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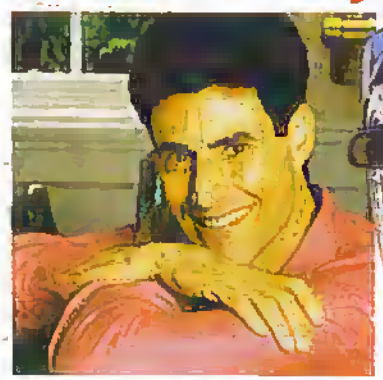

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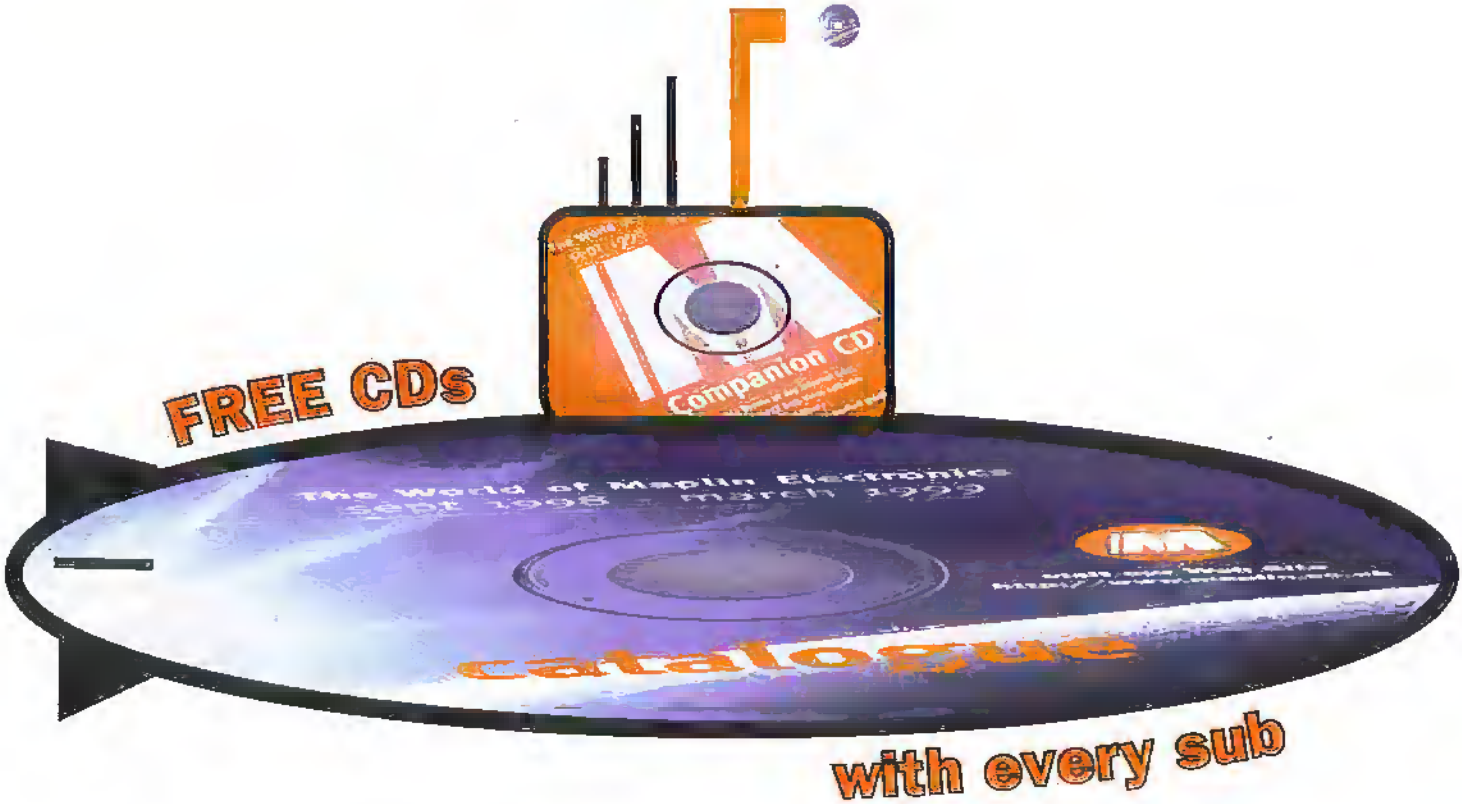

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THE MAPLIN MAGAZINE

ELECTRONICS and Beyond

December 1998 Vol. 18 No. 132

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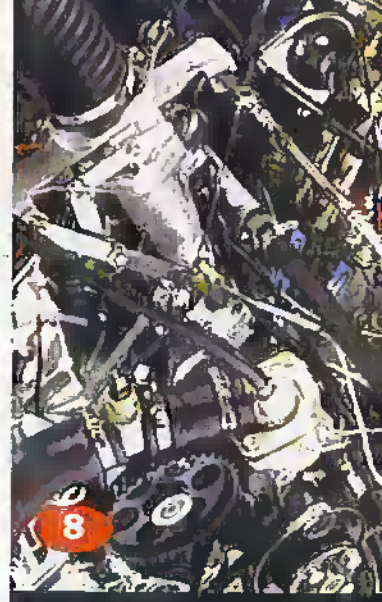
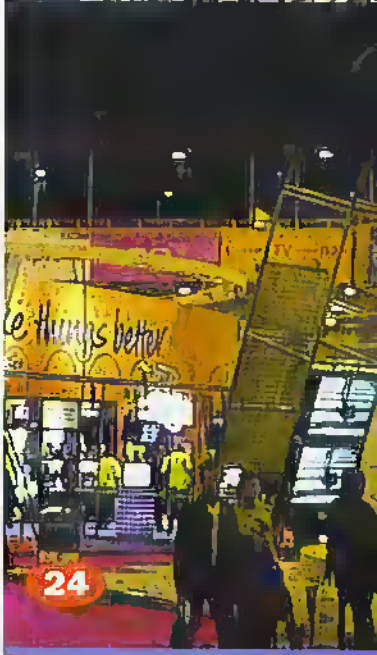
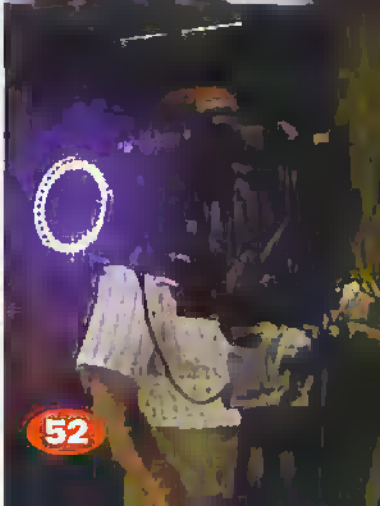
Features

Regulars







Editorial
Editor Paul Freeman-Sear BSc (Hons)
Technical Author John Mosely
Editorial Assistant Lynda Hardy
News Editor Stephen Waddington BEng (Hons)
Technical Illustration Set Square Designs

Production
Design Layout Artist Karen Harris
Photography Librarian Mavis Williams
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Management
Manager
Paul Freeman-Sear BSc (Hons)
Marketing Services Manager
Steve Drake

Subscriptions
Maureen Harvey
Tel: (01702) 554155 Ext. 311.

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

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ELECTRONICS and Beyond

This month we have great pleasure in including the first of a series of articles from Uri Geller. Uri is well known for his psychic activities, but the intention in this column is to stimulate further research into the 'less understood' areas of science - or where science cannot provide suitable theories. No doubt it will provide a suitable forum for discussion.

Maplin is now the sole U.K. distributor of Velleman Kits, and we have included their 32 page Catalogue with this issue. Each month we will be featuring a Velleman Kit, starting with issue 133. In this first article we will describe the construction of the LED Message Display from the 'Light Effects' section. Next month will also include a free PCB to construct an LED Christmas Tree, based on the Velleman Kit.

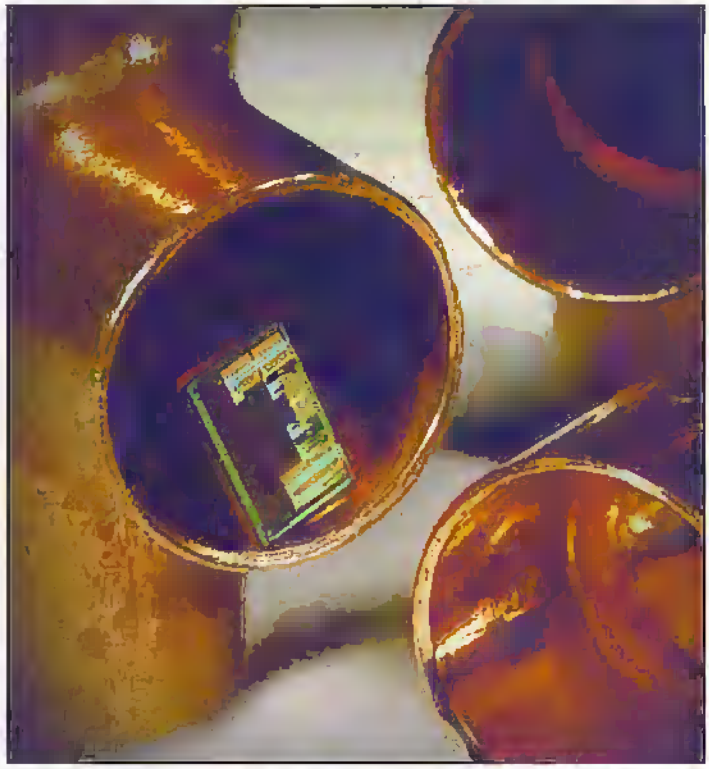
The automobile industry is now coming to terms with accepting electronics as an important part of modern cars. This month Mike Bedford begins a new series on this marriage between electronics and mechanics, and starts with a look at how electronics can performance-enhanced cars. Also this month, Reg Miles looks at the latest special effects techniques used by the BBC in his article Virtual Studios.

We also have a Christmas Promotions catalogue included with this issue. You will find may products at special prices that should make excellent gifts. Do take a look for you are sure to find a bargain!

Finally, why not take a look on page 23 to see if you are a winner for three of our recent competitions.

Britain's Best Magazine for the Electronics Enthusiast

NEWS REPORT



IBM Ships Copper Chips

IBM this month announced the world's first copper-based microprocessors, including a PowerPC 740/750 operating at 400MHz. The company also announced several other initiatives associated with copper, including availability of the fastest embedded processor on the market, a 400MHz embedded PowerPC chip.

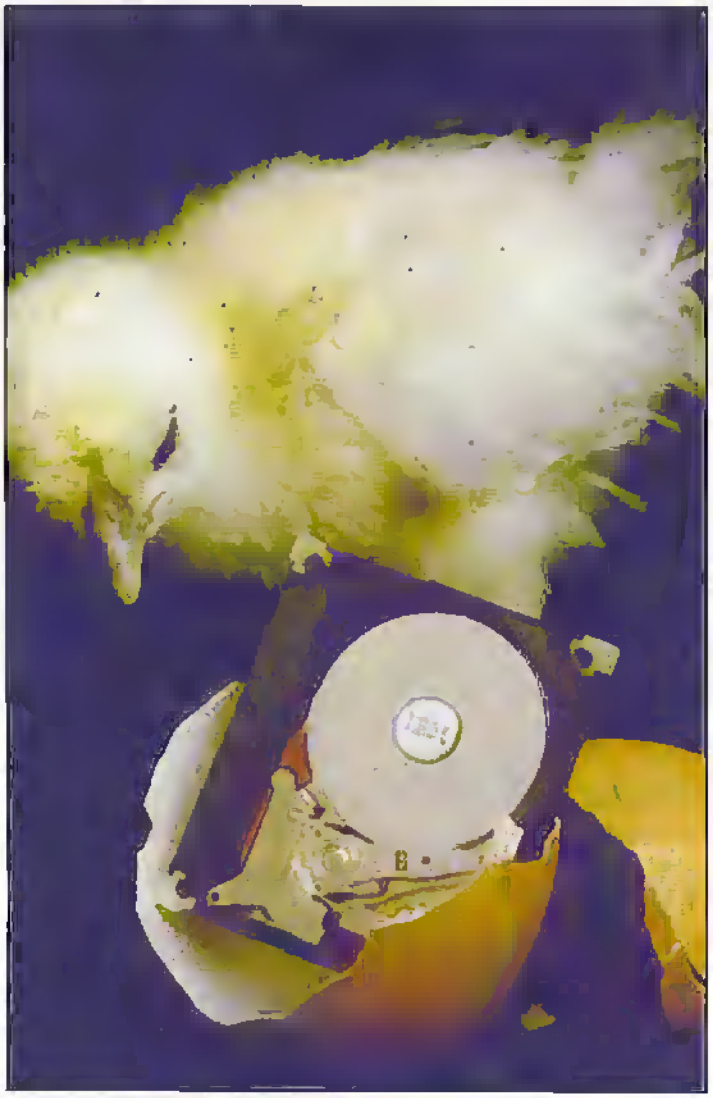
For further information, check: <www.chips.ibm.com>.
Contact: IBM, Tel: (0990) 426426.

