catalysed fusion phenomenon in the framework of a true fusion process, where neutrons, low energy

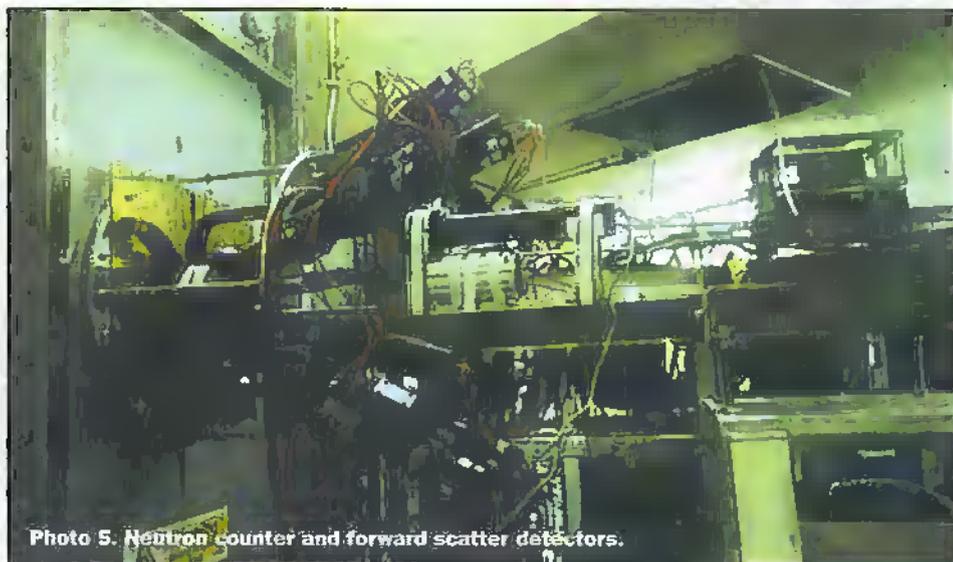


Photo 5. Neutron counter and forward scatter detectors.

gamma rays and alpha particles were produced. This was why, perhaps, 'official' science was so outraged when the term 'cold fusion' was applied to a broad range of phenomenon which did not accurately match the definition outlined by Jones and other workers.

The Way of Hot Fusion

The problems of achieving hot fusion by means of ultra-high temperatures and magnetic containment technology are well known. In this approach to energy generation, the force of mutual repulsion of positively charged nuclei has to be overcome.

In contrast with the curve of probability of hot fusion of two 'normal' hydrogen isotopes, which at low temperatures is vanishingly small, the cross-section for muon catalysed fusion is extremely high so that every muon which can be introduced into a target of Deuterium/Tritium mixture will induce a sequence of catalysed fusions. The ratio of the likelihood of fusion events in the exotic muonic Deuterium and Tritium and 'cold' electron based isotopes of hydrogen Deuterium and Tritium is a staggering factor of around 10^{20} .

Tritium Gas Handling System

A key component of the RIKEN experiment lies in the ability to modify the relative concentrations of Tritium and Deuterium in the sample chamber and also remove the Helium 3 daughter nucleus of Tritium. Where this species is doubly charged, it will cause capture of the negatively charged muon and thus break the sequence of muon catalysed fusion.

A specialised palladium element is used to filter the gas mixture, with Deuterium and Tritium passing through the ultra-fine meshwork of the Palladium but preventing Helium 3 from being transmitted. Photo 3 shows a view of the Tritium Gas Handling System.

The Tritium for the experiment was produced and processed in Japan and transported in two cylinders containing 26TBq in each cylinder. Initially, low levels of Tritium mixtures were produced to verify the intrinsic safety of the Tritium handling system.

In the set of experiments, Tritium concentrations of 70%, 60%, 50%, 40%, 28%, 20% and 10% were investigated. From an existing gas mixture in liquid or solid form, the target is slowly warmed up and the gas absorbed into a uranium getter. The residual gas is removed by a cryopump and the system evacuated by use of specialised vacuum pumps. Deuterium gas is then made available in the system to adjust the D/T mixing ratio. The previously absorbed gas taken up by the uranium getter is released by heating. The new gas mixture is then passed through the palladium filter to remove the daughter product, Helium 3. Finally, the liquefaction or solidification of the target is initiated by cooling with liquid Helium.

In designing the experimental system, the part 1 of the muon beam experiment is designed to ensure containment of the local gas atmosphere at any time. Entry to the active experimental area is via a two-stage

entry system. Routine monitoring of the atmosphere is undertaken to detect any Tritium leakage and in addition, a separate Tritium monitor is relayed back to the ISIS control room as an independent verification of safety.

A gas chromatograph is available within the Tritium Gas Handling System to monitor the level of Helium 3 produced as a daughter product of the Tritium gas. The Palladium filter was found to be highly effective in removing this impurity.

Fusion Detection System

Figure 3 shows a cross-section through the experimental muon catalysed fusion system. The experimental magnet maintains a strong field along the direction of the incident muon beams. This encourages the muons to be directed in a tight spiral and hence, drive the beam into a more concentrated profile. The superconducting magnet is, therefore, essential for improving the statistics of the fusion within the small D/T target volume.

Table 1 indicates the parameters of the superconducting magnet configured at the exit port of the emergent muons.

The magnet, produced by Oxford Instruments, takes between 3 to 5 days to cool down to operating temperatures from room temperature. Photo 4 shows a side of the superconducting magnet for concentrating of incident muon beam.

A low energy Si(Li) x-ray detector is primarily used to detect x-rays emitted at the end point of alpha capture. A separate neutron counter monitors the process of neutron production using liquid scintillation counters. The statistics of experimental observations are improved by the pulsed nature of the muon beam. The detector can be gated with the known pulse window of the muons in order to improve experimental statistics. The muon beam input is extensively shielded by lead blocks to minimise secondary radiation from being detected.

Photo 5 shows the neutron counter (along the axis of muon beam) and forward scatter detectors. These latter detectors were designed to detect the electron resulting from decay of the muon.

The D/T chamber is, in fact, cylindrical, with an inner diameter of 13.6mm and 13.8mm in length. The target cell can be cooled down to around 10K by liquid helium flow. Several hours are required to produce a condensed liquid target and also achieve thermal equilibrium.

| Parameter | Description |
|-----------------------|-------------------|
| Conductor type | 1mm diameter NbTi |
| Coil Current | 228A |
| Maximum central field | 3.8T (est) |
| Stored Energy at 3.8T | 0.85MJ |

Network Computer Reference Profile.

Progress to Date

The muon catalysed fusion experiment has successfully verified the detection system to measure the statistics of recorded data in relation to input muon numbers. The anticipated observation of around 200 muon

fusions per input muon represents a base line for future work with altered target characteristics with a view to seeking to increase in the long term the number of fusions achieved.

The significance of the RIKEN experimental system is that it provides very intense muon pulses, which in turn provide good statistics for the measurement of catalysed fusion events. It is anticipated that the unique RIKEN facilities will provide researchers for many years ahead with a happy hunting ground for 'exotic' reactions involving muons.

Conflict of Terms

The orthodox Physics community looks upon muon catalysed fusion as 'correct' cold fusion. While the scenario of 'cold fusion' in its broadest sense continues to raise issues of controversy within the scientific community, experiments such as RIKEN provide useful information about nuclear fusion events that occur at low temperatures. The practicalities of this relate to developing better models of such 'exotic' muonic atom states and in the future, possibly considering the aspects of the commercial development of reactors using this technology.

It is useful, however, to consider what 'correct' cold fusion is telling us about 'incorrect' cold fusion. For one thing, muons catalysed fusion possibly from the inconstant background from cosmic rays is not involved, since the reaction rates in hydrogen and deuterium are so low.

Also, based on the claimed rates of power gain from 'incorrect' cold fusion experiments, fusion events of hydrogen nuclei are not involved, since the anticipated level of neutron activity is not observed.

Whether 'incorrect' cold fusion is real or imaginary, it would upset less people in the scientific community if it was perhaps termed 'x-energy'.

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informative tour of the RIKEN facility at RAL.)

WHAT'S IN A NAME

PART 11

Hardly a Sparkler!

by Greg Grant

In the James Bond adventure Diamonds Are Forever, our hero, being tutored by 'M' in the significance of different types of diamond, remarks of one stone that it must have cost a packet. His boss replies that it would have been no more than a few pounds for the cutting, adding, witheringly, that it was a piece of quartz. There's more to quartz than meets the eye, however, even if it is often tinted with impurities as Collins English Dictionary makes plain. A lot more, in fact, and it frequently concerns the ear!*

In 1881, the Curie brothers, Jacques-Paul and Pierre, found that some crystals, if impressed in certain directions, produced negative and positive surface charges. These potentials, it turned out, were proportional to the pressure and vanished the moment the pressure was removed.

Piezoelectricity

The brothers had used two minerals, firstly, Tourmaline, a hard, glossy substance of complex composition, and Quartz. In the following year, they discovered the reverse effect, namely, that if an electric field was applied to a slice of these minerals, a minute compression took place in the substance. The Curies termed this phenomenon Piezoelectricity, from a Greek word meaning 'To Press.' Other crystals too, of course, exhibit this feature, among which are Barium Titanate, Rochelle Salt and Ammonium Dihydrogen Phosphate.

* On page 1.270 if - like me - you're of an inquisitive disposition.

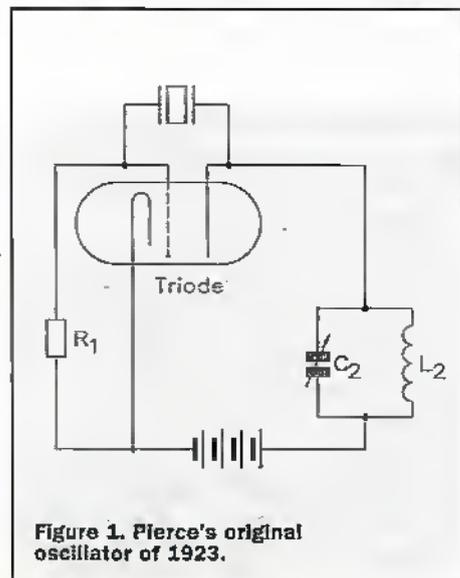


Figure 1. Pierce's original oscillator of 1923.

Frequency Stability

This meant that such crystals could be used to convert mechanical energy into electrical energy and vice-versa. Rochelle Salts, for example, would later be used in inexpensive gramophone pick-ups, microphones and the like. In radio transmitters and receivers, however, quartz crystals came into their own. They provided something that the early pioneers had long sought: frequency stability.

To begin with though, matters were by no means as cut and dried as early expectations had led many to believe they would be. Crystal cutting proved to be a very delicate, all-too-frequently inexact, operation. Consequently, a crystal rarely produced frequencies greater than 7MHz, which meant multiplication factors of anything up to 24 times! Presently, however, advances in crystal cutting techniques mean that crystals

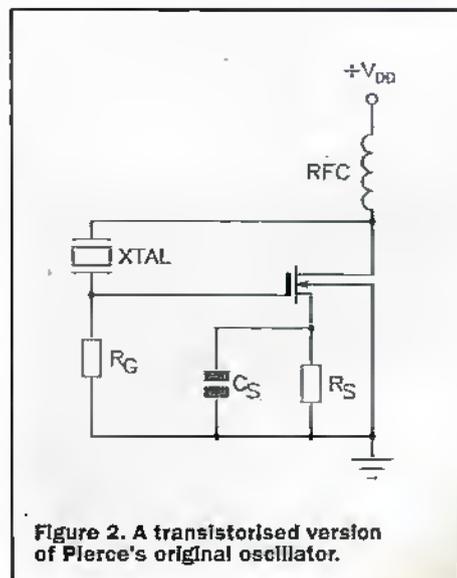


Figure 2. A transistorised version of Pierce's original oscillator.

can be cut and set for far higher frequencies and so multiplication factors have been greatly reduced.

So, who first thought of using the Curies' discovery to control radio communications equipment? The answer to that question is firstly, Walter Guyton Cady and secondly, George Washington Pierce.

Walter Cady was born in Providence, Rhode Island, in December 1874. Having obtained his Master's degree from Brown University, he took up a post at Berlin University to study for his doctorate, which he received as the new century opened. On his return to America, Cady joined the staff of the Wesleyan University in Connecticut, becoming a professor in 1907. In fact, he'd give the university the next 39 years of his life!

By June 1917, the German submarine fleet were giving the Allies the sort of headaches which - the Convoy system apart - they had virtually no answer to. Consequently, a meeting was arranged in Washington DC, where scientists and engineers from the Allied nations were asked to come up with feasible, not to say speedy, solutions to the problem.

It was at this meeting that a proposal from the French physicist, Paul Langevin, created some interest. He'd already begun work on a device consisting of thin layers of quartz between two pieces of metal, his idea being to use the piezoelectric effect to create an ultrasonic beam. The submarine's direction would be given by the direction of the beam's received echo and, since the speed of sound was known, its range could be determined by the time lapse between beam transmission and echo reception.

SONAR

This was the birth of what Langevin called Echolocation. It would subsequently be given the more scientific sobriquet SOUND Navigation And Ranging, eventually being referred to simply by its acronym, SONAR. Today, it's used in the fishing industry and in the study of the seabed, as well as by almost all of the world's navies. Moreover, it has - since the end of World War II - completely revolutionised oceanography.

It was this meeting that gave Cady his enduring fascination with piezoelectricity. By 1921, he and his colleagues at the Wesleyan University had produced the first piezoelectric resonator, and Cady thought that his device could do for communications what the tuning fork had done for music: vibrate at one frequency only. In January 1923, Cady demonstrated his newly-developed circuit to Harvard University's Professor Pierce, who immediately took up the study of the device.

George Washington Pierce was a Texan, born near the state capital, Austin, in 1872. Eighteen years later, he began his studies at the University of Texas, graduating three years later with a BSc degree. In 1897, he set out for Harvard to study for his doctorate and, having gained it in 1900, spent a year at the University of Leipzig, studying under Ludwig Boltzmann.

On his return to America, he rejoined the

Physics faculty at Harvard and, like Cady, devoted the remainder of his life to his alma mater. By 1917, he held a full professorship and was also the first Director of the Crufi Laboratory. Within a few months of Cady's demonstration, Pierce produced the circuit named after him, which is shown in Figure 1, with its transistor equivalent in Figure 2.

In the original circuit, a two-terminal crystal controls the oscillatory frequency in a single-valve configuration.

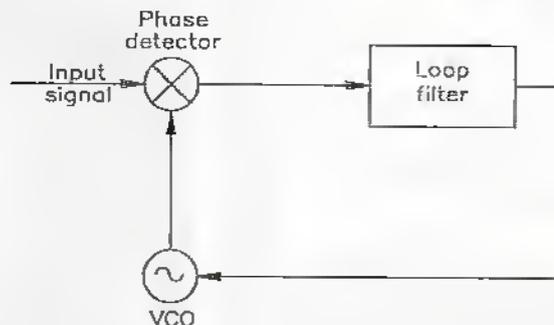
Pierce, of course, had other achievements to his name, although like many other communications engineering pioneers, he is remembered more for the device that bears his name more than anything else.

As early as 1907, he'd begun the study of crystal rectifiers and investigated the electrical characteristics of telephone receivers. In 1912, together with Arthur Kennelly - whom we've already met - Pierce looked into the concept of motional impedance.

He also calculated the radiation properties of various antennae, and 16 years later, developed the Magnetostriction Oscillator. Yet, despite these forays, he never lost his abiding fascination with ultrasonics, and even studied the sound patterns of insects and bats, subsequently writing a book on the subject in his retirement.

Among his many inventions were the Mercury Vapour Discharge Tube - the forerunner of the Thyatron, invented by the American classics scholar and electronic physicist, Albert W Hull in 1928 - and a technique for recording sound on film. In fact, his many patents made him a wealthy man.

Figure 3. A Phase Locked Loop (PLL).



Still Current Technology

Today, piezoelectricity is a universally employed technique, particularly in timekeeping and -naturally- communications engineering. As early as 1942, quartz crystal clocks replaced the Shortt clocks at the Royal Observatory, increasing accuracy by around 2ms per day. Atomic clocks too involve piezoelectricity. A quartz crystal oscillator is controlled by the known relationship between the crystal's frequency and the frequency of radiation created by the transition of the caesium-133 atom.

This atom was chosen because its transition frequency is in the radio spectrum and so can be monitored by standard, readily available, measuring equipment.

In communications engineering, the synthesizer, based on the Phase-Locked Loop (PLL), shown in Figure 3, produces

virtually any number of channels. The PLL's Voltage Controlled Oscillator (VCO) is phase-locked to a multiple of a reference frequency, generated by dividing down from a Temperature Controlled Crystal Oscillator (TCXO), which gives a VERY stable output. The PLL, invented in France in 1932 by the physicist, Henri de Bellescize, enables channel selection by changing the divide ratio of a programmable counter in its feedback loop.

Synthesizers are now standard in Single Sideband (SSB) or Independent Side Band (ISB) communications equipment because of their greater efficiency. Using a synthesizer, for example, gives you equivalent full carrier suppression of between -50 to -60dB. All in all, no mean achievement for colourless pieces of an obscure mineral!

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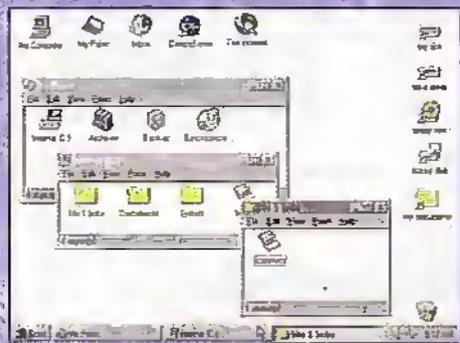


Photo 1. When the Palm Series 5 is connected to a computer, double-clicking the My Palm icon allows access to the Series 5's internal memory (accessed as a hard drive), in standard fashion.

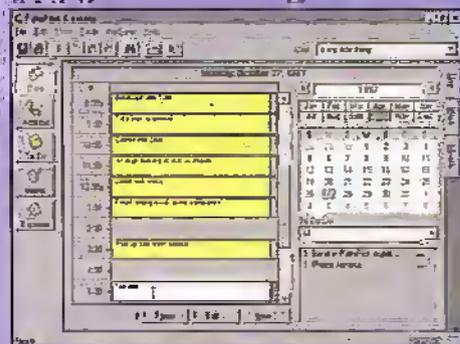


Photo 2. The PalmPilot Desktop application on the computer can be used to enter information. When the computer is Hot Synced with the PalmPilot, data is synchronized.

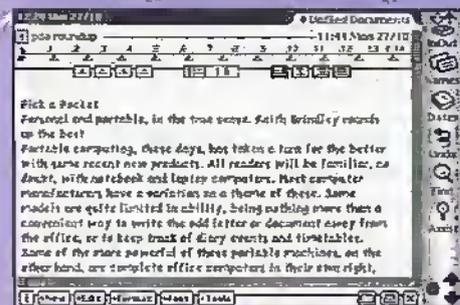


Photo 3. The MessagePad 2000 and eMate 300 screens are identical. Here, an article (the one you're reading) is displayed in the in-built Newton Works office-style program.

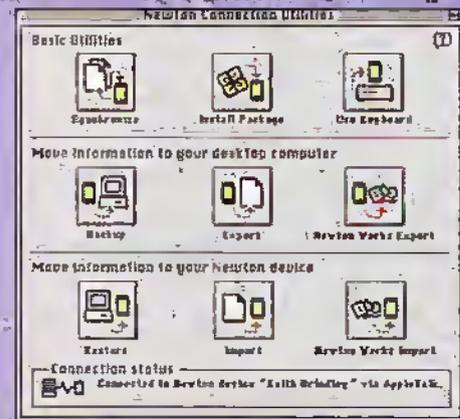
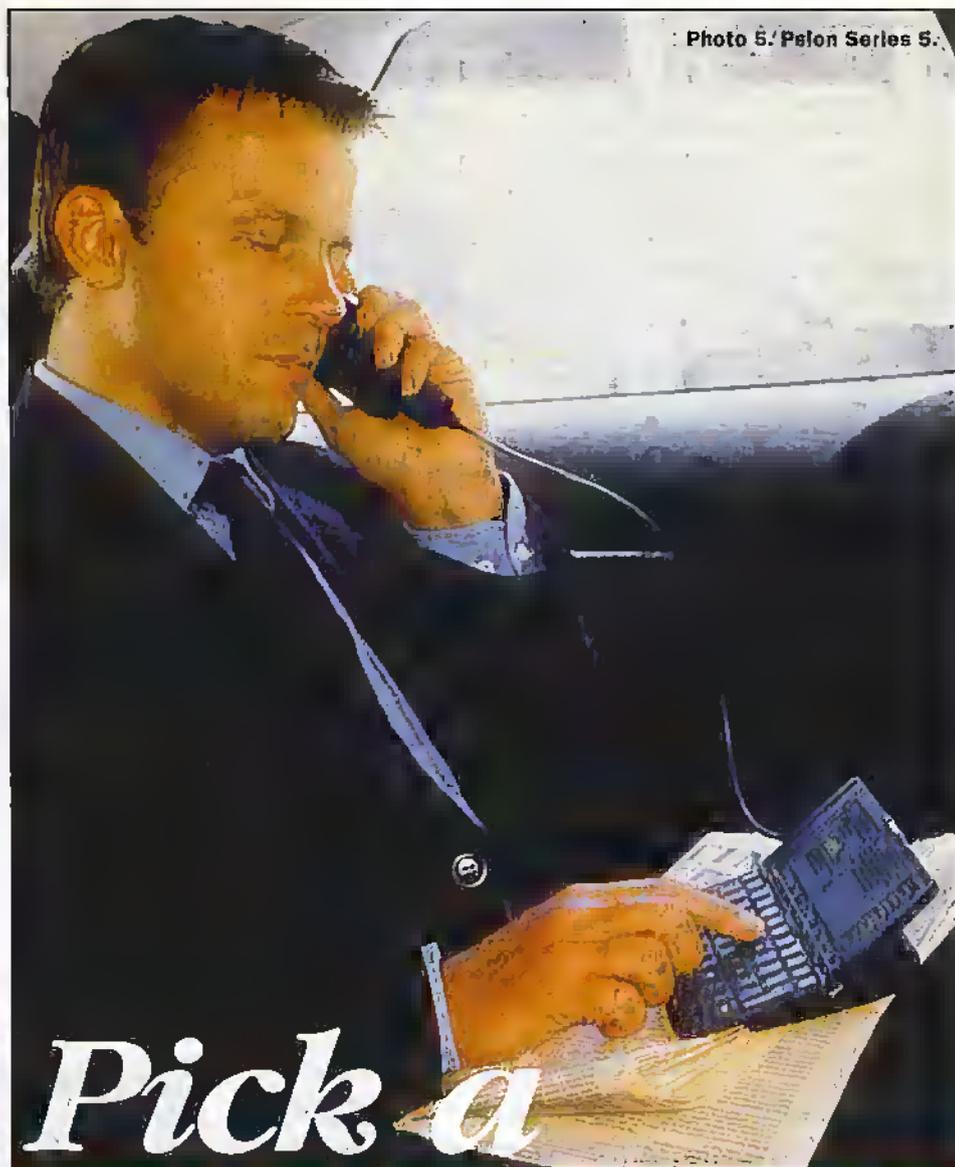


Photo 4. Newton Connection Utilities is the program used to synchronize and communicate with the MessagePad or eMate from a desktop computer.

Photo 5: Palm Series 5.



Pick a POCKET

Keith Brindley rounds up the best in portable computing. These days, portable computing, has taken a turn for the better with some recent new products. All readers will be familiar, no doubt, with notebook and laptop computers. Most computer manufacturers have a variation on a theme of these. Some models are quite limited in ability, being nothing more than a convenient way to write the odd letter or document away from the office, or to keep track of diary events and timetables. Some of the more powerful of these portable machines, on the other hand, are complete office computers in their own right, with full capabilities merely in a small but heavy carrying case.

However, the products here are very much smaller than laptops. Some call them palmtops, while others call them Personal Digital Assistants (PDAs). These two terms show a general divergence which lets us see how the products themselves originate. Palmtops are, to all intents and purposes, small computers. They have similar features to computers, look like them, and operate in a broadly similar way too. Personal digital assistants, on the other hand, exist to aid their users to do the sorts of tasks they need to do on the move. This conceptual shift in priorities allows the personal digital assistant to operate in a way unfeathered by typical computing needs. It also means that people unfamiliar or unhappy with computers in general can usually benefit from a personal digital assistant more easily than with a palmtop.

That said, the functions both these products perform are largely the same. The sorts of tasks users need both products for are, after all, pretty similar. If you think of the needs of the typical user these devices are aimed at, then you end up with a list of features they should have: word processing; spreadsheeting; database; timetable or agenda keeping, along with the ability to connect with a desktop computer back at the office to transfer data and maintain a coordinated diary.

In effect, what this gives is a gadget that performs the same tasks as the more common Filofax-style diary many people depend on. True, coordinating the data between the gadget and a desktop computer is significantly easier and quicker, but the data is very much the same. At the bottom line, if you don't depend on the information held in a desktop computer, then one of these products probably isn't of any real use to you. An office diary, a Filofax-style diary, or even a sheet of paper to write a list is probably all you need. If your life does revolve round a computer though, with your diary, agenda, and document generation all relying on how you interface with it, then a palmtop or personal digital assistant could be of benefit. But which one?

Psion Series 5

First under investigation is the Psion Series 5. This is the latest device from a company well-renowned in the personal digital assistant market. The Series 5's predecessor – the Series 3 – proved to be one of the most-used models on the planet.

First impressions are that the new Series 5 is a great step forward. It's based on an 18MHz ARM processor, and has quite a simple to understand, albeit limited, operating system (called EPOCH32) which has a computer feel to it.

In-built software includes word processor, spreadsheet, database, agenda, sketching and so on – enough for most people; and a wide and increasing range of third-party software is available to fill other needs. A small 640x240 pixel liquid crystal screen gives a surprisingly high resolution and is quite visible under most lighting conditions. Backlighting can be turned on in dim backgrounds, but as this greatly reduces battery life, it isn't advised for long periods. The screen is touch sensitive, and a pen is



Photo 6. PalmPilot Professional shown with clip-on PalmPilot Modem.

supplied for this purpose, held in a spring-loaded internal compartment for storage. However, the way pen operation works isn't as intuitive as it might be – for example, you can't select a word in the word processor by double-clicking (something that any word processor worth its salt really should allow).

For connection to a desktop computer, users need PsiWin or PsiMac software (depending on your computer platform). These give full synchronisation between Psion and computer, together with any required conversion utilities between native Psion files and conventional computer applications. One of the nicest aspects of these applications is that files are viewed as standard desktop files, and can be manipulated by dragging between desktop computer and Series 5 or vice-versa. The effect is that the Series 5 is fully integrated with the desktop computer, and appears just as a collection of windows you open to view files. So, while using the Series 5 itself might be a little archaic, the desktop collaboration with a computer is very good.

Overall, the Series 5 is an incredibly useful and usable tool. Essentially, a full, though relatively low powered by today's terms, computer, its ability to link rapidly to a desktop machine makes it ideal as an organiser-cum-portable office. Light, pocketable, and able.

Indeed, it really only has three drawbacks, in my eyes. First, I always found the Series 3's keyboard a bit restrictive, and hoped that the Series 5's keyboard would allow me to enter text more conveniently. However, while the Series 5 has a much improved keyboard, it's still not ideal for heavy text entry. For many users, however, who don't need to enter significant data on the keyboard, Psion's Series 5 could be ideal. Second, while EPOCH32 is a capable operating system, it hasn't taken the logical step that allows PDAs to dispense with the file-based concept of disks and drives.

The Series 5 still treats documents you create as entities to save – you still see them as physical icons saved in physical directories. More forward thinking PDA operating systems (the PalmPilot and the Newton, say) allow a more forward thinking file and tabbed folder structure. Finally,

however, and ultimately more serious for a PDA, is the total lack of Internet software or connection software. While these are expected by the end of the year, it's a cardinal sin for a new PDA to miss this out of the box. The very people who are likely to buy a PDA are those who will want Internet-ability. After all, it's part of the PDA concept.

3Com PalmPilot

If you think the Psion Series 5 is a good example of modern miniaturisation, just check out the PalmPilot. This is a PDA in the true sense; it's pen-operated (without a keyboard at all) and fits – quite literally – in the palm of your hand. First concern about a pen-based PDA is how good is handwriting recognition? Well, with the PalmPilot (as with the other pen-based PDA in this roundup), handwriting recognition is good. The PalmPilot uses a utility called Graffiti to recognise handwriting. Graffiti has been around a while and has matured into a successful product. After all, the task of recognition of handwriting is huge.

Handwriting is almost as varied as human fingerprints. Everyone has a particular style of writing, and one person's style even varies constantly, almost from letter to letter. Full handwriting recognition obviously requires significant processing power. So, instead of the PDA having to learn every user's handwriting styles, Graffiti forces the user to write individual letters to the Graffiti style. As such, it's quite restrictive – if you don't follow the prescribed style, Graffiti simply picks the closest match. There's no intelligence to determine whether a particular letter is likely to be placed before or after following or preceding letters, and recognition is letter-by-letter so no word recognition occurs. That said, it works remarkably well. It takes about 10 or 15 minutes to pick up Graffiti's letter styles and after that, you're away. True, it's not a particularly fast method of text entry – around the same speed as a slow one-finger typist – but it's solid and reliable, and quite usable for short textual passages.

Several applications are included with the PalmPilot – which ones depend on which model you buy. The PalmPilot Professional (reviewed here) is the top of the range model and has a good all-round package including contact database, diary, e-mail facilities (incorporating TCP/IP connectivity – more of which later). Models lower in the range don't feature some applications, so make sure you get the model to match your needs. A notable omission in all PalmPilots is the lack of a drawing, or even a sketching, application.

Like all PDAs, the PalmPilot connects to a desktop computer for synchronisation of the information it carries. For this purpose, it features a desktop stand it simply drops into. Synchronisation occurs in a straightforward linking process between the main PalmPilot Desktop application running on the computer (Windows or Macintosh) called Hot Syncing, taking only a few seconds. The Desktop program allows information to be entered into the desktop computer too, while the PalmPilot is mobile.

Under general use, the PalmPilot can be used to read and create e-mail. However, it

Photo 7. MessagePad 2000, shown with optional keyboard.



only receives and sends e-mail once it's Hot Synced with the desktop* (note that the Macintosh PalmPilot Desktop program doesn't yet support Hot Syncing of e-mail). This relies on the desktop computer's e-mail facilities, of course. As noted earlier though, the PalmPilot Professional does actually have TCP/IP connectivity, so there's no reason why it couldn't send and receive e-mail directly to the Internet – something that both Windows and Macintosh users can take advantage of.

The only thing missing is the e-mail connection program. There are commercial programs around, but fortunately, a freeware application (TG Postman – available for download from <http://www.isaac.cs.berkeley.edu/>) does the job perfectly. Similarly, commercial World Wide Web browser software is available for the PalmPilot, but a freeware program Palmscape (from <http://sodan.komaba.ecc.u-tokyo.ac.jp/~kazuhiko/Palmscape/>) lets you browse the Web for nothing.

To connect to the Internet, you need a modem, and the purpose-built PalmPilot does nicely. Clipping onto the bottom of the PalmPilot and giving a 14,400 baud connection to the 'phone network, you can have the whole Internet literally in the palm of your hand. The modem can also be used to Hot Sync to your desktop computer, so that files can be synchronised over the 'phone at any time while you're away from your desk.

In a stroke, the PalmPilot gives true portable operation. However, it is fairly limited – its internal memory isn't going to cope with massive applications, and its small display could present concerns. And, unlike the Psion Series, or the Apple MessagePad 2000, the PalmPilot doesn't purport to be a portable computer – far from it. It's an organiser, pure and simple, with e-mail facilities. That said, it's significantly cheaper than the alternatives, and may be ideal for many potential PDA users as long as they are aware of its limitations. That said also, we have to say the PalmPilot is a pocket gem – its size makes it not only pocket-sized but shirt-pocket-sized. If that's not enough, it operates in a very intuitive way, which

totally bypasses the old-fashioned file and directory method of operation that the Psion Series 5 has – the PalmPilot's operating system, in fact, isn't a million miles removed from the Apple variants' Newton operating system in use.

Newton MessagePad 2000

When Apple first introduced the Newton PDA concept a few years back, its handwriting recognition capabilities were perceived by the media as rather poor. In truth, recognition improved as you worked with it, and experienced users got acceptable results. Coming on leaps and bounds since then, the latest version of the operating system (version 2.1) features better handwriting recognition which is both usable by newcomers to the technology and, in fact, fast (faster than many people could type in the same information). If you find there are certain situations where a keyboard is required, an optional external keyboard (shown in the photograph) plugs in.

Apple always intended that the Newton concept be a complete generation of products, although till the eMate 300 came along (see later) the product range centred around its MessagePad devices. In typical Apple style, matching its desktop computers, MessagePads are always best-of-breed products, so always featured from day one all the tools other PDA and palmtop computer makers yet aspire to. For example, while most other PDA, palmtop, and portable computer manufacturers are still scrambling to ensure their products can be used on the Internet for e-mail and Web browsing, MessagePads have always been able to do it. Further, where the current trend is to sell extra software packages that provide PDAs, palmtops and portables with Internet access using mobile phones (giving worldwide availability of e-mail services, for example), Newton devices have the facility built into the operating system.

The latest MessagePads (here, we look at the MessagePad 2000, although the MessagePad 2100, with greater internal

memory, has recently been released) feature a 160MHz StrongARM processor (yes, you read that right – 160MHz) that gives the devices a power greater than many full-blown desktop computer systems.

With all this computing power to hand, it's no wonder that MessagePads incorporate all the applications you could expect in a PDA: desktop computer synchronisation (to Windows or Macintosh), personal information management, word processor, spreadsheet, drawing, and as just discussed; e-mail, Web browser, and full TCP/IP connectivity via conventional modem or mobile phone connections.

As a result, it's impossible to fault the MessagePad concept. It does everything you could expect of a PDA – right out of the box. And, due to the Newton operating system, it does that with a style, elegance and ease simply unmatched by any other PDA, palmtop or portable computer.

Newton eMate 300

The eMate 300 is currently only sold as an education product. Although developed by Apple in the Newton range of products, it's only available in the UK from educational computer supplier, Xemplar (which is jointly owned, as it happens, by Apple and Acorn). As such, it's available to schools, teachers, students, and parents of students.

While it uses the same operating system as the MessagePad 2000, with the same in-built applications, and the same crystal-clear greyscale 100 dots per inch rotatable display, the concept alters from there. Instead of being a pocketable PDA like the MessagePad, the eMate is a portable computer, designed with strength in mind – its case is of an industrial strength, intended to survive in even the hardest of classroom environments. The eMate display, for example, is sprung-mounted for protection. The clamshell shape allows the display to be folded down when not in use, and the integral carry handle makes transport easy. The keyboard incorporated in the base of the case is officially classed as sub-notebook – around 85% of a full-sized desktop computer keyboard – and, with a wonderfully usable feel to it, is great for

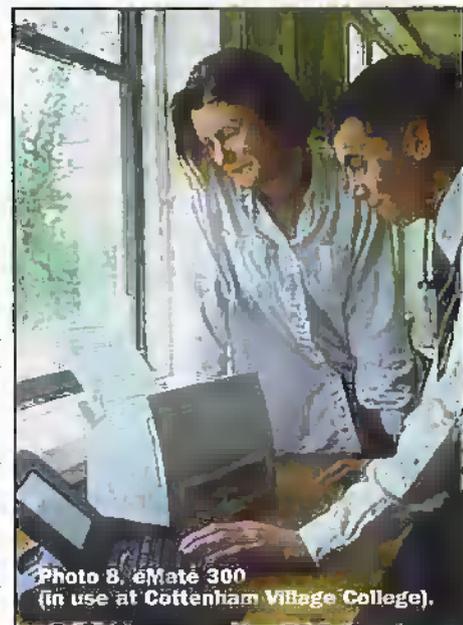


Photo 8. eMate 300 (in use at Cottenham Village College).

small fingers, yet remains large enough for touch-typing by grown-ups.

In performance terms, the eMate incorporates a 25MHz processor, somewhat slower than the MessagePad 2000's, although this is only rarely apparent in use. It also has only 3M-byte of RAM (compared with the MessagePad 2000's 5M-byte, and the 2100's 8M-byte). However, the eMate 300's significantly lower price tag (around a third of comparable disk-based-portable computers) makes up for this.

Unsurprisingly with this specification and price, the eMate is currently selling like hot cakes! Apart from schools buying them by job-lot, it's the ideal Christmas present for parents to buy children – fun to use, useful, and above all – with an educational purpose. Officially, of course, the eMate isn't available to those not in education, but little Johnny had better watch out – Mum or Dad's bound to want to take it to the office!

In the End

PDA's or palmtop computers are only as good as the software available for them. In this respect, the more software available, the better it is for users. That's why Psion's Series 5 and Apple's Newton are guaranteed success. The amount of professional software available for both of these (particularly the Newton) means the devices have a wide and varied marketplace. That's not to say the PalmPilot won't find its own, uses with time. The PalmPilot is a relatively new technology, but being so cheap has guaranteed itself a place in PDA history.

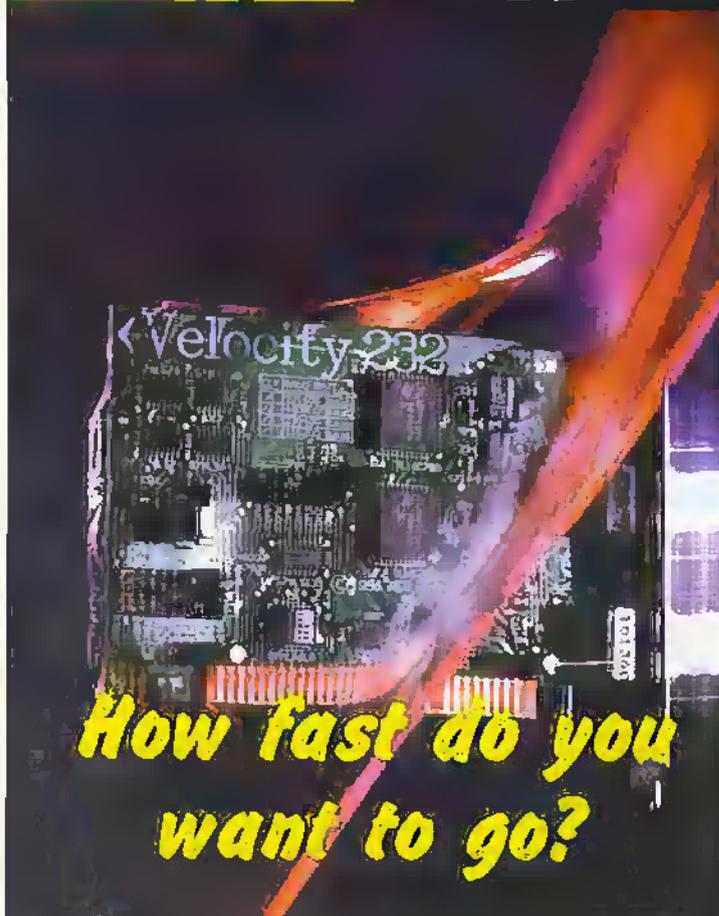
Program developers realise that its cheapness will mean large numbers of users, so they are taking advantage of this by developing quite cheap programs to suit. Its limitations, on the other hand, will always mean that it can never be as capable as its bigger PDA counterparts.