Psion Dacom Extends Leadership

Psion Dacom has increased its lead as Europe's foremost manufacturer of PC Card modem products. According to new figures from Dataquest, Psion Dacom extended its market leading position for PC Card modems shipments in Europe to 16% during 1997.

The latest figures represent the third year in succession that Psion Dacom has held the number one position in the European market. The Dataquest survey, entitled Analogue Modems – Europe 1997, gives details of PC Card sales throughout Europe for January to December 1997.

For further details, check: Web site: <www.psiondacom.com>.
Contact: Psion Dacom, Tel: (01908) 261686.



IBM Introduces World's Smallest Hard Disk Drive

IBM has unveiled the world's smallest and lightest hard disk drive with a disk platter about the size of a large coin. Although IBM's new microdrive weighs less than an AA battery, it can hold over 200 times more data or images than a floppy disk. With its small size and high performance, the microdrive is ideally suited for use in increasingly pervasive portable electronic devices, including still and video digital cameras as well as handheld or 'companion' PCs.

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

Contact: IBM,
Tel: (0990) 426426.

Cell Phone Sabotage Causes Airwave Havoc

A network jamming device, capable of blocking mobile phone calls is set to cause chaos for business and private communications, warns networking specialist, Star.

Wave Wall, the size of a cigarette packet, blocks airwaves within a 20 foot radius. It renders mobile phones mute, as if they had been turned off or been taken beyond the range of the service area.

The device was designed for use in restaurants and cinemas to prevent intrusive phone calls. In the wrong hands, it has the potential to block communication links with devastating results.

Speaking to *Electronics and Beyond*, Jos White, marketing director at Star said, "We all know how irritating mobile phones can be "But people don't realise how reliant society is on all methods of communication until their use is threatened. Network jamming presents very real dangers, not just terms of cost to businesses and inconvenience to private users."

"Malicious jammers run the risk of blocking emergency calls to doctors and paramedics. Whilst possible interference with other electronic devices such as pacemakers is also unclear, this is technology which should be kept firmly at arms' length," added White.

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

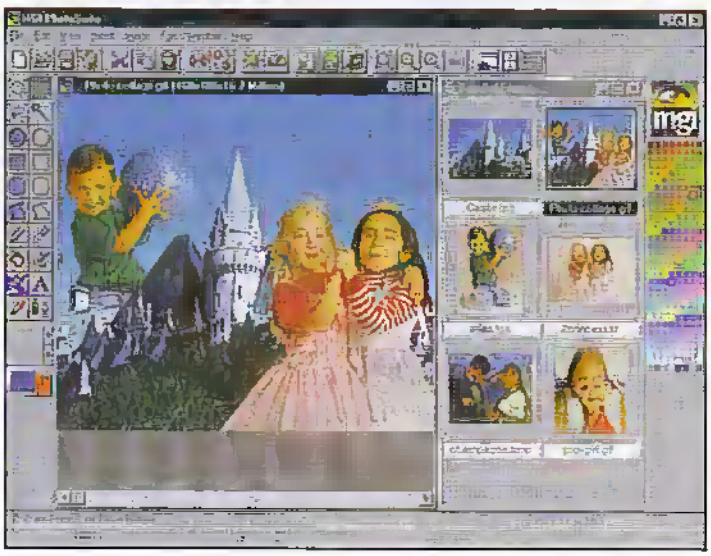
Contact: Star,
Tel: (01285) 647000.

PC Photo Experience Launched

MGI PhotoSuite II is the first product of its kind to integrate Internet browser technology. Priced £49.99, the application provides a complete suite of PC Photography tools for both beginners and advanced users, and includes sophisticated photo correction, manipulation, cataloguing and slide show presentation features in one integrated package.

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

Contact: MGI,
Tel: (0171) 365 0034.



NEWS BYTES

Worldcom Completes MCI Merger

WorldCom has completed its merger with MCI, officially forming MCI WorldCom. The merger creates a new era communications company providing customers around the world with a full set of data, Internet, local and international communications services over its own seamless 'local-to-global-to-local' network.

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

Contact: Worldcom,
Tel: +1 202 887 2241.

The Word Is... Flexibility

Vodafone has extended the scope of its 'Pay as you Talk' service with the announcement of a new lower tariff, a wider range of Top-Up cards, and the launch of four new digital mobile phones.

Pay as you Talk customers are now being offered a reduced tariff rate of 50p per minute peak rate and just 5p per minute off-peak – a reduction of 10p per minute for national peak-rate calls.

Alternatively, customers can choose to pay a flat rate of 40p per minute at all times, making Pay as you Talk one of the most flexible and cost-effective pre-pay packages around.

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

Contact: Vodafone,
Tel: (01635) 33251.

IBM Prescribes Solution for UK Doctors

The Prescription Pricing Authority (PPA) has chosen IBM's DB2 Universal Database to underpin a Web-based application for UK GPs that will lead to better patient care through rationalisation of prescription costs. 1.2 billion prescription records are stored on the database, making it the largest healthcare information repository in Europe. Two hundred General Practitioners in England will have access to the database as part of a year-long pilot programme implemented by the PPA in January 1998. The database will eventually be rolled out to all 27,000 GPs in the UK.

For further information, check: <www.software.ibm.com>.

Contact: IBM, Tel: (0990) 426426.

Intel Launches Pentium II 300MHz Mobile Processor

Building on the broad and rapid market adoption of Pentium II processor-based mobile PCs, Intel has introduced its highest performance mobile Pentium II processor. The new mobile Pentium II processor 300MHz offers mobile PC users a performance boost while preserving system battery life.

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

Contact: Intel, Tel: (01793) 403000.

NEWS BYTES

Budget Bytes – Nearly New Computer Showroom Now Open

Technical Asset Management (TAM), the UK's biggest computer IT remarketing and recycling company, has opened a computer showroom at its head quarters in Welwyn Garden City. For the first time ever, TAM is making available direct to the public quality refurbished computers, printers, laptops and new budget software – at bargain prices – that's around 70% cheaper than buying brand new kit.

Contact: Technical Asset Management, (01707) 885 303.

HP Licenses ARM Core

Hewlett-Packard has licensed the ARM7TDMI and the ARM740T microprocessor cores from ARM, for the design and manufacturing of ARM core-based, super-integrated application specific integrated circuits (ASICs).

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

Contact: ARM, Tel: (01223) 400400.

LSI Logic Exceeds DTT Expectations

LSI Logic's L64780 single-chip Coded Othogonal Frequency Division Multiplex (COFDM) demodulator has gained a further endorsement from the emerging digital television market following the publication of a BBC paper, 'The Results of Tests with Domestic Receiver ICs for DVB-T.

In the BBC tests, the L64780 chip exceeded expected performance for a Digital Video Broadcast – Terrestrial (DVB-T) demodulator in a number of important areas, including co-channel PAL interference, multipath performance, single echo with Doppler, and Additive White Gaussian Noise (AWGN).

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

Contact: LSI Logic, Tel: +32 11 300 351.

Cable & Wireless Strikes Network Support Deal With IBM

Cable & Wireless Communications has announced a strategic IT partnership with IBM, the largest of its kind between a major communications company and a leading IT services provider. Under the 10-year, £1.8 billion (US$3 billion) agreement, IBM will provide the support required by Cable & Wireless Communications to significantly improve business efficiency and service to customers.

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

Contact: Cable & Wireless, Tel: (0500) 100 001.

US Scientists Break Performance Milestone

Silicon Graphics' (SGI) supercomputer programs that model weather in space, plate tectonics and low-gravity fluid dynamics were among those that recently broke a 100-billion-calculations-per-second (gigaflops) performance milestone. The record was achieved as part of a routine investigation for the HPCC Earth and Space Sciences Project at NASA Goddard Space Flight Centre in Maryland, US. The record breaking programs – one of which exceeded the milestone by more than a factor of two – were run on an SGI 1,024-processor CRAY T3E-1200ETM configuration.

For further details, check: <sdcd.gsfc.nasa.gov/ESS/> or <sdcd.gsfc.nasa.gov/ESS/grand.st2.html>.

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

Internet Multimedia Player is Diamond

Diamond Multimedia Systems has launched a portable music player that stores and plays back up to 60 minutes of digital quality music. Based on the most popular Internet music format, MP3 compression, and flash memory technology, Diamond's Rio PMP300 portable music player is like a Walkman or MiniDisk player, only much lighter and smaller. Rio also has no moving parts, which means no skipping, even when subjected to heavy vibration and movement such as during extreme sports activities.

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

Contact: Computer 2000 (Diamond Multimedia UK distributor), Tel: (01256) 841841.

Forbes' Publishes High Tech's 100 Wealthiest List

US business publication Forbes ASAP reckons that the combined wealth of the members of its 1998 'High Tech's 100 Wealthiest' list totals more than $150 billion – most of it created in just the last six years.

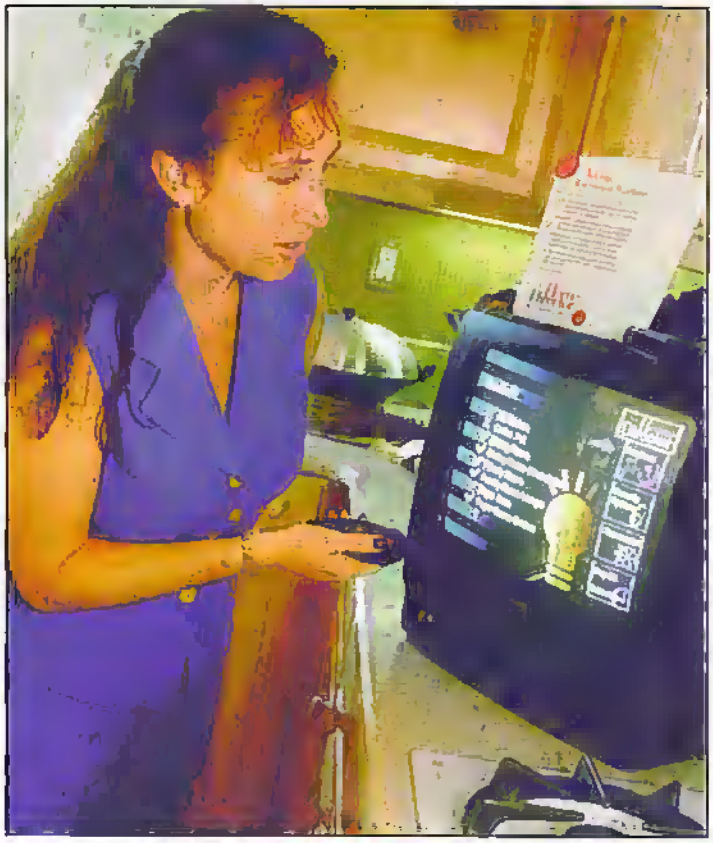
Leading the list is, of course, Microsoft's Bill Gates, with an estimated worth of $58.73 billion. What is remarkable is that there are 15 billionaires on the list. It includes not only Gates' past and present colleagues at Microsoft (Paul Allen at $16.98 billion and Steve Ballmer at $12.99 billion) and such industry legends as Intel's Gordon Moore ($7.62 billion) and Bill Hewlett ($3.41 billion), but also such newly minted Internet tycoons as Jeff Bezos of Amazon.com ($2.14 billion) and Dave Filo of Yahoo! ($1.01 billion). Filo's partner, 29-year-old Jerry Yang, just misses the billionaire list at $993.2 million.

"No question this was the year of the Internet babies. The seemingly endless list of 'dot.com' companies that successfully went public in the last 24 months – most notably Yahoo!, Amazon.com, RealNetworks, Broadcast.com, OnSale, Inktomi, CNET, and @Home – have not only pushed the wealth list upwards, but also given it a very youthful appearance. There are 44 tycoons on the list under 45, four under 30," said Nancy Rutter, who edited the list.

The youngest is 25-year-old Chris Klaus (number 51), founder of Atlanta's Internet Security Systems, whose total worth equals $187.5 million. A whiz kid with supercomputers in high school, Klaus later dropped out of Georgia Tech to write software code.

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

Contact: Forbes, + 1 650 802 6882.



Ericsson Launches World Phone for Global Travellers

Ericsson has announced a GSM world phone that gives international travellers the ability to use a single phone almost anywhere they travel. With an exclusive built-in infrared modem, Ericsson's I 888 World Phone also gives travellers a powerful tool to check e-mail, send and receive faxes, browse the Internet or log on to their corporate network without carrying cables or searching for a compatible phone jack.

The I 888 World Phone works on 1900MHz GSM in the US and 900MHz GSM in Europe and most of the world. Whether in New York, Paris, Cape Town, Singapore or more than 120 countries, the I 888 World Phone enables travellers to carry convenient communications in a pocket or briefcase.

It weighs only 6.3 ounces and is 5.2 inches long, 1.9 inches wide and less than an inch thick.

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

Contact: Ericsson, Tel: (01444) 234354.

IBM Delivers Home Networking System

IBM has announced the availability of its IBM Home Director home networking solution -- the first effort of its kind by a major technology company to deliver a complete home network controlled from a PC or television screen.

Home Director integrates the functions of household systems including security, lighting, heating and air conditioning, network-enabled PCs and PC peripherals such as printers, modems and storage. This functionality enables a multitude of activities; from turning off a light left on by the children at the other end of the house to using the arming of the security system to activate a routine that will turn off lights and adjust the thermostat.

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

Contact: IBM, Tel: (0990) 426426.

Heroic or Ashamed?

A recent survey of over 600 computer users revealed that women are twice as likely to consult a colleague, technical expert or computer manufacturer in a crisis. Men, on the other hand, prefer to muddle through and try to fix the problem themselves.

The survey showed that 71% of women would call an expert in a data loss situation, compared with 45% of men. The most likely port of call for women would be the IT professional in their office (38%), whereas only half as many men would make this call as a first move.

Of the regular computer users surveyed, 49% had lost important files or documents at some stage. If faced with a crisis, 22% of men said they would open the computer and check the hard drive themselves, compared with only 7.6% of women. 27% of men would also prefer to recreate the lost document if unable recover it themselves.

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

Contact: Ontrack, Tel: (01372) 741999.

Digital Radio Arrives in the Home

Digital radio has arrived and it hasn't come from Tokyo, Japan or the Silicon Valley in the US. Cambridge based Arcam has launched the worlkd's first domestic Digital Radio Tuner (DRT) called the Arcam Alpha 10.

The Arcam Alpha 10 is the result of a collaboration with Roke Manor Research. Digital radio is expected to deliver crystal clear interference free sound. A scrolling text display on the radio shows information such as the programme title, presenter's name and the title and composer of musical items.

Over 60% of the UK population can already receive digital BBC Radio transmissions and rapid expansion is planned. The Arcam Alpha 10 is available via the company's 150 UK dealers priced £799.50.

For further details, check: <ww.arcam.co.uk>.

Contact Arcam, Tel 01223 203200.

Anyone Can Use a PC with the Help of Zain Media

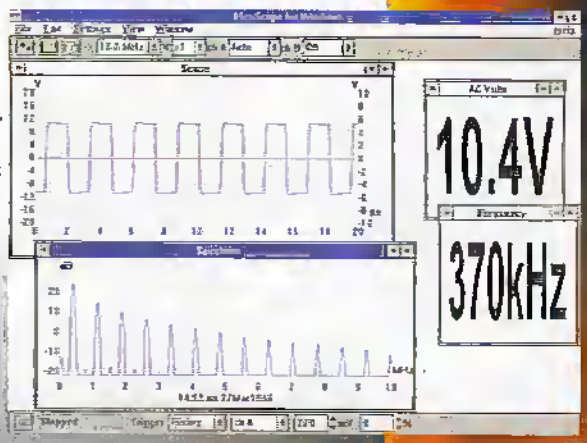
Zain Media has introduced of series of spoken word computer training CDs. The updated range of CDs consists of spoken instructions that the user carries out directly to a computer.

These standard format audio CDs can be played on a PC with a CD-ROM drive or on a normal CD player. With the help of the pause key, users can follow the training at their own speed. The current range of CD titles covers all Microsoft Office applications, including MS Word and MS Excel, as well as WordPerfect and a number of Internet programs.

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

Contact: Zain Media, Tel: (0171) 363 6133.

Transform your PC.... Into an oscilloscope, spectrum analyser and multimeter...



The ADC-200 range of PC based oscilloscopes offer performance only previously available on the most expensive 'benchtop' scopes. By intergrating several instruments into one unit, the ADC-200 is both flexible and cost effective.

Connection to a PC gives the ADC-200 the edge over traditional oscilloscopes: the ability to print and save waveforms is just one example. Units are supplied with PicoScope for Windows which is powerful, yet simple to use, with comprehensive on line help.

Applications

- Video
- Automotive
- Electronics design
- Production line tests
- Fault finding
- Education

Features

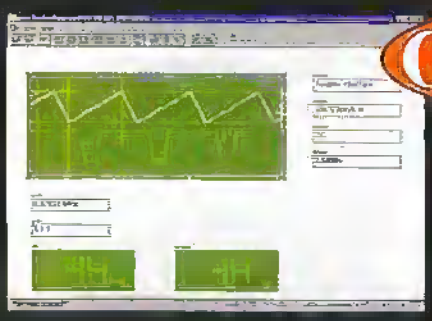
- A fraction of the cost of comparable benchtop oscilloscopes
- Up to 100 MS/s sampling
- Advanced tigger modes- capture one off events.
- Up to 50 MHz spectrum analyser
- Large buffer memory

All units are supplied with software, cables and power supply. Prices exclude VAT.

		Order code
ADC-200/100	£499	VG52
ADC-200/50	£399	GS70
ADC-200/20	£299	GS69

A scope at your fingertips.....

Once oscilloscopes were heavy and clumsy to handle, but over the years they have become smaller and smaller. The latest development in this field has just arrived: a digital storage oscilloscope in a handy slim housing, scarcely longer than a pencil and about as thick as your thumb. Despite its small size, its performance can match that of a service oscilloscope.



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Applications

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- Hobby electronics
- Measurements in amplifiers
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Tel number: 01226 340108 Fax number: 01226 754861
Internet site: http://www.maplin.co.uk

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BMW 750 iL executive saloon.

Electronics in the MOTOR INDUSTRY

PART 1

In this first part, Mike Bedford looks at how electronics is used to performance-enhance modern cars.

"There's more processing power on-board this car than there was on the Saturn V rocket which took Neil Armstrong to the moon". This claim was made by BMW a few years ago, it relates to the 750iL executive saloon, and it hints at the vast changes we've seen to automotive engineering over the past decade or so. But the rate of change hasn't always been as impressive as it is today. Until recently, the motor industry couldn't really claim to have been particularly innovative. Without a doubt the appearance of cars has changed dramatically, and levels of performance have also shown significant improvements. Behind the scenes, little changed until the 1980s. The difference between cars which were preceded by a man waving a red flag and cars of the 70s, which had a top speed of over 100mph, had resulted from a process of evolutionary rather than revolutionary change. Over the years, developments had produced a slight improvement here and another slight improvement there but the underlying technology of a 1972 Ford Consul was little different from that inside a 1908 Ford Model T. In the main, I'm referring to 'greasy rag and spanner' type technology, but exactly the same applies to electronics. In fact, when we think about electronics, the motor industry of a couple of decades ago could be accused of being even more backwards looking. About the only pieces of electrical equipment to be found in most cars of the 70s was the starter motor, the electric lights, the horn and the windscreen wipers. Electronics only made an appearance in the guise of the car radio and even this wasn't fitted as standard on many motors.

Series Content

In this series of articles, we're going to be investigating the use of electronics and microprocessors in cars. We'll also touch on the use of computer technology in designing and testing vehicles. But little of what we talk about will be found in the majority of cars on the road today. Instead, we'll be concentrating on leading edge developments. This includes those systems already available – even though only on high price tag luxury and performance motors – and those systems which are still in the development laboratories but which look likely to shape the cars of tomorrow. Our investigation of car electronics will be split into five parts. First of all, in this article, we'll look at the ways in which electronics is used to improve the performance of vehicles and make them easier to drive. Next month, we'll take a more responsible approach to motoring by looking at the use of electronics to make cars safer and more environmentally acceptable. In the third article, we'll look at periphery systems in cars. By this, we're referring to those added extras such as in-car entertainment, communication facilities and navigational systems. All these first three parts will look at developments which are either already fitted in top-end motors or which will migrate into ordinary road vehicles over the coming years. In the fourth part, however, we'll turn our attention to motor sports, and particularly Formula One, to see how electronics and computing are now essential elements in achieving that winning edge. Finally, in our fifth part, we'll go behind the scenes to look at automotive electronics from the perspective of the designer. Here, we'll be concerned not so much with what electronics can give to the world of motoring but how it is achieved.

Meaner or Greener?

You might be of the opinion that the technology to make cars meaner couldn't be much different from the technology to make them greener. After all, public perception sees the mean machine as the V8 turbo gas guzzler which can do 0-60mph in five seconds and has a top speed of

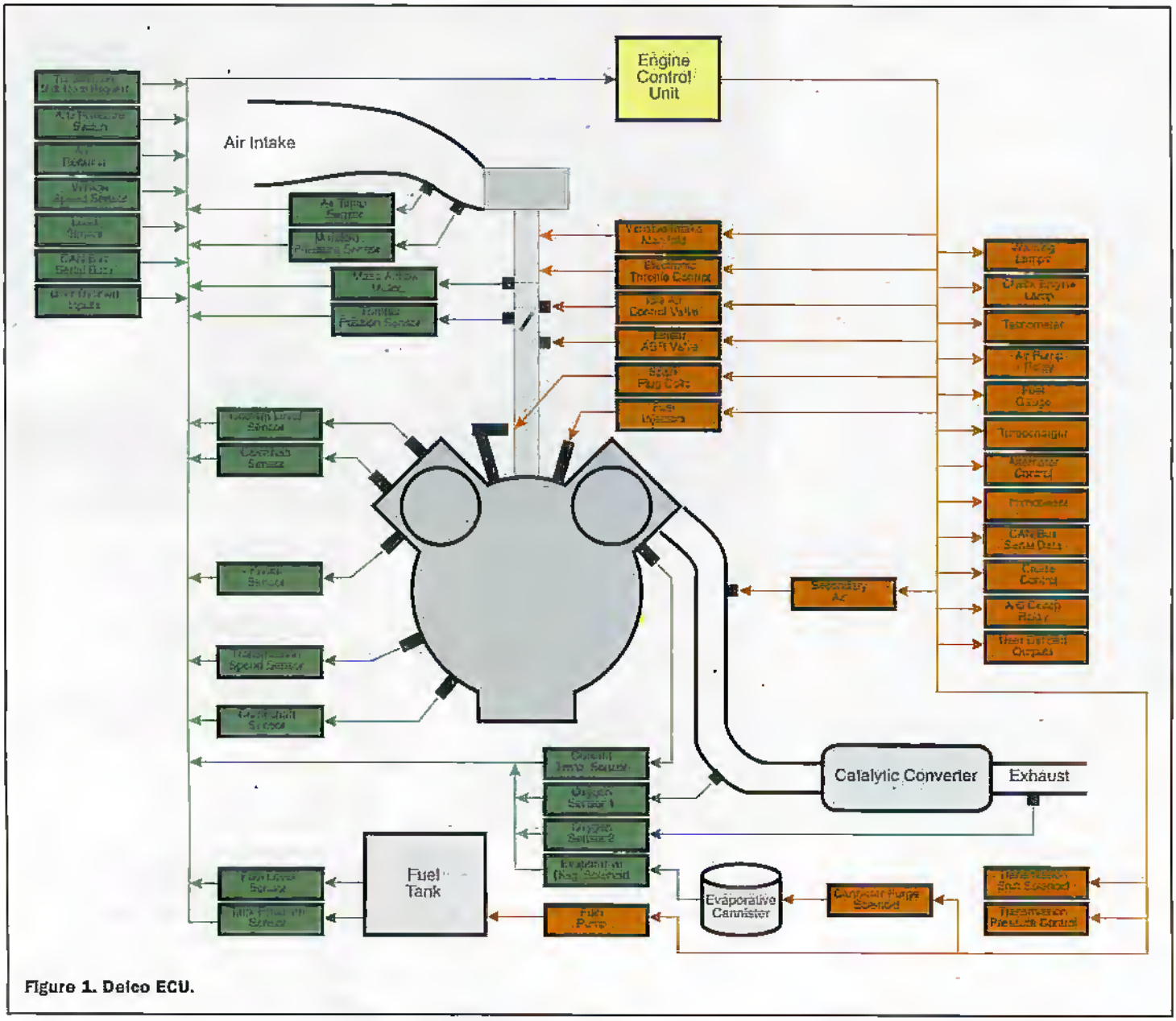


Figure 1. Delco ECU.