The PDA's considered here represent the cream of the current crop. None will disappoint users, but user requirements obviously vary. If you only need basic PDA tools, the PalmPilot will do the job cheaply,

nearly and with a certain convenient flair. If you feel you need an in-built keyboard, the Series 5 or the eMate 300 are ideal. Of these, the Series 5, while not so small and light as the PalmPilot, is still easily pocketable. This can't be said of the eMate 300, which of course, is more a portable computer than a true PDA. Finally, if you need outright power with a coolness factor second only to its brother the eMate 300, the MessagePad 2000 (or the 2100 with its extra memory) is unbeaten. **MARKET**

| Company | Apple | Psion | 3Com | Xemplar |
|---------------------------|---|--|------------------------|---|
| Product | MessagePad 2000 | Series 5 | PalmPilot Professional | eMate 300 |
| Contact | 0800 127753 | 0990 200630 | 0800 225252 | 01223 724201 |
| Price (ex-VAT) | £599 | £499 | £256 | £450 |
| Size (HWD mm) | 210×115×30 | 89×172×24 | 120×80×16 | 290×305×53 |
| Weight (g) | 635 | 354 | 166 | 1,800 |
| Screen size (W×H pixels) | 480×320, 16 greys, hot-rotatable | 640×240, 4 greys | 160×160 | 480×320, 16 greys, hot-rotatable |
| Screen size (W×H mm) | 85×125 | 135×60 | 55×55 | 125×85 |
| Processor speed | 160MHz | 18MHz | Not known | 25MHz |
| Memory ROM/RAM (M-byte) | 8/5 | 6/6 | 8K/1 | 8/3 |
| IO ports | 1 proprietary serial (adapter included); 1 IrDA | 1 proprietary serial; 1 proprietary memory card slot; 1 IrDA | Docking cradle | 1 proprietary serial; 1 serial; 1 IrDA |
| PC card slots | 2 | 0 | 0 | 1 |
| Microphone/speaker | Yes/yes | Yes/yes | No/yes | No/yes |
| Main data entry method | Pen | Miniature keyboard | Pen | Notebook keyboard |
| Battery life/battery type | 24 hours/ 4 × AA | 30 hours/ 2 × AA | Weeks/ 2 × AAA | 28 hours/ rechargeable in 1-2 hours, recharger included |
| In-built Internet support | TCP/IP, SMTP/POP3 | None | TCP/IP | TCP/IP, SMTP/POP3 |
| Web browser/e-mail | Yes/yes | No/no | No/no | Yes/yes |

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Cheap Cable Core Identifier

The Problem: Identifying which cable or core is which at the far end of a multi-way loom (at least 3-way) where there is no colour or other coding. Or, even if the loom is coded, working out which core goes to which pin of a terminating connector.

The problem is worse if the two ends of the loom aren't in easy reach of each other.

The professional solution is to have a cable tracer with transmitter and direct-reading receiver. The Seaward WT500 19-way device (RS stock code 621-253) costs over £86 plus VAT.

Circuit MAKER

by Dr G. L. Manning

any readings go into the next nearest 1kΩ multiple even if the loom adds another 200Ω.

Operation: Find the Common and 0 cores. Connect one meter lead to a

core; test all others for 0 reading. If not found, move meter lead to another core (separate the first one, don't test it again at this stage). Keep trying; the maximum number of trials for an N-way cable is $(N^2-N)/2$. Note the two cores which seem to have 0 (actually you've found R1, the 270Ω resistor) and look for another core exactly 1kΩ away – this will be core 1. Momentarily switch the meter to a lower range to differentiate C from 0 against 1. Apply one meter lead to C; on the 2,000kΩ range, the display will directly read the number of any other core to which the meter lead is applied.

ILLUSTRATIONS

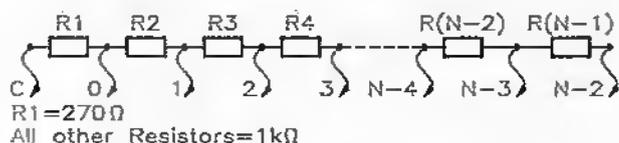


Figure 1. Flying leads with crocodile clips.

Join Resistor Leads and Flying Leads at Board Pins.

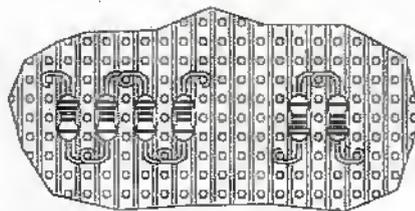


Figure 2. Typical matrix board layout.

The amateur solution this assumes you have a 3½-digit multimeter – now commonly found in the amateur workshop. It needs to be set to the 2,000kΩ range. Secondly, you need to build the resistor network on perforated matrix board (no copper strips necessary) as shown (the recommended box comes with a suitable board). Coded flying leads with miniature crocodile clips enable each core to be connected to the network at one end of the loom. The multimeter explores the other end of the loom. R1 is big enough to be detectable on a low ohms range, enough to make all network readings whole multiples of 1kΩ, and small enough not to make

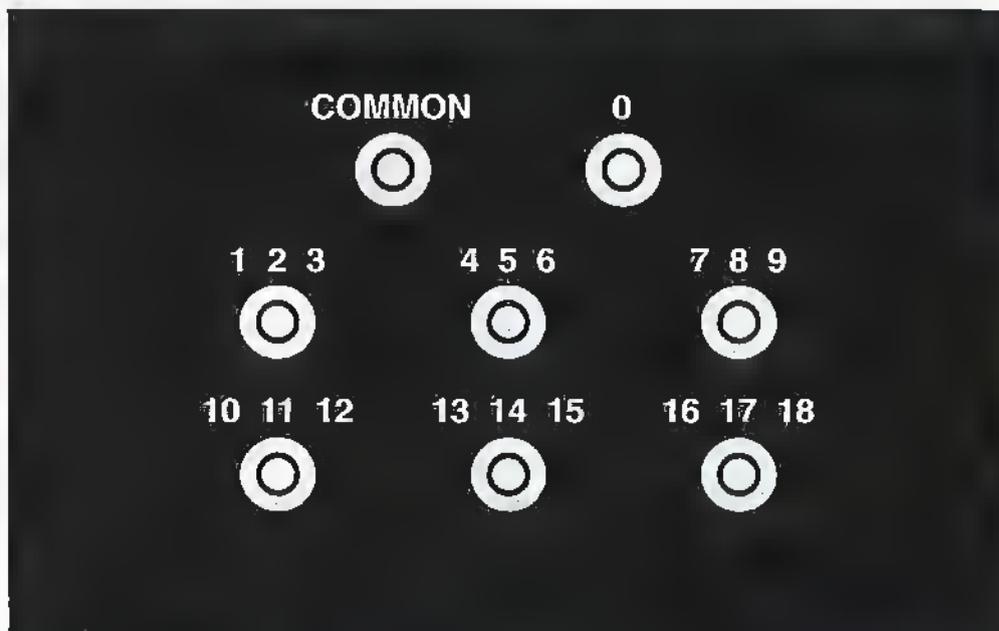


Figure 3. Typical front panel layout for 20-way version (actual size).

CABLE CORE IDENTIFIER PARTS LIST (20-WAY VERSION)

RESISTORS: All 0.6W 1% Metal Film

| | | | |
|----------|------|----|---------|
| R1 | 270Ω | 1 | (M270R) |
| R2-(N-1) | 1kΩ | 18 | (M1K) |

MISCELLANEOUS

| | | |
|----------------------|---|---------|
| Base, Box & PCB TB16 | 1 | (YU47B) |
|----------------------|---|---------|

| | | |
|--------------------|-------|---------|
| 1mm PCB Pin | 1 Pkt | (FL24B) |
| 4mm Grommet | 1 Pkt | (JX64U) |
| 100mm Tie-wrap | 8 | (BF91Y) |
| Crocodile Lead Kit | .1 | (BW69A) |

Rating: Beginner. Recommended options: labels to identify flying leads (see cable markers, Cable & Accessories section of Maplin catalogue – they should in turn be mounted over a short piece of heatshrink sleeve such as CP16 (Maplin BF86T) to provide a firmer hacking).

COMMENT



by Keith Brindley

Microsoft is under attack from all sides these days. Apart from the recent \$1 million a day fine imposed by the US Justice Department on Microsoft for uncompetitive practices, several big guns in the world's software markets are ganging together against Microsoft, in an effort to prevent Microsoft software being universally applied to all computers everywhere.

But before we go off the deep end and join the throng accusing Microsoft of this, let's look at the facts, and view them from beleaguered Microsoft's position.

First, three of the world's largest computer manufacturers (Compaq, Gateway 2000 and Micron Electronics) say that Microsoft threatened to prevent them using Microsoft's Windows software if they did not supply Microsoft's Internet Explorer Web browser as standard on all computer desktops they sold, despite the fact that the three companies wanted to supply Netscape Navigator as the default Web browser. According to one Compaq executive (under oath to a Federal Trade Commission investigation, no less), Microsoft sent Compaq a letter (dated 30th May 1996) stating that it intended to cancel its Windows licensing agreement unless Compaq used Internet Explorer instead of Navigator. Needless to say, Compaq did just that. Surely this isn't uncompetitive practice, it's just a small case of Microsoft looking out for itself. After all, any computer company can choose not to licence and use Windows if it so wishes, can't it? They're perfectly welcome to try to sell computers without an operating system, aren't they? What's uncompetitive about that?

Second, all this will shortly be irrelevant anyway when the next version of Windows, due in mid-1998, is released. In Windows 98, Microsoft's Internet Explorer becomes an integral part of the Windows operating system, which means that it's not a separate product at all, so can't be treated as an add-on. As a result, there'll be no such thing as uncompetitive, will there? After all, anyone wanting to use an add-on such as Netscape Navigator or any other Web browser can do so, can't they? That's competitive, isn't it? Surely, we can't expect Microsoft to take out Internet Explorer from Windows 98, as it's what the whole new version of the

operating system is based on?

Third, over the last few years, the US Justice Department has played second fiddle to Microsoft, when it has overturned several anti-trust suits against Microsoft. The cheek of it, some minor players in the computer world had even suggested that Windows wasn't as original as Microsoft intends us to believe. Indeed, one computer manufacturer even had the nerve to suggest that Windows was a copy of its operating system. This is all stuff and nonsense, of course. If Windows was a copy, why did it take eleven years for Windows to copy it? – Apple's Macintosh operating system first saw light of day in 1984, while Microsoft's best chance so far of emulating it, Windows 95, didn't appear until 1995, giving the MacOS eleven years to move along at a rate of knots in the meantime. Any really uncompetitive software manufacturer would copy a good idea far more quickly than that, wouldn't it?

Fourth, there's talk of the fact that Microsoft has developed Internet Explorer version 4 (that is, the recently released version that is to form the heart of Windows 98) to include Microsoft's new Java extension. Now, as everyone knows, there's a significant move to ensure that Java is used by *all* computer operating systems; simply because it means that any applications (known as applets) written using the Java language can be run on any computer – regardless of the computer's operating system. How could anyone in their right mind accuse Microsoft of being uncompetitive, when it has included Java into Windows? OK, so Microsoft's Java extension is different to everybody else's, limiting applets written using them to run only within Internet Explorer 4 – but that's beside the point, isn't it?

So, let's leave behind all this chatter about uncompetitive practices. Let's just sit back as we have been doing for the last fifteen years, and let Microsoft do as it has always done – freely. Let's look forward to the day when all free competitors have the free right to go freely bankrupt. After all, if they can't compete with a free Microsoft in a free marketplace, they freely shouldn't freely be there in the first free place, should they?

RAMmed Into a Disk

Almost before a standard for digital video disc (DVD) drives and discs appeared, manufacturers already spoke of the next generation of devices that will support rewritable data on discs – effectively known as DVD RAM. Hitachi has already demonstrated a 2.6G-byte DVD RAM drive and expects to have developed 4-7G-byte-a-side DVD RAM drives within a year.

However, as usual and as any reader should expect, there's confusion over standards for this next generation. There are two current standards being promoted, although fortunately, the eventual outcome standard which combines the two formats is expected shortly.

Philips and Sony have developed a scheme using lands and grooves on the disc, while the main competition (Pioneer, Hitachi, and Toshiba) developed a system using wobbled grooves. By combining the two systems for the eventual standard, much lower bit error rates result (in the order of a reduction around 16 orders of magnitude), which accounts for the higher storage capabilities Hitachi expects. To obtain the higher storage disc capabilities, Hitachi has already developed a disc substrate which features an improved signal-to-noise ratio.

For once, it appears that this next generation DVD RAM is going to be compatible with CD-ROM and first-generation DVDs. However, there's time to change this yet, isn't there?

Up in the Sky

Motorola is close to realising its planned international project, aimed at providing a global broadband communications system via 70 low-Earth orbit satellites. It signed an agreement with Matra Marconi Space (MMS) recently, worth around \$1 billion, to provide the satellites for the service, due to become operational in 2003. Codenamed Celestri, the system aims to provide realtime interactive multimedia services such as desktop videoconferencing.

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

Printer TECHNOLOGIES

by Reg Miles

The introduction of relatively inexpensive microcomputers allowed medium and small companies to follow the lead set by the larger companies, and computerise their offices. However, they soon discovered that the concept of a 'paperless' office was illusory – a monitor was no substitute for hard copy.

Printed on the
FUJIX NC-500
digital printer



Image captured on the
PLEASE ONE digital camera back
for the FUJIFIX 680 SYSTEM

And it seemed absurd to continue to use typewriters to get it. Inexpensive and easy to use printers were going to be necessary if the potential of computers was to be fully realised – especially if they were also going to be used in the home. The golfball printer was one such device – already used with mini computers and as a typewriter. The 'golfball' is a spherical print head with raised characters covering its surface. In operation, it is rapidly rotated to bring each character to the printing position, and the ball is then pressed smartly against the ink ribbon and paper beneath. Because the golfball is easily removable, other fonts can be substituted. However, although it could print good quality alphanumeric and symbols, it could not print graphics, and the speed was rather limited while computers were getting faster.

The daisywheel printer had the same shortcomings, but also the same advantages of good quality and interchangeability. In this case, the characters are near the ends of spokes, or 'petals', radiating from a central hub. This rimless wheel is spun to bring the correct character into position, where it is struck and forced against the ribbon and paper.

The limitations of the golfball and daisywheel printers left the way clear for the dot matrix printer, whose print head could also form graphics and different fonts. This consists of a number of spring-loaded wire pins arranged in a single-width column and mounted within a guide block (see Figure 1). Each pin has a solenoid at its top that presses it against the ribbon and paper to produce the required pattern of dots as the head moves across the paper. There may be 9, 12, 18 or 24 pins in the head. Colour printing is achieved by using a ribbon with yellow, red, blue and black colour stripes. The ribbon cartridge is pivoted up and down by a solenoid to align the correct colour with the print head, as both move back and forth together. Besides the three basic colours, orange, purple and green can be obtained by overprinting dots. It is also possible to achieve the illusion of many more colours by printing dots of the basic colours in close proximity so that they merge at a normal viewing distance – a modern version of Pointillism called dither. However, dot matrix printers are now largely confined to basic tasks as other printing technologies, offering better quality, have come down in price.

What a Racket!

One of the disadvantages of the dot matrix printer is the noise made by the impact of the pins – which is probably one of the reasons why the thermal printer was developed. This, too, uses wires in the moving print head, but in this case, they are momentarily heated to form the dots. The print head is pressed against either a thermal transfer ribbon to melt wax-based ink onto plain paper or thermal paper whose coating darkens to black as the heat is applied. The quality of both text and graphics is generally much superior to dot matrix results because the wires are smaller allowing more to be squeezed in. The small head combined with the minimum of mechanism and low power consumption made the technology ideal for portable printers and compact typewriter-computer printers. However, they were slower than dot matrix, and possessed only limited colour ability. Nowadays, the technology

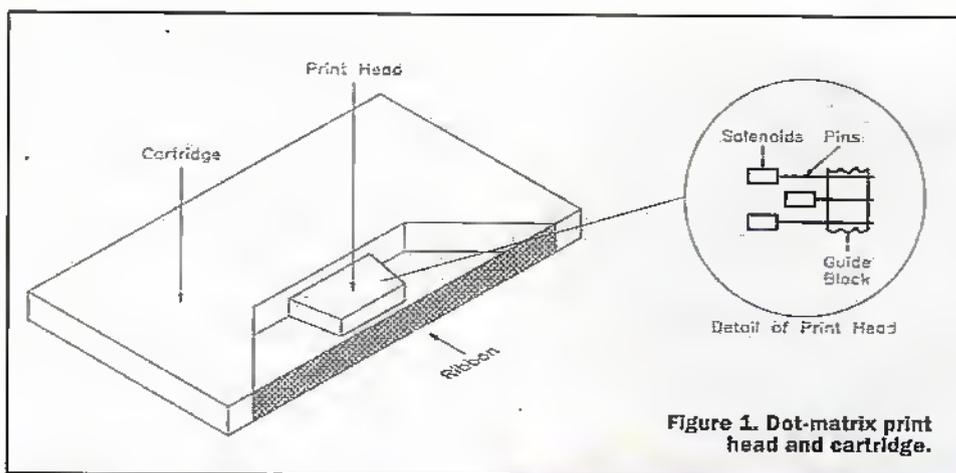


Figure 1. Dot-matrix print head and cartridge.

from Sony Broadcast has 2,408 elements), used four colour dye sheets, and claimed a horizontal resolution of 700 lines. Because it was designed to print from still video, it didn't need a memory; but video printers normally grab images and hold them for printing in a field or frame store. With the former, the printer will normally fill in the spaces between the lines by repeating the field – halving the vertical resolution to make the device more affordable, the latter will use the full 576 active lines of a PAL signal. Modern video printers generally convert the analogue signals to 8- or 10-bit digital for processing, and this has allowed the introduction of printers capable of handling both digital and video inputs. There are also printers that combine

tends to be used in roles such as producing grey scale images from video and medical imaging systems, achieving near photographic quality with a stationary, full width head printing a line at a time on the moving thermal paper.

This potential for high quality images has led to the introduction of several alternative thermal technologies – all capable of full colour in addition to monochrome.

Waxing Lyrical in Glorious Technicolour

Thermal wax transfer uses a wax ink sheet and a stationary print head containing a strip of semiconductor heating elements extending over the maximum width of the paper (for narrower paper, the extremities are turned off). The wax ink sheet and the paper pass over the head and the wax ink is melted onto the paper (refer to Figure 2). The degree of heat from each element controls the amount of wax deposited and thus the density of each dot. The wax sheet has different coloured areas, normally cyan, magenta and yellow (CMY), and these are applied in sequence to build up full colour – which is notable for its good saturation. Some printers are also designed to accept four colour ink cartridges with the addition of black (CMYK – black being the 'key' plate in printing: combining CMY to produce black gives a less satisfactory result). But whether CMY or CMYK, the result is equivalent to a decent half tone.

There is also a variation on thermal wax transfer known as variable dot. This variation in dot size is controlled by the printer's dot gain control, which produces additional variations in the temperature of each individual element to change the amount the wax spreads on the paper whilst maintaining the correct density.

However, the quality still cannot equal that of the dye sublimation process, which can approximate to continuous tone reproduction and give more subtle colours. The process is very similar, however, with the paper and a dye sheet passing over the thermal head, which in this case, operates at a higher temperature. Again, the elements in the thermal head produce differing amounts of heat according to the signal and this evaporates differing amounts of dye onto absorbent paper (where it spreads very slightly to eliminate the dot pattern). The sheets can be CMY, CMYK, or black alone.

Because it can produce 'photo-realistic' images, the dye sublimation process is also used for video printers. That, and the fact that the elements in the printing head can be heated in direct proportion to the



Photo 1. Epson DLQ-3000+ dot-matrix printer.

amplitude of the analogue signal to closely match the range of colours and tones in the original (although no form of printing can exactly match the colours and tones displayed on a monitor). In fact, the first dye sublimation printer was the Sony Mavigraph; a prototype developed in 1982 to accompany the prototype Mavica (magnetic video camera) that recorded still video images on a disk. The Mavigraph had RGB and NTSC inputs, a 512-element thermal head (the latest dye sub printer

thermal wax or variable dot and dye sub technologies. These are used in pre-press work to produce test prints and then continuous tone dye sub proofs.

Alps has recently launched a new version of their Micro Dry printer range that also combines two quality levels. However, although the Micro Dry process is similar in operation to dye sublimation, it uses a dry resin ink that does not permeate the paper but fixes on the surface in a four layer coating just 3µm thick. Using standard

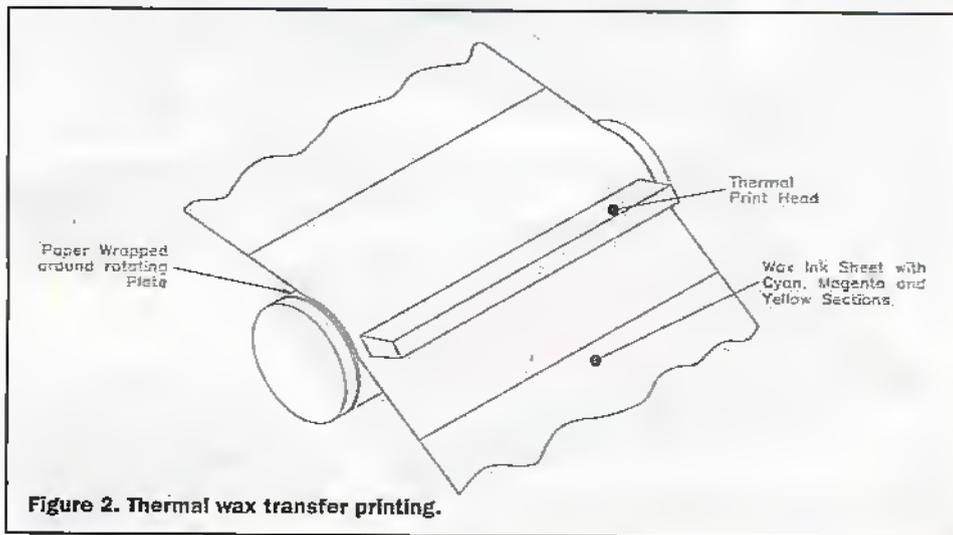


Figure 2. Thermal wax transfer printing.

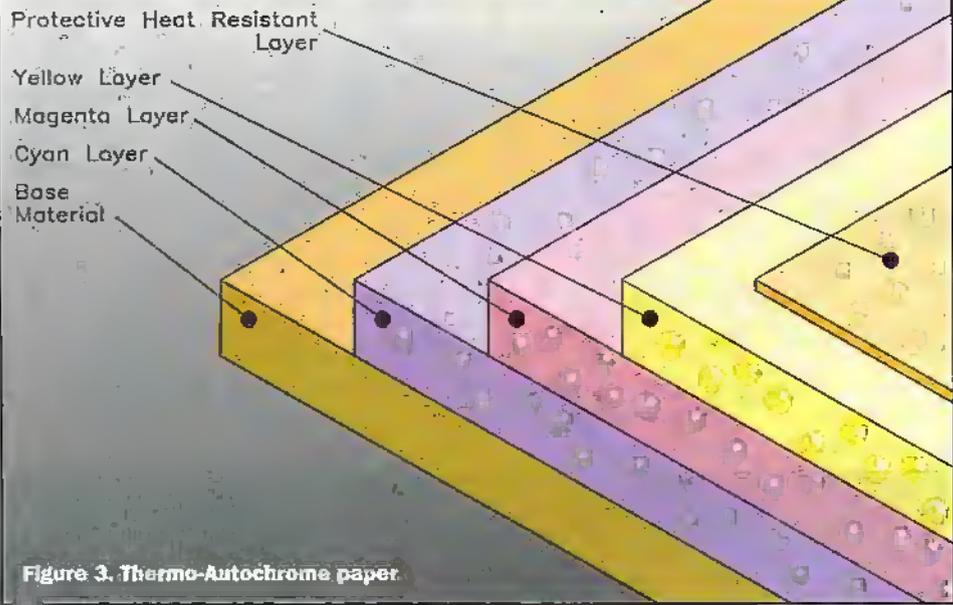


Figure 3. Thermo-Autochrome paper

Micro Dry inks and photo-realistic paper gives prints approximating to dye sub continuous tone quality, while the higher quality print uses finer 'photographic' Micro Dry inks and paper that look very similar to photographs. The latter uses CMY plus a transparent overcoat (some dye sub printers also use this to give a better looking, more durable finish), the former uses CMYK or black alone – with the option of metallic inks.

Thermal Retention

The newest thermal printer technology does away with wax and dye sheets and returns to thermal paper, albeit paper of a special kind, with three colour sensitive layers each containing 1µm diameter microcapsules to produce the CMY colours (as shown in Figure 3). Developed by Fuji, the Thermo Autochrome (TA) process uses a full width thermal head to form the image



Photo 2. Mitsubishi G6800-40 variable dot printer.

in successive bands by controlled bursts of heat lasting only for nanoseconds, with the duration of each burst determining the colour density. Each layer of the paper requires a different temperature to form the image: the uppermost yellow layer requires the least heat and is printed first, then fixed by ultraviolet light; the middle magenta layer is then printed with greater heat, and again fixed by UV light; lastly, the bottom cyan layer is printed at maximum heat, but does not require exposure to UV light (see Figure 4). Prints are of a similar quality to dye sublimation.

Although the various thermal processes can print text, it is normally combined with images or graphics and it would not be practical or cost effective to use one of these printers for text alone – certainly, the results would not be equal to a text printer.

Ink is the Link

Inkjet is a more versatile technology, with printers that can handle text and graphics and the more upmarket models that can also produce images with an appearance varying from a halftone to virtually continuous tone, depending on the technology. Although the name implies a stream of ink, it is actually ejected from the multiple nozzles as fine droplets of constant size in order to restrict the quantity that goes onto the paper and prevent its spreading. The arrangement of the nozzles is essentially the same as that of the pins in a dot matrix printer, only they are much finer and there are more of them so the dot appearance is largely removed (the head also moves across the paper). Colour printing is achieved by dividing the nozzles between the CMY or CMYK inks to avoid contamination. The original inkjet printers operated with a continuous flow of ink, which had to be diverted by a gutter and returned to the reservoir between characters, whereas modern inkjet technologies eject droplets only when required.

The thermal inkjet, or bubblejet, printer was developed by Canon after a fortuitous accident when a researcher accidentally touched an ink syringe with a soldering iron and ink was ejected. Each of around a hundred nozzles in the print head (see Figure 5) has its own heating element which raises the ink temperature to 300-400°C through a pulse of electric current, and the vapour this creates forms a bubble which forces a droplet of ink out of the nozzle. The current is then switched off and, as the ink cools, the bubble collapses and draws in fresh ink from a reservoir (refer to Figure 6). Its viscosity keeps it in the nozzle until the process begins again. Special inks are required that can retain their properties after being boiled. And, because the elements need time to heat up and cool down again, printing is not quite so quick as other inkjet technologies such as piezo inkjet. This relies on the piezoelectric effect, whereby an applied electric field causes some crystals to mechanically deform, in this case, acting as a pump to force a droplet of ink out of the nozzle in response to a control pulse (a cold version of the bubblejet). Epson has developed an enhanced MicroPiezo printhead (see Figure 7) that allows greater control over each droplet and, thus, smaller printed dots of more consistent size and shape.

There is also a solid ink printer. This uses solid wax-based ink that is melted in the printer when needed and passed to reservoirs. It is then sprayed from an almost

full width printing head, which need only move slightly; to form an image on a rotating drum – it being possible to spray up to four colours at once (as Figure 8 shows). Paper is then brought into contact with the drum and the image is transferred. Before the next page is printed, the drum is cleaned of any residue by a maintenance tray using a thin film of fine silicon oil – which also acts to prevent the ink sticking to the drum during the next image transfer.

Quick as a Flash!

The different technologies described thus far all use some form of printing head to produce the results. The laser printer, conversely, borrows technology originally developed by Xerox for document copying (with some machines combining the roles of copier and printer).

A laser printer has a rotating drum that is coated with a photoconductive material. In operation, the photoconductive layer is charged by a corona wire, and a modulating laser beam is then scanned across the drum by an oscillating mirror to form a latent image by altering the charge (shown in Figure 9). Where the image-forming light is at maximum (white), the photoconductive layer is discharged, but as the intensity of the light is reduced, an increasing amount of charge is retained until all the charge is retained in what will become the black areas. Toner is then spread over the image and adheres in direct proportion to the charge remaining. Paper then passes in contact with the drum and, because it has been charged by a second corona wire, it

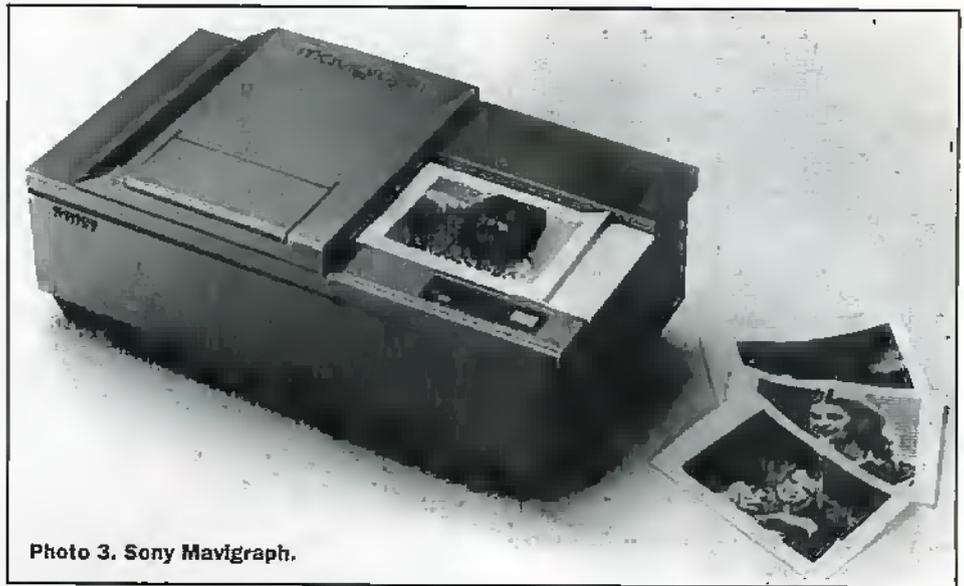


Photo 3. Sony Mavigraph.

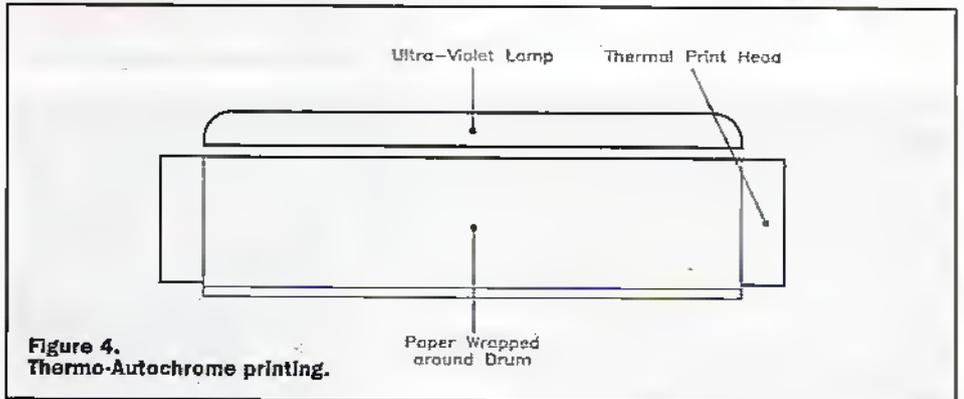
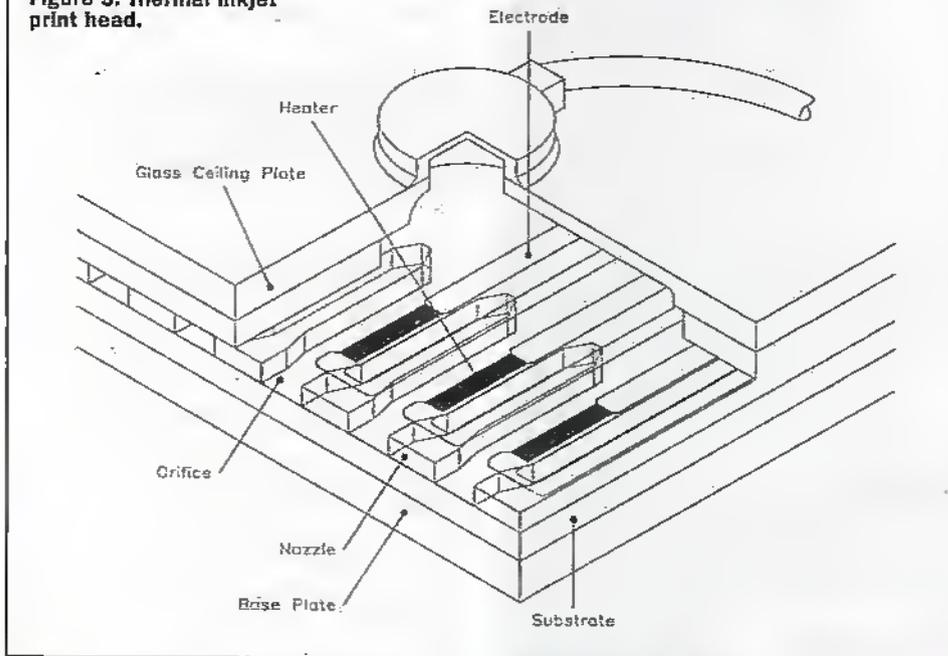


Figure 4. Thermo-Autochrome printing.

Figure 5. Thermal Inkjet print head.



attracts the toner image onto its surface. Finally, the paper passes over a hot roller that fuses the toner to the paper. To achieve colour reproduction, the process is repeated, each time using a different colour toner, thus building up the image in colour separated layers – normally CMYK.

The advantage of this technology is that it gives continuous tone images and accurately formed hard-edged characters and graphics. But, whatever the results look like, to get them on the paper requires some effort when the source is nothing



Photo 4. Fuji NC-3D Thermo-Autochrome printer.

more than a digital code. Basic text printing requires the printer to form characters from internal software instructions that match the character codes sent by the computer (normally the American Standard Code for Information Interchange – ASCII). Or, in the case of daisywheel and golfball printers, to select the already existing characters.

The particular typeface, such as Courier or Roman, will either conform to one of several fonts resident in the printer's memory or fonts supplied as part of a word processor. Scalable fonts allow the size of the characters (measured in 'points') to be adjusted because they exist only as a formula, whereas bit-mapped fonts are a precise arrangement of pixels and enlarging the characters produces a ragged appearance. Additional character codes must be sent to print italics, underlined text,

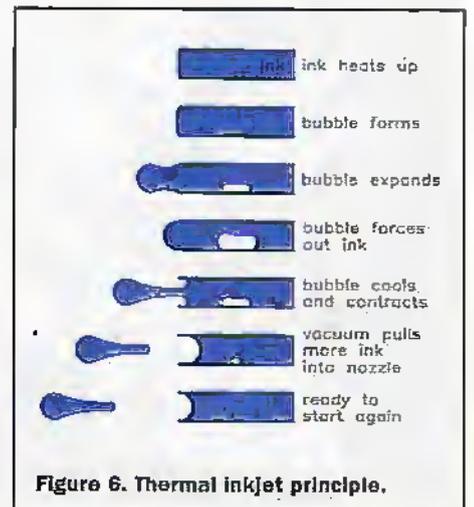


Figure 6. Thermal inkjet principle.

special symbols, etc., plus control codes to inform the printer of margin sizes, line length, line spacing, etc.

In order to correctly respond to these codes, and those for graphics, the printer must obviously understand them and word processors provide a menu of different printer types to ensure that the codes sent are correct for any particular model. However, if the printer is new or one that has a limited market, a definition file may not be included, so printers can be set to emulate other, more popular, printers.

One problem with printing has been that what was shown on the monitor was not what appeared on the paper, e.g., large characters printed small. Now desktop publishing (DTP) and an increasing number of word processor programs allow an exact replica to be printed, including graphics, etc., hence the term 'what you see is what you get', or WYSIWYG. Obviously, this only applies if the printer is physically capable of conforming to all the necessary codes.

The use of laser printers for DTP has seen the introduction of the page description



Photo 5. Canon BubbleJet printer.



Photo 6. Tektronix 350 solid ink printer.

language to interpret commands from virtually any application program, usually in ASCII, into a description of where text, graphics and images should be located on the page. The most popular of these is Adobe's PostScript. And this is increasingly being used with other types of printers. It can also be used to control a raster image processor (RIP) which converts the RGB seen on a monitor into CMYK values to tell the printer where and how much toner or ink should be used (both hardware and software RIPs are available). This may be aided by a colour management, or matching, system which specifies the colours to be used in order to achieve the desired hues. There are a number of different systems, the most popular being the Pantone one. But these are for critical work.

The majority of modern printers operate at 8 bits giving 256 grey scale levels, which, using CMY, translates to a colour depth of 24 bits, or a theoretical maximum of 16.77 million colours (256³).

In order to accept the increasing amount of printing information, in addition to the file that is to be printed, an internal memory is provided. This allows the computer to output all or large chunks of the data and so reduce down time. The more expensive printers will also have a hard disk to store the necessary software.

Video printers allow corrections to be made to contrast, brightness, colour, etc., as there is obviously no computer to do it beforehand. Some digital printers also have correction facilities on the printer, although these will normally duplicate those available from the computer, being merely a matter of convenience.

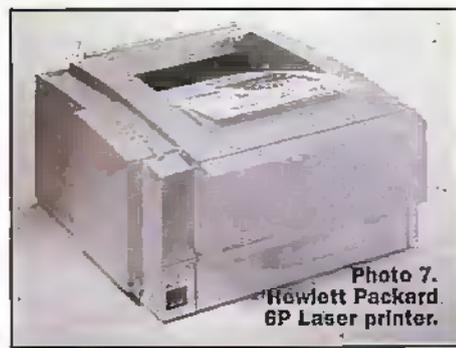
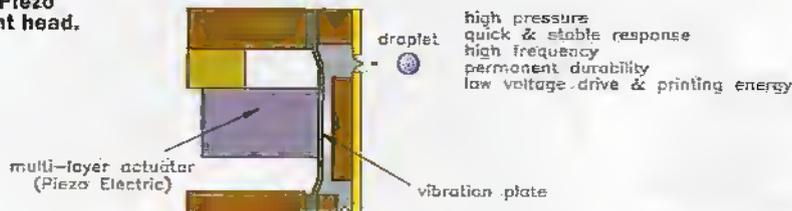


Photo 7. Hewlett Packard 6P Laser printer.