180mph whereas the green option is the electric car which achieves its top speed of 45mph in about half an hour. Slightly tongue in cheek, perhaps, but I'm sure you get the picture. A look back over changes in production motors over the last few years, however, paints a rather different picture. Ten years ago, fuel injection was an option reserved for performance cars. A standard 1600cc Ford Escort, for example, produced about 75bhp but the sporty alternative, the XR3i, used fuel injection and managed to extract 115bhp from that same 1600cc. Top speed and acceleration figures were improved accordingly. Today, the situation is completely different. Virtually all petrol engines are now fuel injected but you don't see many grannies in Mini Metros burning off boy racers at the lights. Rather than producing an overall performance improvement, the move to fuel injection for all has allowed smaller engines to be used without reducing engine power. So, if a manufacturer had a two litre family saloon and decided to introduce fuel injection, the size of the engine could have been reduced to 1600cc. This means less raw materials to build the car and once it's on the road, lower fuel consumption and lower emissions. In other words, fuel injection has been introduced across the board to make cars greener. The same applies to many other developments we've seen over the previous decade. The situation with multi-valve engines is very similar, these having now migrated from the 16-valve hot hatches of a few years ago to the family saloon of today. Even turbo-charging – while certainly still far from universal – has found its way into vehicles other than sports cars.

Of course, all of this has very little to do with our subject of electronics and microprocessors in cars but similar principles apply here too. For example, a number of car manufacturers have been experimenting with active suspension systems. This can be viewed as a safety feature since it reduces roll as a car goes into a corner and thereby helps keep all the tyres in contact with the road surface. However, if it improves the stability and safety of cornering at, say 45mph, that same system might allow the same corner to be taken at a much higher speed than would be possible with a conventional passive suspension system. So, a system which was designed to make cars greener could also be used to make them meaner. However, this is also a point of some concern as Lotus' Alastair Florance pointed out. Even if active suspension is being promoted as a safety feature and it's being included in standard saloon cars as opposed to sports cars, how can we be sure that it will remain an invisible feature in the background which only makes a difference under exceptional hazardous conditions. In other words, how can we be sure that it won't cause the driver to behave differently? If the driver knows that a vehicle is more stable on corners, might he be inclined to push it harder into corners thereby cancelling out the safety advantage? I'll leave that as something to ponder since I certainly won't be attempting to get into this can of worms here. However, my reason for introducing this 'meaner or greener' issue is to point out that it's sometimes difficult to say exactly which category a particular feature comes into. Furthermore, some people will be of the opinion that so-called safety features can have exactly the opposite effect. So, now I've put forward a valid justification for including systems in just about whatever category I choose, let's make a start on the first of these ill-defined areas – systems which improve car performance and handling.

Engine Management Systems

Before we get embroiled in some of the really advanced systems which you'll only find in motors costing £50,000 and upwards, let's take a look at an electronic system which is now found in virtually all cars. Unlike electronic systems such as ABS and cruise control which – although they're not universal – virtually everyone has heard of, this is one which many car owners will be totally unaware of. Yet engine control units or ECUs can be found under the bonnets of most new cars sold today. So what is an ECU and why is it needed? Let's find out.

An engine control unit is the heart of an engine management system, the purpose of which is to control the engine, taking into account the objectives of maximising performance and fuel economy and minimising emissions. Furthermore, the engine must operate efficiently not only under ideal conditions but also when the engine is cold, whatever the air temperature and however the car is being driven. Clearly, traditional engines with mechanical distributors and no way of sensing changing conditions were not very effective at this. But by putting all this under the control of a microprocessor, it becomes possible to achieve a reasonable compromise between performance, economy and environmental concerns under a wide range of conditions. To give you a feel for the power of an ECU, I'll present a few facts and figures relating to Delco Electronics engine control module.

In comparison to the processors in today's PCs, the processor inside the ECU seems remarkably under-powered with a clock speed of just 8.4MHz, a 16-bit architecture, 96K of EEPROM for the program and just 3K of RAM. In fairness to Delco, however, I should point out that our experience with PCs tends to cause us to loose sight of just how little computing power is needed to perform real-time control functions so long as a state of the art GUI isn't required. The processor has 64 I/O lines which connect to a wide range of sensors and actuators in the vehicle. On the input side, sensors include air temperature, oil temperature, manifold pressure, camshaft and crankshaft position, knocking, transmission speed, exhaust gases and throttle position. On the output side, the fuel injectors, spark plugs, and variable intake manifold are all under control of the ECU. Furthermore, the ECU performs various monitoring and housekeeping functions such as checking oil and fuel levels and illuminating warning lamps as appropriate. The block diagram shows a typical ECU and is based on a Delco product.

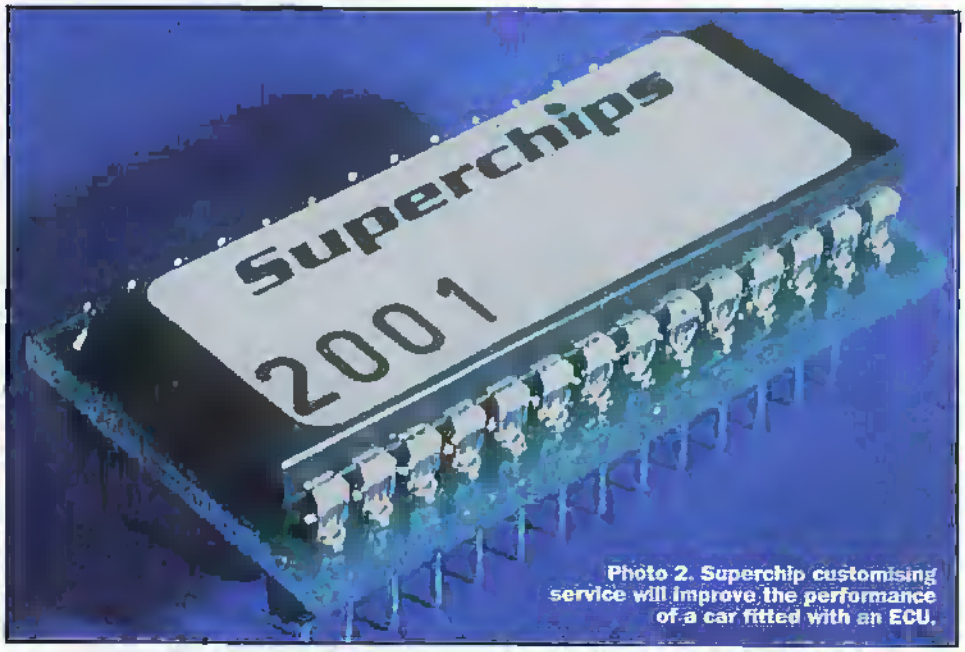


Photo 2. Superchip customising service will improve the performance of a car fitted with an ECU.

Many motor manufacturers don't produce their own ECUs relying, instead, on standard parts such as those by Delco, Bosch and various other companies specialising in automotive electronics. The job of the car manufacturer is to adapt the ECU to their particular engine and this is essentially a programming job. But according to companies such as Superchips, most ECUs aren't fully optimised for performance, and for those drivers who want to obtain the absolute best from their cars, these companies and their dealers provide a re-chipping service which can increase torque and power by up to 10% for normally aspirated engines and up to 35% for turbo engines. So if this amount of potential power is sitting there untapped, it's pertinent to ask why the car manufacturers don't write the software to make use of it. Let's take a look at Superchips' views on this question. "The manufacturers have to make a compromise when writing the program. They must allow for fuel economy, exhaust emissions, the very worst grades of fuel being used and for the car going months without proper servicing. If you are prepared to service your car on time, use four star or 98 octane unleaded fuel and sacrifice a little (a very little!) fuel economy, there is great potential for optimising or remapping the chip." If an extra 10% more power isn't enough and you've already had other performance-related modification

Photo 3. Porsche 911 Carrera with 5-speed Tiptronic 'S' automatic gearbox.

Photo 4. Lotus development car.

done to your car, then as an option to standard chips, Superchips offers a customised service. The dealers will analyse your car on a rolling road, send information by modem back to Superchips and the information will be sent back within a day allowing the dealer to programme a chip specifically for your motor. If you're curious about the idea of re-chipping, Superchips can be contacted on 0990 143 005 or www.superchips.co.uk.

When the Rubber Hits the Road

So we've seen something of how engine management systems – in conjunction with non-electronic developments such as turbo-chargers and multi-valve cylinders – have dramatically improved the power which can be generated by an engine of a given size. Depending on your market, this can be used either to improve economy by reducing the engine size or to improve performance by sticking with the same engine capacity. Since the theme of this article is performance improvement, we'll assume that the technology has been used to produce a seriously powerful engine. But, of course, power isn't the only ingredient of a performance motor. It's also necessary to transmit that power to the road in a safe and controlled manner and to make the vehicle stable at high speeds, especially when cornering, and in many of these areas, electronic systems are now coming to the fore.

Have you ever tried accelerating from a standing start by flooring the accelerator and taking your foot off the clutch? If you have, you'll probably have discovered that one of two outcomes is likely. Depending on the size of the engine, the size of the tyres, the state of the road surface and the speed at which you lift the clutch, either you'll stall the engine or you'll end up spinning the wheels. Without some degree of skill, you're unlikely to achieve the efficient get-away which would be needed to clock the 0-60mph time quoted by the manufacturer. We have probably all seen the changes in position which often occur during the first couple of seconds of a Formula One Grand Prix which testify to the skill required to get a good standing start. In order to de-skill this, traction control systems were developed in the early 90s by F1 teams, subsequently banned by the FIA, and now finding their way into a number of production cars. And here, it's used not only to achieve maximum traction in a straight line from a standing start but at all times, and especially during cornering. Take for example, BMW's ASC+T (Automatic Stability Control plus Traction) which is fitted to the 750i and 750iL saloon cars. With a 12 cylinder engine developing 326bhp and allowing a 0-60mph time of 6.6 seconds, there is quite some scope for loss of traction without some form of traction control. ASC+T constantly monitors front and rear wheel speeds and by comparing the speeds of the front wheels and the rear wheels, the onset of wheel spin can be detected. Under these conditions, power is reduced to keep the wheels within the grip threshold, no matter what the road surface. Of course, few automated systems are totally fool proof so, in those cases such as while driving on snow when a limited amount of wheel spin is necessary to maintain movement, ASC+T can be switched off.

Another factor which is vitally important to maintaining stability is a car's suspension which, traditionally, comprises a combination of various passive mechanical components. Also on the BMW 750-series is EDC III, the Electronic Damper Control system. This adjusts the stiffness of the damper within a fraction of a second to respond to different road conditions and driving styles. By monitoring all the movements of the car, the associated processor can determine the best damper settings for both safety and comfort. When accelerating, cornering or braking, the damper forces are increased whereas for cruising at a constant speed, they are reduced. For more aggressive driving, the driver can choose a firmer setting from a dashboard switch.

Transmission

If you're serious about performance, then forget about automatic transmission, and if you're looking for fuel economy then, once again, stick with a manual shift. This is the traditional view and explains, at least in part, why manual transmission remains popular in Europe where fuel prices are high despite it being made virtually obsolete in the USA decades ago. The fact that a conventional automatic transmission isn't as efficient as a manual one really isn't too surprising. After all, an automatic transmission is a dumb

Figure 2. Computer software has become an indispensable tool in car design and manufacture.

mechanical device which is based on very old technology. Electronics provides the means for producing an automatic gear box which can compete much more closely with a manual transmission, and although you're still going to sacrifice a little in the way of performance by going automatic, a number of vehicles are now fitted with very efficient and very clever electronic automated transmissions.

At one time, the idea of fitting an automatic transmission in a top-end sports car would have been laughable. But this is exactly what Porsche have done in their 911 Carrera and the performance doesn't suffer as much as you might expect. Whereas the manual version of this 3.4litre, 300bhp motor achieves a top speed of 174mph and a 0-62mph time of 5.2 seconds, the automatic version can do 171mph and 0-62mph in 6.0 seconds. However, it's pertinent to point out that the automatic version has five gears compared to the manual's six and that the automatic version weighs 3.5% more. In fact, the automatic 911 Carrera is normally referred to as the Tiptronic S model because, in addition to its automatic mode, it can also be used in a semi-manual mode in which the driver shifts up or down by pressing the appropriate Tiptronic switches built into the steering wheel. However, of particular interest to us here is how electronics is used to control the gearbox in its true automatic mode.

On standard mechanical automatic boxes, it's now common practice to provide two modes, one for performance and the other for economy. The 911 Carrera's Tiptronic S gearbox, on the other hand, offers no less than eight different shift patterns which are selected automatically depending on driving style and conditions. These range from a particularly economical mode for smooth motoring to all-out dynamic motoring with the engine reving to maximum torque and power in each gear before changing, and downshifting appropriately from relatively high engine speeds. This intelligent shift programme includes the following features to overcome some of the classic problems with conventional automatic boxes. During warm-up, early up-shifting is suppressed to ensure a rapid rise of the temperature to the engine's normal operating temperature. Overrun up-shift is prevented when suddenly lifting the throttle. Down-shifting occurs on braking for more efficient engine braking. Gears are held during corners. Gears are held for longer on up-hill stretches, and finally, up-shifting occurs when slip is detected to improve lateral guidance of the driving wheels.

The Next Stage

Virtually all we've seen so far is technology which you can go to a car showroom and buy today, so long as you have a sufficiently healthy bank account, that is. However, Lotus Engineering, the research and development arm of the Lotus Group, has worked on a number of exciting systems over the course of the past decade. But such are the lead-times involved in bringing cars and automotive systems to production, it could still be a few years before some of these ideas come to fruition. Rather than look at any of these in any detail, we'll close this first article by outlining a few of these systems to give you a feel for what might be on the way.

As we've see, BMW has a system which can control the stiffness of a conventional suspension to adapt to conditions and driving styles but the next stage is the fully active suspension system. Instead of springs and dampers, an active suspension system has double-acting hydraulic units which, under microprocessor control, can respond to road irregularities as well as braking, accelerating and cornering. Unlike conventional vehicles which have suspensions designed for a particular type of ride, an active suspension can be changed, at the touch of a button, from providing a soft limousine-type ride to sports car handling.

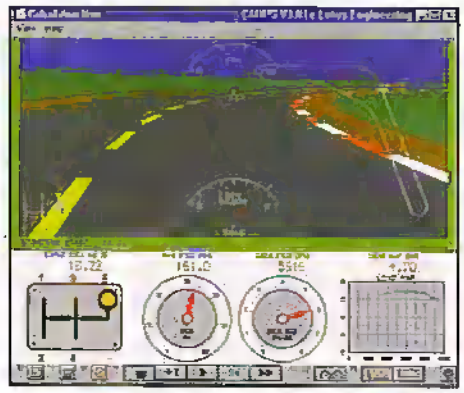
Another Lotus development is cam profile switching. Unless you're a motor mechanic or engineer, you probably don't know a great deal about camshafts so here's the simplified story. The camshaft is the mechanical linkage which controls the opening of the valves on each cylinder, ensuring that they open at the correct time with respect to the other valves. As with so many parts of a motor vehicle, the camshaft is often designed to present a compromise, in this case, between performance and the goal of near zero exhaust emission. In order to allow a vehicle to achieve both performance and reduce emissions, cam profile switching swaps between a pair of

camshafts depending on the conditions. Although a significant element of cam profile switching is mechanical, electronic control systems are needed, of course, to make the decision regarding when to make the transition. Going beyond this, Lotus are also working on an active valve train in which the mechanical camshaft is totally replaced by electronic control.

In the last two examples of systems which are still in the development laboratories, you'll notice that safety and comfort were coupled with performance in the first and that exhaust reduction was coupled with performance in the second. And this underlines my earlier comment that it's often very difficult to categorise advanced automotive systems as performance-related, safety-related, environmental-related, or luxury-related. And with that we'll bring this, the first part of our investigation of automotive electronics to a close. However, since many of these issues are inter-related, there's a good chance that we'll encounter some further performance enhancing systems as we look at safety and environmental issues next month and at periphery systems the month after. Certainly our look at motor sports later on in this series will be concerned almost exclusively with performance.

Behind the Scenes

My interest in advanced automotive electronics was prompted by the claim I quote in the introduction, namely that by BMW which suggests that their top-of-the-range motors have more processing muscle



than the spacecraft which NASA used to put man on the moon. My emphasis throughout this series will be electronic systems which are actually built into the vehicles themselves. However, we really can't dedicate a five article series on electronics and computers in cars without also touching on the advanced software which is being used behind the scenes to design the vehicles.

Lotus is a name which most people will associate with prestige sports cars and perhaps some will also remember the Formula One Lotus Team which last competed during the 1994 season after a successful career. But Lotus Engineering also provides design and consultancy services to many of the world's car manufacturers. You probably recall the Lotus Carlton, a 377bhp version of the Vauxhall Carlton with much improved handling. The Lotus name was key to the marketing of this vehicle but you may be surprised to learn that although none of these vehicles carry the Lotus badge, Lotus Engineering have been involved in the design of cars and motorcycles by Opel, Daewoo, KIA, Dodge, Chevrolet, Triumph and Volvo. I don't suppose it will come as much of a surprise if I tell you that software tools are essential to Lotus in providing a timely service to their clients.

The most fundamental type of software used is Computer Aided Design (CAD) packages and these are augmented by ICAD (Integrated CAD) software which can , for example, work out where – within the vehicle – a particular part can be located. Using this sort of tool, the job of component placing for a vehicle can be reduced from three months to just two hours. But in addition to off-the-shelf software, Lotus' design engineers rely heavily on associated software which has been developed in-house for simulation and analysis. For example, before a car has even been prototyped, the Car Performance Simulator is able to provide a wealth of information on aerodynamic performance, handling, and can even predict the 0-60mph acceleration figure. The design can be fine-tuned at this early stage, the final parameters communicated to the CAD systems, and a first prototype built with a high degree of confidence in its suitability. Similarly, Lotus have software tools for simulating key components such as the internal combustion engines and the suspension. Clearly, the reduced time-to-market which results in the use of advanced analysis and simulation is vital in an increasingly competitive marketplace.

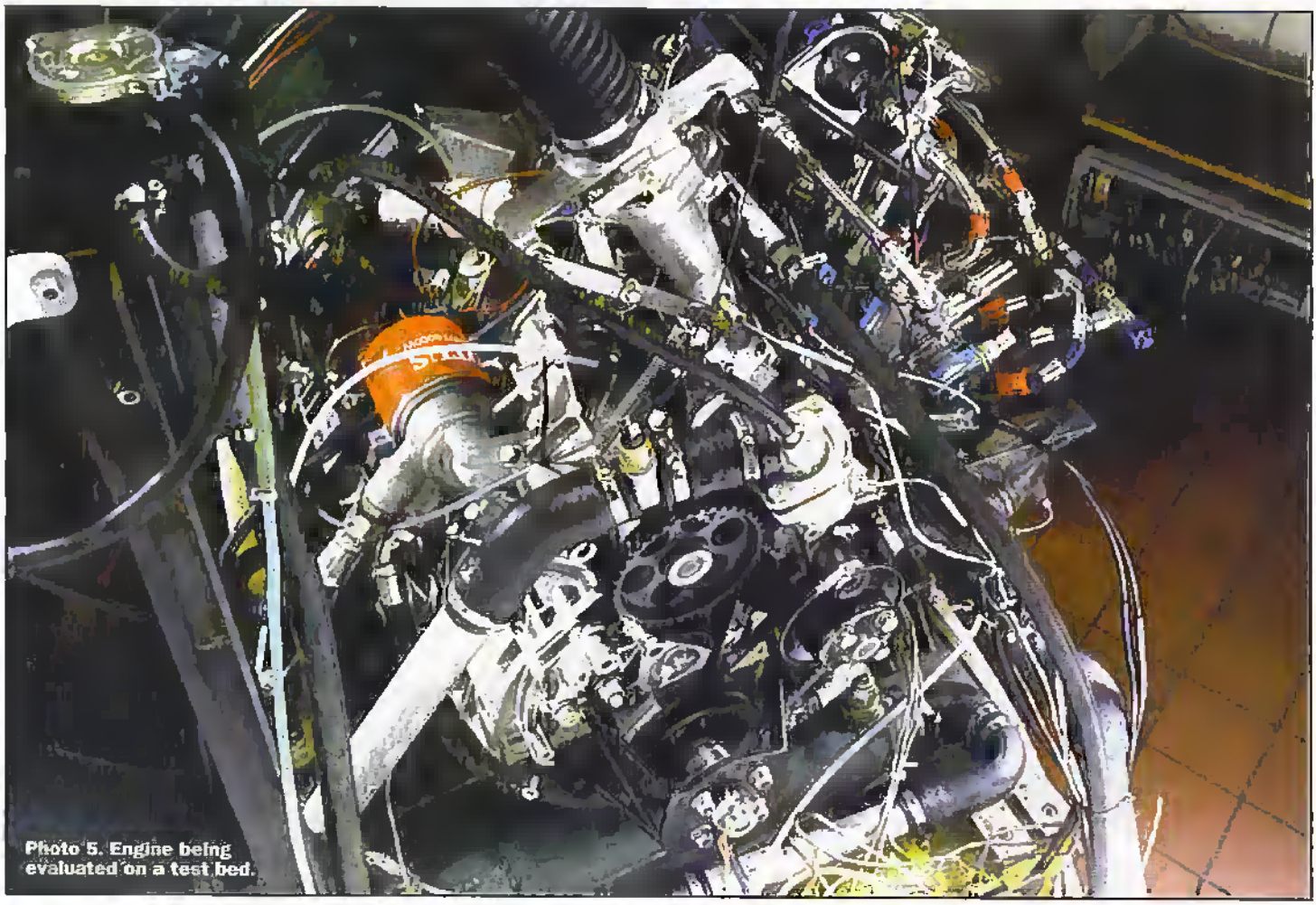
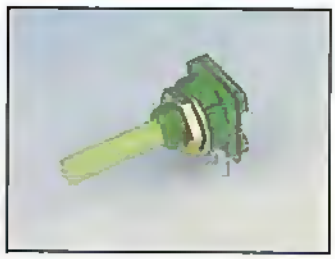
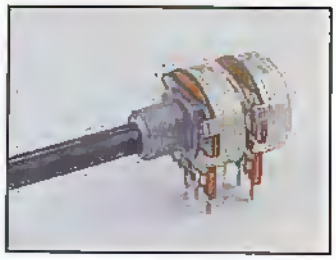


Photo 5. Engine being evaluated on a test bed.

Digital POTENTIOMETERS

PART 1





Gavin Cheeseman looks at digital potentiometers and their applications.

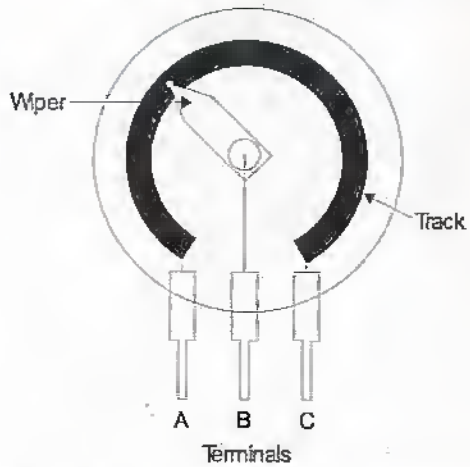
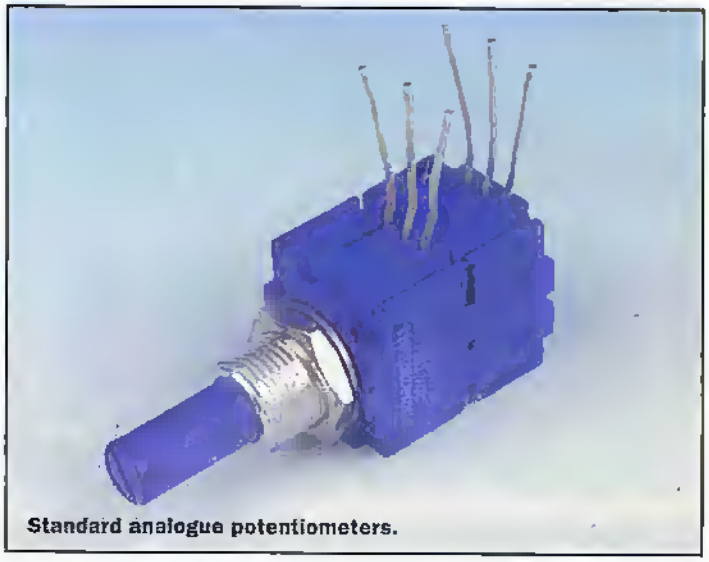


Figure 1. Simplified diagram of a typical rotary potentiometer.



Standard analogue potentiometers.

In this article we look at digital potentiometers and their applications. Some readers may not be familiar with the operation of potentiometers, so we start with a basic overview.

Potentiometers, sometimes called variable resistors crop up in many areas of analogue electronics. They provide a method of adjusting voltage or signal level and come in a variety of types for a range of different purposes. Typical examples are the small pre-set trimmers, adjusted using a tool and often used for circuit alignment and the larger panel mounting potentiometers used as front panel controls.

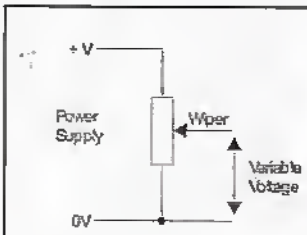
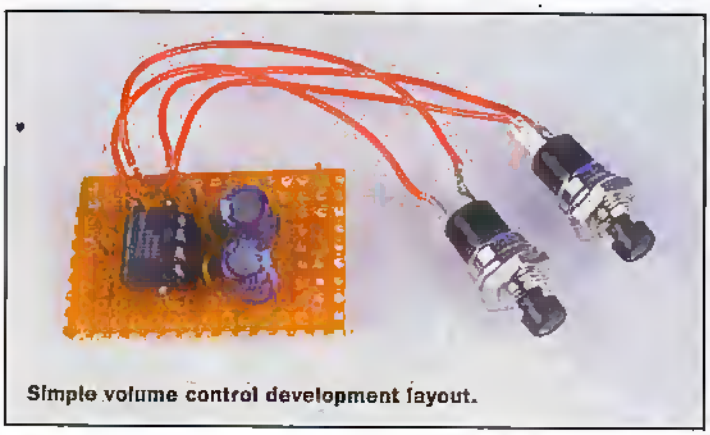


Figure 2. Using a potentiometer to produce a variable voltage.