Figure 7. Piezo inkjet print head.



the maximum paper size and the maximum print size: unless the specifications state 'full bleed', there will be unprinted margins left on the paper.

Most printers give better results with special paper having the characteristics to suit the particular print medium than with plain paper – and some can only use special paper. Most printers are also capable of printing on transparency film or semi-transparent paper for use with an overhead projector (OHP). A printer that is intended for large print runs will probably use paper rolls, while others will use individual sheets fed from a paper tray.

Summary

With the rapid progress of technology, printers that were originally developed for office and then home use have taken on roles that would have been inconceivable just a decade or so ago. And the price-to-quality ratio at all levels is improving constantly.

New Year's Resolution

Print resolution is normally quoted in dots per inch (dpi). A common figure is 300×300dpi (horizontal × vertical), while more upmarket machines claim 600×600dpi or more. Some printers increase the resolution further by interpolation. But

however the resolution figures are achieved, they are not a completely reliable guide to how the finished print will look: a print with the appearance of continuous tone will seem to have a higher resolution than one that looks like a halftone, even though they both have the same number of dots per inch. With text, however, any differences in dpi are likely to be obvious. The size of the print may not be all that it seems, either. There is frequently a discrepancy between

Figure 8. Solid ink printing.

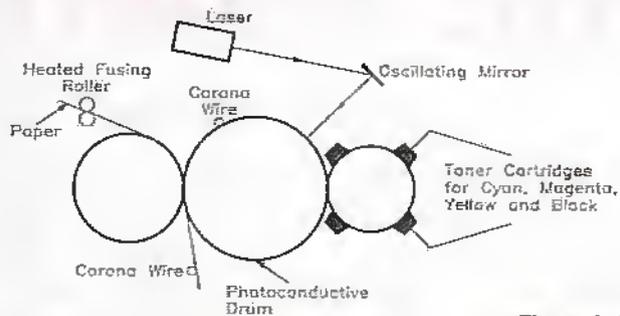
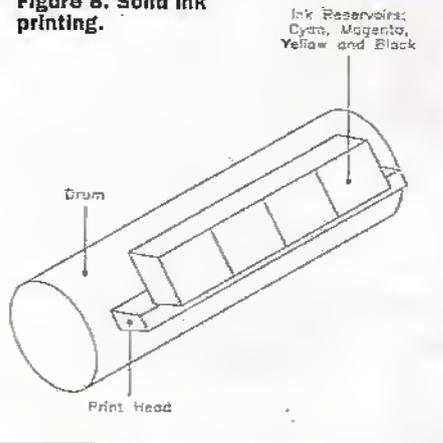


Figure 9. Laser printing.

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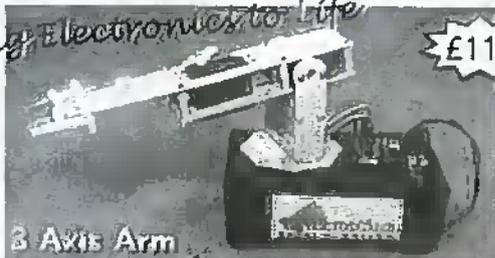
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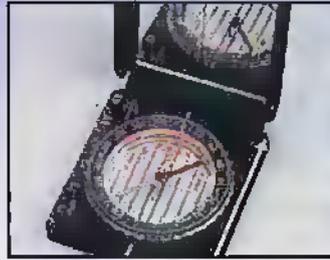
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Electronic equipment used on Rob Sperring's mountain expedition: Casio G-Shock Altimeter Watch (Stock Code CK56L); Garmin GPS Compass (Stock Code KX38R); Silva Sighting Compass and Clinometer (Stock Code WC52G) and Lago Halogen Head Torch (Stock Code BN77J).

Technology IN THE MOUNTAINS

by Rob Sperring

On August 21st this year, I set off on a climbing expedition to the Peruvian Andes with the intention of climbing peaks in excess of 20,000 feet. The weather conditions at this time of year were beginning to deteriorate as this was the end of the climbing season, which was exacerbated by a warm pacific current which occurs every ten to twelve years in this region and is known as El Nino.

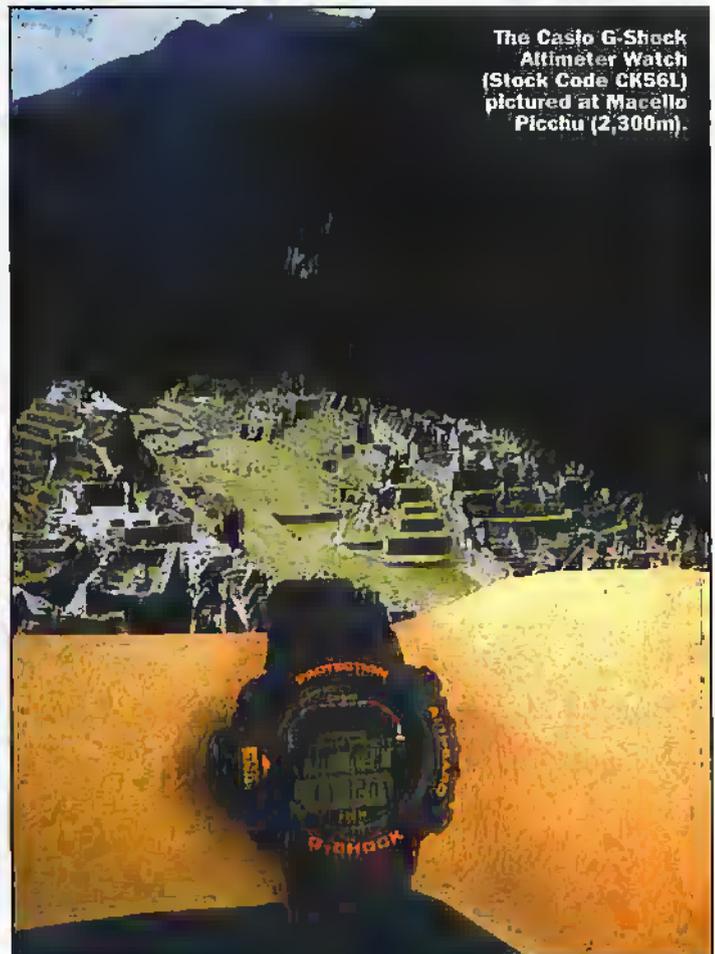
the relevant maps and climbing information, before setting off to Huaraz, which was to form the base for my climbing in the Cordilleras Blanca and Huayhuash mountain regions in Peru. As Huaraz is a town situated at 10,000 feet, I spent a few days here in order to acclimatise, followed by a day trek to Churup Lake at an altitude of 14,000 feet. Two days later, I was able to begin my mountaineering in earnest, and began with a non-technical climb of Mount Pisco at 19,000 feet to familiarise myself and gain confidence with my technical and electronic equipment. Subsequently, I made a technical ascent of Mount Ishinca at 18,750 feet and five summit attempts of Mount Tbellaraju, a peak of

With this in mind, my selection of equipment was of paramount importance with the prime considerations being weight, bulk and durability. In addition to the essential clothing and technical climbing equipment necessary for this trip, I also chose to take four items of electronic equipment for evaluation of their performance in this demanding and hostile environment. These included the following items which can be found in the

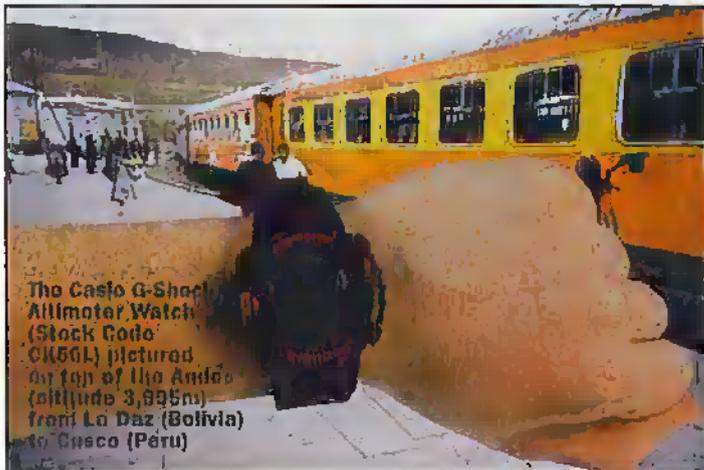
current Maplin Electronics catalogue and retail stores: Casio G-Shock Altimeter Watch (Stock Code CK56L); Garmin GPS Compass (Stock Code KX38R); Silva Sighting Compass and Clinometer (Stock Code WC52G) and Lago Halogen Head Torch (Stock Code BN77J).

Acclimatising

On arriving in Peru, my first port of call was the South American Explorers Club in Lima, where I was able to obtain



The Casio G-Shock Altimeter Watch (Stock Code CK56L) pictured at Macello Picchu (2,300m).



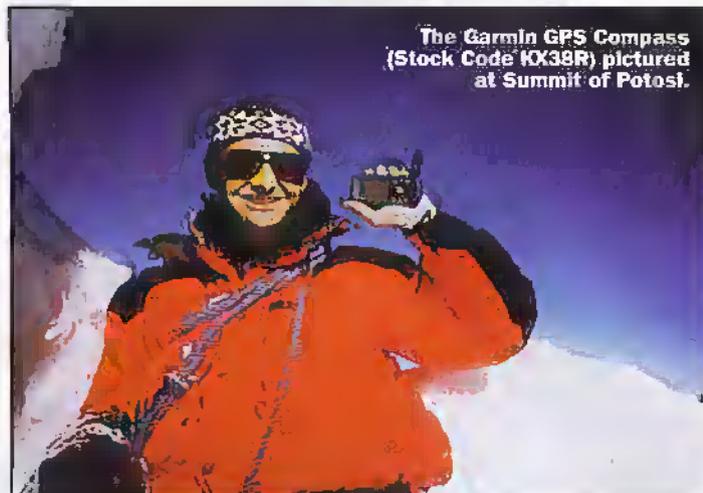
The Casio G-Shock Altimeter Watch (Stock Code CK56L) pictured on top of Uto Ando (altitude 3,895m) from La Paz (Bolivia) to Cusco (Peru)

The Garmin GPS Compass (Stock Code KX38R) pictured at Churup Lake (approx. 4,800m)



more than 20,000 feet. It was here that I stayed at summit camp at 18,000 feet for six days in the most extreme weather conditions that I was to encounter during my trip. Although I was within 500 feet of summit on one of my final attempts, the adverse conditions proved too perilous. I returned to Huaraz with frost-bitten fingers and realizing that the weather conditions were unlikely to improve, I decided to set off for Bolivia to Mount Huayna Potosi in search of my 20,000 foot peak.

Throughout all my climbs, the specific features contained in the watch proved to be very useful aids on the mountain. In particular, on the approach from base camp to summit camp on the Tocllaraju climb, the barometric pressure graph forewarned me that a large fall in atmospheric pressure had occurred even though the immediate weather conditions gave me no indication of the impending snow storm. As a direct result of this warning, I decided to make more haste in my ascent to the summit camp and pitch my tent earlier than I had originally planned. The storm hit later that evening, by which time, I had long since



The Garmin GPS Compass (Stock Code KX38R) pictured at Summit of Potosi.

pitched my tent and cooked my evening meal and was able to weather out the first day's storm in shelter. In the absence of this warning, I would have been placed in the position of having to pitch camp in a blizzard. An additional feature of the watch which I was able to exploit is the built-in altimeter. This measures heights up to a maximum of 13,360 feet, which is ideal for climbing and mountaineering in all but the highest mountain ranges in the world. At lower levels, I found the watch to be an excellent indicator of height, showing less than a 5% margin of error at its limits.



The Garmin GPS Compass (Stock Code KX38R) pictured at Summit of Ishinca (5,590m).

Look, No Hands!

On one of my summit attempts on Tocllaraju and on my first and successful attempt at summit on Mount Huayna Potosi, it was necessary to begin climbing at 0300 hours in order to reach summit and return to camp within sufficient time should the weather deteriorate. It was on these occasions that the hands-free halogen head torch was invaluable, not only for initial preparations and leaving the tent, but also illuminating the grade 4/5 near-vertical ice face, for which I needed both hands free to climb with ice axes. Without the use of this torch, I would have been forced to climb by starlight, as there was a new moon which offered very little illumination. I found the torch very comfortable to wear, the battery at the rear counterbalancing the filament housing at the front perfectly, and the inclusion of clips allowed secure attachment to my helmet. In all but the most severe blizzard conditions, the beam angle and penetration were excellent, enabling safe

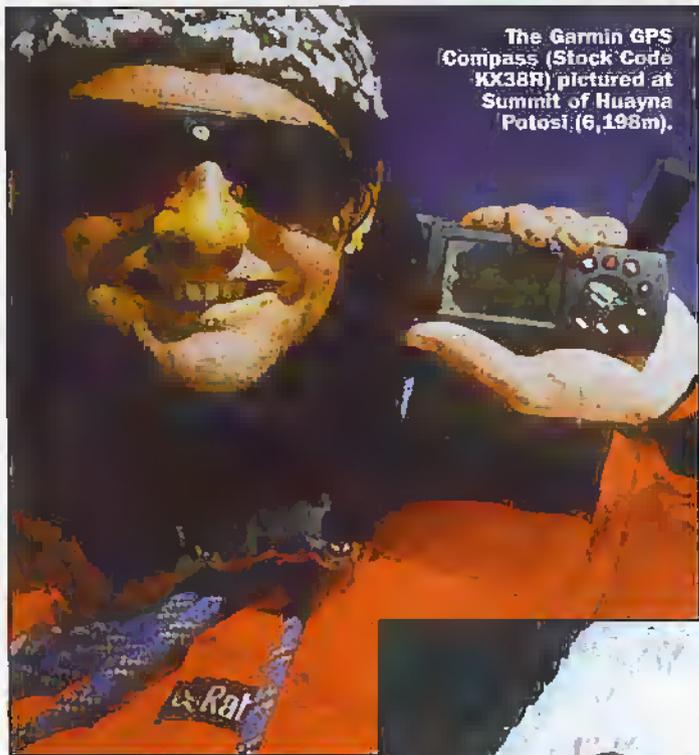
navigation, even on the glacier at night when the call of nature beckoned.

One of the most used items on my trip, whether I was trekking, on an approach or climbing, was the Silva Sighting Compass and Clinometer. A handy feature of this was that it fitted unobtrusively into my breast or sleeve pocket, which made it readily accessible for taking quick bearings. Due to the innovative sighting design of this compass, I found that I was able to take back bearings very accurately for precise positional fixes. The alignment mirror also had an unexpected function, that of a vanity mirror for applying my yellow zinc total sun block lipstick without smudging it! As for the Clinometer, I used this on several occasions for assessing the grade of an ice-climb and for finding level ground on which to pitch my tent but realistically, this was used more out of interest than for any real practical need.

GPS Proves its Worth

The star banana of all the pieces of equipment was the Garmin GPS II Plus Satellite Compass! I have used many GPS compasses previously, but was impressed with the speed of acquisition of this instrument, the size of the LCD display screen and its economical use of the batteries. Other attractive features are its ergonomic shape and size and its user-friendly menu driven display screens. One of the most notable incidents occurred when I was on the summit camp of Tocllaraju, caught in a total whiteout. I had been climbing on a 5,000 foot ice-face alongside the summit

The Garmin GPS Compass (Stock Code KX38R) pictured at Summit of Huayna Potosi (6,198m).



Approach to Huayna Potosi. Note curvature of the Earth and Lake Titicaca (altitude 19,500ft. approximately).



Final ice wall, Huayna Potosi, at 6,150m (20,000ft.).



Summary from the Summit

All four of the electronic items I carried with me on my climbing expedition in the South American Andes acquitted themselves admirably under extreme conditions of temperature and altitude, all of them justifying their cost. Having used this equipment to its full potential, I feel it is highly suitable for outdoor enthusiasts and climbers alike. With the festive season approaching, I would not hesitate to recommend one or all of these as gifts for use in the UK and Europe.

Finally I would like to thank the following:

Asolo for the Supersoft plastic boots and Inca Trail approach shoes, Terra Nova for the Super Quasar tent, Rab for the Zero Down jacket, O.T.T. Expeditions for all their help and advice.

camp and wanted to return to the shelter of my tent before the impending storm. In order to do this, I had to negotiate several snow hidden crevasses to locate my tent whilst avoiding other perilous near vertical ice-faces which dominated the glacier on three sides. Fortunately, I had carried the GPS compass with me on this climb and had switched it on for the entire ascent. I was therefore able to backtrack with a high degree of accuracy, my snow covered tracks from earlier. Although this compass has a differential error of up to 100 metres in theory, on this particular descent, I found it to be unerringly accurate. During this descent, I could not help wondering at the fate of several of the climbers on the Everest expedition of May 1996 and whether for the sake of the extra few hundred grams in weight of this compass, the outcome might not have been different.

The definitive memory of this compass was when it logged my position on the summit of Huayna Potosi at 6,198 metres or 20,701 feet. My goal achieved at last, I could have kissed it!

For extended expeditions where base camps could be set up for several weeks on end, technology has provided mountaineers with additional communication aids offering increased information, thereby making ascents more calculated and less hazardous. These products include two-way mobile radio transceivers

such as the Alinco DJ-190E (Stock Code KN44X), which offers line-of-sight communications of up to 25 miles; solar panels as listed on page 662 of the current Maplin Electronics catalogue, which allow the continuous trickle charging of 12V lead acid batteries or powering the Maplin weather satellite receiver (Stock Code AQ49D), which when used in conjunction with a laptop computer, will give live meteorological information from Russian and American geostationary weather satellites.

Final summit on Huayna Potosi at about 0330 hours!



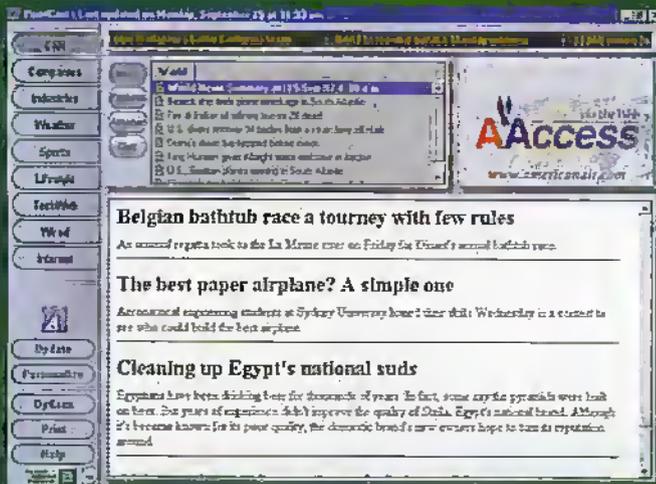


Photo 1. PointCast Network is one of the most popular news delivery mechanisms on the Internet.

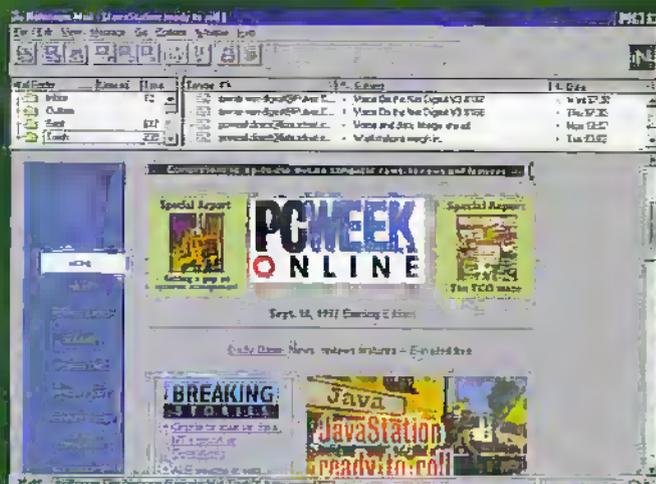


Photo 2. Push technology enables publishers to distribute electronic publications such as PC Week Online to a wide audience.

The Information ECONOMY

PART 5

Information Overload

by Stephen Waddington

Latest estimates put the size of the Internet at over one million Web sites, with more than 50 million individual Web pages. Add to this the daily torrent of news published on the Web and the fact that over 500 Web sites are added to the Internet every day, and it quickly becomes apparent that the sheer scale of the Internet is growing beyond the comprehension of an individual human being. So how does a user find, and more importantly, extract meaningful information from the Web? Here, Stephen Waddington examines a series of tools to enable Internet users overcome information overload.

Information overload is a symptom of the explosive growth of the Web and traditional broadcast and print media. The sheer amount of electronic material on the Web makes it difficult even to find — much less read and assimilate — relevant news and information. Consumers want to find and access information in a timely manner, while publishers face the challenge of creating and building the most effective channels to get their published content through all the noise to its target readership.

Electronic Junk

While 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. Users looking for information on a particular organization or topic need to access relevant Web sites in a matter of minutes, and can ill afford to spend hours surfing from site to site.

"The ability to access the right information at the right time is absolutely

critical. The problem is that the Internet falls short of expectations. Rather than giving users tools to assimilate the right information into useful knowledge, it is being overloaded with too much irrelevant data", said Dr. Mike Lynch, Managing Director, Autonomy. Lynch founded Autonomy, an artificial intelligent agent company, in March 1996 to develop tools to manage information on the Web.

Tools to Overcome Overload

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 — or at least, build tools that enable structure and order to be superimposed upon the Internet.

The complexity of this new wired environment demands a new style of human-computer interaction, where the computer becomes an intelligent, active and personalised collaborator. During the course of this article, we will examine a series of emerging tools that are being developed to help individual users access the information appropriate and relevant to their needs on the Web. These range from push and pull technologies which are both modelled on the traditional publishing industry: to intelligent agents and search engines that track down requested information on the users' behalf in real time.

News and Views

Over the past few months, a number of Internet-based news delivery products have been trialled on the Internet to enable publishers to build a direct relationship with their readers. Here, information is despatched to the user as it is generated or a software application is used to grab information from a specified Web site for storage and subsequent viewing locally.

The majority of the tools, which we will

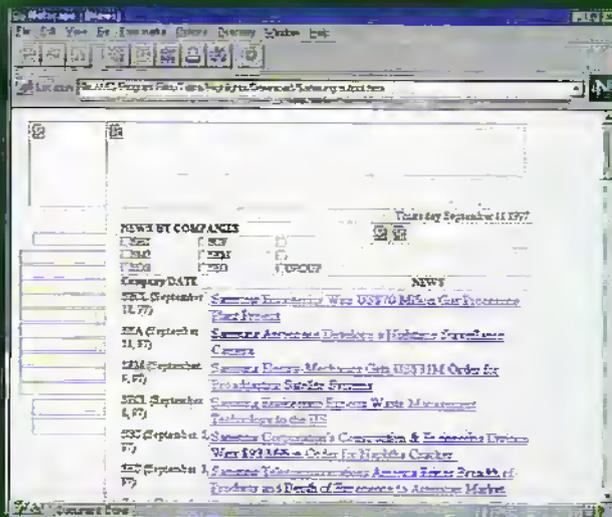
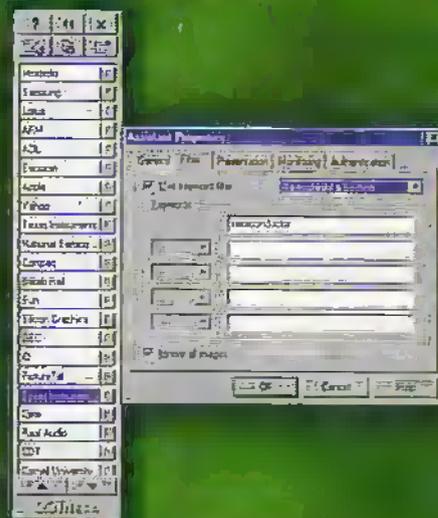


Photo 3. Highlights2, a leading pull application, automatically monitors Web pages by downloading new content of significant to the user.

Photo 4. An Assistant is defined to highlight any material containing the keyword 'semiconductor' on the Texas Instruments press information site.



examine here, require a direct connection to the Internet. This means you are able to make a direct connection to the Internet without using proprietary browsers or offline reader applications from your Internet Service Provider (ISP). If you are unsure about the type of connection you have, contact your ISP to check that you can establish a direct connection to the Internet.

The product that has enjoyed the widest mind share is the PointCast Network, as shown in Photo 1. However, a number of other equally significant players also compete in this market space as well. Generally, these technologies employ one of two delivery methods:

Push Technology

In this model, the content provider collects, assembles, and integrates information and 'pushes' the complete product to the user. This is also referred to as Internet broadcasting or narrowcasting.

Pull Technology

Here, client-based software on the user's PC proactively monitors a user-defined set of Web sources at user-defined periods looking for information from a user-specified set of topics and interests. Periodically, the pull product will bring the specific, relevant information that is customised and personalised for the individual subscriber.

Push Or Pull

Pull technology is typically subscription-based and operates in exactly the same manner as a traditional magazine subscription. In this model, the end user – or subscriber – typically pays for the content, software, or service that enables him to monitor a customised set of raw news and information sources, and pull it directly to the desktop on demand.

By comparison, push methodologies are ideally suited for mass-appeal information for a very wide audience. Here, a defined set of information such as the daily edition of PC Week Online, part of the Netscape In-Box direct service at www.netscape.com as shown in Photo 2, is distributed to the user by e-mail as it becomes available. But push

| Application | Trial | Contact | Price |
|--------------------|--|--------------------------------------|---|
| Tierra Highlights2 | Download 30-day version from Cross Atlantic Web site at www.crossatlantic.co.uk | Cross Atlantic, Tel: (0171) 228 6992 | £39.99 |
| PointCast | Download free from www.pointcast.com | Download from Web site | Free – PointCast is advertising driven. Still in beta. |
| Autonomy | Download free 30-day version from Agentware Web site at www.agentware.com | Agentware, Tel: (01223) 421220 | Check with Autonomy for pricing and availability of commercial version. |

Table 1. Software sources and availability.

technology is also perfect for distribution of information for a smaller audience such as a niche trade publication, which cannot typically support a broader advertising revenue base.

Push technology can be very attractive because it requires less intervention or mental processing. The product such as PC Week online is packaged with graphics, animation and flashing headlines and is pushed out to the user on publication. Essentially, it is a passive medium.

Both push and pull technologies deliver news and information to the user's desktop. However, each method is suited to different types of information and to different user styles. Since the push model requires central editing of the information to prepare it into appropriate packets for distribution, this model is most cost-effective if the information has wide appeal – world news, updated stock market indexes, football scores, or weather maps.

However, pull technology is best implemented in situations where the user decides which information sources are most interesting or useful. In this case, the individual user can decide the unique mix of information which he wishes to view. This could include a mixture of 'broadcast' news such as a roundup of rugby statistics, some specific technical news, and personal-interest items such as match reports on a particular football team, or data on weather patterns in a particular part of the UK.

Because the user is pulling documents, the sources and topics can be literally anywhere on the Internet. Naturally, over time, topics will move in and out of favour with each user, and so the list of monitored items will be modified by adding or deleting

Web sites and pages.

Pull technology, because of its ability to uniquely focus information for the user, provides a very efficient delivery medium for new information – far more efficient than simply browsing to find the information, or using a bookmarks system to look at pages that have some change on them. Both pull and push provide an information delivery channel that is very efficient for the user, since the delivery is typically performed in the background, and the information is available at the user's desktop for viewing on demand.

Pull with Highlights

While lots of companies claim to be building both push and pull technology, the market is currently limited to a handful of commercial products. Without a doubt, Highlights2 from Tierra Communications, shown in Photo 3 (see Table 1 for download/availability details), is the leading pull application. Highlights2 monitors Web pages by looking for new content of significant interest to the user and then downloading to the user's hard disk for subsequent viewing.

Using Highlights2 in conjunction with a Web browser, users can improve their efficiency in getting personalised news and information from the Internet – improving the speed and quality while streamlining the quantity of content they read. A new information source can be added instantly by creating an Assistant based on the page currently viewed in their browser.

Each Web page to be monitored is assigned an Assistant. For each individual Web address, the Assistant stores details of

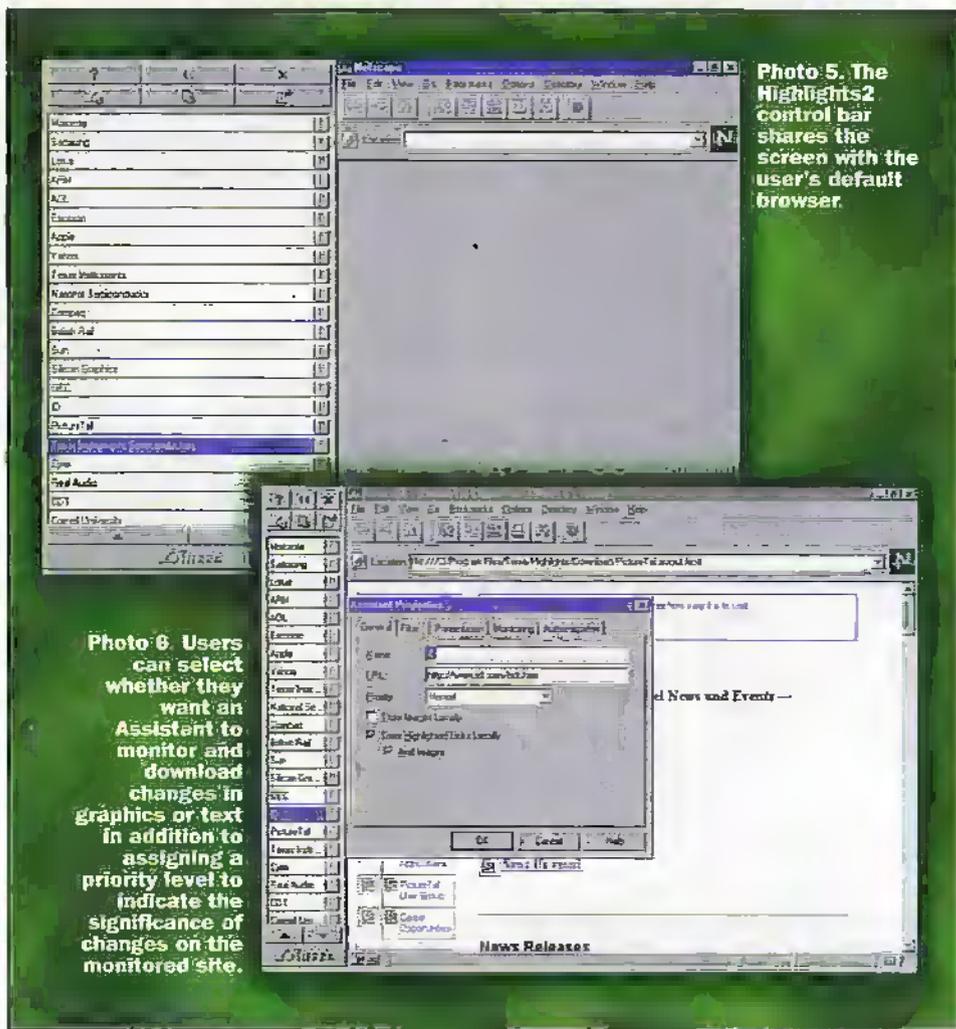


Photo 5. The Highlights2 control bar shares the screen with the user's default browser.

Photo 6. Users can select whether they want an Assistant to monitor and download changes in graphics or text in addition to assigning a priority level to indicate the significance of changes on the monitored site.

the most current version of the Web pages from that site held locally and details of specific information to be highlighted on the retrieved page. Highlights2 will embolden information of particular interest to the reader by checking retrieved Web pages against a list of keywords assigned by the user and recorded by the Assistant. Photo 4 shows an Assistant being defined to highlight any material containing the keyword 'semiconductor' on the Texas Instruments press information site.

The Tierra Highlights2 control bar is an application taskbar, which contains a variety of controls for setting and changing the Highlights2 Assistants. The control bar docks to the edge of the screen in a manner similar to the Windows 95 taskbar. This means the application control bar is present on the screen but still co-operates with any existing applications. The Highlights2 control bar can be stretched, by grabbing an edge of it, to a width that suits your assistant names and screen size, as shown in Photo 5.

Selected Web pages are monitored for updates whenever the user connects online. This can either be handled manually, or scheduled using an auto dialler feature. Changed pages are stored locally, enabling users to browse their entire list of bookmarks offline. Users can select whether they want an Assistant to monitor and download changes in graphics or text or both, as shown in Photo 6. Switching off graphics significantly decreases the amount of data to be downloaded. Highlights2 downloads the Web page specified by the

Assistant and the first tier of hotlinked pages, which link from the page defined within an Assistant by a user.

Assistants

Assistants are assigned priority levels — Normal or High priority, as shown in Photo 6. When a change occurs in a High Priority Assistant, the user is notified both audibly with a beep while online and visually with a red check mark. When a normal priority Assistant change is registered, a simple check mark appears. Other symbols are used to indicate when Highlights2 has been unable to download information, or when information has been read.

Highlights2 gives users further options for organising and viewing their information by adding the ability to group and arrange Assistants by topic. Pages may be grouped under more than one topic, if desired. For example, a stock listing page might be viewed either as a personal interest item, or as an investment item, or even as a corporate page. Users can define, name and organise the topics to suit their own interests.

Push PointCast

Now compare pull with push, or Highlights with PointCast. PointCast Network shown in Photo 7 (see Table 1 for download/availability details), is reckoned to be the first news and information service to broadcast up-to-the-minute news directly to a viewer's computer screen. The company also claims to have pioneered the concept

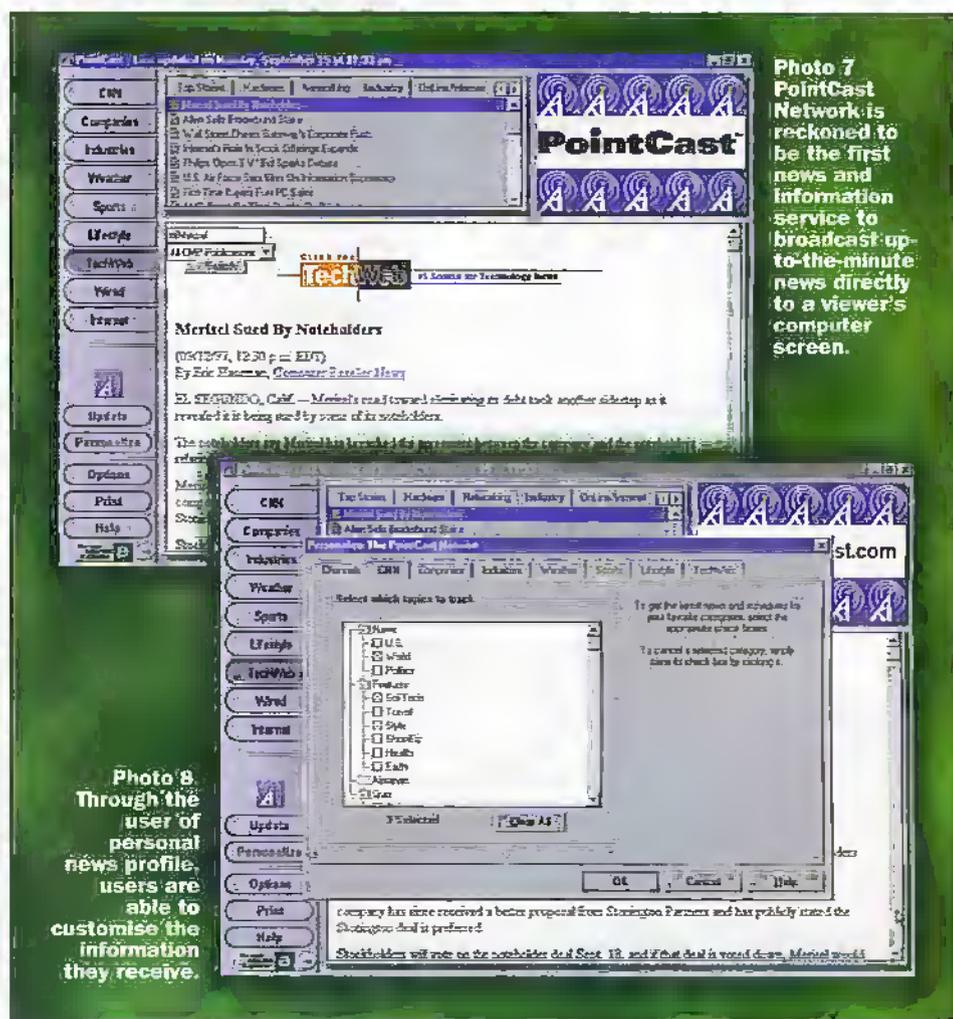


Photo 7. PointCast Network is reckoned to be the first news and information service to broadcast up-to-the-minute news directly to a viewer's computer screen.

Photo 8. Through the user of personal news profile, users are able to customise the information they receive.

Photo 9. Yahoo is a sophisticated directory-based search engine where users can either browse sites by subject classification, or search on keywords.

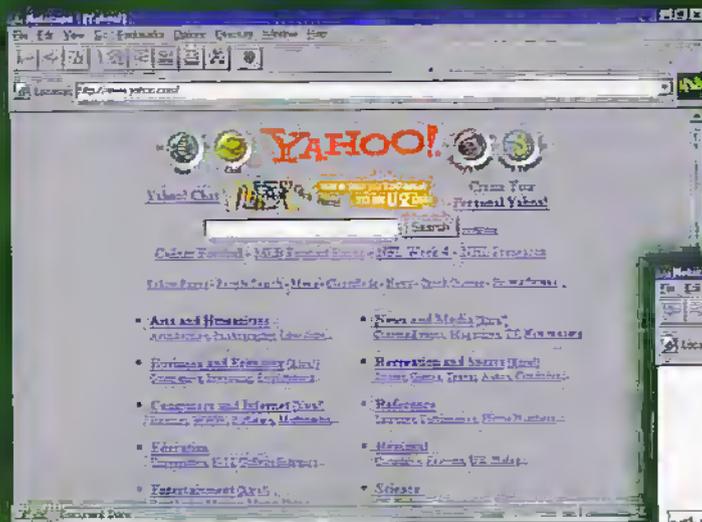
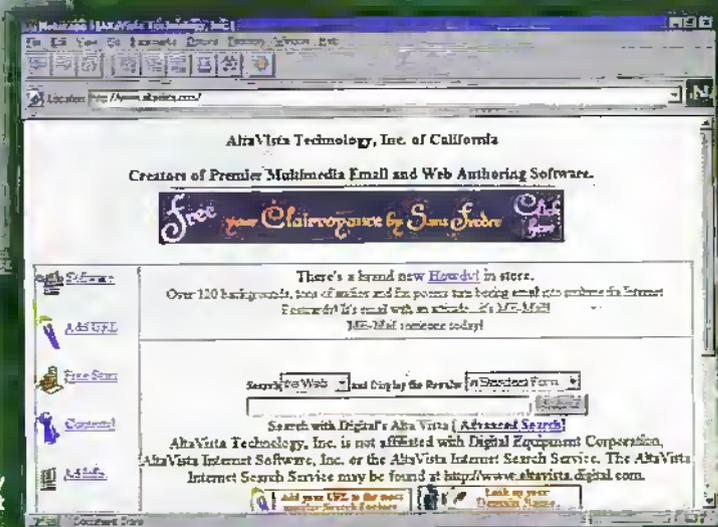


Photo 10. Alta Vista uses a query tool or data collector to collect information about Web sites.



of broadcasting information over the Internet, tailored to the interests of each individual viewer.

PointCast delivers up-to-the-minute news and information free to Internet users. The network features six channels – News, Companies, Industries, Weather, Sports and Lifestyle. These channels offer business, international and political news, stock quotes, sports news, weather reports and maps, entertainment news and more from various sources, such as Reuters.

Through personal news profiles shown in Photo 8, viewers are able to customise the information they receive. Viewers specify news topics of interest and the PointCast Network delivers current news to their desktop. Personal news profiles can be modified at any time.

PointCasting is an almost halfway house between simply browsing the Web, and setting rigid parameters for information retrieval using pull technology such as Terra Highlights. It combines many of the best aspects of traditional broadcasting in which top stories are researched, identified and delivered to audiences by news professionals with the personalisation options offered by the PointCast Network.

Like television, the PointCast Network is supported by advertising to provide users with complete PointCast services free of charge. PointCast creates commercials for advertisers using a built-in technology that minimises hardware requirements. And continuing the TV analogy, patent-pending SmartScreen technology replaces the PC's regular screen savers with rolling up-to-the-minute headline news. But a failing of PointCast generally is its lack of European-focused news and information sources.

Numerous publishers are now making their publications available to readers as soon as they are completed using services

such as PointCast, or are even e-mailing HTML documents direct to subscribers. Many of the analyst houses such as Dataquest and Giga are now using e-mail as a mechanism to distribute reports and briefing papers.

Specific Information Requests

Push and pull technologies deal with the regular delivery of news and information. What if a bespoke piece of information is required? For instance, perhaps you are keen to build a green energy supply and want to track down details of solar panels. How do you go about locating this information?

One of the solutions is to use a search engine to scan through Web pages for keywords or search themes on your behalf. 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.

Directory Enquiries

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 receive details of all relevant sites contained within the directory.

Undoubtedly, the most sophisticated directory type Web search engine is Yahoo (Yet Another Hierarchical Officialicious Oracle), located at www.yahoo.com. Yahoo, shown in Photo 9, 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'.

Data Collection

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. The most popular search engine in this category is Alta Vista at www.altavista.com, as shown in Photo 10, created and maintained by Digital.

By basic definition, this type of search engine is more comprehensive. This is because it uses agent 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 is not the case: a robot simply visits a site by requesting and downloading documents.

Executing a Search

Searching for a Web site or information on a particular topic is relatively straightforward. A selection of search engines is shown in Table 2. Start by loading up the Web page of the search engine you want to use in your

Search Engines URL Addresses

| | |
|----------------|-------------------------|
| Alta Vista | www.altavista.com |
| BizViz | www.bizviz.com/bizviz |
| Galaxy | www.galaxy.einet.net |
| Infoseek | www.infoseek.com |
| Lycos | www.lycos.com |
| Open Text | www.opentext.com:8080 |
| Starting Point | www.startpoint.com |
| WebCrawler | www.webcrawler.com |
| What's New Too | www.newtoo.manifest.com |
| Yahoo | www.yahoo.com |

Table 2. Selection of popular Internet search engines.

search engine as shown. As a general rule, use a simple Index engine such as Yahoo to search for company Web sites and a more complex engine such as Alta Vista to search for more generic keywords or themes.

Companies that create and publish a Web site will register the name and Web address of that site with all the major search engines – thus, you should locate it easily using a simple index search engine. By comparison, the complex robot generated search engines will return from every Web page where the company name or subject is used as the search term is listed.

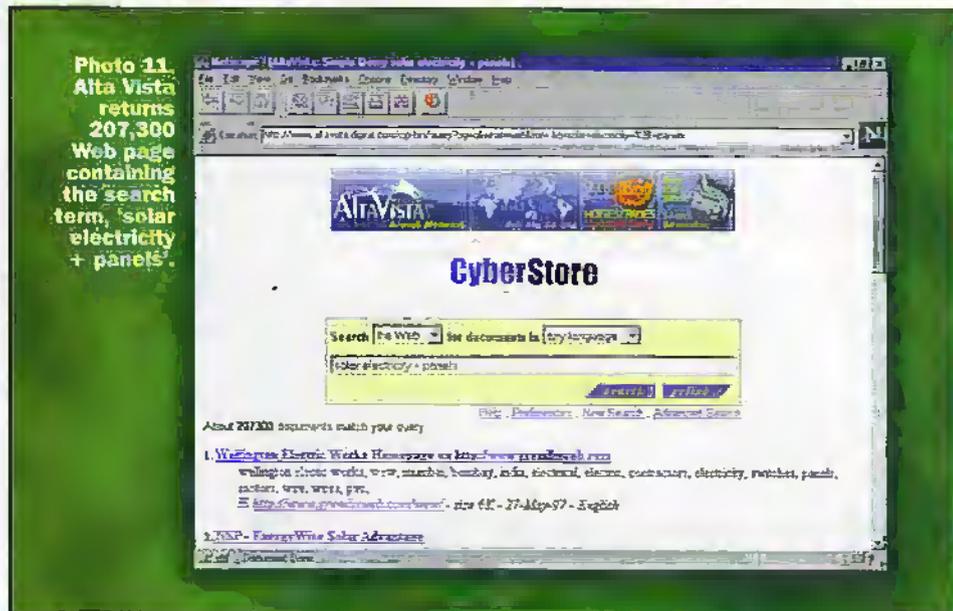
Search Example

We are searching for information on green electricity, and more specifically, solar panels. As this is a generic topic, enter the search term 'solar electricity + panels' on Alta Vista. On the search engine, enter the keyword 'solar panel' in the box provided and click the submit button. You should always be as specific as possible when entering search terms; remember that there are more than 50 million Web pages that could contain pertinent information. A series of search tips are shown in Table 3.

A matter of seconds later, Alta Vista returns a series of Web page references, as shown in Photo 11. First in the list is the Wellington Electric Works Homepage at www.grenlinweb.com. By clicking on the reference, it's possible to jump to the

- ◆ Plus and Minus: Precede a required word or phrase with plus '+' and a prohibited one with minus '-'.
- ◆ Punctuation: Adding punctuation to search strings forces words into a phrase, as do quote marks.
- ◆ Case sensitivity: a lower case search string will pull up upper case matches. The reverse is not true – upper case search strings produce only exact matches.
- ◆ Fieldnames: It is possible to restrict searches to certain portions of documents by preceding the search terms with the fieldname to search in lower-case, followed by a colon (such as title: 'The Wall Street Journal'). Fields to search include: title; anchor; text; applet; object; link; image; url; host; domain.
- ◆ Boolean operators: Use Boolean operators such as AND, OR, NEAR, and AND NOT to force words to be included or excluded from the search result. The operators can be written in lower-case.
- ◆ Display: Simple Query results are ranked according to a scoring algorithm, and displayed in declining order of relevance. A document has a higher score if the query words or phrases are found in the first few words of the document or if the query words or phrases are found close to one another in the document.

Table 3. Search engine hints and tips.



referenced Web page and check if it's relevant to your needs. If not, skip back to the search engine page using the navigation buttons on your browser and check the next link.

Using Alta Vista to search on 'solar panel' generated more than 207,300 responses. After half an hour scanning through the first 100 or so of these references, we found only one site that described how to build a solar electricity supply. Other search themes such as 'solar electricity supply', 'building a solar supply' and 'solar battery supply' were equally fruitless.

The reason for this is that conventional search engine techniques are limited by a rigid, structured implementation, simple decisions based on keywords and forms filled out by the user. Even when it seems to be capable of intelligent functions, at best, the software is only able to act according to a complex set of pre-programmed instructions.

Agent Software

The next generation of Internet-search software – called agent-technology – incorporates decision-making capabilities. Agent software or agentware is a new breed of search technology that uses Web-robots that are sent out onto the Web with a search-definition or description to work on behalf of the user.

Autonomy Agentware, as shown in Photo 12, is the first mass-market application of Neural Network based Artificial Intelligence technology for the Internet. The core technology behind Agentware is based upon research carried out by Cambridge Neurodynamics in the field of Neural Networks and has been in commercial use since 1991.

Autonomy's unique innovation is to apply such a high level of Artificial Intelligence to the tasks of personalising and understanding information from the Web. Neural Networks give computers some independence of thought. These systems are capable of learning to spot patterns and inter-relations in large amounts of information.

The core Neural Network technology in

Agentware is known as the Dynamic Reasoning Engine (DRE). Because the DRE understands the context of content, Autonomy's Concept Agents work by searching for patterns of information, rather than specific words or phrases. The DRE is capable of understanding a complete subject or topic so when a user briefs a Concept Agent, they are giving the DRE a sample pattern to work with.

By matching the available patterns to data found in environments such as the Web, the Agent is able to distinguish relevant from irrelevant information. A user who re-trains an Agent gives it the opportunity to develop a richer pattern to operate with.

Neural Networks also use fuzzy logic which allows an Agent to suggest other ideas the user may find useful. Cambridge Neurodynamics, which developed the technology for Autonomy, maintains close links with Cambridge University, and undertakes collaborative research in order to continue to develop the field of Artificial Intelligence and Neural Networks.

Autonomy uses a unique technology advance called concept clustering. Rather than using keywords or query terms, Autonomy Agents develop knowledge of a concept area. This can be given by the user via simple explanations or by showing the Agent sample documents that describe the concept.

The success of an agent-based search lies in the creation of the agent. An Agent is named and trained by typing in a sentence or two in plain English, as shown in Photo 13. No complicated keyword-based query is necessary. The Agent can now be sent out to scour the Internet, bringing back a selection of relevant information. The Agent keeps learning about your user's interests and will adapt accordingly as your interests change.

Autonomy Agents are mobile. They can 'live' on the user's PC or on a publisher's Web site and travel from one to the other to perform tasks. Autonomy Agents are small, typically between 2 and 4k-bytes. Their small size enables them to move quickly across the Web, Intranets or other client-server networks.

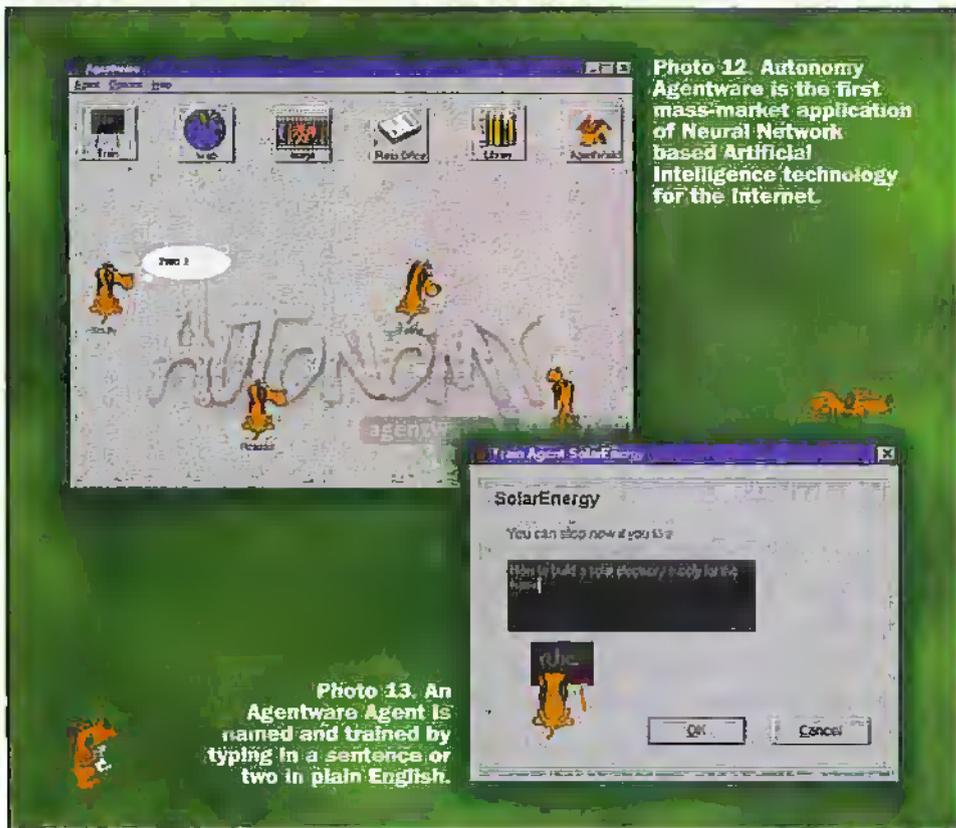


Photo 12. Autonomy Agentware is the first mass-market application of Neural Network based Artificial Intelligence technology for the Internet.

Photo 13. An Agentware Agent is named and trained by typing in a sentence or two in plain English.

Agentware 1.5 (see Table 1 for download/availability details) includes six pre-programmed, pre-trained agents as follows:

- ◆ **Web Researcher:** a service enabling your Agents to research the Web.
- ◆ **Press Office:** an automated news service that utilises online media resources to create personalised newspapers.
- ◆ **Art Agent:** a service that gathers images from the Web.
- ◆ **Library:** a service to store retrieved data on the user's hard drive.
- ◆ **Agent World:** a service on an Autonomy Agentware server where agents can be sent to search the Internet while the user is offline.
- ◆ **Agent Dating:** a service on an Autonomy Agentware server where Agents can find other Agents with similar interests, creating dynamic affinity groups among users.

Agentware in Action

How do Agentware Agents perform in action? Returning to our solar electricity search example, Photo 13 shows an agent being trained to search on material related to 'how to build a solar electricity supply for the home'. Photo 14 shows other parameters being defined, such as the level of curiosity and activity to be attached the agent. Finally, when the agent is defined, a connection to the Internet is made, so that the agent can be despatched to commence its search activity.

Before very long, a series of locations containing appropriate information is collated, as shown in Photo 15. These can be viewed and analysed sequentially, as

shown in Photo 16. If material is not appropriate to user requirements, the agent is informed of this and retrained before returning the Internet to conduct a second search.

Closing Word

It cannot be long before the phrase 'growing like the Internet' enters the English language to describe rapid, uncontrollable growth. While the growth of the Internet and availability of information is a good thing, the fact that it is unstructured making the locating of even the most basic item of information an arduous task, tempers its practical use to consumers.

The good news is that the Internet community has recognised the need for organisation. But it is unlikely that this organisation will ever come in the form of a re-organisation of the Internet. This task would be completely impractical. Instead, Web developers are concentrating their efforts on the development of smarter search engines and sophisticated tools such as Agentware. Meanwhile, push and pull technologies are already redefining the future of Web publishing, enabling the publisher to re-establish a one-on-one relationship with readers.

RESEARCH

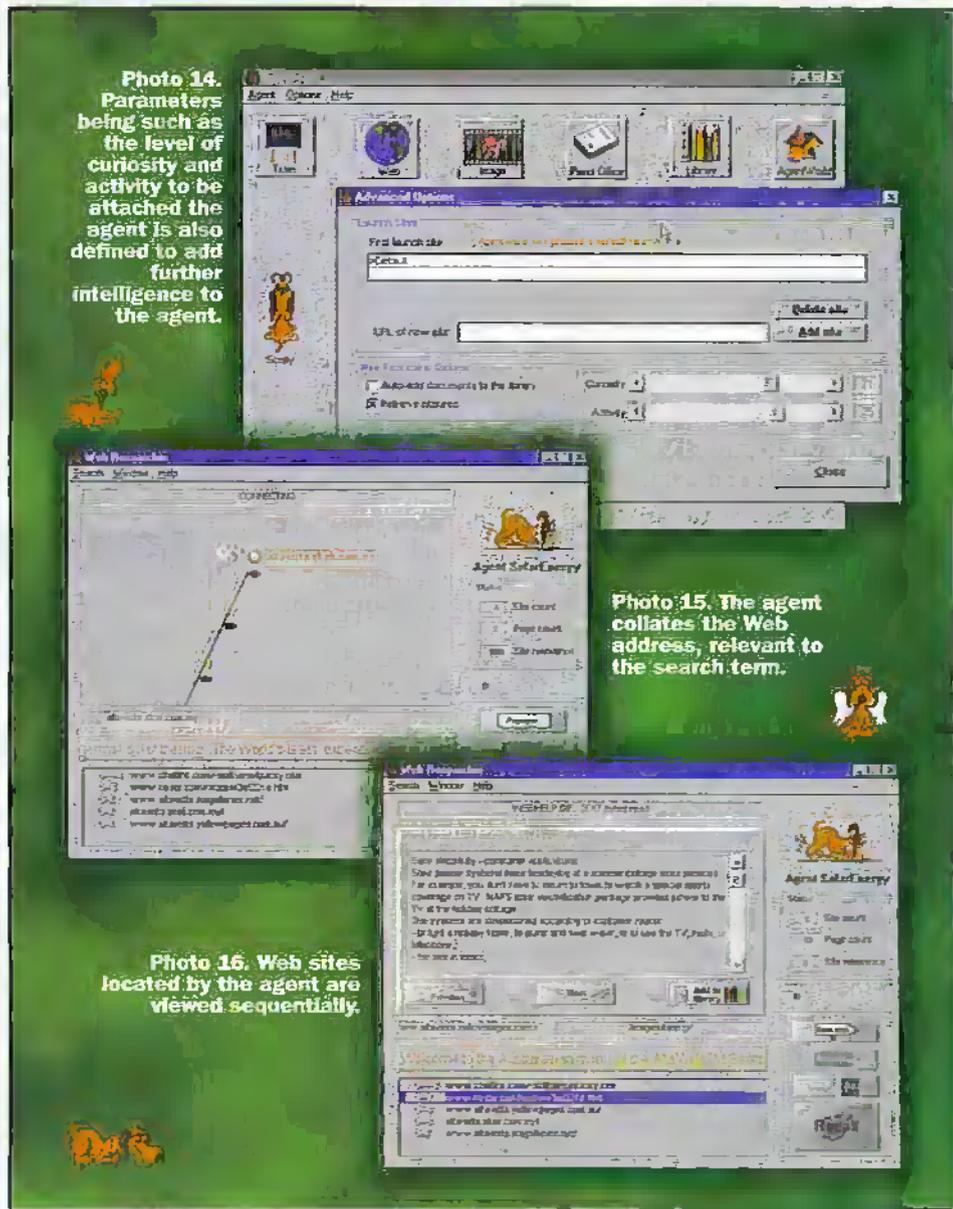


Photo 14. Parameters being such as the level of curiosity and activity to be attached the agent is also defined to add further intelligence to the agent.

Photo 15. The agent collates the Web address, relevant to the search term.

Photo 16. Web sites located by the agent are viewed sequentially.

Touch Hybrid INTERFACE

Design by S. Litchfield BEng AMIEE and K. Kirwan

The Touch Key Hybrid Module from ERD has been available and widely used for several years. The raw module is, however, only capable of operating from a regulated 5V supply and requires interface components operating at 5V TTL or CMOS levels. The Interface described here is intended to overcome the Interface limitation and enhance many of the features found on the Module.

The Touch Hybrid Interface is intended as a complete interface for most applications and a development bed for engineers or accomplished hobbyists. It is not intended for beginners or individuals without a reasonable working knowledge of digital and analogue design techniques.

Functional Description

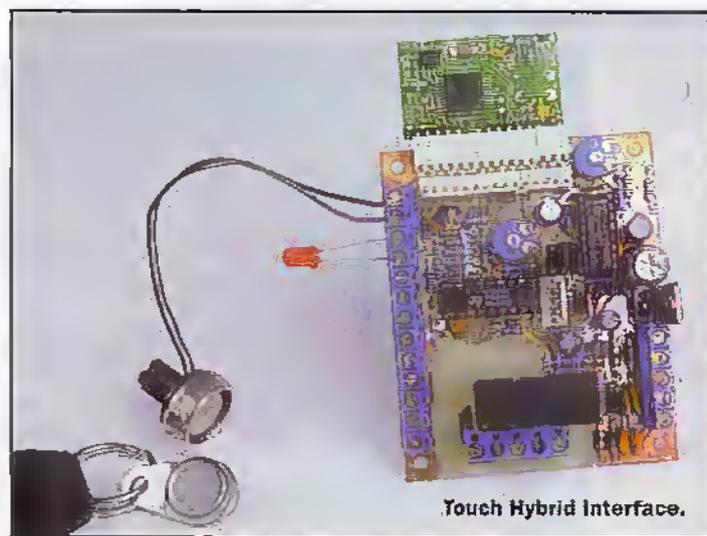
With reference to Figure 1. The Module receives arm - disarm data from the Touch Key Receptacle. Direct Connection is allowed to the Module via a set of connectors spaced at 0.1" intervals, suited to the PCB Latch Plugs supplied by Maplin.

An Output Mode Select jumper, also on a 0.1" pitch to accept standard headers, selects the adjustable Output Timer triggered by either;

- ◆ a Module output (OUT) which toggles on alternate Touch Key Access or
- ◆ a Module output (SIREN) which is asserted following an alarm condition initiated by a Trigger input (3 are provided on the Interface).

When triggered, the timer changes the state of a relay and two complimentary buffered-outputs. The output and relay conditions hold for the duration of the Output Timer which is normally no longer than 30 seconds.

A connection is provided to allow continuous operation of



Touch Hybrid Interface.

the Relay and Buffered Outputs. A change of state is realised by a Touch Key read giving an asserted state when the unit is armed.

A Relay Voltage Select is provided to allow the relay to be powered by the 5V supply or the pre-regulator supply.

The Passive Re-arm Timer is triggered coincidentally with the Output Timer but has an independently adjustable period. If selected by the Re-arm Mode Select-jumper, this timer will cause the module to passively re-arm following a disarm or alarm (depending on Output Mode Select) state. This timer normally allows passive re-arming up to 30 seconds after the selected event.

The Trigger Inputs and Annunciator Outputs are fully buffered from the module by open collector driver devices. A

FEATURES

High current, fully protected buffers

Two independent timers

Passive re-arming from 0 seconds to minutes

Relay output with timer

AC/DC PSU and Regulator on board

3 operational modes

APPLICATIONS

Touch Hybrid front end

Fully featured car- or house alarm

Entry access controller

Replaces password access

Buffer / Translator Select allows the user to determine if the external buffering is to 5V (buffering) or higher voltages (level translation).

Input and output protection diodes are provided. Where necessary, weak pull-ups or pull-downs are added to prevent unintended operation.

A bridge rectified and filtered input is provided (AC PSU). The bridge can be bypassed with a pre-regulator DC voltage (DC PSU). This voltage is fed directly to the 5V Regulator. The 5V

SPECIFICATION

Supply Voltage:

| | |
|-----|-------------------------|
| Vss | 6.5V to 15V DC (Note 1) |
| Vcc | 4.75V to 5.25V DC |
| AC | 4V to 11V AC |

Supply Current

| | |
|-----------------------|-----------------------------------|
| Output Current (low) | 350mA |
| Output Current (high) | depends on pull-up value (Note 3) |
| Input Current (low) | depends on pull-up value |
| Input Current (high) | 2mA (max.) (Note 4) |
| Input voltage | Vss (Note 5) |

Note 1. The lower voltage can be increased if a low dropout regulator is used. The dissipation rating of RG1 should not be exceeded. The Interface accepts both T092 and T0220 packaged devices: If RG1 is a T0220 package this can be clamped to a local panel. RG1 can be mounted off board but keep connecting wires as short as possible.

Note 2. Fully populated PCB with 10K pull-ups, LED on TB1/4-5, no connected loads, 12V DC supply and includes Touch Hybrid supply current.

Note 3. Must not exceed 350mA.

Note 4. Applies to Trig2 only.

Note 5. Vss + 0.6V absolute maximum rating. The Interface will power via inputs due to the action of the protection diodes. It is recommended that if IC2 is fitted, the Interface be used in open collector mode only.

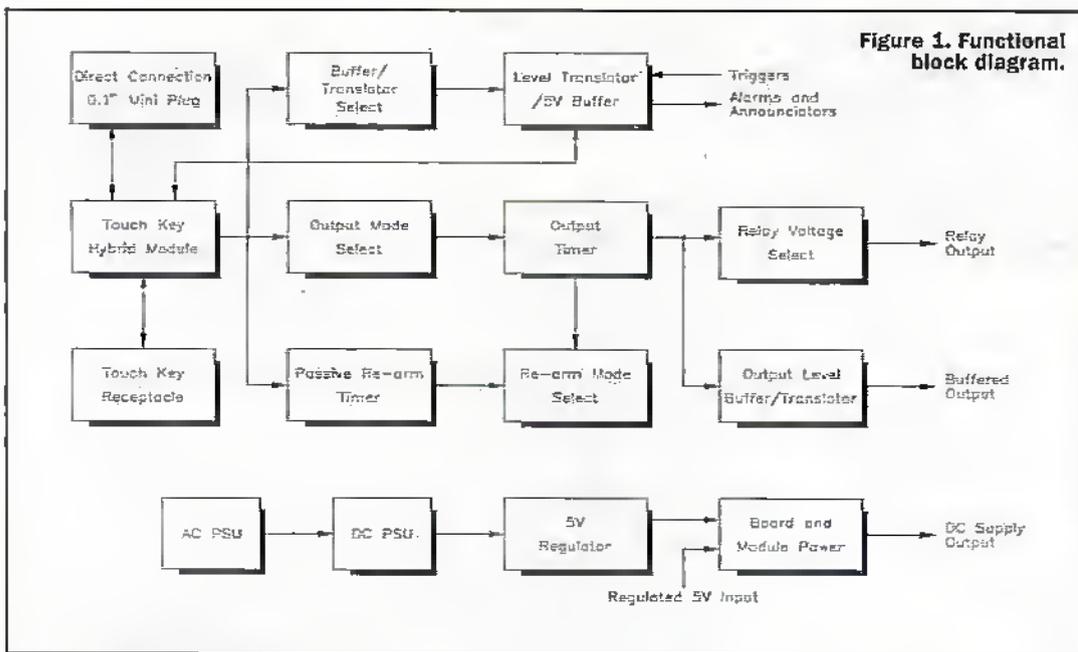


Figure 1. Functional block diagram.

Regulator can be bypassed with an external regulated 5V supply. Alternatively, the pre-regulator and regulated inputs can be used as outputs to supply external components.

Some components, C13, C10, C5, C11 and RG1 have a dual footprint to allow for large variations in component value and type. This gives the user greater flexibility in component choice for these devices. See Figure 7. TB1, TB2 and TB3 pads are drilled to accept terminal blocks or Veropins. See Figure 7.

Circuit description

The full circuit diagram is given in Figures 2 and 3. D5, D7, D8 and D9 form a bridge for input rectification. C6, C7, C8 and C9 are required to prevent line disturbance when the bridge diodes switch. C13 is the reservoir capacitor. RG1 provides voltage regulation to 5V and may be a TO92 or TO220 style device. D10 provides reverse polarity protection for RG1. C10 is the output de-coupler for the regulator. J5 provides a selector (wire link or header) for IC2. The Vcc position provides buffering of the output for TTL or 5V CMOS compatibility. The Vss position allows level translation of the output for higher >(5V + regulator dropout voltage) interfacing. Jumper locations are given in Figure 4. C12 and C1 are local de-couplers for IC1 and IC2 respectively.

The Module provides two status signals; BLEEP and LED. LED is used to indicate module status and BLEEP used to indicate arm / disarm transitions

when initiated by Touch Key. The LED output is used to drive a LED directly via PL1 pin15 (PL1/15) and PL1/3, or buffered by IC2 via TB1/4 and TB1/3. When a LED is directly driven, the Module provides the necessary current limiting. When driven buffered, R2 is the current limit. R9 provides a pull-

up for IC2f output if the LED- is used for purposes other than directly driving a LED. The BLEEP output is directly available at PL1/10, and buffered and inverted at PL2/5 and TB1/6. R8 is the pull-up resistor for the buffered Bleep output. SIREN is the Module alarm output which is asserted when

a trigger input is asserted and the module is in its armed state.

SIREN is available directly on PL1/2 and buffered and inverted on TB1/5 and PL1/1. R3 is the pull-up resistor for the buffered Siren output.

The Receptacle is a bi-directional, two-wire data link and is not buffered on the Interface. The Receptacle may be connected to PL1/5 and PL1/7 or TB1/1 and TB1/2 without fitting IC2.

Triggering the Module is effected by taking its TRIGGER inputs high. On the Interface direct connection is via PL1/4 and PL1/12 with a high asserting TRIGGER. With IC2 fitted, triggering is asserted by pulling low PL1/4 or TB1/9 (do not use both), pulling low PL2/3 or TB1/8 (do not use both), or pulling high TB1/7. If using TB1/7 then note the input current is limited by an internal 2K7 resistor. Input voltages in excess of 5V must be current limited externally. D1 and D2 provide supply isolation. R1 and R7 hold the trigger inputs off if not used or if connected by O.C drivers. G2 provides input filtering for IC2d if long

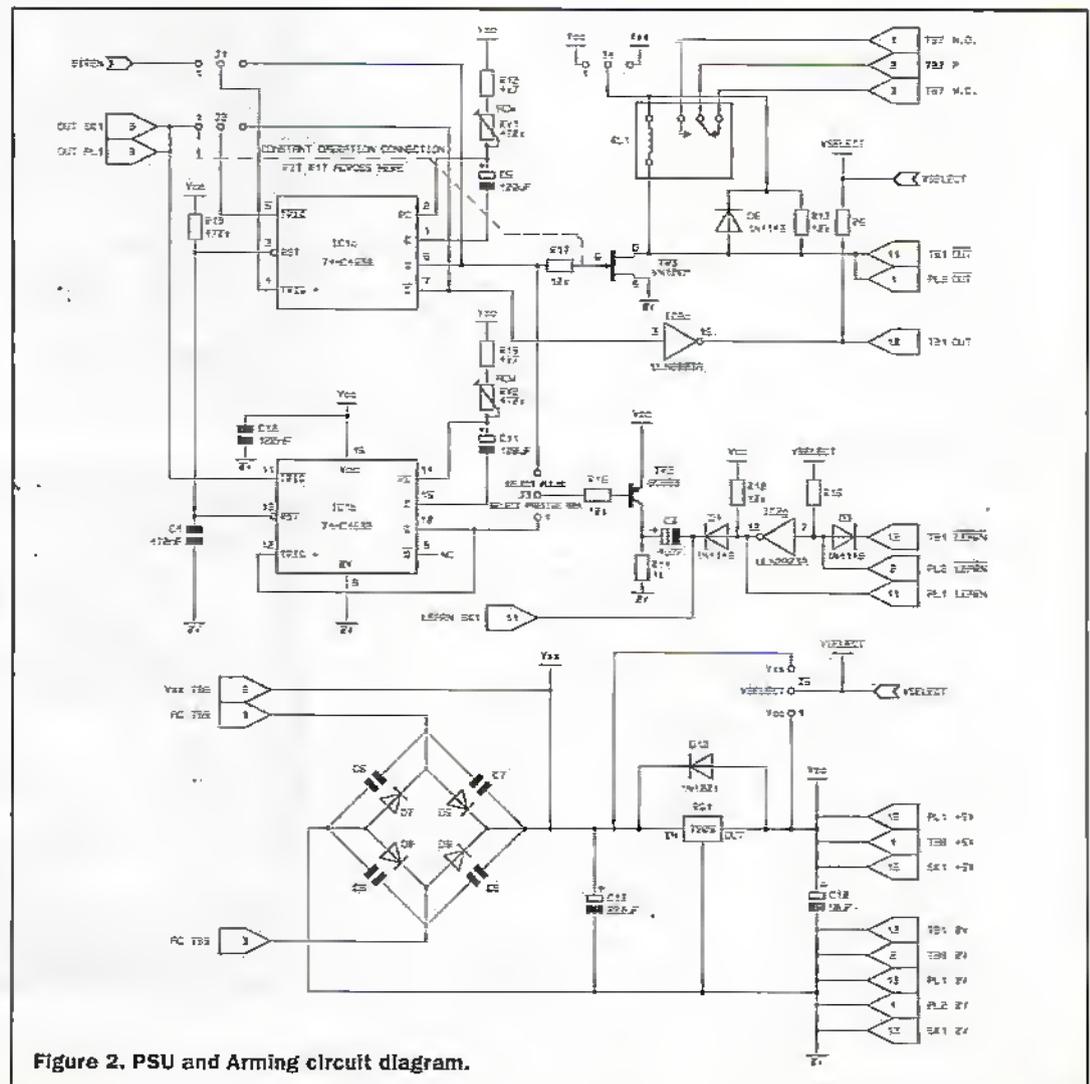


Figure 2. PSU and Arming circuit diagram.

| Mode | J1 | J2 | R17 |
|-------------------------|-----|-----|--------------------|
| 1. SIREN trigger | 1,2 | 2,3 | Normal Position |
| 2. OUT trigger (timed) | 2,3 | 1,2 | Normal Position |
| 3. OUT trigger (toggle) | 2,3 | 1,2 | Alternate Position |

Table 1. Timer Mode Selection.

Figure 3. Input and Output circuit diagram.

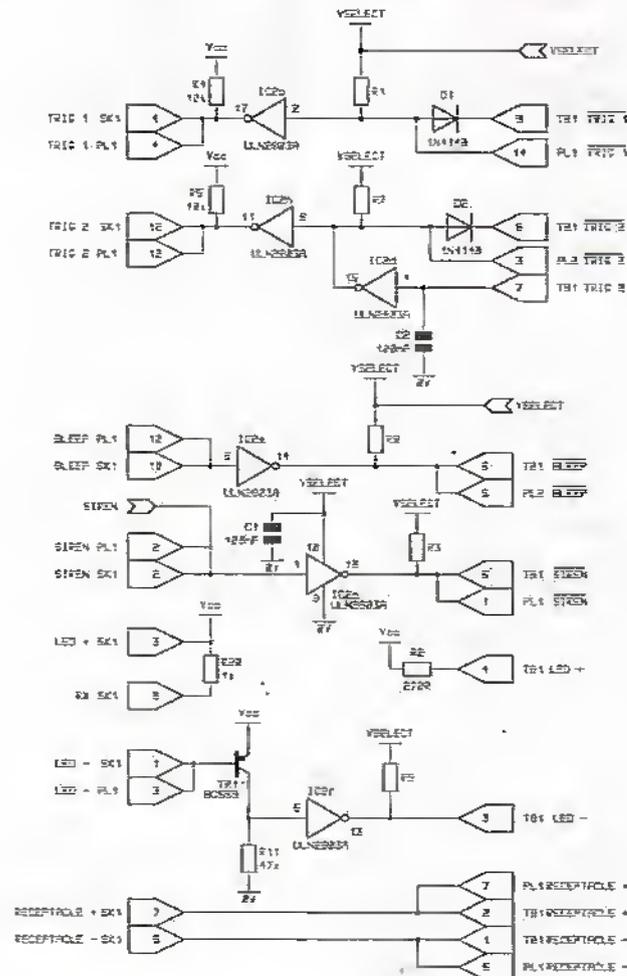
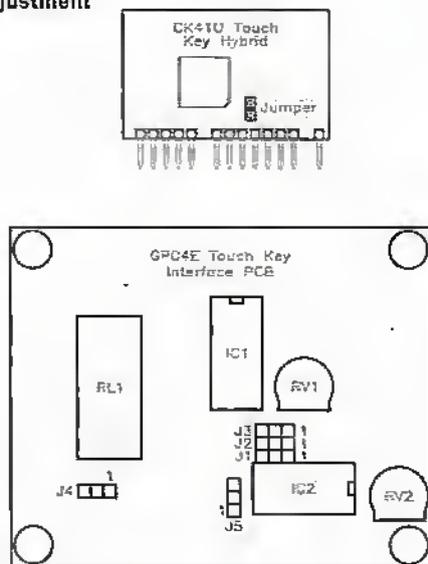


Figure 4. Jumper and Timer adjustment locations.



connecting wires are used. IC2 provides diode clamps to both supply rails for ESD and spike protection. IC2d provides an effective internal pull-down of 15K.

IC1a provides a timed Out output and relay drive period. J1 and J2 wire the timer for SIREN or OUT triggering from the Module. Table 1 gives the required jumper connections. The three modes are:

- 1. SIREN trigger.** When the Module is armed and a trigger is asserted, the Module will set SIREN. This will initiate a timer cycle causing; TB1/10 to go high for the timed period; TB1/11 and PL2/1 to go low for the timed period; RL1 to energise. This mode is used to provide a timed alarm period.
- 2. OUT trigger (timed).** When a Touch Key is read, the Module will switch to its opposite state (armed or disarmed). If the current state is armed then the disarmed state is entered and the cycle described in 1 occurs. Module state changes from disarmed to armed have no effect. This mode is used to provide a timed period with no alarm states available during the timed period.
- 3. OUT trigger (toggle).** When a Touch Key is read, the Module will switch to its opposite state (armed or disarmed). If the current state is disarmed and the armed state is entered, then the Interface will cause TB1/11 and PL2/1 to go low; RL1 will energise; TB1/10 will go high for the timed period then return low. This state will continue until the next Key read when; TB1/11 and PL2/1

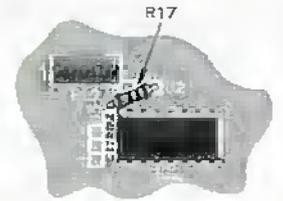


Figure 5. Alternate position for R17.

will return low; RL1 will de-energise; there will be no effect on TB1/10 which will remain low if the timer period has expired or will return low when the timer period expires. This mode is used to provide a toggle action on TB1/11, PL2/1 and RL1. It also provides a timed high cycle on TB1/10 when the unit is disarmed. R17 must be moved to its alternate position in this mode. See Figure 5.