Most manually operated potentiometers consist of a track of resistive material, such as carbon or resistance wire and a sliding contact or 'wiper', the position of which may be adjusted by a rotary control or slider. This is illustrated in Figure 1. The resistance between points A and C remains constant independent of the position of the wiper; however, the resistance between points A and B or points C and B varies as the wiper is moved across the track. If an AC or DC voltage is applied between points A and C and an output is taken between points B and C, the output voltage level will be directly relative to the position of the wiper on the resistive track (Figure 2). This arrangement forms the basis of most common types of volume control.

Many different types of potentiometer are available with widely varying characteristics. Some types have linear tracks whereas others have a logarithmic response suited to audio applications. Maximum power handling also varies considerably.

Mechanical potentiometers have been used very effectively for many years and generally



Simple volume control development layout.

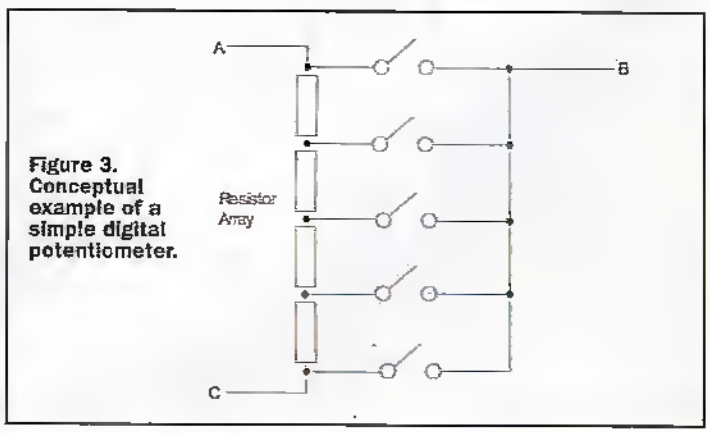


Figure 3. Conceptual example of a simple digital potentiometer.

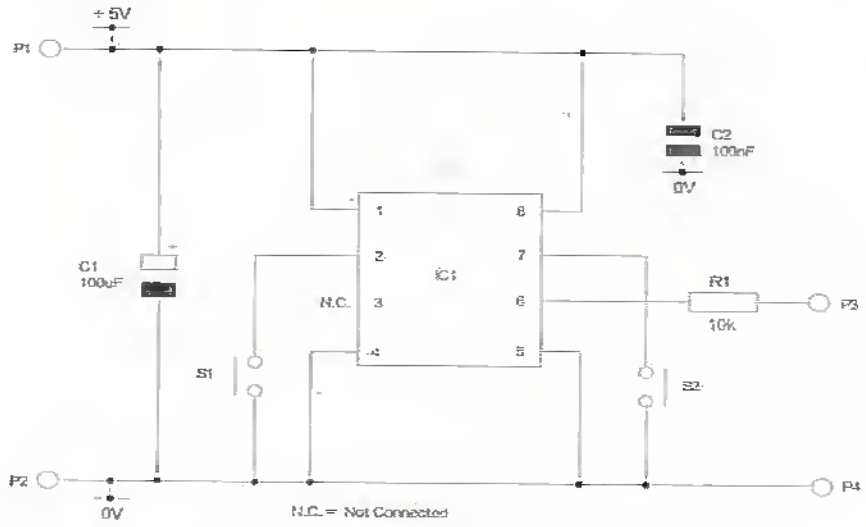


Figure 4. Digital Voltage Control.

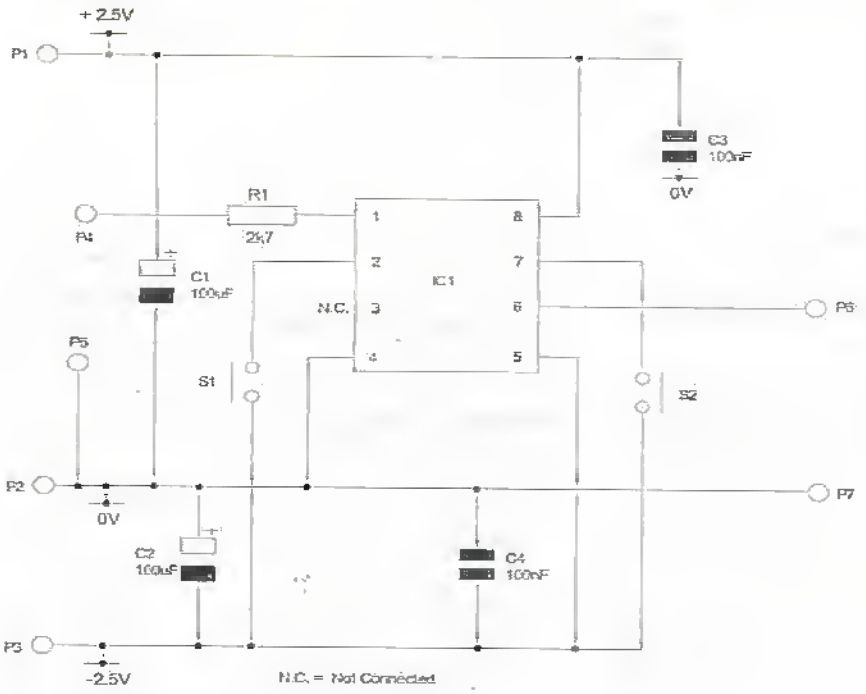


Figure 5. Circuit diagram of simple mono volume control.

provide good performance. They do, however, suffer from some inherent disadvantages:

As with most mechanical devices, signs of wear become apparent after a long period of use. The resistive material is slowly worn away by the passage of the wiper over the track. In addition, dust can collect on the contact surfaces. After a while, dead spots appear where the wiper is no longer in contact with the track. This can manifest itself as rumbling or popping when a volume control is adjusted and in an extreme case there can even be complete loss of the audio signal. With modern potentiometers, the materials used are relatively resilient to wear and tear and problems of this kind usually only occur after long periods of use.

Mechanical potentiometers, by their very nature, rely on physical adjustment. In order to vary the resistance, it is necessary to physically change the position of the wiper on the track. This is not normally a problem for a simple volume control, for example on a small radio receiver but can become considerably more tricky if you want to adjust the volume automatically or by remote control.

Ganging together a large number of mechanical potentiometers can be awkward and may take up considerable space. Also, there may be considerable variation in resistance characteristics between different potentiometers and this may affect the operation of the circuit.

With the above points in mind, the advantages of an electronic potentiometer without a mechanical contact can be clearly seen. There is no physical wiper or track to become worn and automatic or remote operation is much simplified. The introduction of digital potentiometer technology allows electronic control to be achieved with predictable and reliable results. As an added advantage, push button control of volume and other parameters is easily achieved and can be particularly useful in miniaturised products.

The concept of a simple digital potentiometer is illustrated in Figure 3. In the illustration, mechanical switches are used for ease of explanation but in practice solid state switching techniques would be employed. The arrangement shown consists of an array of resistors connected in series effectively forming a divider chain. Point B may be connected to point A, point C or any of the junctions between resistors using the five switches. In this example points A, B and C are analogous to the corresponding terminals in Figure 1. Point B is effectively equivalent to the wiper connection of a mechanical potentiometer. Closing any one of the five switches results in point B being connected to a different point in the divider chain. The arrangement shown is considerably simplified and omits the necessary interfacing circuitry. This type of circuit would not normally be used in practical applications.

There is an important difference between analogue potentiometers and their digital counterparts; analogue types provide continuously variable wiper position whereas digital devices provide a set number of pre-determined wiper positions (tap points). In our example, only five effective wiper positions may be selected by closing one switch at a time. Simultaneously closing more than one switch would change the total resistance of the chain, an effect which is normally undesirable. Therefore, the simple arrangement shown would be of very limited use in a practical application such as a volume control. Of course more wiper positions could be added by using additional resistors and switches resulting in a much closer approximation to the continuously variable wiper of an analogue potentiometer.

For most purposes, building a digital potentiometer with a large number of tap points and the necessary control and interfacing circuitry from discrete components is not practical or cost effective. Luckily devices are available off the shelf, providing excellent performance characteristics with large numbers of tap points and requiring minimal external circuitry. ICs providing either single or dual potentiometer functions are available and some types may be cascaded. Devices are

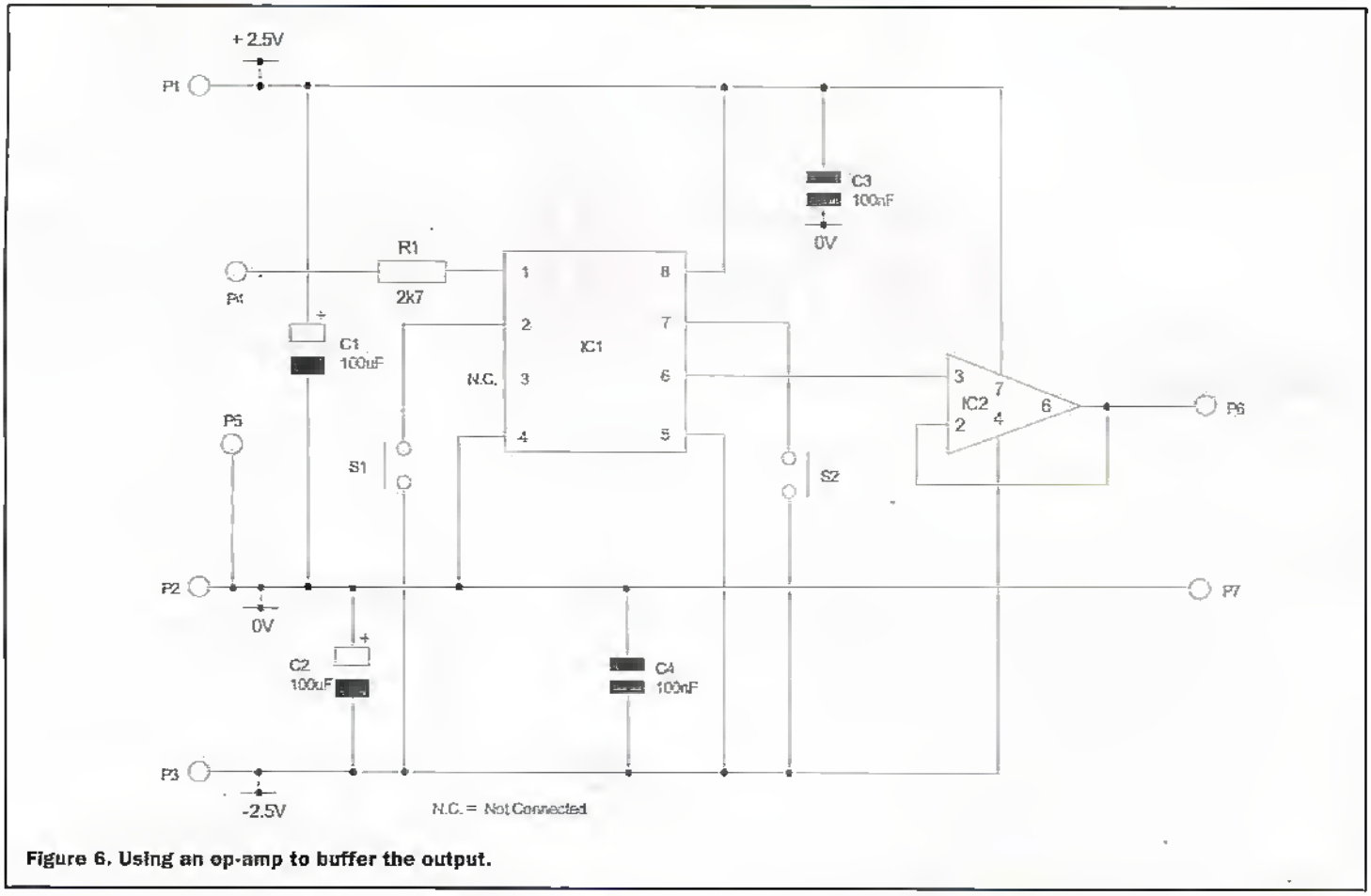


Figure 6. Using an op-amp to buffer the output.

available with either linear or logarithmic characteristics.

The design of proprietary digital potentiometers is varied and complex and to cover this in any detail is outside the scope of this article. Therefore readers are referred to the relevant manufacturer's data sheet for details of specification and operation. Instead, we look at some applications and circuits that can be built using digital potentiometer ICs. The circuits and parts lists shown are intended to provide a starting point and may require some optimisation or modification to achieve the best performance for a specific application.