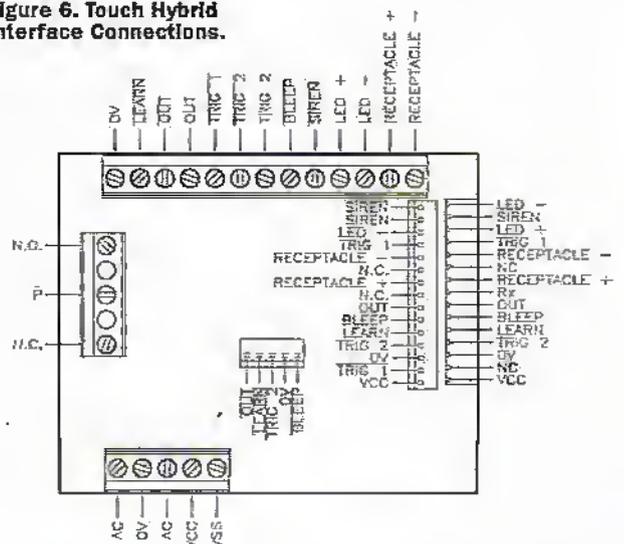
The jumper locations are given in Figure 4 and connection labelling in Figure 6. R12, RV1 and C5 provide the timer period. The period is given by:

$$0.7 \times (R12 + RV1) \times C5.$$

RV1 should be between 0Ω and 1MΩ. C5 should be between 1μF and infinity. R17 provides current limit to TR3, a VMOS power FET, that is used as the driver for RL1 and the output buffer for OUT. D6 provides clamping of the relay back – E.M.F. R6 and R13 provide pull-ups for OUT and OUT. R13 is not required if RL1 is fitted. J4 provides the voltage select for the relay. This can be different to IC2's clamp and pull up voltage.

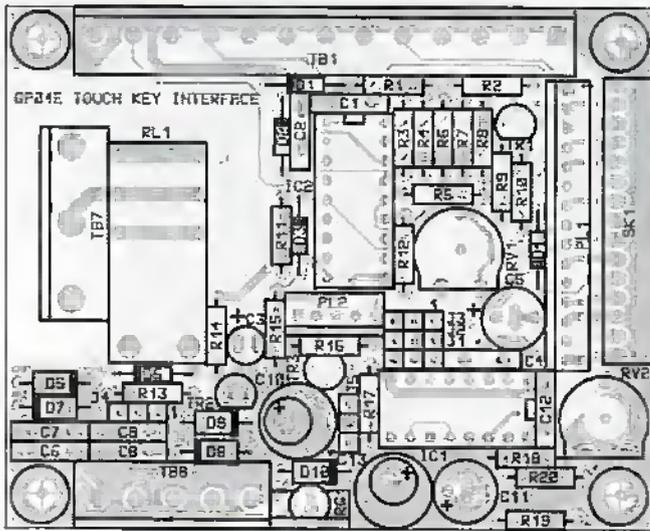
The second timer, built around IC1b, R18, RV2 and C11,

Figure 6. Touch Hybrid Interface Connections.

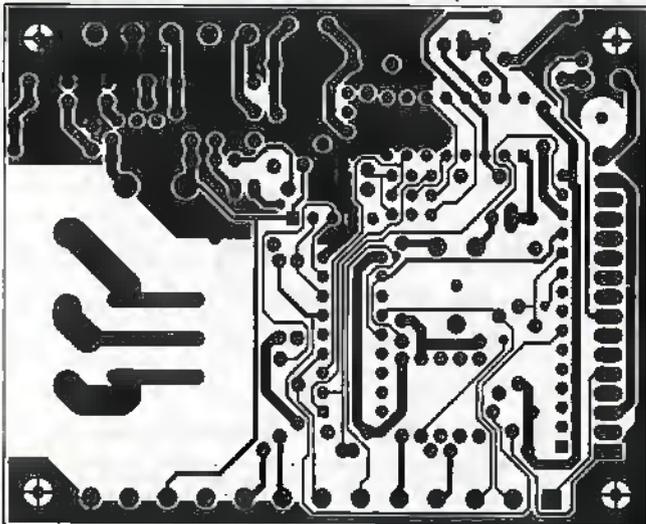


provides a passive re-arm timer. The Module has an in-built 30 second passive re-arm period set by an on-board jumper, see figure 4. IC1b provides an adjustable re-arm period

between 0s (for practical purposes) and 30s the module re-arm period. To enable passive re-arming the Module jumper must be fitted and J3 shorted between pins 1 and 2.



Solder side (bottom).



Component side (top).

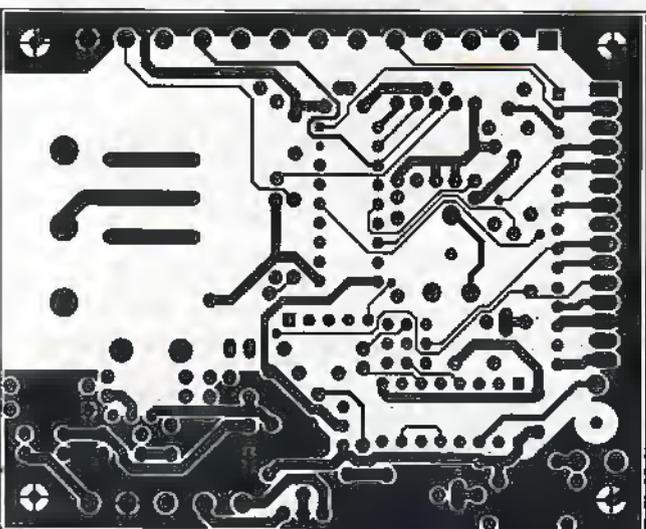


Figure 7. Track layout and component overlay for the Touch Hybrid Interface.

Disarming the unit triggers IC1b which sets Q turning off TR2. The positive plate of C3 discharges rapidly via R14. The negative plate is held at 0V by a pull-down resistor on the Module. When the timer cycle ends, Q resets turning on TR2. C3 charges very rapidly pulling its negative plate to nearly 5V. The negative plate then discharges through the Module. The high period on the

upon application) must be wired across the load-current carrying terminals. The terminal block suggested for TB3 is rated to 240V AC and clearances on the Interface allow 230V AC support. The track is rated to carry a current of 10A AC or DC with acceptable temperature rise and a rupture capacity beyond that of Quickblow type fuses. If loads beyond 5A, or AC loads

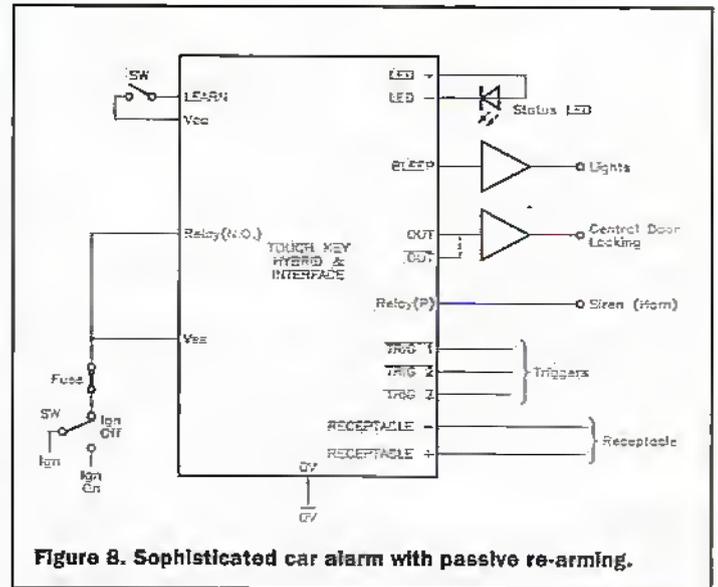


Figure 8. Sophisticated car alarm with passive re-arming.

Module's LEARN input causes passive re-arming to occur. Passive re-arming can be effected by timer IC1a such that it runs concurrently with relay energising states. This permits system cycling, desired in a door entry system, where each Key read would energise the door lock and disable the alarm system for a timed period. If no link is fitted at J3, the Modules in-built passive re-arm period, if selected, can be used. If not selected, there will be no passive re-arming, as required for OUT trigger (toggle) mode. R19 and C4 hold both timers of IC2 in reset state during power on cycles. To prevent false triggering the supply voltage risetime must exceed 10ms or 100V/s. The Module can be taught keys by asserting Learn or Learn on pins PL1/11, PL2/2 and TB1/12. D3 Provides diode isolation between PL and TB connections. D4 provides isolation from the passive re-arming circuits. IC2g is the buffer used for other inputs / outputs. R10 and R15 provide pull-ups for correct operation on unconnected inputs.

are switched, relay contact suppression (including filters and screening) will be required. Consideration must also be given to the safety aspects arising from high voltage use. For example, clearances between the Interface and side and base panels, method of mounting, type and rating of cables, method of cable securing etc. Suitable fusing of the supply and load is recommended.

Construction

It is assumed that the constructor will be fully conversant with the method of PCB construction. The kit PCB is a double sided-board with top-to-bottom connection made by plated-through holes. Many pads are deliberately made small and care must be exercised when soldering or desoldering components not to damage either the hole plating or pad. The track layout and component overlay are given in Figure 7.

To comply with EC directives the relay load must not exceed 5A at 24V DC (resistive) and a 0.22µF 250V AC X-rated capacitor (Maplin stock code JR35Q or other type depending

Conventional practice is to fit the lowest components first (resistors etc.) and progress to the highest (connectors and relay). Before commencing assembly it is wise to carefully confirm the circuit options required and mark the overlay

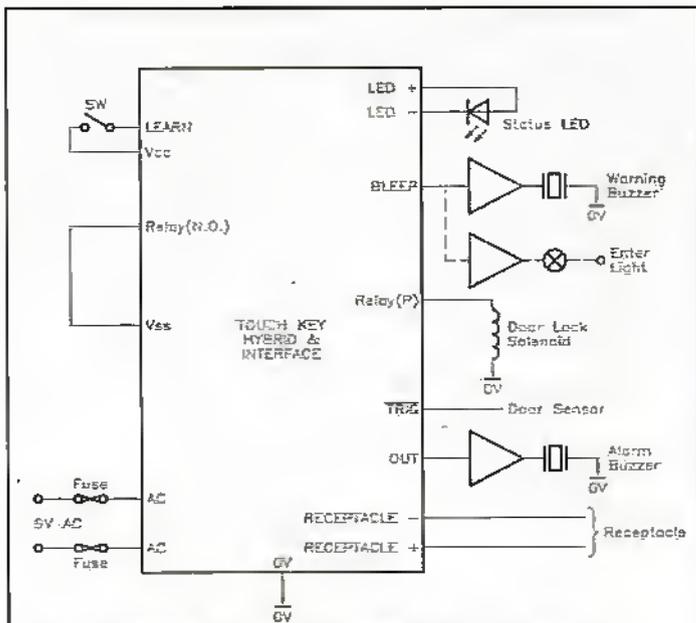


Figure 9. Door entry system including entry enunciators and tailgate / jamming prevention.

accordingly. Values for the pull-up resistors on outputs are determined by the user and dependent on application.

Testing

Confirm that the AC connections are not shorted to any DC rail including 0V. Check that AC to AC is open circuit on a low voltage ohmmeter and that two diode drops exist on a high voltage ohmmeter or diode tester.

Using the circuit diagram and track layout check that the appropriate Module connections are floating, connected to 5V or connected to ground via a resistance.

Inputs can be tied to their non-active level but this should not be necessary. Pull-up values can be set to 10K temporarily.

Do not connect the Module yet.

Apply power to the Interface and check the current is below 200mA. Check that the appropriate voltages appear on the terminals, remembering that some pins are floating. Remove power and, after discharging the 5V decoupling capacitance, connect the Module.

Connect an LED to TB1/3 and TB1/4 if IC2 is fitted, or to PL1/15 and PL1/3. Re-apply power and verify the LED flashes. If not, use an oscilloscope to check that the receptacle positive terminal

(centre) is high and that short low going pulses are visible. If pulses are present, apply the Touch Key (not the master key). The LED should now flash.

Depending on the state of the Module when power is removed and the setting of the jumpers, the relay may energise at switch on. **ILY**

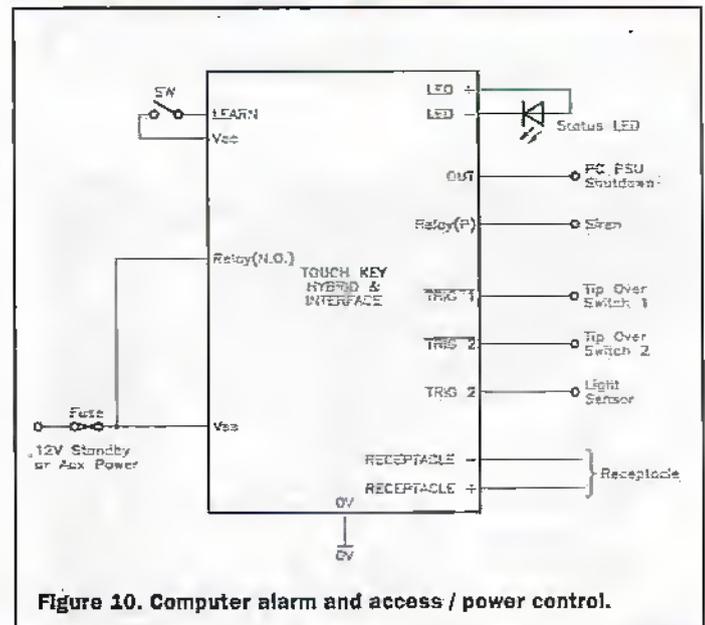
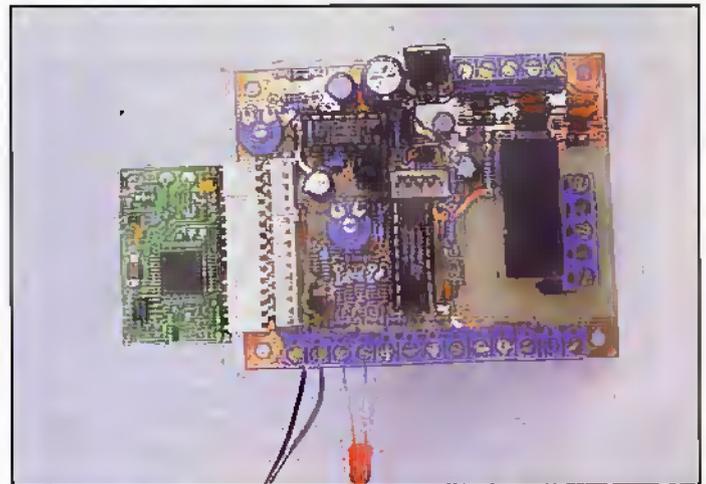


Figure 10. Computer alarm and access / power control.

PROJECT PARTS LIST

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

| | | | |
|-----------|-------------|---|-------|
| R2 | 270Ω | 1 | M270R |
| R12,18 | 4k7 | 2 | M4k7 |
| R13,16,17 | 10k | 3 | M10K |
| R14,20 | 1k | 2 | M1K |
| R19 | 470K | 1 | M470K |
| RV1,2 | 470K Preset | 2 | UH08J |

CAPACITORS

| | | | |
|-------|-------------------------------|---|-------|
| C4 | 470nF Layer Ceramic | 1 | RA52G |
| C12 | 100nF Ceramic | 1 | YR75S |
| C3 | 4μ7 63V Radial Electrolytic | 1 | AT76H |
| C5,11 | 100μF 16V Radial Electrolytic | 2 | AT40T |
| C10 | 10μ 63V Radial Electrolytic | 1 | AT77J |
| C13 | 220μF 25V Radial Electrolytic | 1 | AT49D |

SEMICONDUCTORS

| | | | |
|-----|--------------|---|-------|
| D6 | 1N4148 | 1 | QL80B |
| D10 | 1N4001 | 1 | QL73Q |
| IC1 | M74HC4538B1N | 1 | UF19V |
| RG1 | LM78L05ACZ | 1 | QL26D |
| TR2 | BC559 | 1 | QQ18U |
| TR3 | VN10KM | 1 | QQ27E |
| | RED LED 5mm | 1 | WL27E |

MISCELLANEOUS

| | | | |
|--|-----------------------------|---|-------|
| | DIL Socket 16 pin | 1 | BL19V |
| | Touch Key Interface PCB | 1 | GP04E |
| | Touch Key Interface Leaflet | 1 | XZ51F |
| | Constructors Guide | 1 | XH79L |

OPTIONAL ITEMS (Not in Kit)

| | | | |
|-----------------|-----------------------|---|-------|
| R1,3,6,7,8,9,15 | User determined | 7 | |
| R4,5,10 | 10k 0.6W MF | 3 | M10K |
| R11 | 47k 0.6W MF | 1 | M47K |
| C1,2,6,7,8,9 | 100nF Ceramic | 6 | YR75S |
| D1,2,3,4 | 1N4148 | 4 | QL80B |
| D5,7,8,9 | 1N4001 | 4 | QL73Q |
| TR1 | BC559 | 1 | QQ18U |
| RL1 | 240V 5A DPCO Relay | 1 | DC54J |
| J1,2,3,4,5 | 0.1 Pin Strip 1x 36W* | 1 | JW59P |
| | Pin jumpers | 5 | UL70M |

Connectors Low Cost PCB connectors. Plugs, Socket Housing and Terminals are available in various configurations. Terminal blocks are also available in various ratings and configurations.

IMPORTANT. If the relay is used to switch mains voltages, use terminal block JR80B.

The Maplin 'Get-You-Working' service is available for this project, see Constructors' Guide or current Maplin Catalogue for details. The above items (excluding optional) are available as a Kit.

Order as LUS1J (Touch Hybrid Interface Kit) Price £24.99

Please note: Items in the Parts List marked with a * are supplied in 'package' quantities (e.g., packet strip, reel etc.), see current Maplin Catalogue for full ordering information.

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LIDAR Optical Sensors in the Battle for Environmental Critical Monitoring

Optical technology is now finding many applications in the areas of environmental monitoring and pollution control. Pollution exists in various forms, such as noise, ionising radiation, pesticides, liquid chemicals and toxic gases. It is this great diversity in the type of pollutant that makes it extremely difficult to establish any single technique for universal monitoring. Issues such as the greenhouse effect, ozone depletion and air pollution have heightened public awareness of man's affect on his environment, which has been shown demonstrably in the dramatic man-made smog shrouding Indonesia caused by large-scale forest burning.

'Green' philosophies demand a reduction in the energy and materials consumed by manufacturing industry and calls for sustainable development. Governments are now being forced to deal with the recycling of durable waste such as glass and plastic, the disposal of nuclear waste, and the removal of dissolved metals in rivers. As a consequence, environmental pollution has become a politically sensitive issue, and the Economic Union has emerged as a tough driving force behind new legislation. In 1992, the UK introduced stringent regulations governing car exhaust emissions. However, in order for the legislation to be enforced effectively, it is essential to monitor the effects and quantity of toxic substances as well as limiting their release.

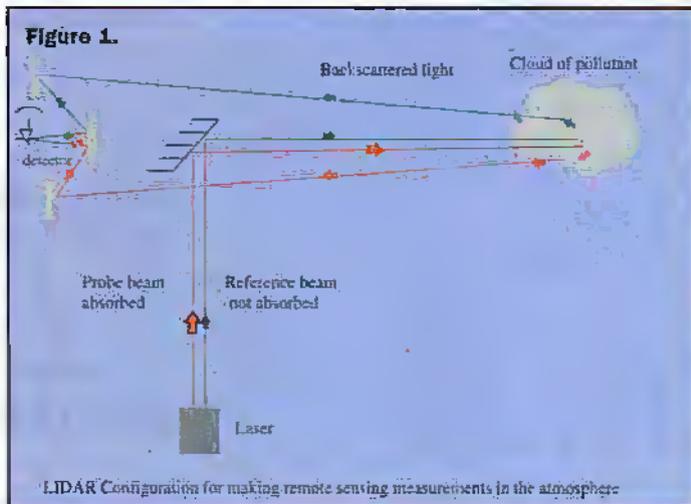
Optics has a considerable contribution to make in the monitoring of sea and airborne pollutants. Cars are a major source of carbon dioxide, nitrogen oxides and hazardous hydrocarbons. In 1993, all new cars sold in the EU were obliged to be fitted with 3-way catalytic converters. Infra-red sensors that measure oxygen content and monitor the vehicle engine's air/fuel ratio are now under development. LIDAR (Light Detection And Ranging) is proving to be a versatile tool for air quality monitoring, particularly when measuring lower atmospheric ozone levels.

In LIDAR, optical radiation from a laser may be backscattered by particles or molecules in the atmosphere of similar size to the incident wavelength. Different

RESEARCH

NEWS

by Dr. Chris Lavers



pollutant gases will absorb light at different wavelengths, thus allowing simultaneous probe and reference measurements to uniquely determine the gases present. The returning signal's time of flight is recorded ($3 \times 10^8 = 2 \times \text{Range/time}$) yielding range, and the backscattered light intensity is then measured (see Figure 1). This technique is rapid, and is sensitive to recognising individual gases, and permits measurements to be made from fixed equipment through free space (it is a remote sensing technique).

In November 1991, Berlin became the first German metropolitan area to monitor its air quality daily using a stationary LIDAR system detecting both the levels and locations of gases such as sulphur dioxide and ozone to parts per billion accuracy. The measurements provide a 3D map of pollutants over a built up 10km range. This technology is now routinely applied in many developed Western urban centres.

In the marine environment, oil slick sensors also utilise the LIDAR principle but here, they are fitted to aircraft. With such equipment, it is possible to obtain rapid slick detection and, therefore, treatment can take place much sooner, necessary if the environmental impact of oil tanker disasters such as the 1989 Alaskan *Exxon Valdez*, is to be limited. Recently, LIDAR has been

demonstrated as a tool for fish detection surveys and in monitoring the depletion of global fish stocks. A prototype imaging LIDAR has been developed to detect and identify fish species for commercial fisheries. Survey work led by Dr James Churnside at the National Oceanic and Atmospheric Administration (NOAA) Environmental Technology Laboratory in Boulder Colorado has taken a twin approach using both airborne and seaborne LIDAR.

Airborne remote sensing of fish is not new: seabirds are capable of locating fish near the ocean surface and spotter pilots are used by fishing fleets to locate fish and direct boats to the fish during the day. At night, the bioluminescence stimulated by the movement of large numbers of fish near the surface is observed. Pilot reports have been compiled over several decades to provide information on the relative abundance of mackerel, sardines, etc., however, visual observations are severely depth limited. The detection depth is short and depends strongly on illumination, sea state (rough or calm) and the individual observer's skill. For such reasons, laser systems are being developed; laser illumination allows greater depth penetration and range gating (timing of echoes) reduces the air-sea interface noise.

An airborne fish-LIDAR sensor system installed on an aircraft could be used to locate tuna. Such a sensor, able to detect and track schools of larger tunas separate from dolphins, would offer an ecologically sound alternative to existing methods. The NOAA team installed a LIDAR system on a King Air airplane, which Jim Wilson from NOAA informs me ran almost continuously for 3 weeks. The LIDAR system has also been installed on two smaller aircraft, a Partenavia and a Cessna 177.

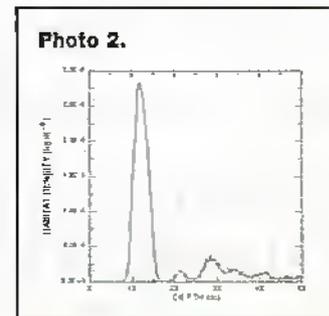
The NOAA team uses a very simple radiometric LIDAR, where each pulse of blue-green light from an Argon-ion laser provides a full depth profile from the angled LIDAR returns. As the aircraft moves forward, the system produces a 2D picture of fish schools as a function of depth, with target strength integrated over the width of the strip probed by the LIDAR. Several previous radiometric systems have been trialled: ORIC, Macrel-2 and Osprey. The NOAA system, Experimental Oceanic Fish LIDAR (FLOE!) was also fitted onto a research trawler, the David Starr Jordan (see Photo 1) with the LIDAR optics package mounted on the ship's flying bridge during 1995. Photo 2 shows typical fish density for a habitat surveyed on the 24th September 1995. From this data, it is possible to estimate accurately the fish density in kgm^{-3} . Data taken in conjunction with SONAR allows a full analysis to be made.

Dr Churnside is now trying to take the process one step further by carefully analysing the precise species of fish involved. Reflectivity of different fish species in the blue/green part of the spectrum lies typically between 15% and 25%. The probe laser is operated alternatively on the Argon ion laser 488nm (blue) and 514.5nm (green) lines with a constant output power of 150mW. The reflectivity response is quite different for different species:

- anchovy* 21.0 ± 0.3 (blue), 17.4 ± 0.3 (green)
- smelt* 25.6 ± 1.5 (blue), 22.3 ± 1.9 (green)

Clearly, work on these kinds of optical sensors, to assess environmental pollution and the impact of global temperature changes and human activity on fish stocks, allows more rigorous calculations to be made for a sustainable future. More information about the FLOE seaborne LIDAR may be found at the website:

<http://www1.etl.noaa.gov>



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Radio COMMUNICATION PRODUCTS

PART 1

Aerials, Preamplifiers and Filters

by Harry Watkins

In this, the first of a series of looking at some of the radio communications products in the Maplin Catalogue, I thought that I would have a look at some of the accessories that are available for scanners. Scanners are receivers that cover VHF and UHF and sometimes HF as well.

Aerials

Once someone has purchased a scanner and used it for a little while, the question invariably arises "How can I get more from my receiver?" Very often, the simple answer is to improve the aerial. I am not going to dwell on aerials this time, as this will be the subject of a later article, but basically, if you are inside something like a house or car, for example, put an aerial on the outside. The Maplin catalogue caters for every situation with aerials and you will find one to suit your needs in there.

I want to give you some information on preamplifiers



Photo 1.
The book *Scanning Secrets*
(Stock Code YE84F).



Scanners in their present form are a fairly new innovation that only recent technology has allowed to be made. Many thousands of them are in use all over the world and although the law varies from country to country, listeners' natural curiosity make these items one of the most popular

receivers on the market today.

If you are new to scanners and want to learn all about them, then you would be well advised to buy the book *Scanning Secrets* (Stock Code YE84F), shown in Photo 1, as this explains in a simple way all you need to know to be well-versed in the subject.

and filters. These are both capable of improving reception provided they are used under the right circumstances.

Preamplifiers

The next best thing after sorting out a decent aerial is to further amplify the signals. This is done

with something we call a preamplifier. (An amplifier in radio terms is to amplify a signal being transmitted, not received). The best all-purpose aerial amplifier available is the WATSON WRP-1300 (Stock Code NV43W) – see Photo 2. This is priced at £39.95, making it the best value on the market. Only a year ago, you would have had to pay about twice the price for an alternative. The NV43W amplifies incoming signals between 25-1,300MHz, which is the usual listening range of a scanner. The preamplifier boasts a minimum 13dB gain over the range.

The preamplifier is small (95x50x33mm), and is easily fitted between the scanner and the aerial with BNC connections via a small lead (supplied). Weighing only 180g, it can run from an internal PP3 battery (not supplied) for many hours. External DC can also be connected if required in a base or mobile installation.

Don't expect the unit to make a difference on good strong signals. But weak signals that you only ever heard in the background will become perfectly readable and you will also hear signals on your scanner that you never heard before. Further improvements will be experienced because the preamplifier also rejects out of band signals. These out of band signals are also known as spurious emissions, breakthrough, sproggies, etc., and are a symptom of the scanner's front end being overloaded by signals. Recently, pagers have been to blame for a lot of these signals, which, while they come in on the wanted frequency, are definitely *not* wanted!

The first generation of scanners covered little more than the VHF airband (118-

Photo 2. The best all-purpose aerial amplifier available is the WATSON WRP-1300 (Stock Code NV43W).



136MHz). There are still many enthusiastic listeners who are only interested in listening on these frequencies. The WATSON WRP-125 (Order Code NV44X) – see Photo 3 – priced at £32.95, is a preamplifier dedicated to that band. There are still some scanners on the market that just cater for this band as very often, a receiver that just covers a small range of frequencies will be better than the reception of the same frequencies on a different receiver that has a much wider receive range. This is because a dedicated receiver will be optimised just for one particular band and not have the compromises necessary to cover almost the entire spectrum.

The NV44X offers a minimum 15dB gain and in tests, I found that using this pre amplifier on both a dedicated airband receiver as well as a much wider range scanner, I could hear airband signals from airports that were previously out of my usual range. This preamplifier is the same size and weight as the NV43W and connections and power are carried out in the same way as well.

Filters

Most scanners are designed to be used in the worst possible situation from a signal strength point of view. The manufacturers provide a short

this is just the piece of equipment that you need. As we have said, many receivers can suffer from overload or breakthrough from strong signals which come in on the wanted frequency. The NV45Y will give you much clearer signals on your scanner by greatly reducing this interference and in many cases where the signals are widely spaced from the wanted signal, it can usually effect a complete cure.

With a tuning range of 85-175MHz, this unit is especially useful for screening out band II (FM) broadcast signals and VHF paging transmitters. This notch filter also incorporates a fixed high pass filter, which reduces short wave and medium wave interference.

Connection is easy, you will be pleased to know. Just join the filter between the antenna



Photo 4. The WATSON WAF-125 tuneable notch filter (Stock Code NV45Y).

telescopic or flexible whip aerial and anticipate the user initially using just this set up. This requires the designers to provide a high level of amplification in order to make the best of a pretty poor aerial. They have to do this because many scanners are used in exactly this fashion. They find themselves on desk tops, on car seats, in pockets and all manner of locations.

Unfortunately, when we connect our super sensitive scanner to an outside aerial, it suddenly finds itself fed with many more signals than it did on a short whip. As soon as this happens, it can lead to the overloading described above, and an extra filter is necessary to alleviate the problem.

The WATSON WAF-125 (Stock Code NV45Y), shown in Photo 4 and priced at £31.95, is a tuneable notch filter. For older scanners or for those listeners in an area of high interference,

feeder and the input to the receiver. The BNC patch lead provided is used for this purpose. The filter is a passive device and therefore, needs no power. The unit measures 115x85x45mm and weighs only 160g. Once in place, only the tuning knob needs to be turned to eliminate the interference. When using this filter, I noticed the difference immediately. Signals were sharper and much easier to listen to.

Although this filter does not cover all of the frequencies found on today's wide coverage receivers, it certainly covers the frequencies that are most likely to suffer from interference.

So, whether you need to amplify your scanners signals or reduce unwanted interference, one of these units will increase the signals on your scanner and thus enhance the pleasure you receive from listening. 

Photo 3. The WATSON WRP-125 VHF preamplifier (Order Code NV44X).



IEE President Says Engineering Profession Should Make its Voice Heard

Engineering has lost its ability to inspire the young and is losing valuable new recruits to more fashionable subjects such as economics, business studies and media studies. This was the warning given by David Jeffries in his Inaugural Address as President of the IEE at www.iee.org.uk, Europe's largest professional engineering society. Jeffries, who is chairman of the National Grid Company was addressing an audience of over 400 senior industrialists, engineers and academics.

Speaking to Electronics and Beyond, Jeffries said, "Few young people dream of designing communication systems or perfecting the electric car. They dream instead of trading options, or making TV programmes. When media studies becomes the most popular course on campus, then

surely something is out of balance.

"The engineering profession needs to ensure its voice is heard. Our task is to identify what makes engineering so vital and so exciting and then communicate that excitement so that we can attract bright young people into the profession. It is essential that we make them aware that if they want to change the world, then once of the best ways to achieve this is by becoming an engineer".

The IEE President went on to praise the achievements of the Year of Engineering Success (YES) in increasing awareness of engineering across all ages, but stressed that, to be fully effective, the initiative must continue.

"The support that YES has received from organisations throughout the UK has been tremendous. Moreover, their commitment to the continuation of YES is an indication of how important the engineering community now views public understanding of its work.

"Our message is simple. This is a time of great change and new vision. Engineering can help secure the benefits of change and provide individuals with a diverse, challenging set of skills, which help them, and the country, to realise the vision of where we want to be".

Focus is the Key to Media Regulation

In a speech to Marketing Week's Television Conference in London at the end of

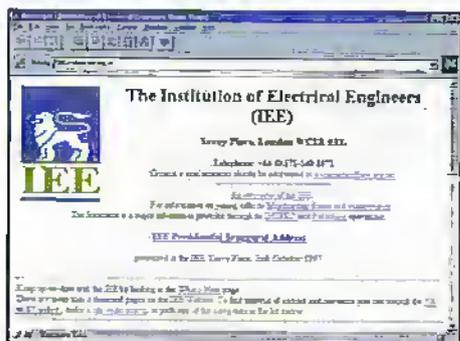
September, Tony Stoller, chief executive of the Radio Authority, outlined how new television services can learn from commercial radio.

"It is no coincidence that the explosive growth and success of commercial radio has come about substantially in this decade. In 1990, the structures which used to govern both television and radio were split to allow radio its own sectoral regulator, and that in turn made it possible to change the approach to developing the system.

But if the key to future success for radio and television is focus, then focus is also the key for regulation, claimed Stoller. As the technologies for television and telecoms converge, there is inevitably a wish to find a system of control, licensing and regulation which is in tune with the new pattern of the media. In doing so, however, it is important the Government does not lose the experience and focus of individual sectoral regulators.

"It is equally important that there is no attempt to impose a single pattern on all of the diverse types of medium at their different development stages. Radio cannot be regulated in exactly the same way as television, nor television in exactly the same way as telecoms", said Stoller.

Stoller concluded by saying, "Whatever is done to bring together aspects of regulation and development is appropriate to each medium. That is a lesson for us to learn as we wrestle with the shape, structure and regulation of media beyond the millennium".



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TECHNOLOGY WATCH



with Martin Pipe

A new (and well-publicised) data transmission system currently being successfully trialled in the North West of England could revolutionise wide-area telecommunications, and access to the Internet in particular, as we know it. The Digital Powerline system, jointly developed by the communications arm of electricity supplier, Norweb, and the Harlow-based research laboratories of Canadian telecoms giant, Nortel, effectively converts a mains distribution system into a broadband communications network capable of carrying data at high speeds – the peak is 1M-bps.

This is considerably faster than regular land-line based modems (the fastest speed currently available from these is 0.576M-bps, if you're lucky) and even business-oriented dial-up services like ISDN. Potentially, it's cheaper too, since the most expensive part of the link – the transmission medium – is already in place. No roads to be dug up, no overhead constructions or planning restrictions, because all of this was done years ago when the mains infrastructure was pieced together. The system will be marketed first in Europe, and then the Asia-Pacific region.

It's not the first time that mains-borne communication has been tried. Mains intercoms, which transmit voice over superimposed narrowband FM carriers, have been popular for some years, since they avoid the need for messy wiring. Indeed, Maplin sells them in pairs (YT16S, if you're interested). Data communications over mains is rather more complex, and the first such product was launched in 1990 by Marconi offshoot, Verran. The AC Datalink, which consisted of modem-like boxes that interfaced to serial or parallel ports, was intended for the transfer of data between computers and peripherals plugged into the same mains phase.

As with mains intercoms, frequency modulation was used (zeros were sent on a carrier of 112.5kHz, and ones on a second centred at 122.5kHz). The system was highly advanced for its day. It employed packer-

based communications protocols, addressability (for multiple users), CRC error correction and encryption of data with a 22-bit key (in comparison, the Nortel/Norweb system doesn't offer hardware encryption at present). The maximum speed? A then-impressive 9,600bps. Unfortunately, like so many good ideas, the AC Datalink bombed.

Transmitting data over mains circuits is fraught with problems. The first is switching noise from thermostats, light dimmers and other equipment, most of which is designed with no thought as to the levels of interference chucked back into the electricity supply. It might cause slight noise levels on FM intercoms, but it does no good for data whatsoever – in some cases, whole chunks of data may need to be retransmitted (regular modem users may have noticed this happening, due to noise on the phone line).

A problem for wide-area systems is that mains circuits were simply not designed for anything other than power transmission at 50Hz. This is particularly true of substation transformers. Then there's the issue of termination, which is important at the relatively high frequencies required to carry data – reflections could corrupt data. A termination problem could affect many users, and might not be easily rectifiable. Even if the location of the fault could be traced, access to the premises involved might not be possible (if a consumer wasn't at home, for example).

The electricity industry has been looking into many of these problems for some time, with various companies and academic institutes (such as the University of York) independently carrying out research. The initial drive wasn't public telecoms, although

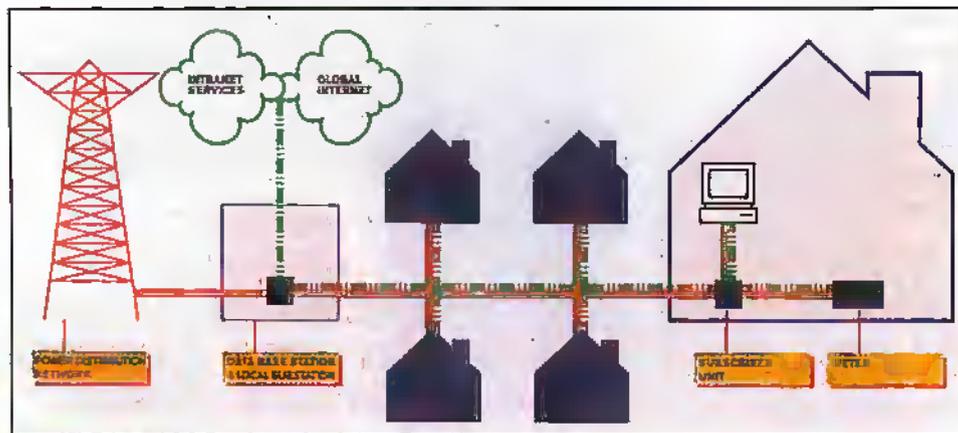


its potential for this was soon realised. It was telemetry – in the form of system that allowed the reading of meters to be achieved remotely. That way, armies of expensive metermen can be made redundant (and profits/directorial bonuses presumably reach even sillier levels). While a meter reading may only consist of a few infrequent bytes of data, Internet access – which requires constant and reliable data throughput at a comparatively high rate – is somewhat different. However, many of the solutions that were conceived, such as spread-spectrum signalling, have universal application in both applications.

The Digital Powerline system is the fruit of three years' collaboration, and has resulted in a number of patents. At the local substation, which typically serves 200 customers, is a box of electronics that connects to the low voltage 230V lines (in other words, the secondary windings of the step-down transformer) responsible for carrying power to users. One of these boxes exists for each of the three mains phases that can be found at each substation. The job of this equipment is to inject the data-carrying RF signals, which span several MHz and use a proprietary modulation technique that is loosely based upon existing systems. The system, like the Verran, uses a packet-based communications protocol.

Another group of substation boxes interface the consumer distribution equipment to the primary high voltage side of the transformer, thus facilitating (eventual) connectivity to a command centre, responsible for organisation and remote electricity meter reading. But what about back-haul, or connection to other communication networks such as the Internet? There are three approaches that can be applied. The first is to use the aforementioned high-voltage side for data transmission, which would be popular in more remote regions where alternatives would be expensive to implement.

One of these alternatives is high bandwidth fibre-optic cable, the stuff that forms the backbone of modern broadband cable TV/telecom systems. In some cases, this would exist already. High take-up of a service would perhaps warrant the



installation of such cable if it wasn't already present. A single fibre optic cable would have sufficient bandwidth to serve many substations, and hence, thousands of users. The final option, which is available in between 30 and 40% of the country, involves existing multi-way pilot cables that run between substations. These cables, which contain 21 twisted wire pairs, were introduced years ago for remote power supply monitoring and communications between technicians. They're no longer needed for such purposes, and hence, could be pressed into service as a data carrier.

At the domestic end is a box that safely extracts the RF, and converts it into data. The consumer box links, via coax, to a card that sits inside a PC. It looks suspiciously like a bog-standard Ethernet card, although a Nortel spokesman denied this. The 1M-bps is divided between users, which could slow things down if all of the 200 households in a road decided to opt for the service. This, for the present at least, is highly unlikely.

Unlike other high-speed systems, such as domestic satellite modems, the Digital Powerline link is symmetrical. In other words, you can upload and download at the same high speed. In comparison, satellite modems can download at a tremendous load but are restricted to slow upload speeds, since the return path employs a conventional land-line and modem. For regular use, such as Web access, this isn't really much of a problem since most uploads are file (page, image, compressed program, Java applet) requests.



Peter Dudley
Vice President
Public Networks
Europe Nortel

If you're a telecommuter, however, you may need to send large files - here, a fast symmetrical link is thus an advantage. This is why domestic adoption of ISDN, which is still rather expensive, is beginning to take off. Another work-related possibility is the overnight back-up of files to a remote server, something likely to be offered as a value-added service (the issue of encryption is, however, important here).

In terms of domestic use, the benefits of a fast symmetrical link are realised through emerging Internet applications such as voice telephony - an increasing threat to long-distance phone calls - and audio/video streaming. The real potential of Digital Powerline, however, is that it facilitates a permanent Internet connection. As a result, a connected computer could effectively be an Internet Web/FTP server if it were to be left on 24 hours a day, seven days a week. Presently, the only way of doing this is to link your computer up with the Internet via a leased-line, at a cost of many thousands of pounds per year.

Although permanently connected users of the service will undoubtedly be charged more, the costs are likely to be a fraction of those associated with leased-line connectivity, encouraging small companies and individuals to host their own Web sites instead of relying on storage space provided by a traditional Internet service provider. When it is commercially launched, and other electricity companies adopt it (or licence the data-carrying potential of their power distribution infrastructure to a third-party telecoms operator), Digital Powerline will generate competition for existing providers, and thus force down the prices of, for example, ISDN - which is much dearer in the UK than it is in some other countries.

E-mail your comments or suggestions to
Martin Pipe at whatsnet@ix.computik.co.uk

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PART 2

The Lake Effect and Polarisation

by George Pickworth

The logical explanation for the 'lake effect' as mentioned in Part 1 last month, was that polarisation of electrodes CD caused them to emulate a capacitor or cell: this occurs when electrodes are energised with currents with a potential of less than 1.7V which, of course, was the case with electrodes CD. (see Figure 1)

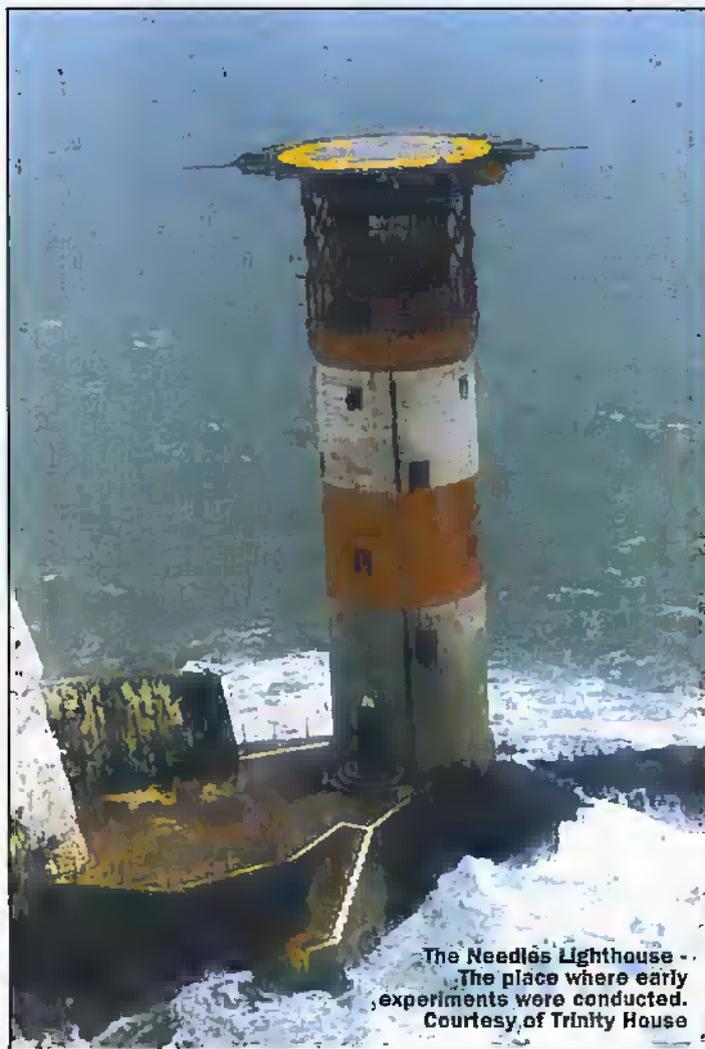
Forward current can, therefore, be regarded as charging current and reverse current as discharging current; this can be demonstrated by using the simple set-up shown in Figure 2.

However, it was more difficult to produce the model that could explain how electrodes CD were polarised by electric charges carried via current field lines (the best I could do is shown in Figures 6a-c). But before progressing further, let us look at some simplified 'text book' notes polarisation. Electrodes are the interface where a current propagating by electrons in a metal conductor is carried as electric charges by ions present in the water. However, when a current travels through water, it decomposes into oxygen, which is released at the anode and hydrogen at the cathode.

Less Than 1.7V

When the applied current has a potential of less than 1.7V, oxygen and hydrogen bubbles adhere to their respective electrodes to progressively form a gaseous film; the electrodes are then referred to as being polarised.

When polarised, the electrodes produce an opposing current that 'shadows' the applied current up to a maximum of 1.7V. Forward current ceases when the two potentials become equal and this can occur at any level below 1.7V.



The Needles Lighthouse - The place where early experiments were conducted. Courtesy of Trinity House

Capacitor or Cell

Let us visualise a pair of polarised electrodes as a capacitor with the gaseous film forming the dielectric; indeed, it can be made to discharge through a load in exactly the same way as with an ordinary capacitor. The magnitude of the charge held is determined by the surface area of the electrodes and the potential of the applied current.

However, as I have not observed gases escaping from the electrodes, it seems as if the oxygen and hydrogen recombine during discharging,

thereby reversing the charging process; in this context, the electrodes behave as a secondary cell which has the extraordinary ability to have any potential between zero and 1.7V. Perhaps the best description is a cell that behaves like a capacitor.

Greater Than 1.7V

The gaseous film dielectric breaks down if the potential of the applied current exceeds 1.7V and this, of course, applies to electrodes AB. Forward current then flows continuously, electrolysis occurs, so oxygen and hydrogen is released from

the electrodes at a rate in direct ratio to the current. However, the instant the potential of the applied current is reduced to less than 1.7V, the gaseous films re-form and the electrodes behave as a self-healing capacitor. Very strange!

Experimental

To throw more light on text book explanations, I conducted the following simple experiments whereby the electrodes that had been used for CD in the lake and millrace experiments were now inserted in a 200-litre plastic tub filled with tap water.

Shadows Applied Current

The arrangement shown in Figure 2 demonstrates that the potential of the opposing current 'shadows' that of the applied current up to a maximum of 1.7V. The potential of the applied current was varied from zero to almost 3.0V by means of the potentiometer. For potentials between 3.0 and 24V, a variable voltage PSU was employed, but its output was shunted with a 1k Ω resistor.

Obviously, when the switch (SW1) is closed, the DMM indicates the potential of the applied current, and when open, the potential of the charge, i.e., the opposing current.

In a more sophisticated repeat of the above experiment, a pulse generator and relay switch allowed the on/off cycle to be varied from less than 0.1Hz to 1kHz. The potential of the applied current was then increased in increments synchronised with the 'on' period.

The ADC was connected directly to the electrodes and the potential during both on and off periods was displayed by the lap top computer (see Graph 3).

Storage

To demonstrate that polarised electrodes store energy required a slight change to the circuitry and the addition of a 500.0-500.0 μ A meter, as shown in Figure 3.

Each incremental increase in potential caused a momentary forward current surge as the electrodes 'charged' to the higher level. Conversely, each decline in potential caused a reverse current as the potential across the electrodes equalised with that of the applied current by discharging through the potentiometer. The above effect was essentially the same when the electrodes were replaced by an electrolytic capacitor.

Figure 1. The Millrace experiment.

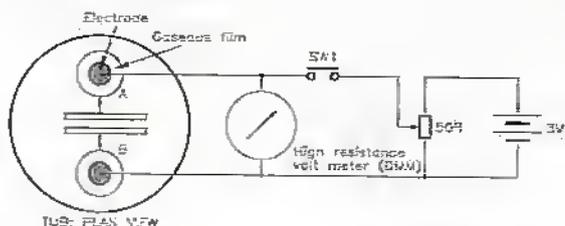
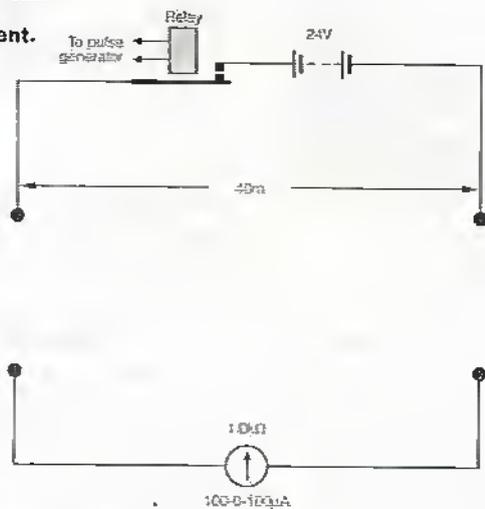


Figure 2. Measuring the potential of opposing current. When SW1 is pressed, the meter indicates the potential of the applied current; when released, the potential of the opposing current.

Indeed, it was a surprise was to find that the rate of charge and discharge with the copper tubes used in the millrace was comparable to that of a $10,000\mu\text{F}$ capacitor.

Carbon Rods

In a follow-up experiment, the metal electrodes were replaced by smaller carbon rods, 280mm long and 13mm in diameter (arc lamp type). Remarkably, the carbon rods were found to hold an infinitely greater charge than the larger copper tubes.

Moreover, the carbon rods retained their charge after being removed from the water, wiped with a cloth (which should have removed the gaseous film) and then re-inserted in the water. This immediately questioned the concept of the gaseous film being a dielectric or an electrochemical reaction involving the recombining of the gases.

Furthermore, it was difficult to completely discharge the carbon rods; shorting for a few seconds under the water had virtually no effect; I found it best to allow them to discharge in their own time through the meter. Indeed, when the electrodes were charged to 600mV discharge current through a $600\mu\text{A}$ meter was still $325\mu\text{A}$ after one minute and $10\mu\text{A}$ after 10 minutes.

Micro-scale

As electrodes CD were the same as used in the millrace experiments, it was only necessary to add electrodes AB to simulate the millrace experiment on a micro-scale – see Figures 4 & 8. Electrodes

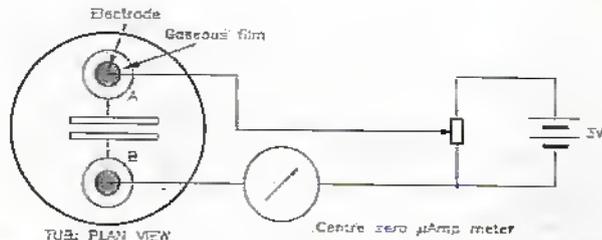


Figure 3. Electrodes behaving as a capacitor. Increasing the potential across AB causes the meter to indicate a momentary forward current; reducing potential causes a momentary reverse current.

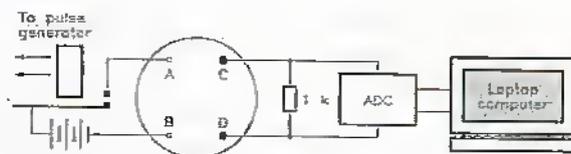


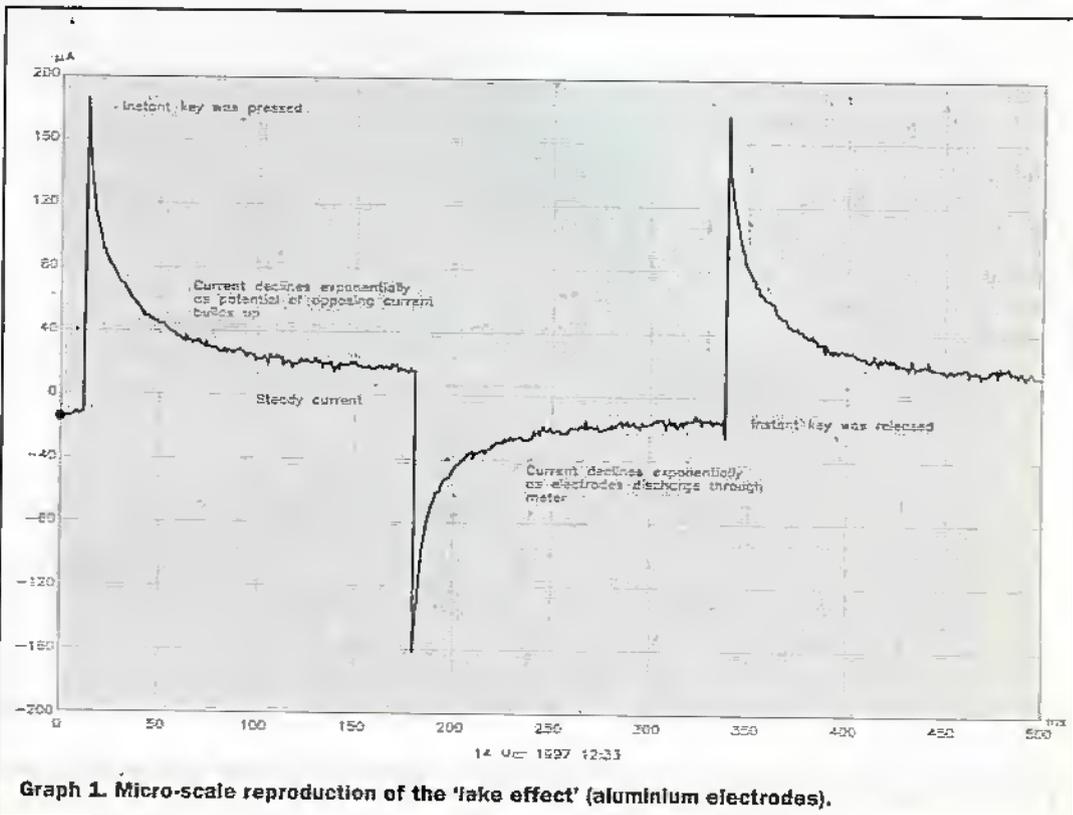
Figure 4. Microscale reproduction of the Millrace experiment in the tub (see also Figure 8 in Part 1).

AB were short lengths of bare 1mm copper wire energised with 6V, which was adequate to break down the dielectric; this was periodically interrupted by the pulse-generator/relay. The relatively short connecting leads to CD minimised induced 50Hz and allowed the ADC/computer to automatically plot the potential across CD.

During set up, A & B were inserted to depth (about 30mm), just sufficient to cause the steady current across CD to approximate that measured during the millrace experiment with CD suspended from bamboo poles, i.e., $35\mu\text{A}$.

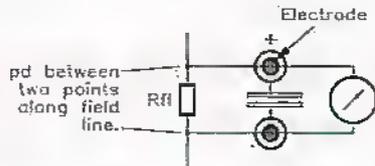
The microammeter had a resistance of approximately $1\text{k}\Omega$, so once again, readings in μA are equivalent to mV. Obviously, the meter resistance has to be low enough to allow a significant current to flow and for this reason, the ADC was either connected in parallel with the microammeter or shunted by a $1\text{k}\Omega$ resistor.

The current energizing AB was periodically interrupted and current across CD displayed by the computer – refer to Graph 1. Attempts to explain the phenomena were based on the following models:



Graph 1. Micro-scale reproduction of the 'fake effect' (aluminum electrodes).

Figure 5. Model A, simulating electrodes CD making metallic contact with an imaginary resistance wire field line (see also Figures 2 & 3).



Model A

In Part 1, current field lines were depicted as lengths of resistance wire tapped two points along its length by electrodes CD so as to produce a potential difference. However, during experiments representing the resistance wire analogy, i.e., when electrodes CD were energised via direct metallic contact, they behaved as capacitor or cell in parallel with the meter (see Figure 5). There was obviously no reverse current.

In order to produce the reverse current, the meter and electrodes had to be arranged in a series configuration and as already mentioned, the following is the best model I could come up with.

Model B

This model requires electrodes CD to be considered as two terminal devices. One is metallic contact with the leads to the meter and the other via water, where electric charges are carried by ions. Resistor Rfl simulates two points along a field line and the resultant p.d. across CD causes a forward current through the meter (see Figure 6a). Forward current causes the gaseous films to develop, so the potential of film around electrode C becomes positive whilst the actual electrode becomes negative. The opposite applies to electrode D.

However, the potential of the opposing current does not

equal that across Rfl, so some forward current continues to flow, i.e., the steady current – refer to Figure 6b.

Reducing the potential across Rfl causes a reverse current until an equilibrium is attained and the steady current resumes. By the same token, increasing the potential across Rfl causes an increase in forward current until an equilibrium is reached. However, the steady current increases in direct ratio to the

potential across Rfl.

If the potential across Rfl falls to virtual zero, i.e., when the current energizing AB is interrupted, electrodes CD instantly discharge through the intervening water (Rw) and the meter to indicate reverse pulse (see Figure 6c).

Two Tubs

To demonstrate the series configuration, electrodes AC and BD were placed in separate plastic tubs. The potentiometer simulates a field line (see Figure 7). As with Model B, increasing the potential across AB caused a momentary forward current surge whilst a reduction caused momentary reverse current surge. Keying simulated the 'lake effect' – refer to Graph A and B.

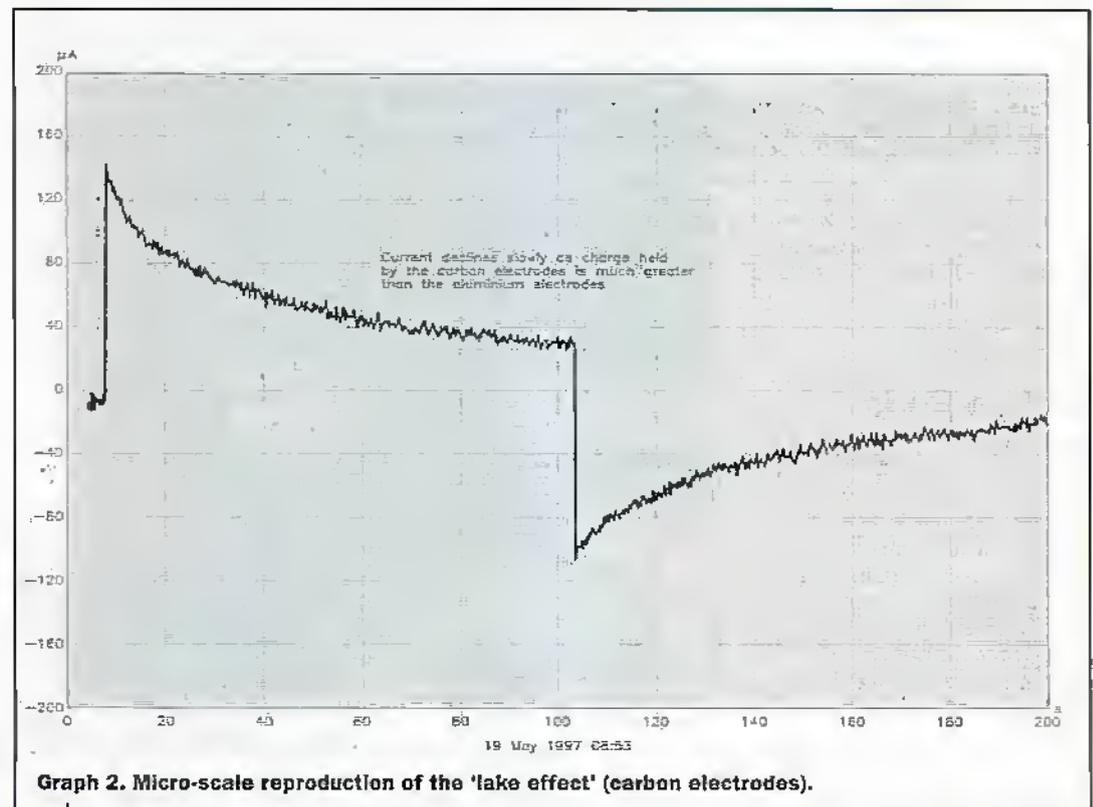
Steady current increased almost linearly from $5\mu\text{A}$ to $80\mu\text{A}$ as the potential across AB was increased from 250mV to 1.5V but suddenly shot up to

more than $200\mu\text{A}$ when the potential across AB exceeded 1.7V . This was consistent with the gaseous film around C and D behaving as a dielectric which broke down when the potential exceeded 1.7V .

Slow Build-up

Because the charge held by the aluminum electrodes was relatively small, the potential of the opposing current quickly built up to maximum, but with the copper tubes, it took a minute or so for the potential of the opposing current to incrementally build during each on cycle to the level shown in Graph 2. The effect is analogous to charging a capacitor.

In a further experiment, the metal electrodes were replaced by the carbon rods but as these held a very large charge, it took several minutes for the opposing current to build up to maximum level.



Graph 2. Micro-scale reproduction of the 'lake effect' (carbon electrodes).

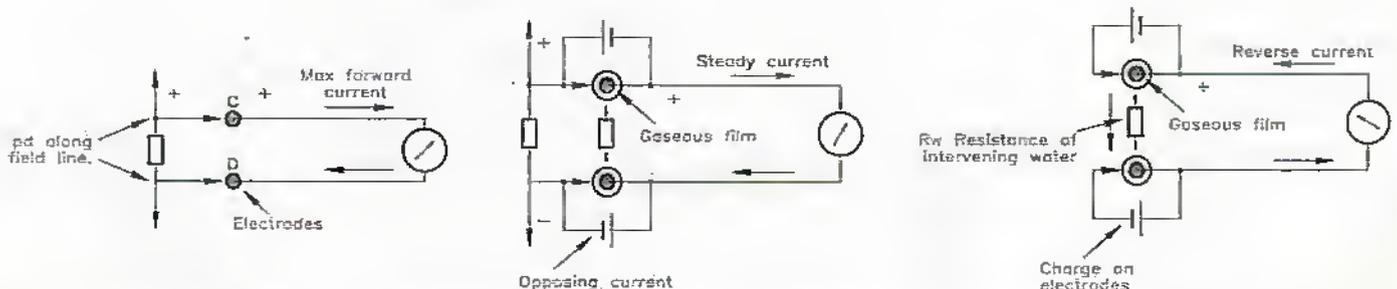


Figure 6. Model B: (a) No gaseous films – forward current maximum; (b) Gaseous films produce opposing current; (c) Field line not present – electrodes discharge through Rw to produce reverse current.

Natural Currents

By employing additional electrodes to simulate a natural field line, the polarity and potential across CD was found to be determined by the collective effect of both sets of field lines. The simulated natural field lines simply offset the meter needle but had no effect on the magnitude and duration of forward and reverse pulses.

EM Pollution

I was puzzled as to why induced 50Hz did not seem to impede polarisation of electrodes CD in the millrace. So, 50Hz was applied to CD and its potential increased until the meter needle began to quiver, i.e., much higher than in the millrace.

Nonetheless, graphs produced by the ADC showed the 50Hz simply riding on the DC signal current. The inference is that because the magnitude and polarity of the opposing current is slow to change, 50Hz was too fast to cause polarisation.

Scouring

Up to this point, the electrodes CD were the same ones that had been used in all previous experiments and had received no attention except for wiping with a soft cloth after removing from the water. During further experiments, the metal

electrodes were cleaned with a plastic scouring cloth; this completely inhibited polarisation and it took several weeks of exposure to the air before it would reoccur. Indeed, after scouring, the charge held was found to be in direct ratio to the length of time the electrodes were exposed to air.

So presumably, oxidation has some effect on polarisation. Scouring had no effect on the carbon electrodes, in any case, carbon oxides are gases.

Large Electrodes

Morse used 8x4ft. copper sheet and Johnson used similar

large electrodes; it seems that the principal reason for large electrodes was to provide a low resistance path across AB and thereby maximise field line magnitude with low voltage primary cells.

However, my experiments indicate that the surface area of electrodes CD has little effect on actual potential. So, it would seem that Johnson could have used much smaller electrodes for CD but for two-way working; it was logical to employ the same size electrodes for both AB and CD.

Anomalies

I was puzzled why Johnson made no mention of a reverse current. I then realised that he had buried the electrodes in the river bank. As we have seen, laying the electrodes on the river bed mud attenuated the forward and reverse pulses, so burying them in the bank probably suppressed them completely. Johnson may, therefore, not have observed the 'lake effect'.

However, on the basis of my experiments, Willoughby-Smith must have observed the 'lake effect' during his trials. Indeed, it is a mystery why he made no mention of the phenomenon.

Reference

J. J. Fahie *A History of Wireless Telegraphy*, 1901.

Figure 7. Demonstration of series configuration; increasing potential across AB causes momentary forward current. Reducing potential causes momentary reverse current.

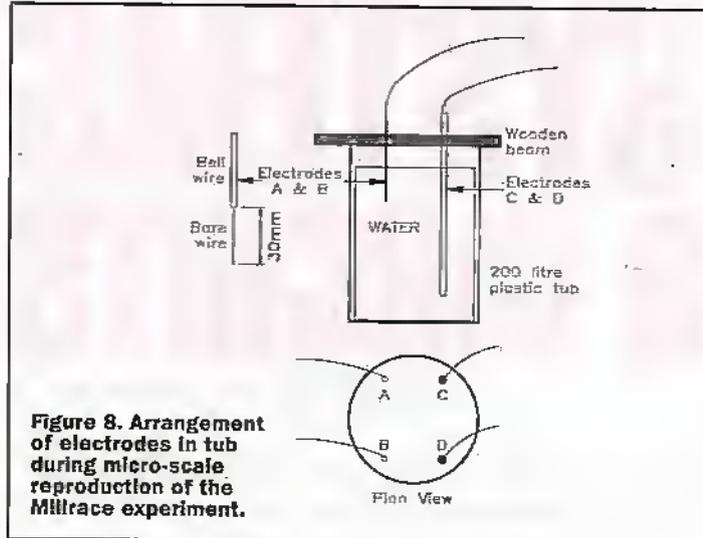
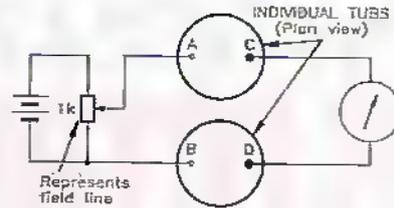
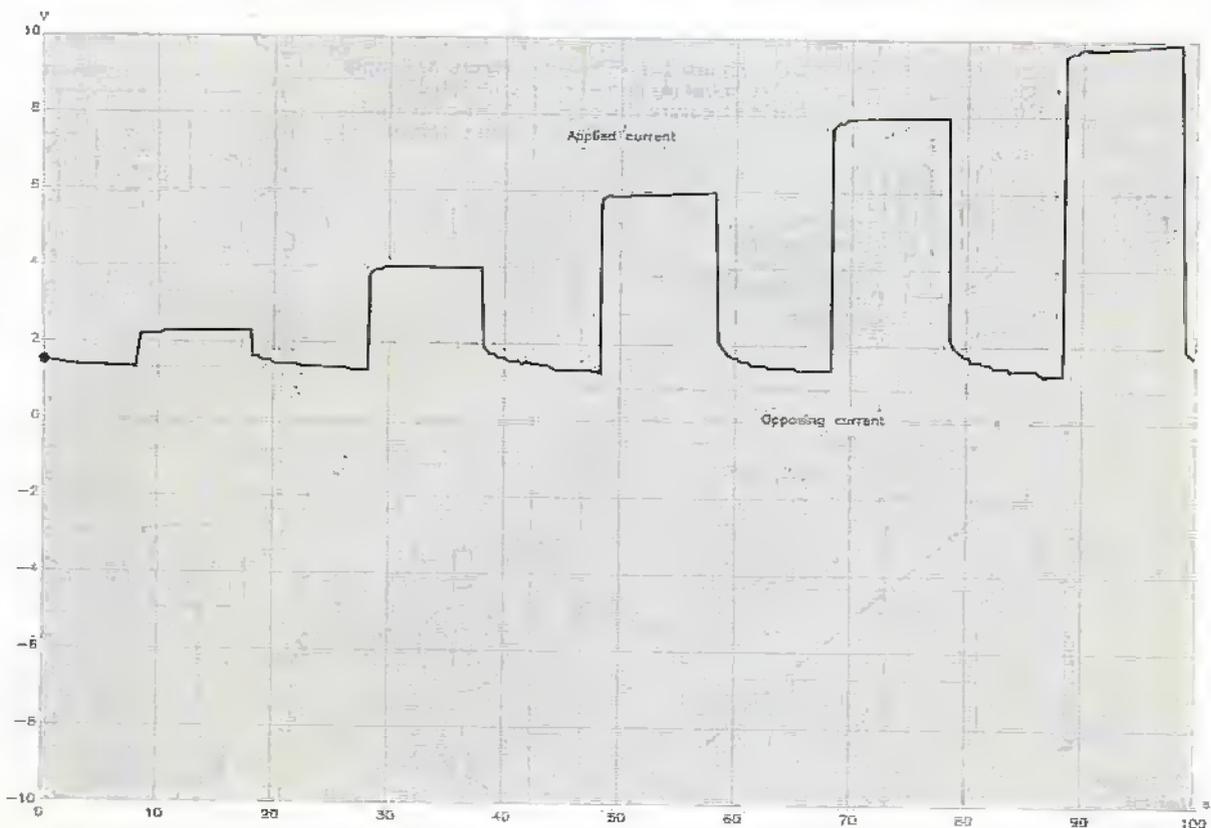


Figure 8. Arrangement of electrodes in tub during micro-scale reproduction of the Millrace experiment.

Graph 3. Showing that potential of opposing current does not exceed 1.7V.



Optoelectronic circuits — which respond to either visible or invisible (usually infra-red) light levels — are widely used in modern domestic and commercial security systems. Optoelectronic security circuits come in three basic types, the first of which is the simple 'visible-light-level' type that reacts when a light level goes above or below a preset value. The second type is the light-beam alarm, which reacts when a person, object or animal breaks or reflects a projected visible or infra-red (IR) light beam. The third type is the passive infra-red (PIR) detector, which is sensitive to the heat-generated infra-red light radiated by the human body, and thus reacts when a human or other large warm-blooded animal comes within the sensing range of the PIR detector. A range of practical optoelectronic circuits of the 'visible light' type are described in this month's part of this series; practical IR 'light-beam' and PIR circuits will be described in next month's episode.

'Visible-Light-Level' Circuits

LDR Basics

Most optoelectronic circuits that are designed to respond to normal visible light use a cadmium sulphide (CdS) LDR (Light Dependent Resistor) as

Security ELECTRONIC SYSTEMS & CIRCUITS

..... PART 4

Ray Marston looks at practical visible-light optoelectronic security circuits in the fourth episode of this series.

their light-sensing element or photocell. Figure 1 shows an LDR's circuit symbol and basic construction, which consists of a pair of metal film contacts separated by a snake-like track of light-sensitive cadmium sulphide film; the structure is housed in a clear plastic or resin case. Figure 2 shows the

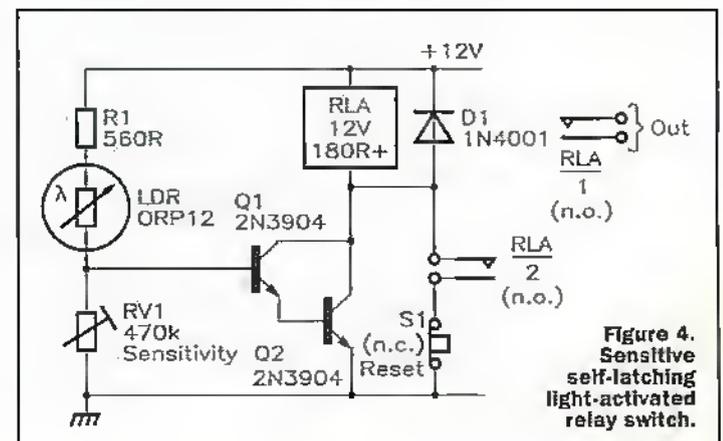
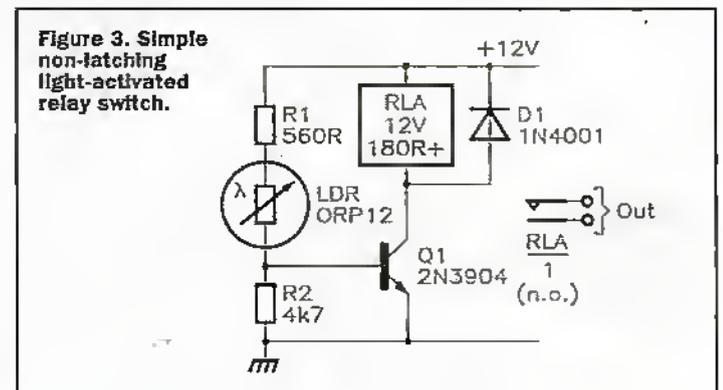
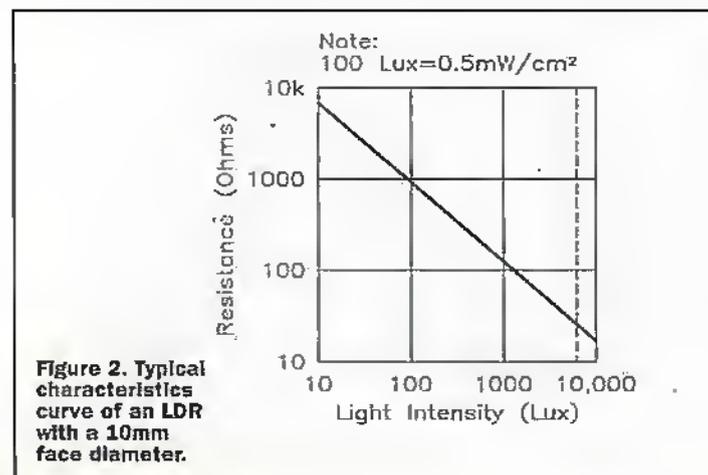
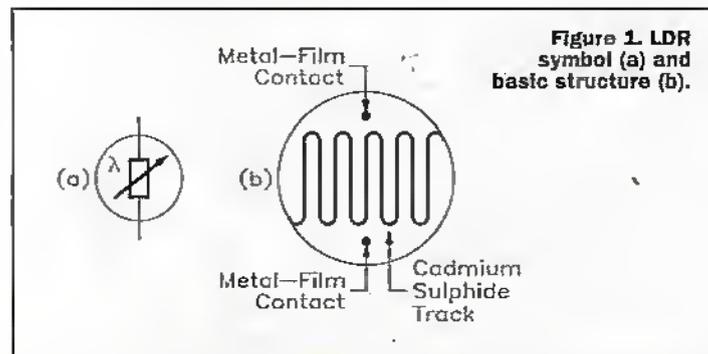
typical photoresistive graph that applies to an LDR with a face diameter of about 10mm; the LDR acts as a high resistance (typically hundreds of kilohms) under dark conditions, falling to about 900Ω at a light intensity of 100 Lux (typical of a well-lit room) or about 30Ω at 8,000 Lux (typical of bright sunlight).

Note that although most of the practical circuits shown throughout this 'Visible-light-level' section of this article are shown using an ORP12 photocell, they will in fact work well with almost any general-purpose LDRs with face diameters in the range 3 to 12mm.

Simple Relay Switches and Alarms

The simplest 'visible-light-level' security circuits are the types that are designed to activate when the light level goes through a large change, such as from near-dark to a moderately high level, or vice-versa. Some circuits of this type function as 'light-activated' units that switch on a relay or safety mechanism or sound an alarm when light enters a normally dark area such as the inside of a storeroom, wall safe, or security case, etc. Other circuits are designed as 'dark-activated' units, and activate when the light level drops well below some nominal value. Figures 3 to 7 show some simple circuits of these types.

The Figure 3 circuit is that of a simple non-latching light-activated relay switch. Here, R1-LDR and R2 form a potential divider that controls the base-bias of Q1. Under dark conditions, the LDR resistance is very high, so negligible base-bias is applied to Q1, and Q1 and relay RLA are both off.



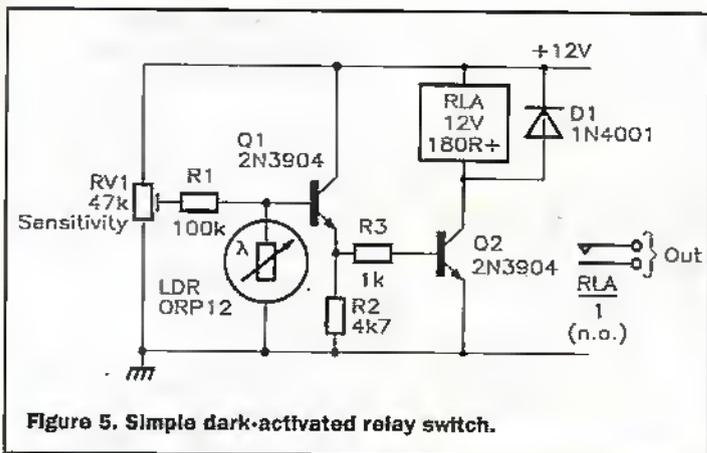


Figure 5. Simple dark-activated relay switch.

When light enters the normally dark area and falls on the LDR face, however, the LDR resistance falls to a fairly low value and base-bias is applied to Q1, which thus turns on and activates the relay and its RLA/1 contacts, which can be used to control external circuitry. The relay can be any 12V type with a coil resistance of 180Ω or greater.

The simple Figure 3 circuit has a fairly low sensitivity, and has no facility for sensitivity adjustment. Figure 4 shows how these deficiencies can be overcome by using a super-alpha-connected pair of transistors in place of Q1, and by using sensitivity control RV1 in place of R2; this circuit can be activated by LDR resistances as high as 200kΩ (i.e., by exposing the LDR to very small light levels), and draws a standby current of only a few microamps under 'dark' conditions. The diagram also shows how the circuit can be made to give a self-latching action via relay contacts RLA/2; normally-closed push-button switch S1 enables the circuit to be reset (unlatched) when required.