Practical Devices

The DS1869 IC, manufactured by Dallas Semiconductor and available from Maplin, is an excellent device, providing a single linear digital potentiometer function in a standard eight pin DIP package. The device is suited to a wide range of applications and may be controlled either using single or dual mechanical push button switches or via a digital interface. Use of EEPROM technology allows the wiper position to be stored and retained when the device is powered down.

Digital Voltage Control

Figure 4 shows a simple circuit which will produce a digitally controlled voltage output using the DS1869 IC. The circuit shown will operate from a single +5V supply, connected between P1 (+V) and P2 (0V). Capacitor C1 helps to ensure that the power supply to the device is free of unwanted noise and C2 acts as high frequency de-coupling. These capacitors may not be required in many cases but this will depend on the type of supply being used and whether it is also supplying other circuitry. Resistor R1 provides current limiting, ensuring that the maximum current specification for the wiper is not exceeded. The voltage output is available between P3 (output) and P4 (0V). As with a mechanical potentiometer, the output resistance is variable depending on the effective position of the wiper. In practice, the output would normally be used to drive into a high impedance. To drive a lower impedance a suitable buffer circuit should be employed.

The circuit may be used as a variable voltage source in applications such as digital gain control of a voltage controlled amplifier or to form the basis of a simple digitally controlled variable power supply.

Circuit Operation

The effective wiper position and hence the voltage level at the output of the circuit is controlled using two push to make switches, S1 and S2. The circuit will produce 64 different output levels. Momentarily closing S1 results in the output voltage increasing by one step. Conversely, momentarily closing S2 decreases the output level by one step. If either of the switches is closed for more than 1 second, the output voltage will automatically increase or decrease one step every 100ms depending on which switch is closed. On reaching the maximum or minimum step no further changes to the output level occur. For example, if S1 is held closed, the output voltage of the circuit will increase in steps until the maximum level is reached. No further voltage changes will occur until S1 is released and S2 is closed. The output voltage will then decrease. If S2 is held in the closed position for more than one second the output voltage will automatically decrease in steps until the minimum level is reached. The setting of the potentiometer is retained when the power supply is disconnected. When the device powers up, the effective wiper position is the same prior to power down.

Testing

The circuit is easily tested using an oscilloscope or a high impedance multimeter set to measure voltage. This should be connected between P3 (output) and P4 (0V). Step through the various tap points using S1 and S2 and check that the appropriate voltage is produced at the output. If the circuit is connected correctly very few problems should be encountered.

Digital Volume Control

Although the DS1869 provides a linear response, it can be used as a volume control. A simple mono digital volume control circuit can be constructed using the IC as shown in Figure 5. Unlike the Digital Voltage Control discussed above, this circuit is designed to operate from a split rail power supply of -2.5V with a centre 0V rail. The +V connection is made to terminal P1, 0V is connected to P2 and –V goes to P3. The audio

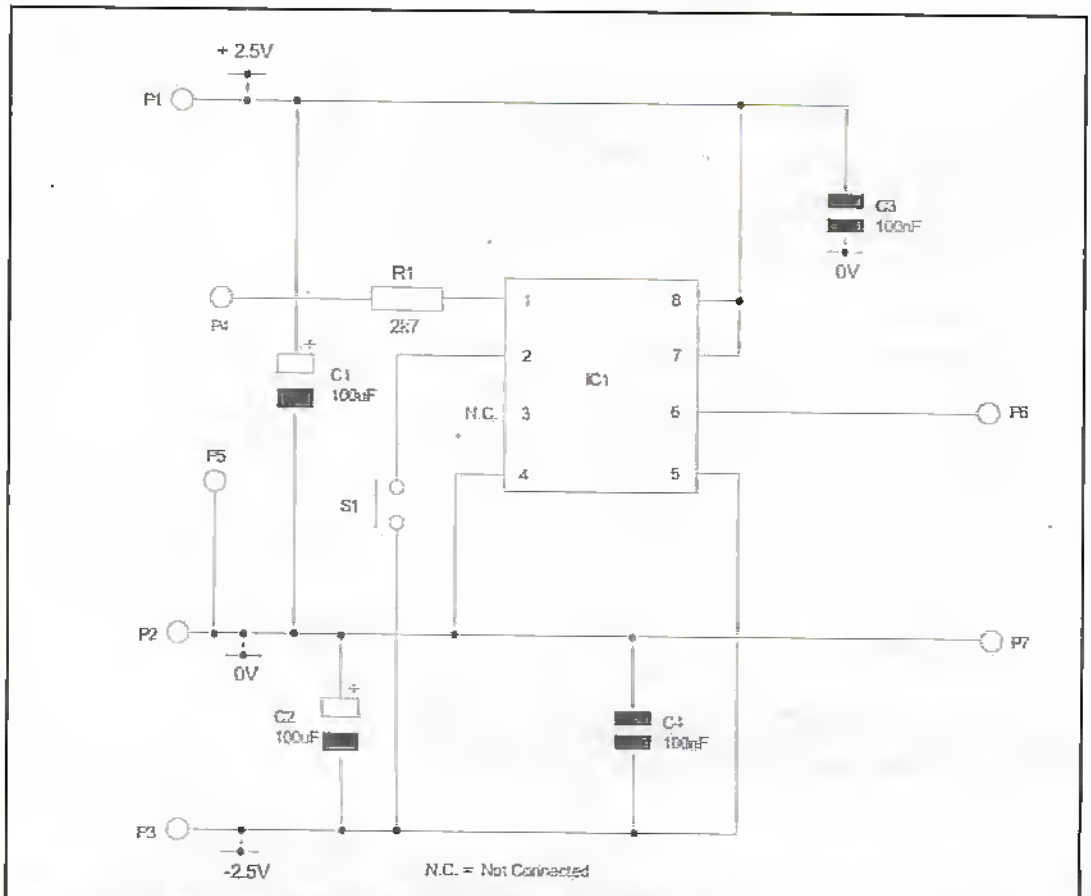


Figure 7. A simple volume control circuit using single button control.

input signal is applied between P4(input) and P5 (0V) with the output available between P6 (output) and P7 (0V). It should be noted that the IC control inputs, to which S1 and S2 are connected are referenced to the –V supply. To prevent overload and possible damage to the IC, the input signal voltage swing should not be allowed to exceed the supply voltage.

Operation

The operation of the circuit is similar to that of the Digital Voltage Control. The difference is that the device controls the audio signal level at the output as opposed to producing a DC voltage. Operating S1 will result in an increased signal level at the output whereas pressing S2 will produce a level reduction.

As with a volume control using a standard 10k mechanical potentiometer the output is suitable to drive a high impedance amplifier input. If necessary the output may be connected to lower impedance inputs using a simple buffer stage. An example of how to achieve this is shown in Figure 6 for guidance. The type of op-amp used will depend on the application. The circuit shown is based on the TL071 IC and should be suitable for most general purpose applications but other devices offering enhanced performance can be substituted where necessary. It should be noted that some op-amps have a different pin-out and some devices do not operate at voltages as low as ±2.5V, so it is best to double check this when choosing a device. Of course, it is possible to power the op-amp from separate supply rails at a higher voltage as long as the digital potentiometer supply remains within specification.

Testing

The circuit may be tested using an oscilloscope connected between P6 (output) and P7 (0V). A suitable signal source will be required to drive the input. An audio frequency signal generator or a line level music source is ideal. Connect the signal source between P4 (input) and P5 (0V). Check that S1 and S2 control the output level correctly and that the circuit does not introduce any unwanted distortion. The output should be referenced to the 0V rail.

Single Button Control

The device may also be configured to provide single button level control using just one switch as opposed to the two button arrangement discussed above. This is achieved by connecting pin 7 of the IC to +V during power up. An example of a circuit providing single button control is shown in Figure 7. In this case IC1 pin 7 is permanently tied to the +V supply. In this mode, closing S1 will result in an increase in output level in the same way as with the previous circuits. However, this time if the switch is not closed for a period of one second or more, this results in a change of direction. Another difference is that when the maximum level is reached, further operation of S1 will result in a reduction in level as opposed to no change with two button operation. If S1 is closed continuously, the effective position of the wiper will cycle between maximum and minimum via all intermediate tap points.

The digital input on pin 3 of the IC is not connected in any of the above circuits as they are all designed to operate using momentary action push to make switches. The digital input may be used for interfacing the IC to a microprocessor or similar control device. The operation of the IC when controlled via pin 3 is broadly the same as for single button operation although it is possible to change the potentiometer setting at a faster rate. The digital input can be used in connection with applications such as automatic level control. The IC may be controlled digitally via pin 3 in addition to any mechanical switching arrangement.

Creating a Half Supply Reference

An alternative to using a true split rail power supply in some applications is to use an op-amp circuit to produce an artificial centre reference rail that can be connected in place of the 0V rail. This type of circuit can be used where the devices connected to the input and output of the potentiometer circuit are not directly referenced to the +V or –V supplies. If this is not the case capacitive coupling must be used for the potentiometer inputs and outputs. An example of how to generate a centre reference voltage is shown in Figure 8. This circuit is simple and effective. Terminal P1 is connected to supply +V and P2 is connected to supply –V. The centre reference output is taken from P4.

Resistors R1 and R2 act as a potential divider producing a half supply reference level. Capacitor C1 acts as bulk de-coupling whereas C2 and C3

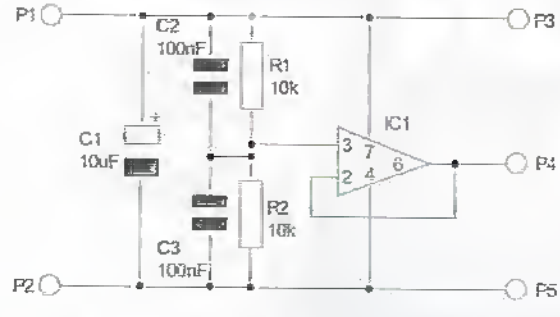


Figure 8. Using an op-amp to produce a centre reference voltage.

help to reduce any high frequency noise that may be present on the supply rails. Although the potential divider formed by R1 and R2 produce a half supply reference without any additional circuitry this is relatively high impedance. The resistor values could be reduced but this would result in increased current drain from the power supply, even when no current is being drawn from the circuit. For this reason an op-amp follower circuit is employed. This provides the same half supply reference level (allowing for any error) at a relatively low impedance but without an unnecessarily high current drain. Once again, it is necessary to use an op-amp which will operate from a low voltage supply such as the TL071.

Circuit Construction

All of the circuits shown may be constructed on matrix board or printed circuit board. Circuit layout is not particularly critical although it is advisable to keep input and output connections separate to prevent stray coupling. It can also be advantageous to use separate wiring runs for analogue (signal) and digital (control) supply lines if low noise performance is to be achieved.

As always, take care when fitting any polarised components such as semiconductors and electrolytic capacitors as incorrectly fitted components are often damaged and can present a safety hazard. The polarity of electrolytic capacitors is normally marked by a negative (-) symbol on the component body. The IC's have a notch at one end. The pin to the immediate left of the notch, when the device is viewed from above, is pin 1 (see Figure 9).

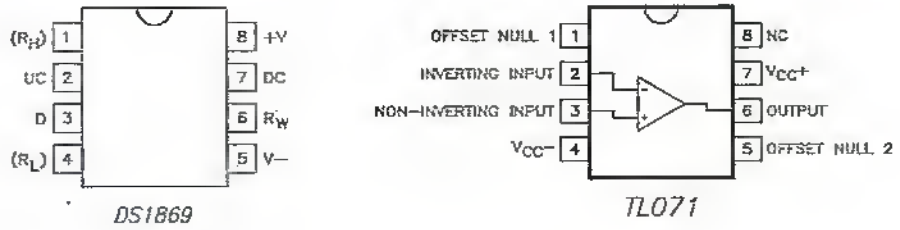


Figure 9. IC pinouts.

Although it is possible to solder directly to the IC's, it is sensible to use a DIL socket. This makes life so much easier, should it be necessary to replace the IC, and prevents the possibility of damaging the device during soldering due to overheating.

Standard PCB pins have been specified in the parts list for simplicity but other types of terminal may be used if preferred. Alternatively the input and output connections may be hard wired onto the circuit board.

Once you have completed construction of the circuit, take some time to double check your work. In particular, look over the soldering to make sure that there are no dry joints or unwanted short circuits. All soldering should be neat and any excess component leads should be removed.