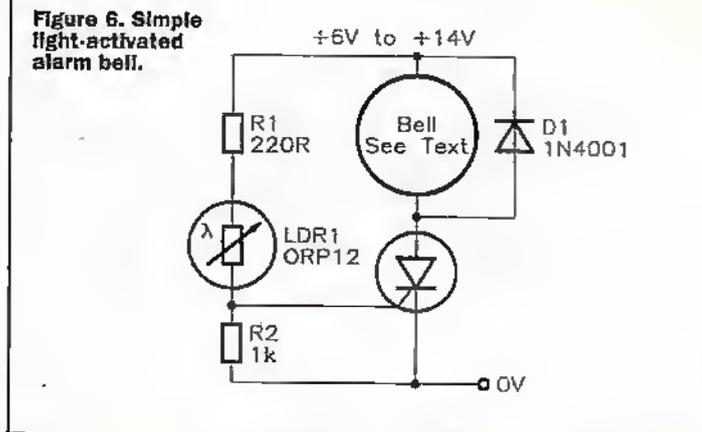
Figure 5 shows an LDR used in a simple dark-activated circuit that turns relay RLA on when the light level falls below a value that is preset via RV1. Here, R1 and LDR act as a potential divider that is fed with a preset DC voltage from RV1 and generates an output voltage that rises as the light level falls, and vice-versa. This generated voltage is buffered by emitter follower Q1 and used to control the relay via common-emitter amplifier Q2 and current-limiting resistor R3. Thus, when the light level falls below the preset value, the R1-LDR divider's output voltage reaches a large enough level to activate both Q1 and Q2, and the relay turns on.

Figures 6 and 7 show simple silicon controlled rectifier (SCR)

circuits that – under the light-sensitive 'alarm' condition – activate an ordinary self-interrupting electromechanical alarm bell. This bell must (when the specified C106D SCR is used) consume an operating current of less than 2A, and the circuit's supply voltage must be at least 1V greater than the bell's nominal operating voltage.

The Figure 6 circuit is a simple non-latching one, in which the alarm bell is wired in series with an SCR that receives its gate drive from the positive supply rail via the R1-LDR-R2 potential divider. Thus, under dark conditions, the LDR resistance is very high, so

Figure 6. Simple light-activated alarm bell.



negligible gating voltage appears across R2, and the SCR and alarm are both off. When light enters the normally dark area and falls on the LDR face, however, the LDR resistance falls to a fairly low value, and if this value is below roughly 10kΩ, the LDR passes enough current to gate the SCR into the 'on' mode, thus sounding the alarm bell. Most LDRs (including the ORP12) give a resistance of less than 10kΩ when exposed to low-intensity room lighting or the light of a torch, so this circuit operates as soon as it is exposed to a moderate amount of illumination.

Note in the above circuit that, although the SCR is a self-latching device, it automatically unlatches each time that the bell enters a self-interrupt phase (and the SCR anode current drops to zero). Consequently, the alarm bell automatically turns off when the light level falls back below the SCR's 'trip' level.

The Figure 6 circuit has a fairly low sensitivity and has no facility for sensitivity adjustment. Figure 7 shows how these deficiencies can be overcome by using RV1 in place of R2 and by using Q1 as a buffer between the LDR and the SCR gate; this circuit can be activated by LDR resistances as high as 200kΩ (i.e., by exposing the LDR to very small light levels). This diagram also shows how the circuit can be made self-latching by wiring R4 across the bell so that the SCR anode current does not fall to zero as the bell self-interrupts. Switch S1 enables the circuit to be reset (unlatched) when required.

Siren-output Alarms

The Figure 2 to 7 circuits are designed to give either alarm-bell or relay outputs. In some applications, an electronic 'siren sound' output may be

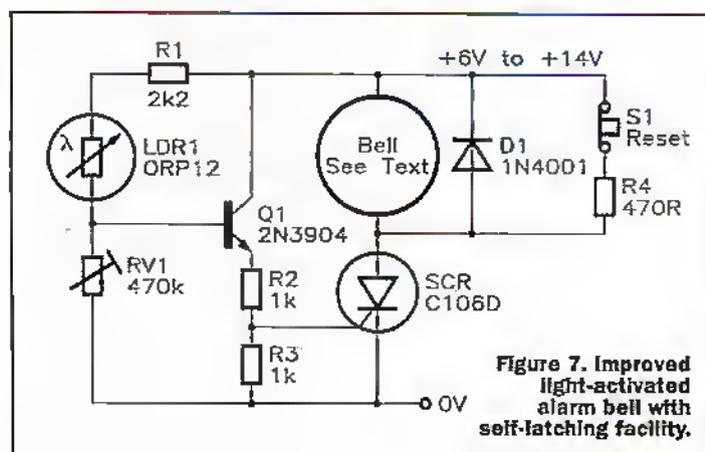


Figure 7. Improved light-activated alarm bell with self-latching facility.

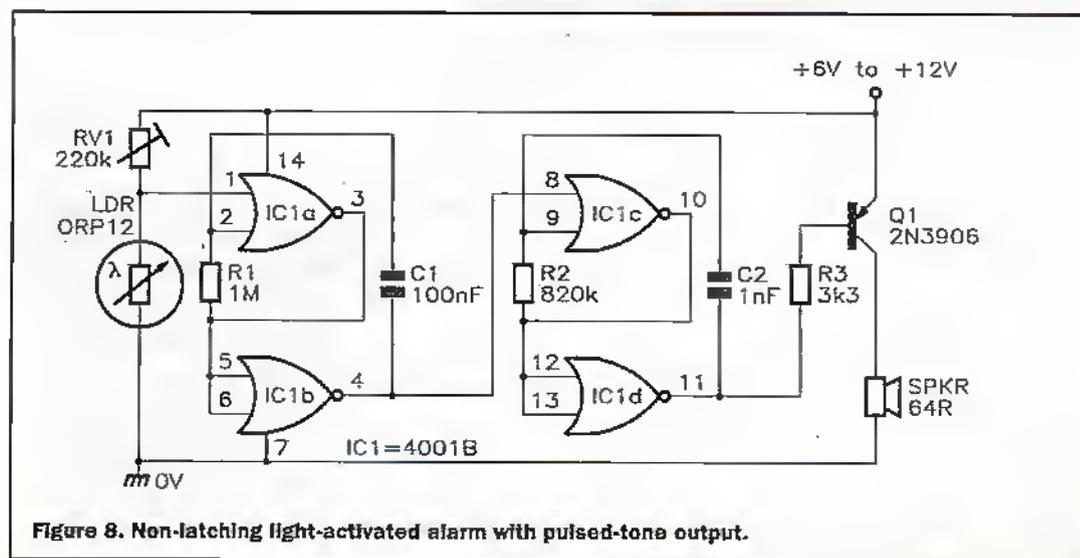


Figure 8. Non-latching light-activated alarm with pulsed-tone output.

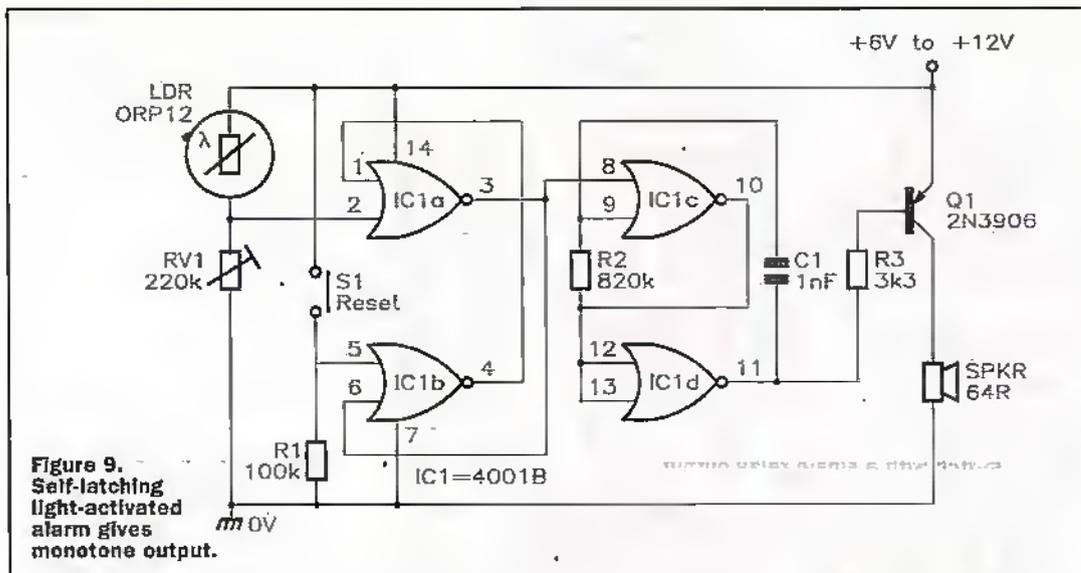


Figure 9. Self-latching light-activated alarm gives monotone output.

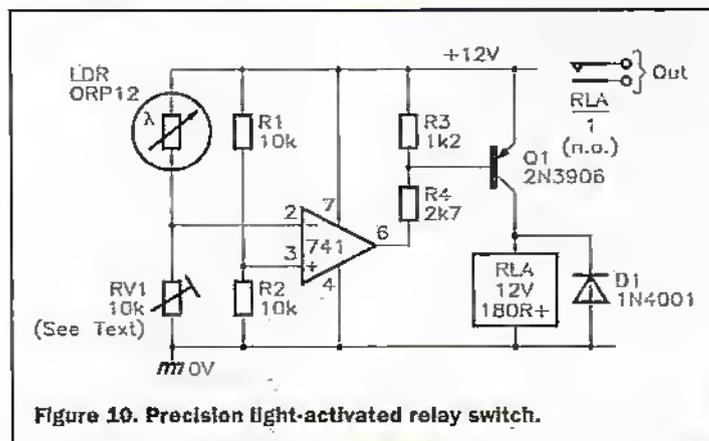


Figure 10. Precision light-activated relay switch.

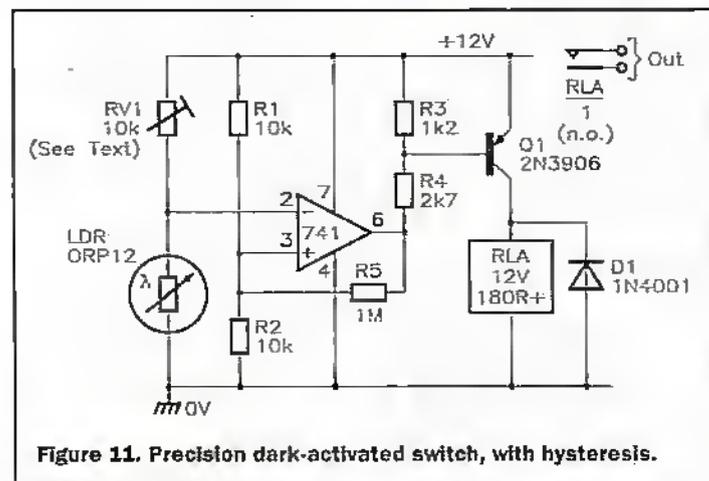


Figure 11. Precision dark-activated switch, with hysteresis.

preferable, and Figures 8 and 9 show low-power (up to 520mW) speaker-output circuits of this type. The Figure 8 circuit gives non-latching operation and develops a pulsed-tone output signal. The Figure 9 circuit gives self-latching operation, and develops a monotone output signal. Both circuits are designed around a 4001B CMOS IC.

In the Figure 8 circuit, the IC's two left-hand gates are wired as a low-frequency (6Hz) gated astable multivibrator that is activated via the light-sensitive LDR-RV1 potential divider, and the two right-hand

gates are wired as a gated 800Hz astable that is activated by the 6Hz astable. Under dark conditions, the LDR-RV1 output voltage is high and both astables are gated off, and the circuit consumes a fairly low standby current, but under bright conditions, the LDR-RV1 output voltage is low and both astables are activated, with the left-hand astable gating the 800Hz astable on and off at a 6Hz rate, thus generating a pulsed 800Hz tone in the speaker.

In the self-latching Figure 9 circuit, the IC's two left-hand gates are wired as a simple

bistable multivibrator that can be activated (SET) by a high voltage on the output of the light-sensitive LDR-RV1 potential divider, and the two right-hand gates are wired as a gated 800Hz astable that is activated by the bistable's output. Under normal dark conditions, the output of the LDR-RV1 divider is low, the bistable output is in the high 'RESET' state, thus gating the astable off, and the circuit consumes only a small standby current. When the LDR is exposed to light, however, the LDR-RV1 junction goes high, flipping the self-latching bistable into the SET mode, in which its output goes low and gates on the 800Hz astable, thus generating a monotone speaker signal. Once it has been activated, the circuit can only be turned off again by removing the LDR's illumination and briefly closing RESET switch S1, at which point, the bistable output resets to the high state and the astable is gated off again.

Note that the trigger points of the Figure 8 and 9 circuits occur at the point at which the LDR-RV1 junction voltage swings above or below IC1's 'transition' voltage value, which lays somewhere between 1/3 and 2/3 of the supply voltage value. In practice, the light-trigger points of these circuits are not greatly affected by supply voltage variations. Also note that, when using the output stages shown in the diagrams, these two circuits each give maximum output powers of only 520mW into the 64Ω speakers, but that these powers can be boosted to as high as 13.2W by replacing the Q1 output stages with the power-boosting circuits shown in Figures 21 or 22 in last month's Part 3 of this series.

Precision Relay Switching Circuits

The relay-switching circuits of Figures 3 to 5 are fairly sensitive to variations in supply voltage and temperature, and are not suitable for use in precision light-sensing application. Figure 10 shows a very sensitive light-sensitive relay-driving circuit that is not influenced by such variations, and is thus suitable for use in many precision light-sensing applications, and which turns the relay on when the light level rises above a preset value. In this case, LDR-RV1 and R1-R2 are connected in the form of a Wheatstone bridge, and the op-amp and Q1-RLA act as a highly sensitive balance-detecting switch. The bridge balance point is quite independent of variations in supply voltage and temperature, and is influenced only by variations in the relative values of the bridge components.

In Figure 10, the LDR and RV1 form one arm of the bridge, and R1-R2 form the other arm. These arms can actually be regarded as potential dividers, with the R1-R2 arm applying a fixed half-supply voltage to the non-inverting input of the op-amp, and with the LDR-RV1 divider applying a light-dependent variable voltage to the inverting terminal of the op-amp. In use, RV1 is adjusted so that the LDR-RV1 voltage rises slightly above that of R1-R2 as the light intensity rises to the desired trigger level, and under this condition, the op-amp output switches to negative saturation and thus drives RLA on via Q1 and biasing resistors R3-R4. When the light intensity falls below this level, the op-amp output switches to positive saturation, and under this condition, Q1 and the relay are off.

The Figure 10 circuit is very sensitive and can detect light-level changes too small to be seen by the human eye. The circuit can be modified to act as a precision dark-activated switch (which turns the relay on when the light level falls below a preset value) by either transposing the inverting and non-inverting input terminal connections of the op-amp, or by transposing RV1 and the LDR. Figure 11 shows a circuit using the latter option. This diagram also shows how a small amount of hysteresis can be added to the circuit via feedback resistor R5, so that the relay turns on when the light

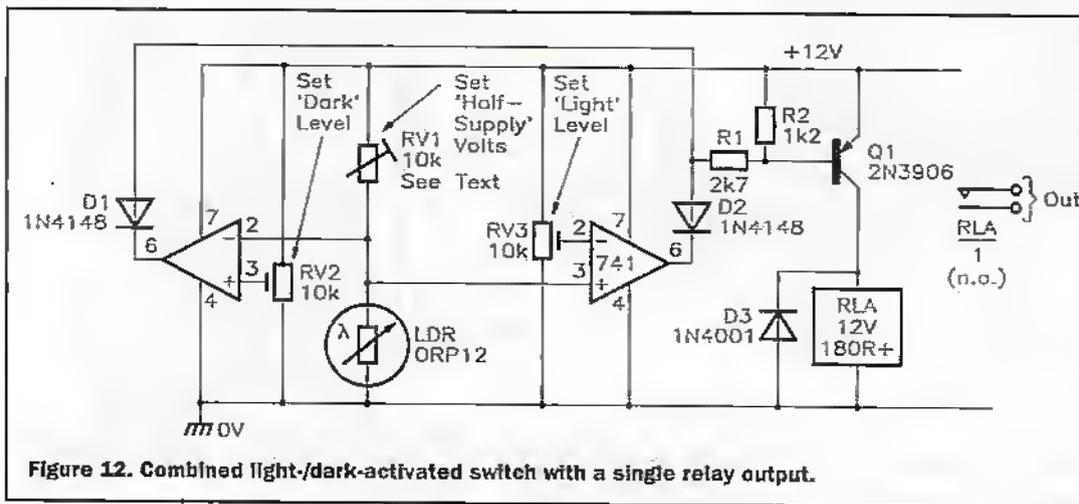


Figure 12. Combined light/dark-activated switch with a single relay output.

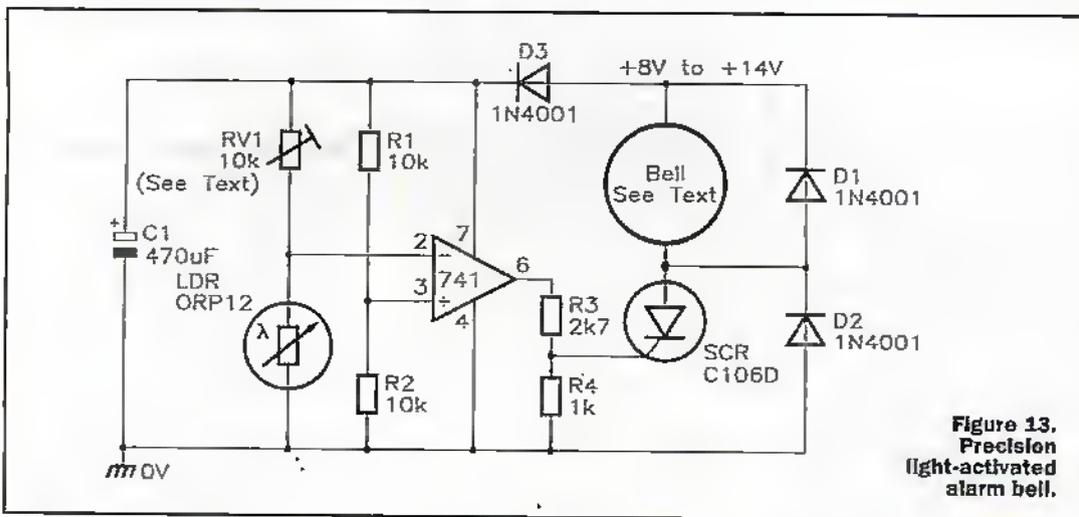


Figure 13. Precision light-activated alarm bell.

level falls to a particular value, but does not turn off again until the light level rises a substantial amount above this value (this action helps prevent spurious switching due to passing shadows, etc., in automatic lighting-control circuits). The hysteresis magnitude is inversely proportional to the R5 value, being zero when R5 is open circuit.

Figure 12 shows how a precision combined light/dark-activated switch (which activates a single relay if the light intensity rises above one preset value or falls below another preset value) can be made by combining the 'light' and 'dark' switch circuits of Figures 10 and 11. To set up this circuit, first pre-set RV1 so that roughly half-supply volts appear on the LDR-RV1 junction when the LDR is illuminated at the mean or normal intensity level. RV2 can then be preset so that RLA turns on when the light intensity falls to the desired dark level, and RV3 can be preset so that RLA activates when the light rises to the desired 'bright' level.

Note in the Figure 10 to 12 'precision' circuits, that the basic RV1 value should be

roughly double that of the LDR resistance value at the desired 'trigger' light levels, so that RV1's slider is reasonably close to its central position under this condition. Thus, the RV1 value

may have to be reduced below 10kΩ if a circuit is set to trigger under very bright conditions, or may have to be increased above 10kΩ if used to trigger under very dark conditions.

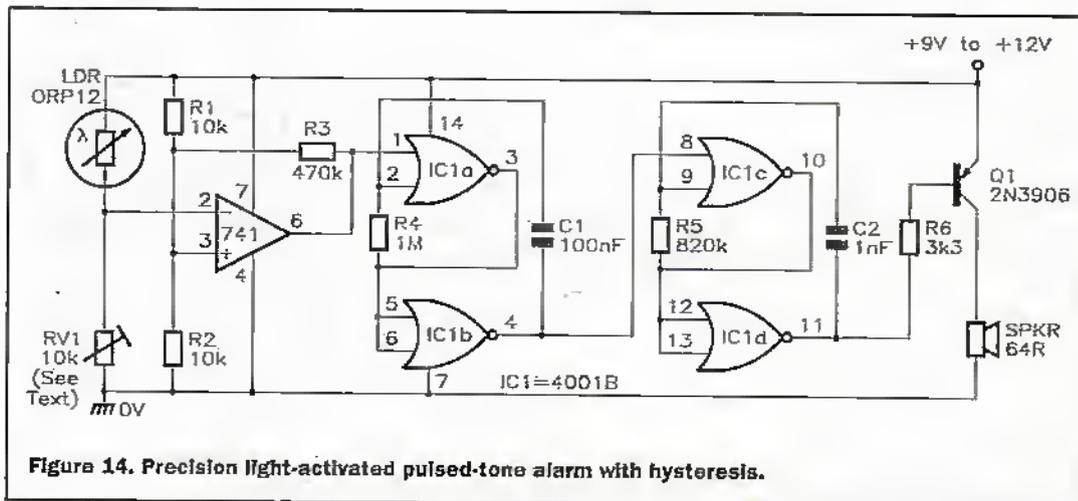


Figure 14. Precision light-activated pulsed-tone alarm with hysteresis.

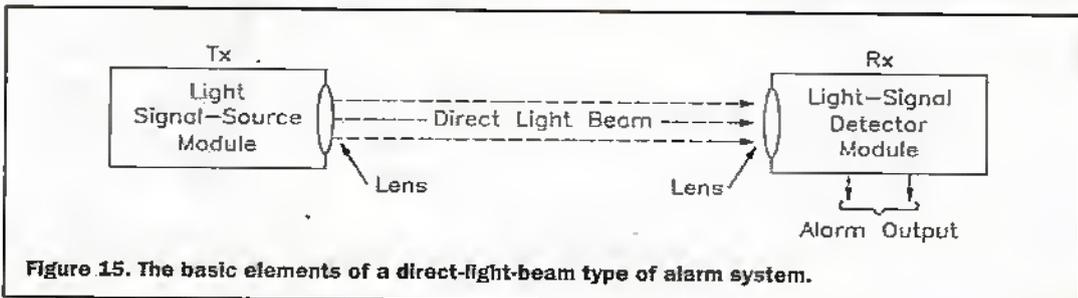


Figure 15. The basic elements of a direct-light-beam type of alarm system.

Precision Alarm-sounding Circuits

The basic op-amp based precision circuits of Figures 10 to 12 can easily be used in conjunction with some of the alarm-bell activator or siren-sound generator circuits already shown in this article, to make various precision alarm-sounding circuits. Figure 13, for example, shows modified versions of the basic Figure 6 and 10 circuits combined to make a precision light-activated alarm bell circuit that can easily be changed into a dark-activated unit by simply transposing RV1 and the LDR. Note that the op-amp's supply line is decoupled from that of the bell via D3 and C1.

Similarly, Figure 14 shows modified versions of the basic Figure 8 and 10 circuits combined to make a precision light-activated pulsed-tone alarm with built-in hysteresis. The hysteresis is controlled by R3, which can have its value altered to obtain different hysteresis values, or can be removed if hysteresis is not needed.

Light Beam Alarm Circuits

Simple Visible-light Designs

A light-beam alarm system consist of a focused light-beam transmitter (Tx) and a focused light-beam receiver (Rx), and

Figure 16. Simple direct-light-beam alarm with alarm bell output.

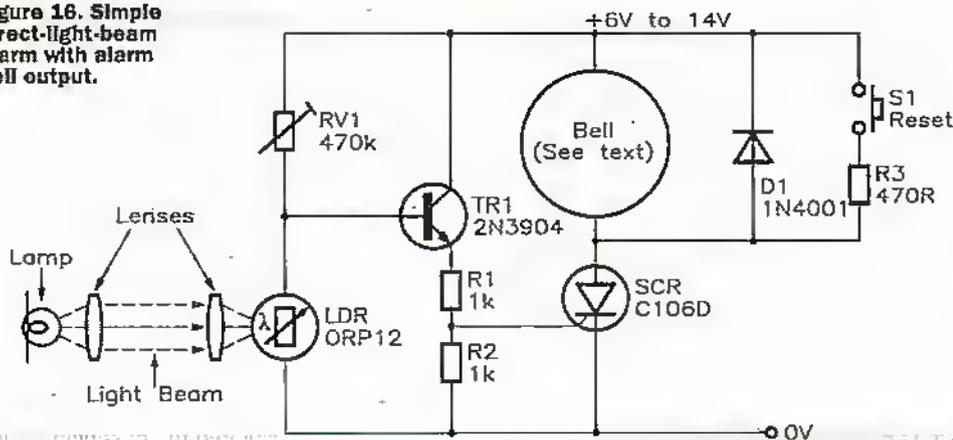
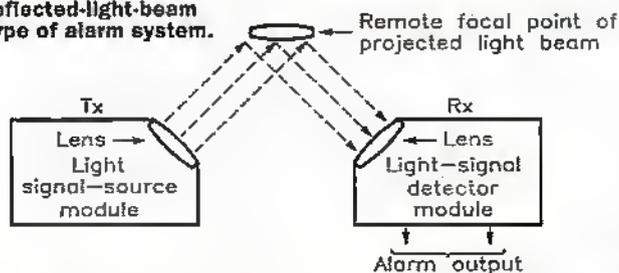


Figure 17. The basic elements of a reflected-light-beam type of alarm system.



may be configured to give either a direct-light-beam or a reflected-light-beam type of optical contact operation. Figure 15 shows the basic elements of a direct-light-beam type of alarm system, in which the sharply focused Tx light-beam is aimed directly at the light-sensitive input point of the Rx unit, which (usually) is designed to activate an external alarm or safety mechanism if a person, object, or piece of machinery enters the light beam and breaks the optical contact between the Tx and Rx.

Figure 16 shows a very simple example of a lamp-and-LDR direct-light-beam system that activates an alarm bell if the beam is interrupted. The beam is generated via an ordinary electric lamp and a lens, and is focused (via a 'collector' lens) onto the face of an LDR in the remote Rx unit, which operates as a dark-activated alarm. Normally, the LDR face is illuminated by the light beam, so the LDR has a low resistance and very little voltage thus appears on the RV1-LDR junction, so the SCR and bell are off. When the light beam is broken, however, the LDR resistance goes high and enough voltage appears on the RV1-LDR junction to trigger the SCR, which drives the alarm bell on; R3 is used to self-latch the alarm.

Figure 17 shows the basic

elements of a reflected-light-beam type of alarm system, in which the Tx light-beam and Rx lens are optically screened from each other but are both aimed outwards towards a specific point, so that an optical link can be set up by a reflective object (such as metallic paint or smoke or fog particles) placed at that point. This type of system is usually designed to activate an alarm when the presence of such an object is detected, but can also be configured to give the reverse action, so that the alarm activates if a reflective object is legally or illegally removed.

Units of the Figure 17 type were once widely used in

conjunction with reflection-type fog and smoke detector units; Figure 18 shows a sectional view of a smoke detector unit of this type. Here, the lamp and LDR are mounted in an open-ended but light-excluding box, in which an internal screen prevents the lamp-light from falling directly on the LDR face. The lamp is a source of both light and heat, and the heat causes convection currents of air to be drawn in from the bottom of the box and to be expelled through the

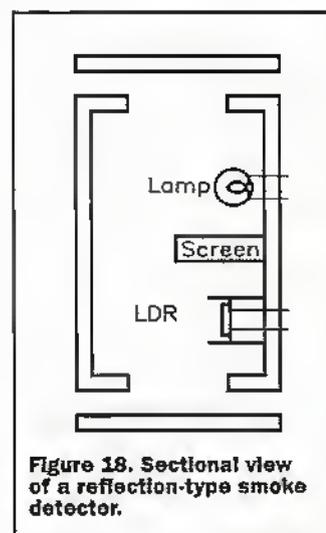


Figure 18. Sectional view of a reflection-type smoke detector.

top. The inside of the box is painted matt black, and the construction lets air pass through the box but excludes external light.

Thus, if the convected air currents are smoke-free, no light falls on the LDR face, and the LDR presents a high resistance. If the air currents do contain smoke, however, the smoke particles cause the light of the lamp to reflect onto the LDR face and so cause a large and easily detectable decrease in the LDR resistance. Figure 19 shows the practical circuit of a reflection-type smoke alarm that can be used with this detector; the circuit acts in the same way as the improved Figure 7 light-activated alarm circuit.

IR Light-beam Alarms

Simple lamp-and-LDR light-beam alarms of the types described in the last section have several obvious disadvantages in most modern security-alarm applications. Their light-beams are, for example, clearly visible to an intruder, the transmitter's filament lamp is unreliable, and the systems are (because the transmitter's filament lamp consumes a lot of power) very inefficient. In practice, virtually all modern light-beam security systems operate in the invisible infra-red (rather than visible light) range, and use one or more pulse-driven IR LEDs to generate the transmitter's 'light beam', and use matching IR diodes or transistors to detect the beam at the receiver end of the system. Next month's episode of this series will give detailed descriptions of various modern IR light-beam security systems, and will also describe the operating principles of modern PIR body-detection security devices.

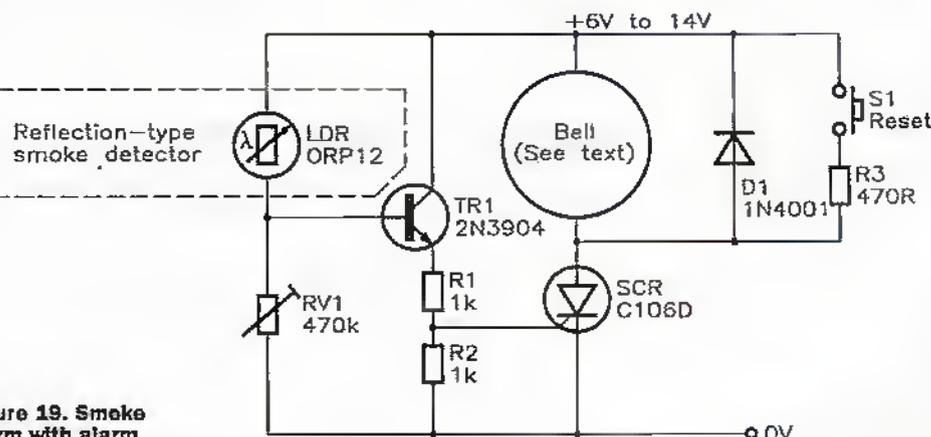


Figure 19. Smoke alarm with alarm bell output.



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Customer Complaint

Dear Sir,

I would like to air a complaint about your subscriber offers. I saw in your December issue which arrived on the 7th November, that you were offering Gordon McComb's latest book, *Lasers, Ray Guns and Light Cannons*, with £3 off. As a fan of his books, I decided to get a copy and when I was in Edinburgh the following day, I went out of my way and called into your store. I had taken the magazine with me and I found the book on the shelf and took it to the pay desk. To both the assistant's and my surprise, the offer code was not on the computer. After a half hour wait while he phoned the area manager, I was told that the offer didn't start until Friday 14th November, when the magazine was released to the public. In the end, I bought the book at the full price because I would have had to pay the postage on top of the offer price if I was to order it mail order, which amounted to about the same price. I think this is terrible that

I was kept waiting for so long and couldn't receive the £3 discount on the book. I understand that the shop is not at fault here as they didn't even have their own copy of the magazine to check the details of the offer and had to rely on what they were told. Looking again at the subscriber offers page, the only date mentioned is that of when the offer ends and there is no start date. I don't see what the date the magazine is released to the public has to do with the subscriber offers, as these offers are for subscribers only. It seems ironic that the page tells you to hurry to qualify for the savings but when you do hurry, they don't apply. I hope this problem doesn't affect other subscribers and is rectified for future offers.

Tim Kerby, Newport on Tay, Fife.

We are extremely sorry that you experienced this problem with obtaining your subscriber discount. Subscribers get their copies some time before the official publication date. The special offers are in fact for mail order only. We will see what can be done to rectify the situation. By way of compensation, we are sending you Maplin gift vouchers.

Low-cost Security – Don't Knock It!

Dear Sir,

I have bought one of your *Electronics* magazines (Issue 89). I read about your Alarm Upgrade kit, and decided to rush to my nearest Maplin store and buy it, because it was at an astonishing price. I also found it ever so easy to install. Six months after I had installed

the upgrade kit, I had a burglary and the burglar tried to break the box, which set off the tamper alarm. I also think it was an excellent idea by Tony Bricknell.

PS. I am writing this letter now because I bought a pack of 5 old magazines for 99p.

Asif Alibhai, Ilford, Essex.

We are pleased that this simple project upgrade proved to be effective at a time of crisis.

In this issue, G. K. Bartlett, e-mail: 106755,1065@compuserve.com, wins the Star Letter Award this month for writing in to ask "How do they do that?"



Dear Sirs,

As a retired Electronics-comes-Instrumentation Technician, I have little interest in electronics as a hobby; preferring model and experimental engineering and only using electronics as a tool. Nevertheless, I do occasionally buy your excellent magazine and use your catalogue. May I say, I agree entirely with your report on the Velleman scope, as this is excellent value for money. I purchased mine as a kit and am delighted with it, particularly the quality of construction and its performance, of course. However, and this is not a criticism as I was aware of the problem before purchase, there is one very simple function that this type of scope cannot perform, and that is an analogue external X deflection. The reason this would be useful is that my hobby is largely to do with Stirling engines (I am treasurer of the Stirling engine society) and to display indicator diagrams would be extremely useful. The method I use for this is very simple, e.g., a pressure transducer and amplifier form the Y input and a magnet on the end of the engine shaft plus a Hall effect IC can be made to produce an X deflection which is at least first order linear with crank position. The method is X position for 0°, X gain for 180° and a slight juggle with the sensor position to get 90° in the centre. From then on, with no more fiddling of the scope controls, the usual elliptical indicator diagram is formed, irrespective of engine speed. Using an old fashioned scope this is easy, but the old scopes are ungainly, long, awkward devices to have in a mechanical workshop, also of course, the same thing can be done with very much greater

complexity with a computer but who wants a computer in the workshop? I long ago explored the possibility of an ICD display and drivers but cost makes it out of the question, so how about that for a possible project, LEDs would also be costly for any worthwhile resolution. I know this can be done with the Velleman scope by using the timebase and a trigger signal but the picture would change with engine speed and need constant resetting to keep one complete cycle on the screen. As a secondary comment, Mr Garwell's article in the September issue is interesting but at first glance, slightly misleading as he shows as the current-to-voltage converter what is plainly a non-inverting voltage amplifier. Further thought, however, makes it quite acceptable and the reason for doing it that way perfectly understandable, as the normal current-to-voltage converter would need a 2,500MΩ feedback resistor (not on). Perhaps describing R2 as just for DC restoration when in fact it is really the measuring resistor could cause some misunderstanding. No criticism meant, just comment. As a side issue, how do dogs have prior knowledge of electrical storms – electrical or pressure changes?

We are not certain how dogs manage to detect the onset of electrical storms. However, it has been suggested that they have some form of built-in magnetic direction-finding system that allows them to be able to find their way 'home' from far away, so perhaps it is linked to this. Or perhaps their highly sensitive snouts (over a million times more sensitive than ours) can smell the change in the air that storms often bring about due to the influx of positive ions in the vicinity. Who 'nose'?! Your project suggestion has been noted, and thank you for your comments.

MAPLIN

ELECTRONICS

CATALOGUE PREVIEW

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- Free delivery for orders over £30 (inc. VAT)
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In general prices are valid until 28th February 1998.
* Subject to availability.

TELECOMMUNICATIONS

In this well-connected age, telecoms doesn't stop at the humble telephone. There are now all kinds of useful gadgets that you can connect to your telephone line, all of which are available through Maplin. It hasn't always been like that, though. Before 1984, British Telecom (originally the Post Office) had the monopoly on UK telecommunications, and the equipment that you could use on it. In those days, you would rent, rather than buy, the equipment – and the choice available to you was low.

1984 brought significant change, through the privatisation of BT, and deregulation of the telecommunications market. With it came competition, in the form of Mercury/Cable and Wireless and the cable companies. It also meant that you could connect equipment purchased or rented from a third party, as long as it was approved (look for the BAPT logo, which is present on all of the Maplin equipment covered in this article).

To connect such equipment, you must get BT to install a master socket, into which your apparatus plugs. If you don't already have such a socket, then you're probably still renting your telephone from BT. Many people still do this, particularly those who've lived in the same home for more than twenty years, and indeed, a high proportion of these subscribers have the old rotary-dial telephones. In the long-term, however, renting doesn't make economic sense.

At the time of writing, BT charges £3.24 per quarter (£4.47, but with a rebate of £1.23), or nearly £13 per year. In comparison, a basic pushbutton phone, such as Maplin's Dialatron 66/1 (BJ49D), can be bought outright for £7.99. In other words, the new phone isn't that much more expensive than half a year's rental – and remember, there's no more equipment rental to pay thereafter. BT will charge £29.38 to remove your old phone and install the required master socket. If you're disabled, then BT will do the job for free. The socket will allow you to connect other telecommunications products – such as modems, fax machines and answerphones – more of which later.

Despite its low price, that inexpensive Dialatron will do more than many of BT's rental old-timers. Such features include support for DTMF (Dual Tone, Multiple Frequency) tone-dialling (for accessing telephone banking and voicemail), a privacy mute facility, * and # keys for accessing value-added network services, and last-number redial to save fingerwork if a number you've dialled is engaged.

More expensive phones have extra goodies. Such features include a Mercury-access button (Mercury works out cheaper than BT for certain calls), one-touch memories for storing frequently-dialled numbers, display of the number being entered, and – in the case of the Betacom Executive Featurephone (YD38R) – a hands-free facility that allows you to converse without the need to grasp a handset. Pub landlords and hotelkeepers, meanwhile, will appreciate payphones like the Solitaire 6000 (YD09K). With these, it's possible to benefit customers – while generating useful additional revenue.

CORDLESS TELEPHONES

Cordless telephones are popular items, since you're no longer anchored by a couple of metres of cable, or indeed, tied down to a room with a phone socket. They're also great if you like pacing up and down the room while you're conducting a conversation. The systems, which consist of a portable handset and a base station, have sufficient range to cover all but the very largest premises. As with most pieces of domestic equipment, prices of cordless phones have fallen considerably in recent years. Maplin's most affordable model, the Betacom Discovery (YD22Y), offers all of the features of a decent corded telephone (such as tone dialling and last-number redial), plus a pager facility. This allows another person in the household to summon you – to the dinner table, perhaps?

Maplin's more upmarket cordless phones add other useful features, such as one-touch dialling, noise reduction, built-in answerphone and intercom (the latter is a development of the Discovery's pager). The Binatone Airlink 8 (BJ55K) has the ability to work on eight different frequency allocations. This is useful in built-up areas where many cordless phones could be in use. A related advantage of the Airlink 8 is a coding system that ensures that nearby cordless phone users cannot dial out on your line – whether accidentally or on purpose. Most cordless phone base stations take their power from the mains, but some will switch over to battery power in the event of a power cut. This is worth considering in rural areas served by an unreliable mains supply.

The current state-of-the-art in cordless phones is DECT (Digital Enhanced Cordless Telecommunications), a standard employed by the Hagenuk HomeHandy (MU63T). As the name suggests, digital transmission – and encryption – is employed by DECT handsets and base stations. The

Microcassette Cleaning Kit
ORDER CODE: 72260
£4.99



Betacom Exec Feature Phone
ORDER CODE: 72253
£34.99

Dialatron 66/1
ORDER CODE: 72252
£7.99



Solitaire 6000 Payphone
ORDER CODE: 72254
£189.99



Binatone Airlink 8
ORDER CODE: 72256
£59.99



DIY Telephone System
ORDER CODE: 72245
£159.99



Betacom Discovery
ORDER CODE: 72255
£54.99

This is just a small selection of products in this range. See the latest catalogue for more details. All prices include VAT.

system consequently offers much better sound quality than analogue cordless phones – there's no buzzing, hiss or breakthrough from nearby users – and there's a better range to boot. What's more, DECT is more secure than analogue cordless phones; there's no chance of a local scanner enthusiast intercepting and listening in to your calls.

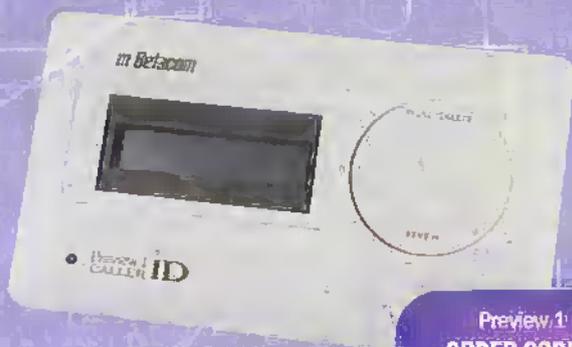
If the range of your existing cordless phone doesn't seem as wide as it did when you originally bought it, or you find that battery life (and hence, talk-time) has diminished, it's time to consider a replacement battery. Maplin sells a range of Ni-Cd battery packs for popular models. They're easy to fit – in many cases, you won't even need a soldering iron. If you've dropped your cordless handset and its telescopic aerial has broken, then you'll be pleased to know that Maplin stock a range of standard replacements. In many cases, fitting the new aerial won't even involve opening the handset.

FAXES, FAX MODEMS AND FAX SWITCHES

Despite the increasing use of E-mail, facsimile (fax) is still popular as a method of instantaneously sending documents around the country – or planet. Sales really began to take off with the postal strike of 1988, and more recent disputes have also demonstrated the value of fax. Although they are seen as a business tool, domestic fax has its value. You can send letters to friends or family abroad; even if such people don't have a fax, most towns and cities worldwide have bureaux that can handle the sending and receiving of such documents for a nominal fee. It's a lot quicker than international post, and is hence of particular value where time is of the essence!

A range of fax machines are available from Maplin, the prices of which start from just over £200. All are easy to use – in the vast majority of cases, it's simply a case of feeding in the document, punching in the number and pressing the 'send' key. All of Maplin's fax machines have memories for storing numbers, the ability to copy documents onto fax paper and an in-built telephone handset (which will only ring if the incoming call is not a fax transmission). Features found in the more expensive models include a non-volatile memory for storing documents when the paper supply runs out, a document feeder (for multiple pages), greyscale support (for better results from photographs) and an answerphone.

Maplin's base model, the BT DF50 (YD11M), prints onto thermal paper, while the Betacom range (PPF200/700/800,



Preview 1 Caller
ORDER CODE: 72249
£29.99

Betacom Swift
ORDER CODE: 72263
£39.99



Automatic Fax Switch
ORDER CODE: 72250
£59.99



DECT Cordless Telephone
ORDER CODE: 72257
£139.99



Microcassette
ORDER CODE: 72261
£5.99

BT DF50 Fax
ORDER CODE: 72258
£229.99



MU17T/VD23A/MU18U, respectively) incorporate an inkjet-type printer mechanism that will take regular A4 photocopier paper. The real advantage of a plain paper fax machine is that received documents don't discolour or fade with time. Betacom's top-of-the-range PPF800 is particularly interesting in that it can be interfaced to a PC – there's an RS232 port round the back. As a result, it can be used as a black-and-white scanner or a printer. Faxes can also be transferred into and out of the PC, a system in which the PPF800 is essentially used as a fax/modem.

Fully-blown fax/modems, such as the Motorola VoiceSURFR (KQ16S) provide the best of both worlds. Communicating by e-mail is possible if you've got an Internet dial-up account – the VoiceSURFR's support for the latest K56 modem speeds makes the most of Net access. You can also fax directly from a computer program (such as a word processor), eliminating that time-consuming intermediary printing stage. Received faxes can be viewed on screen, or printed. All fax/modems ship with user-friendly fax applications, most of which are designed to run under Windows. These programs, an example of which is Delrina's WinFax, include a virtual printer driver (to allow faxing directly from applications), a dialling directory and fax viewer.

The main problem with fax occurs

when you have only one phone line. If somebody tries calling and the fax machine is left plugged in, then they will be treated to a series of horrible bleeps as the machine tries to negotiate with its non-existent counterpart. Fax machines with built-in telephones (or fax-modems with voice support) are intelligent enough to recognise the nature of the incoming call, and route it accordingly. Stand-alone fax machines (particularly the older models) and many fax-modems don't do this.

If you don't want to run to the expense of a second line or a replacement fax machine, then there's an alternative. The Avro Pacific Fax Friend (YD61R, reviewed in the December 1997 issue of Electronics and Beyond) is an automatic fax switch – a box of tricks that accepts connections from fax machine/fax/modem, telephone and BT wall socket. Its sole purpose in life is to ensure that phone calls are routed to the telephone socket, and everything else to the other socket.

THE HOME OFFICE – AND A USEFUL TIP

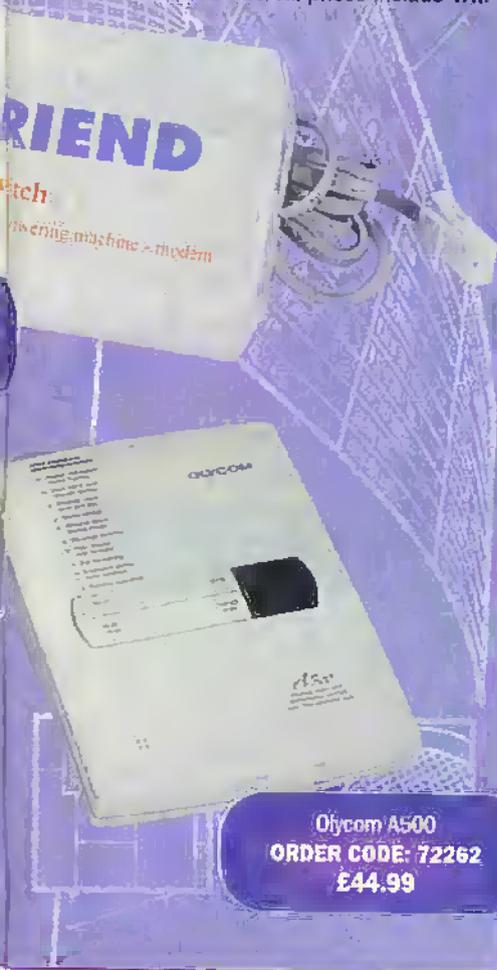
The Fax Friend is an essential piece of equipment in any situation when you can't predict when a fax will arrive. One such instance is the home office. An increasing number of people are opting to work from home, and that

includes sub-contractors and freelancers – the growth employment trend of the 1990s. Employees can save on travel costs, and – if small children are involved – nursery bills. Plus, there's the added advantage of reduced stress. Many employers are keen to encourage working from home – or 'telecommuting', as it is now fashionably known. They save on expensive office space, plus all of the associated hidden costs. In many cases, employees will offer computer and other equipment to potential telecommuters.

Two lines are undoubtedly better than one, however. One could be reserved for incoming calls, and the other for faxes, outgoing calls and Internet access. Not many people are, however, aware that the added advantages of a second line might end up being completely free! All around the country, cable networks are springing up. All offer to undercut BT's call costs – whenever BT cuts its prices, they claim to not only follow suit but go a little bit further. BT offers a scheme, known as Low User, in which line rental is greatly reduced in exchange for slightly dearer calls.

I pay around £10 per quarter – in other words, just over £3 per month – on the BT scheme, because I use cable exclusively for outgoing calls. Telecommuters tend to make a lot of calls, and the call savings yielded by cable will pay for you to keep your BT

This is just a small selection of products in this range. See the latest catalogue for more details. All prices include VAT.



Olycom A500
ORDER CODE: 72262
£44.99

line, moving it to the low-user tariff and restricting it to incoming calls only. My local provider, Telewest Communications, gives me a high user rebate – a 'carrot on a stick' for heavy Internet users! Other cable operators offer similar incentives. Some cable companies are currently waiving installation charges to improve takeup, particularly in recently-passed areas. Another advantage of this approach is that you get to keep your BT number!

ANSWERPHONES

Answerphones are desirable items for domestic use, but essential for teleworkers. You can leave a cryptic message if you don't want callers to know you're not in, or list other ways in which you can be contacted (mobile or pager numbers, for example). Answerphones are capable of doing more than simply taking messages in your absence. They help you screen calls, so that you don't have to speak to somebody you don't want to. Decent-quality answerphones are now inexpensive items, and in some cases, they're built into cordless phones and fax machines – helping to cut down on plates of spaghetti and clutter.

Maplin's budget answerphone, the Binatone Telecorder (BJ54J), records messages onto microcassette tapes. Impressively, you can access your messages remotely – and it will even let you know, through the number of rings given before answering, whether

you have messages or not. If you count more than a certain number of rings, then there are no messages for you and you won't have to waste your phone bill (or somebody else's) finding this out. If you allow it to answer, you have to enter a unique code number on the phone (which must be a DTMF type) to access your messages – this prevents your business from being broadcast to anybody who happens to call you.

Other answerphones store messages in non-volatile RAM, rather than tapes. The advantage of these is that callers don't have to wait to leave a message – with tape-based answerphones, there's a delay after the outgoing message while the mechanism spools the tape to the end of the last recorded message. If your answerphone does use tapes, incidentally, then it's important to clean the heads, pinch roller and capstan periodically. Answerphone manufacturers also recommend that tapes are replaced annually – with all that spooling, they're subjected to a lot of wear. Maplin sells both cleaning kits (KS73Q) and replacement tapes (BD66Q) for answering machines that use microcassettes. Regular maintenance is preferable to the possibility of lost messages. . . .

The Olycom A500 (MU74R) is a unique piece of equipment. After somebody has left a message, the A500 dials 1471 – now available on pretty much all exchanges – and records the response. As a result, you know the number of the person who left the message – handy if they forgot to mention it! – and the date/time on which it was recorded. Other answerphones, such as Betacom's Swift (YD41U) have a simpler system that leaves a time stamp after the message – they incorporate a clock and speech synthesiser to this end.

EXCHANGES, EXTENSIONS AND ACCESSORIES

Another piece of telecoms hardware of interest is a miniature exchange. The Maplin D-i-Y Telephone System (KC60Q) is ideal for use in home offices. It allows users with only one telephone to make, receive, hold and transfer calls in complete privacy from any of up to four different locations. Features include inter-extension intercom, the ability to monitor a baby (leave the relevant extension phone's handset off the hook), fax compatibility and a 'ring-me-back' facility that requests users to call you when they get off the phone.

The D-i-Y Telephone System is supplied in a kit with cable and telephone sockets. A more comprehensive small-scale exchange, the Omnicom FS2828 (YE15R) will work with up to two lines and eight extensions, making it a better choice for small businesses. Additional features provided by the FS2828 include interfaces for smoke alarms and electromechanical door locks, and

a speaking clock.

If you don't need the features provided by an exchange but would like additional phones around the house – in the bedroom or study, for example – then why not consider an inexpensive extension kit? These consist of a length of cable, a wall-mounting socket and an adaptor plug that allows the original phone to be simultaneously plugged into the master socket. If you just want to temporarily extend the cable on your existing phone so that you can take a call in the garage, for example, then trailing extension cables are perhaps a better bet. One extension cable (15 metres, YT15R) is supplied in a reel for easy storage.

Other accessories available from Maplin include sockets, cable, external ringers (with illumination for the hard of hearing), multiple-socket adaptors, telephone recording adaptors, telephone amplifiers and DTMF tone-dialling pads (for accessing telephone banking and mail-order ordering systems from older phones). If you want to know who's calling you before you answer, consider the Betacom Preview 1 Caller ID. With this, the number of the caller is shown on a LCD screen. To take advantage of the Caller ID service, a nominal subscription is normally required by your telecoms company.

ALL ABOUT REN

Unfortunately, you can't connect an unlimited number of devices to a phone line. Somewhere on the equipment, along with the BAPT symbol, you should find something like 'REN=1'. REN stands for Ringer Equivalence Number, and is a user-friendly way of describing the amount of current required from the line to activate the ringer. The higher the number, the more current is needed. A phone line can only supply so much ringing current – if the load is too great, then reliable ringing won't be guaranteed. If you add up all of the RENs, they shouldn't exceed 4. Telephones aren't much of a problem – the RENs tend to be 1, or even 0.5 in some cases.

Older fax machines are a little bit more troublesome; their REN of 3 means that there isn't much drive left for anything else other than a telephone. Fortunately, newer equipment is much better in this respect. Second-hand fax machines are offered at very tempting prices at boot sales and although they don't tend to offer the facilities or print quality of newer models, they may still appeal to those on a limited budget. In such cases, it is worth noting that an automatic fax switch, such as the aforementioned Fax Friend will also act as a REN buffer. A fax switch places a low load on the line – typically REN=1 – regardless of the combined total of the fax and telephone connected to it. The mini exchanges mentioned earlier also provide REN buffering.

@Internet

HoTMetal Pro 4

If you're into creating your own Web pages, look out for the latest version of a very good program. Over the years, HoTMetal Pro has matured from a fairly basic (and quite limited) HTML editor into a fully fledged Web page creator with full WYSIWYG (What You See Is What You Get) support. In truth, HoTMetal Pro has always been a capable HTML editor, at each stage of its life able to create HTML pages that fully utilised the power of the HTML standards that prevailed at those times. Previous incarnations, however, never quite did that in a truly WYSIWYG way. Indeed, elaborate pages in earlier versions would be cluttered with HoTMetal Pro tags, which often defeated the program's own objective of making HTML editing easy.

Version 4 of HoTMetal Pro brings the program right up to date, with the ability to switch between a full WYSIWYG display (without HoTMetal Pro tags), a tagged display, to a pure HTML coded display. The result is that the program can be used equally by modern Web page designers who work in a graphically-orientated way, and those die-hard eggheads who prefer to work with pure HTML code, stepping off at all points in between. It's not the easiest of applications to get to grips with, but it certainly is powerful.

Hot Stuff

56k-bps modems are starting to pop-up all over the place these days, despite there being no ITU ratified standard yet. Most modems it appears, are using the k56flex technology developed by Rockwell and, to match, most Internet service providers are at least providing trial connections with that technology. Many modems now available also have voice ability, in that voice messages can be taken (say, as an answerphone) and many provide messaging to multiple mailboxes, depending on the software running on the computer the modem is connected to.

To date, though, all conventional modems require that the computer they're connected to be turned on - after all, how can the computer receive a fax, or answer the voice call if it's not? Well, Olicom's brand-new, piping-hot Self Memory range of modems features internal memory that allows storage of incoming faxes and voice calls, even when the computer is turned off! Then, when the computer is turned back on, faxes can be downloaded or calls directed to voice mailboxes. In this stand-alone mode, the 2M-bytes of internal memory means the modem can receive and store up to 20 minutes of voice messages, or between 50 and 100 fax pages.

An internal loudspeaker and microphone allows your answer machine message to be stored, and the received voice messages to be listened to, as well as allowing full speakerphone capabilities. Voice calls can be listened to without the computer being on, and can be retrieved remotely. Calls and faxes aren't lost in the event of a power supply failure. As if this were not enough, all this is supported in a device measuring just 64x104x40mm.

While the Self Memory 33600 model supports the ITU-T V34+ standard for 33.6k-bps data transmission and is fixed at that, the Self Memory 56000 supports the Rockwell k56flex technology according to its internal flash memory, so can be flash upgradeable as and when the final standard is ratified. Available in all good retail and mail order outlets, these modems are not to be missed. Windows and MacOS versions are available.

Yell Launches 30,000 Businesses on the Web

Yell, the Yellow Pages web site at www.yell.co.uk

has launched the first 30,000 new web sites

for companies who have already taken up the offer of a free web site.

This is the first tranche of response to a mailing campaign, which is being issued to all 1.6 million businesses listed in Yellow Pages. The mailing offers a free one-page web site on Electronic Yellow Pages.

Businesses may contact (0800) 935569 to request a free web site. Information on further advertising options can be obtained through (0800) 777499 or by e-mail at gypsales@yellowpages.co.uk.



BT Cuts Costs for Schools Accessing the Internet

BT at www.bt.com has slashed the price of Internet access to allow schools across the country access to the Internet for £445 a year. The service, using ordinary telephone lines, will allow unlimited access for up to 10 hours every school day.

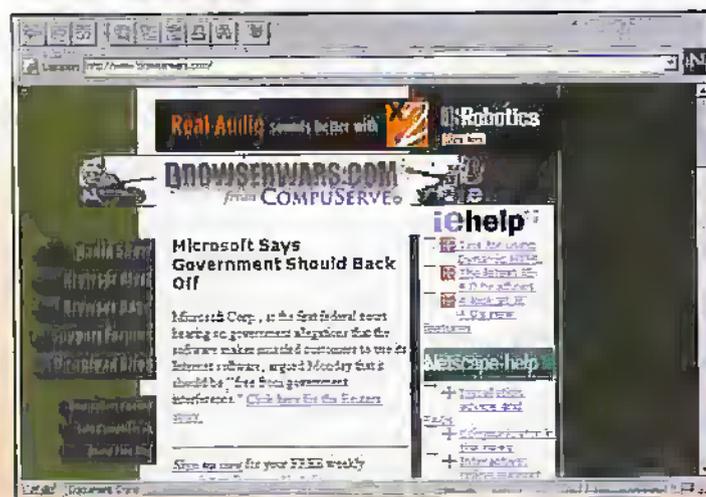
BT is also to offer low cost high-speed digital access to the Internet using ISDN lines

for £790 a year. This will also give unlimited access between 8am and 6pm on school days. There will be no separate connection charge.

Currently, only 6,000 schools in Britain are connected to the Internet. Prime Minister, Tony Blair, has a set target of getting all students connected via the Internet by 2002.



Browserwars.com Provides News from Front Line



In the beginning, it was mainframe versus desktop, then the PC versus Macintosh. Now, the online community is bracing itself for the next battle in the great technology war: Microsoft Internet Explorer 4.0 versus Netscape Navigator 4.0. It's the Battle of the Browsers and the winner will determine the standard for accessing the World Wide Web.

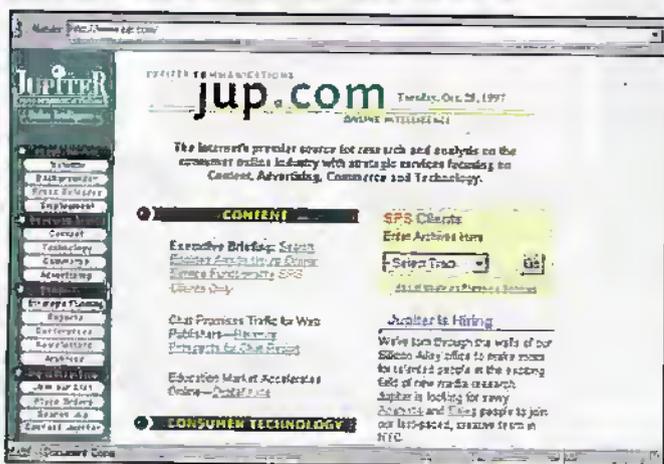
BrowserWars.com from CompuServe at www.browserwars.com is an independent web site dedicated to providing an unbiased source of information and expert

analysis for Internet users trying to understand which browser is best for them.

The site features message threading, a system of posting messages and replies, as well as in-depth editorial content from recognised industry experts such as Will Zachman, a US-based computer and communications analyst.

Speaking to *Electronics and Beyond*, Zachman said, "There are loyalists in both camps, and we are counting on them to put both browsers to task. No one will be tougher critics than actual users; they're the shock troops in this war".

Jupiter Predicts Service and Social Markets for Chat



A new report, 'Revenue Prospects For Online Chat' from Jupiter Communication at www.jup.com, the Internet analysts, recommends that businesses consider adding chat rooms to augment their Web site services with publisher-to-user communication, in addition to rooms where users talk amongst themselves. This type of communication will not only foster better client relationships, but also aid in marketing products, closing sales, competitive positioning, and building communities.

Speaking to *Electronics and Beyond*, Kate Doyle, an analyst at Jupiter Communications and author of the report said, "While there is significant interest in social chat environments, the

[Internet] chat market is growing in different directions. Social chat has a definite place as a value-add on niche-interest Web sites and large aggregators. However, this application is also becoming a great asset in terms of improving customer service and promoting cross-sell opportunities".

The report also notes that the chat market is still evolving with instant messaging applications playing a large role in the common perception and usage of chat. Almost one-quarter of the online audience use these applications today; Jupiter predicts that this usage will grow dramatically in the next few years, surpassing that of chat rooms on Web sites.

Sun Sues Microsoft for Java Changes

Sun at www.sun.com, which has licensed its Java language to Microsoft at www.microsoft.com and other computer companies, is suing Microsoft on the grounds that Microsoft's new Explorer 4.0 software has misappropriated Java by deviating from the formal standard.

The suit charges Microsoft with unfair competition and interference and requests financial damages as well as an injunction against further shipment of Explorer 4.0 until Microsoft adds two components of Java which it did not include in that software.



AltaVista Unveils Largest and Freshest Web Index

AltaVista, at www.altavista.com, has unveiled a larger index, an accelerated program for index refreshing, and a series of aggressive anti-spamming measures.

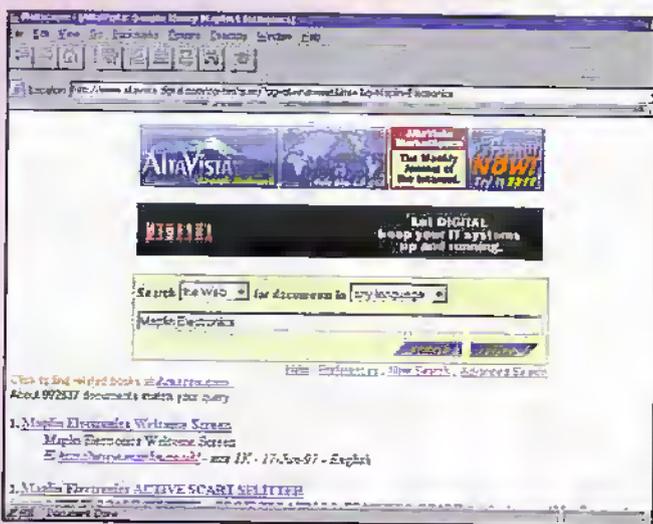
Now containing 100 million pages, the new index is three times the size of the previous AltaVista Search index, and contains virtually no duplicate pages. Monthly crawls of the entire Web and continuous purging of dead links, duplicates and index spam are aimed at maintaining AltaVista's leadership in Web search services.

Currently, the AltaVista Search service delivers 20 million searches per day, with more than 400 million page views. The service has 18 million unique users per month, which makes it one of

the most popular sites on the World Wide Web.

With new software enhancements and continuous crawling, the AltaVista Search service now indexes up to 10 million pages per day. This provides Web users access to the freshest, most accurate results and greatly reduces the possibility of dead links and irrelevant matches.

Each day, the AltaVista Search service visits URLs submitted by users, evaluates them against anti-spam guidelines, and adds the pages overnight to the index. In addition, AltaVista continuously crawls and indexes the 2,000 most active sites on the Web as well as selected public service and government sites to provide even fresher search results for the most popular sites.



TV First Choice for Non-PC Online Services

A new report from Ovum, the industry IT analyst, released this month maps the development of network computing in the home. According to Ovum's latest report, 'Network Computing: Opportunities for the Consumer Market', penetration of networking computers in the home will be closely tied to the development of the TV and the launch of digital services, enabling access to network-based information to expand dramatically.

Speaking to *Electronics and Beyond*, John Davison, Ovum

senior consultant and co-author of the report said, "Most people today use a personal computer as the access device for receiving online information, however, PCs are relatively expensive and complex. The complication of setting up and managing the system and ensuring the software is up to date is a daunting challenge to the consumer. The user interface needs to be more familiar to people. We therefore believe that the TV will be the first choice as a vehicle for a non-PC data access service".

For further details, check: www.ovum.com.

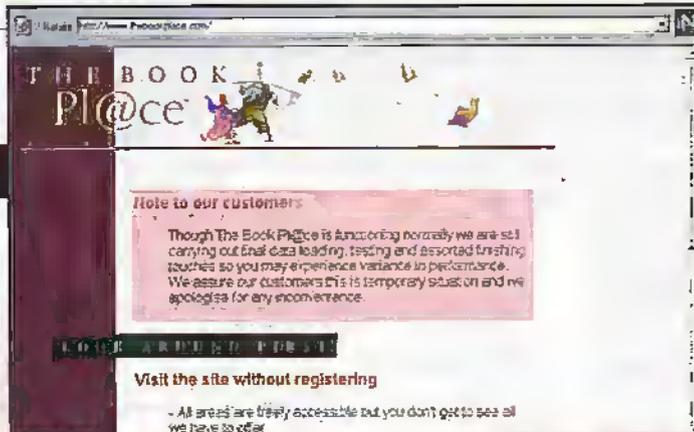
Contact: Ovum, Tel: (0171) 312 7238.

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UK's First Internet Bookshop Goes Live

The frustration of finding a book when you don't know the author, the title, or even both, is at an end, thanks to The Book Pl@ce at www.thebookplace.com, the UK's most comprehensive Internet bookshop. The Book Pl@ce

incorporates an intelligent search capability, allowing consumers to search over a million titles using an author, title or keyword from the book. For example, by entering the keywords 'Mr Darcy', Book Pl@ce will retrieve Jane Austen's 'Pride and Prejudice',



whilst entering 'Gandalf' or 'Bilbo Baggins' will bring back the Tolkien classics.

Virtual bookshops are not a new phenomenon on the Web. US-based Amazon.com, at www.amazon.com, launched earlier this year, claims to offer a catalogue of more than 2.5 million titles but as yet, fulfilment is currently limited mail order distribution in the US.

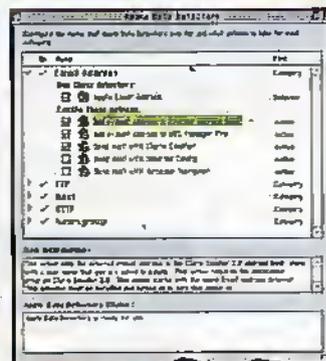
A massive database of over 1.2 million book titles lies at the heart of The Book Pl@ce.

Reviews and synopsis from the publishing industry Book Data trade database have been made available to consumers via the new site.

In addition to searching for titles and reviews, visitors to The Book Pl@ce can choose a supplier, place an order, and monitor the status of the order. The Book Pl@ce's supply partners; Dillons, Hammonds, Peters Booksellers and The PC Bookshop, fulfil orders placed via the Web site by mail.

OS 8

Users of Apple's brand new Macintosh operating system MacOS 8 already have a wonderful and unmatched set of Internet tools on their computers. However, as ever hitting the ground running, Apple has just released a new utility as an add-on to MacOS 8 called Internet address detectors (IADs). The utility combines a rather neat facility, automatically searching through any block of selected text to detect any occurrence of URLs, with the in-built



standard MacOS 8 contextual menu feature. Thus, with a click of a mouse, you can scan through text to list any URLs in a contextual menu, then forward them in various selected ways to linked programs. In this way, you can bookmark selected URLs in Netscape Navigator or Microsoft Internet Explorer, or generate a new e-mail to a selected e-mail address, or even send the e-mail address to your e-mail program's address book. Internet address detectors are so powerful, yet so simple to use that there's only

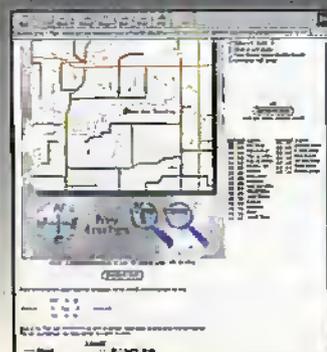
one word for them - cool!

Once the utility is installed, the Apple Data Detectors Control Panel allows you to specify URLs of all types linked to various selectable applications. Other program makers have already realised the power of Internet address detectors, and have already started releasing new versions of (or plug-ins to) programs to take advantage of this immensely powerful facility. Download Internet address detectors free from <http://www.macos.apple.com/macos8/iad/>.

Site Survey

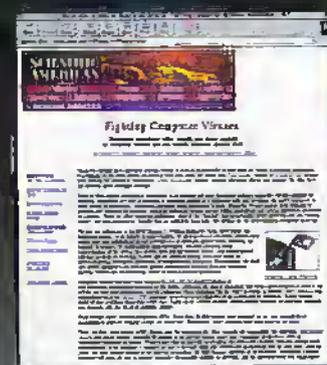
The month's destinations

If you need to locate places in the USA, check out...

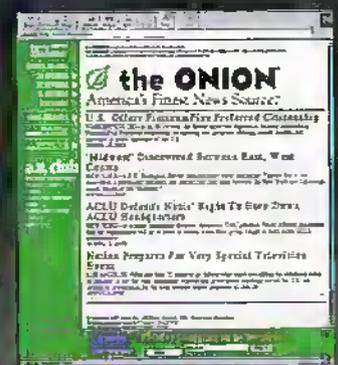


<http://www.census.gov/cg1-bin/gazetteer>. This is the US Government census department's gazetteer; you can find much information, as well as being able to display maps based on several selectable variables. It's a worthy site for anyone needing to research US towns and cities for whatever reason.

If you are one of the unfortunates who need to know (with first-hand experience, say) about computer viruses, a good starting point for information



is a Scientific American feature in the November issue of the magazine. Located online at <http://www.sciam.com/11971ssue/1197kephart.html>, this report takes an in-depth look at computer viruses, what they are, who creates them, how they work, and more significantly, the damage they can do. Notably, the fact that computer viruses are multiplying so rapidly (the first documented virus was in 1987, while there are now



some 10,000 PC viruses, and new ones are occurring at a rate of about 6 a day!) brings much cause for concern. There are many good links here.

Finally, for a jolly good belly laugh, point your Web browser to <http://www.theonion.com/>, to see The Onion. This is, for want of a better term, a news site that looks at happenings from a very different angle to conventional news sites.

ELECTRONICS

and Beyond

in the pipeline

Don't miss another great assortment of entertaining and easy-to-make projects and essential electronics information aimed at the novice constructor.

Issue 122 on sale Friday 2nd January

MIDI Thru-box
Updated version of a popular electronic music project.

Making Your Own CDs
Part 2 of Martin Pipe's project showing you how to compile your very own CDs.

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Fan Failure Alert

Avoid costly overheating damage on your computer by installing this protective project.

PLUS

Renowned Jack-of-all-trades, Stephen Waddington, turns ironmonger to give us a Nuts and Bolts Review.

Part 5 of Security Electronics Systems and Circuits by Ray Marston covers infra-red light beam and PIR movement detector circuitry.

The twelfth and final part of Greg Grant's What's in a Name? series looks at the achievements of one of the most gifted electronics engineers of this century. — Alan Dwyer Blumlein

Part 2 of Mark Brighton's guide to getting hooked up to the Internet.

More handy Software Hints and Tips from Ruth Hewer.

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 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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- 2 Write your order on the form printed in this issue and send it to Maplin Electronics PLC, P.O. Box 777, Rayleigh, Essex, S56 8UJ. Payment can be made using Cheque, Postal Order, or Credit Card;
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- 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 DCTM 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) 554092 and we will happily issue you with one. Payment can be made by credit card;
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- 1 Over the phone, telephone (01702) 556001 between 9.00am and 6.30pm Monday to Friday, except public holidays;
- 2 By sending a facsimile, Fax (01702) 554001;
- 3 Or by writing to Technical Sales, Maplin Electronics PLC, P.O. Box 777, Rayleigh, Essex, S56 8UJ. 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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| | | | | | |
|--------------------------------|-----|------------------------------|-----|--------------------------------|-----|
| AJ&D | p55 | JAB Electronics | p37 | Number One Systems | p7 |
| Braintboxes | p29 | Kevin Jarvis Electronics Ltd | p59 | Right First Time | p53 |
| Conford | p7 | Manchester University | p55 | Technical Information Services | p53 |
| Crownhill Associates Ltd | p18 | Mauntron Technical Services | p55 | Technology Education Index | p37 |
| EPT Educational Software | p12 | Millford Instruments | p53 | Three Crowns Publishing | p25 |
| Forest Electronic Developments | p25 | Minicraft | p19 | Veronica FM Kits | p59 |
| | | NCT Enterprises | p7 | | |

Unfortunately for me, I started with MS Dos, since Windows™ wasn't even a twinkle in Mr. Gates' eye! To be able to print a letter (assuming you had worked out how to begin typing it in the first place!), you needed to know a complex series of keystrokes involving lots of the 'F' keys and crossing of the fingers. Now, it's just a matter of 'point and click'.

I have to say that with the dawn of Windows, I took to computing like a duck to water. I found it all so easy and I totally lost my fear. With this new confidence, I decided to tackle the computer I had at home, moving files, deleting files, losing files. . . . It was early one morning when I turned on my PC and it just flickered dimly at me and proceeded to ignore every command I gave it (I swear if a computer could laugh, that one did!) I decided that I should perhaps invest in some lessons.

The lessons encouraged me to learn more and I eventually became a trainer myself. I have spent many a happy moment trying to convince a technophobic MD that 'double-clicking' the mouse should be done slightly quicker than click click. Or training otherwise intelligent people who collapsed into fits of hysteria if asked to touch a button they were not familiar with!

So, now I have been asked to perform in the role of 'disk doctor'. I am here to assist you with your software problems. Each issue I shall be entertaining you with tips and tricks to make your computer life far more enjoyable. I shall also endeavour to answer any questions you may have. All questions can be sent by the power of e-mail, but for those of you, who have not yet explored the realms of the World Wide Web, good old Royal Mail, or 'Snail Mail' as it is known, is just as good. The appropriate addresses will be given at the end of this article. Just a tip though, this will not be a 'help-desk' service and we cannot guarantee an answer for every question put to us; we shall select the more common problems or unusual ones and answer them in the articles.

The software programs which I shall be covering will be Windows 95 and 3.11, Microsoft Office, including; Word, Excel, PowerPoint, Access, Outlook and how to use the facilities of Office to

Software HINTS & TIPS

by Ruth Hewer

Hello there. My name is Ruth Hewer and I shall be here every issue to assist you with any PC software problems. Like many people, when I first encountered a computer, it could have been described as 'fear at first sight'. I was petrified to touch anything as everyone kept telling me that you could 'wipe the hard disk' with one foul keystroke!

copy, paste and merge between applications.

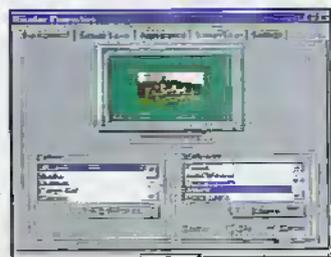
Now! Onto some hints and tips. Let's start with some Windows 95 do's and don'ts.

A lot of people have the latest in screen saver technology and I have seen many computers with dogs walking around the screen and cows flying through the air. This is all very interesting, but on some computers, I see no screen savers at all. It is very important that you use a screen saver, otherwise your screen will become damaged after a while. To activate a screen saver, use the following steps:

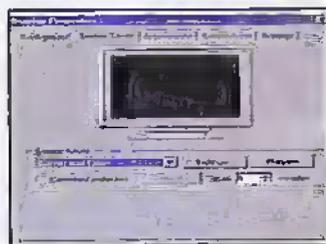
- ◆ Click on the Start button 
- ◆ Click on Settings and select Control Panel; the following will appear:



- ◆ Select Display, the following dialog box will appear: 



- ◆ Select Screen Saver, the following dialog box will appear:



- ◆ Click on the drop down arrow to select the screen saver you require. If you click in the box marked 'password protected'; this will enable you to set a password so that no one can do anything on your computer once the screensaver is activated, without the password. You can change the settings. If you have an option called 'scrolling marquee' or 'marquee', you can set up a screen saver, which will provide a message.

A lot of people ask me how to copy images on the screen; this is a very easy and effective way of copying what you have on the screen and using it in a document.

- ◆ Once you have the image on the screen that you want to copy, press the Alt + Print-Screen button on the keyboard. This pastes the image onto a clipboard and holds it there until you want to use it.

- ◆ Select Start, Programs, Accessories and Paint. This will open up the paintbox for you. Select Edit and Paste and the image will appear on the page. If you want to cut the object up or just copy one specific bit, use the select option on the toolbar: 

- ◆ Once you have selected the button, click and drag round the item you want to cut. A dotted line will appear around the object. Select Edit and Copy. The object you have selected is now ready to be pasted into Word, Excel, PowerPoint, etc. Just go into the appropriate package and select Edit and Paste, and the object will appear.

Finally in this issue, I will show you how to get your computer to automatically open the programs you use the most when you turn the computer on. You need to select the programs you want to open and put them into the startup folder.

- ◆ Click on Start, select Windows Explorer.
- ◆ Click on the program you want to open automatically, to highlight it.
- ◆ Select Copy.
- ◆ Open the folder Windows.
- ◆ Open the folder Start Menu.
- ◆ Double click on the Programs icon.
- ◆ Double click on the Startup icon.

A folder will open and you will be able to see all the programs which automatically open each time you start up the computer.

- ◆ Click on Paste.

The new program will now appear in the folder. From now on, every time you start up your computer, that program will open automatically.

If you have any queries, please feel free to contact us either directly via Maplin Electronics PLC., PO. Box 777, Rayleigh, Essex SS2 8LU or via the Internet at ruth@maplin.demon.co.uk and I look forward to hearing from you.

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