DIGITAL VOLTAGE CONTROL PARTS LIST

RESISTORS			
R1	10k	1	M10K
CAPACITORS			
C1	100µF 10V	1	AT30H
C2	Minidisc 0.1µF 16V	1	YR75S
SEMICONDUCTORS			
IC1	Dig Lin Pot 10k	1	LE21X
MISCELLANEOUS			
S1, 2	Blk Push to Make Sw	2	ND91Y
	Pin 2145	4 pins	FL24B
	DIL Socket 8-Pin	1	BL17T

DIGITAL VOLUME CONTROL PARTS LIST

RESISTORS			
R1	2k7	1	M2K7
CAPACITORS			
C1, 2	100µF 10V	1	AT30H
C3, 4	Minidisc 0.1µF 16V	1	YR75S
SEMICONDUCTORS			
IC1	Dig Lin Pot 10k	1	LE21X
MISCELLANEOUS			
S1, 2	Blk Push to Make Sw	2	ND91Y
	Pin 2145	7 pins	FL24B
	DIL Socket 8-Pin	1	BL17T

Switches

All of the digital potentiometer circuits shown are controlled using momentary action push to make switches. Maplin stock code ND91Y is specified in the parts lists as it is a relatively low cost general purpose component. However, almost any type of push to make switch providing a clean switching action can be used with good results. In fact, the choice of switch is probably more related to aesthetic considerations than electrical specification. It is not necessary to use any additional de-bounce components with the DS1869 as this is dealt with on chip.

Next month...

This month we have covered some of the fundamental differences between analogue and digital potentiometers and investigated a few simple circuit ideas. In the next part, we will look at some more specific practical applications for dual digital potentiometer IC's.

Software HINTS & TIPS

That 3.2Gbyte disk getting rather full already? This month Mike Bedford takes a look at how to free up some valuable disk space.

Experience has shown us that however large a PC hard disk is, it is rarely large enough. Even though that 3.2Gbyte disk may have seemed huge when you bought your PC a couple of years ago, it's probably already starting to bulge at the seams. And if your PC is more than a year old, then finding disk space is likely to be a continual problem. So how do you free up valuable disk space without loosing useful information or jeopardising your system? This is the subject of this month's column.

Temporary Files

The way to free up information, of course, is to find files which you can live without and delete them. The knack, of course, is finding out which files these are. A good place to start is with temporary files, files which applications use for temporary storage. You might hope and expect that such files would be deleted when you exit from the application. In fact, this often doesn't happen so there's probably plenty of scope for saving some space here. As a general rule, temporary files have the extension .tmp and it's usually OK to delete them. Do make sure you close all your applications first, however, or you'll find that – some of the files are locked and can't be deleted. Also, make sure you delete them as opposed to just moving them to the recycle bin – we'll look at this later.

So, where are you likely to find these temporary files? The most likely directories are /temp/ and /windows/temp/ although it's possible that some applications will put them elsewhere. You'll notice from the portion of screen dump taken from Windows Explorer that a lot of space can be tied up in temporary files. Look also, for files (even if they don't have the .tmp extension) which are stored in directories which have temp or temporary in their names. And if you're not absolutely sure that the contents of a directory can be deleted, move them first to the recycle bin and delete them properly only when you're sure you haven't broken anything.

Contents of 'C:\WINDOWS\TEMP'

Name	Size	Type
~d1314.tmp	6,652KB	TMP File
~d9183.tmp	8,492KB	TMP File
~d910e0.tmp	8,747KB	TMP File
~dde365.tmp	12,293KB	TMP File
~d40f4.tmp	12,654KB	TMP File
~dfb038.tmp	13,392KB	TMP File
~dde223.tmp	17,209KB	TMP File
~d9140.tmp	17,279KB	TMP File

102MB (Disk free space: 1.12GB)

Somewhat similar to temporary files are backup files. Some applications keep the previous version of a file with a new extension such as .bak. The idea of backup files is that they allow you to revert to the previous version if you've made a mess of the edit, even after saving the new version. However, if you're sure you'll never want to revert to the previous version, there's some space to be saved here. Corel Draw is a popular application which keeps backups and these files can be particularly large. Internet cache files are also good candidates for deleting – take a look at the options in your browser.

Deleting Files

We've looked at some files which can be safely deleted and no doubt you'll find plenty of others, but the subject of exactly how to delete a file is important. If you simply press the delete key or select the Delete menu option in the Windows Explorer, the selected file(s) will be moved to the recycle bin rather than deleted. As such, you won't actually free up any space. If you want to truly delete a file, you need to hold down the shift key before pressing the delete key or select the Delete menu option. To confirm that this is happening, the icon on the confirmation window will be different. However, you should be aware that anything you delete this way is gone for good. If you're in any doubt whether you need a file, always move it to the recycle bin.

Another area to look at is

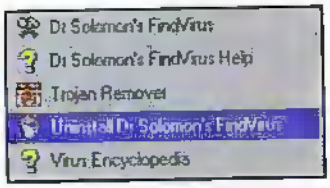
files which are already in the recycle bin. When it gets full, the older files will be deleted as new ones are put into the bin but you can also delete files manually. Double click on the recycle bin icon shown above and a window will be displayed showing its contents. Individual files can be deleted by selecting them and pressing the delete key or the bin can be emptied by selecting the Empty Recycle Bin option from the File menu. Remember, however, once you've done this, those files can't be recovered so be careful.

Having done some housekeeping on your recycle bin you'll have freed up some space but as time goes on, this space will start getting eaten up again. One way to avoid this is to reduce the size of the recycle bin. By default, it is 10% of the size of your hard disk which is probably larger than most people will need. Click right on the recycle bin icon and select Properties from the menu which is displayed. On the Properties window, reduce the size of the recycle bin as required.

Fonts & Packages

So far, we've concentrated on getting rid of files which – hopefully – are of no value whatsoever. From here on, however, we'll have to move our attention to files which, although they have some value, aren't necessarily of value to you. For example, you probably have dozens of fonts installed on your PC yet you rarely use more than two or three. Certainly most people will never use some of the more bizarre fonts which are installed on their PCs. What about your applications? Certainly I wouldn't suggest that you get rid of your major applications or anything else you use on a regular basis. But what about that shareware program or that evaluation software from a magazine cover disk you installed six months ago and haven't used since? In all probability, there's considerable scope for a bit of housekeeping here.

However, don't be tempted just to delete the associated files – even if you can figure out which those files are. Both fonts and applications should be removed from Windows 95 in the proper way. Some applications – like the one shown in the screen shot below – have their own un-install option which you should



use. Failing this, un-install the application using the Add/Remove Programs option in the Control Panel (accessible from the Settings option on the Start menu).

Similarly, fonts should also be removed from the Control Panel, specifically from the Fonts option.

Be Ruthless

Hopefully, the measures we've already seen will free up a significant amount of disk space. However, if you still don't have enough free space, you're going to have to be ruthless. In other words, you're going to have to start deleting some documents. Most people hoard files forever, yet very often, stuff more than a few months old is never accessed again. So look through your documents – concentrating on those files with graphical content since these tend to be the largest – and delete those you can live without. You'd be surprised how much space this could give you. If you have a backup device such as a tape streamer, a sensible approach would be to archive them rather than simply deleting them.

Diary Dates

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

November 1998

10 to 12 Nov. Project Data Management 98, National Exhibition Centre (NEC), Birmingham. Tel: (01932) 564455.

10 to 12 Nov. Control Systems Integration 98, National Exhibition Centre (NEC), Birmingham. Tel: (01932) 564455.

10 to 12 Nov. Computer Aided Manufacturing 98, National Exhibition Centre (NEC), Birmingham. Tel: (01932) 564455.

10 to 12 Nov. Process 98, National Exhibition Centre (NEC), Birmingham. Tel: (01932) 564455.

10 to 12 Nov. Fifth International Conference on Trends in Distribution Switchgear, IEE, The Commonwealth Institute. Tel: (0171) 240 1871.

11 Nov. Alternative Teaching Methods, Colloquium, Savoy Place, London, IEE. Tel: (0171) 240 1871.

11 to 12 Nov. National Project Management Exhibition, National Motorcycle Museum. Tel: (01256) 762 460.

11 to 12 Nov. Data Warehousing, Olympia, London. Tel: (0181) 879 3355.

11 to 12 Nov. Softworld Sales and Marketing, National Exhibition Centre (NEC), Birmingham. Tel: (0181) 541 5040.

12 to 13 Nov. Practical Digital Signal Processing (DSP) for Engineers, Manchester. Tel: (0181) 335 4014.

16 to 17 Nov. Practical Digital Signal Processing (DSP) for Engineers, Birmingham. Tel: (0181) 335 4014.

16 to 17 Nov. Middleware Choices Europe, Giga Information Group, Frankfurt. Tel: (01753) 831 731.

17 to 19 Nov. Digital Media World, Wembley Exhibition Centre, London. Tel: (0181) 742 2585.

18 Nov. Exploring Learning Technology: Issues for Educators and Trainers, Colloquium, Savoy Place, London, IEE. Tel: (0171) 240 1871.

18 Nov. Working Experiences in Europe, Colloquium, University of Sheffield, IEE. Tel: (0171) 240 1871.

19 to 20 Nov. Practical Digital Signal Processing (DSP) for Engineers, Bath. Tel: (0181) 335 4014.

23 to 24 Nov. Practical Digital Signal Processing (DSP) for Engineers, Southampton. Tel: (0181) 335 4014.

24 Nov. Computational Neuro-Science, Colloquium, Savoy Place, London, IEE. Tel: (0171) 240 1871.

24 to 25 Nov. Image Processing and Digital Document Management, Fielder Centre, University of Hertfordshire, Hatfield. Tel: (01727) 813 651.

25 Nov. Enterprise Networking for SMEs, Colloquium, Savoy Place, London, IEE. Tel: (0171) 240 1871.

25 Nov. Modern Methods of Detection for Buried Utility Services, Discussion Meeting at Savoy Place, London, IEE. Tel: (0171) 240 1871.

25 to 26 Nov. Developments For The Web, The Commonwealth Institute, Kensington, London. Tel: 01908 373311.

26 to 27 Nov. Practical Digital Signal Processing (DSP) for Engineers, London. Tel: (0181) 335 4014.

December 1998

1 to 3 Dec. Year 2000 Conference, Giga Information Group, Berlin. Tel: (01753) 831 731.

8 to 10 Dec. Online Information 98, National Hall & Olympia 2, London. Tel: (01865) 388000.

14 to 16 Dec. Second International Conference on Partial Discharge, IEE, Edinburgh. Tel: (0171) 240 1871.

Please send details of events for inclusion in 'Diary Dates' to: News Editor, *Electronics and Beyond*, P.O. Box 777, Rayleigh, Essex SS6 8LU or e-mail to swaddington@clx.compulink.co.uk.

What's On?

Intel Developers Gather to Reflect on PC Platform

The great and the good of the PC industry gathered at the Intel Developer Forum to learn about new capabilities for the coming year's computing platforms. The group studied developments ranging from the redesign of the PC to remove legacy issues to new platform designs for more powerful, less costly Basic PCs.

Also highlighted were technologies that increase computing power and battery efficiency for mobile computers, continuing developments for Intel Architecture-based workstations and servers, and new rich media instructions for a 1999 line-up of Intel microprocessors.

"The Intel Developer's Forum is a technical forum that is short on marketing hype and long on details. The core challenge facing our industry is to make computers ever more powerful while being easier to use and simpler to maintain. The solution to this challenge begins with the technical experts of the industry coming together at this forum," said Dr. Craig Barrett, Intel president and chief executive officer.

Organised by Intel's chief technology architects, the forum, which ran from September 15 to 17, addressed solutions for desktop, workstation, server, mobile and embedded platforms. A wide range of topics covered in the 15 graduate-level technical tracks and over 80 in-depth technical sessions and hands-on labs provided insight to design engineers.

There were also be 80 exhibits, which facilitated peer discussions and distribution of developer toolkits that will prepare the industry to focus its energies on the opportunities as well as the challenges in the year ahead.

In addition, Intel announced the formation of a publishing house called Intel University Press. This organisation will distribute publications such as Hardware Test Specifications that will help define the architecture for developers and design engineers.

The Intel Developer Forum is a semi-annual technical forum designed to be the PC industry's premier source of tools and training for advanced platform developers. It is one of the few company-sponsored technical conferences targeted at technical computing experts.

More information on the Intel Developer Forum can be found at <developer.intel.com/design/idf>. Updated information between Intel Developer Forums is available by subscribing to the Platform Solutions Newsletter at <developer.intel.com/solutions>.

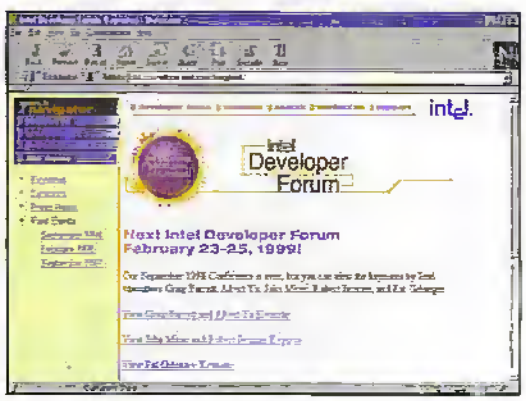
Apple Previews Mac OS 8.5 at Seybold

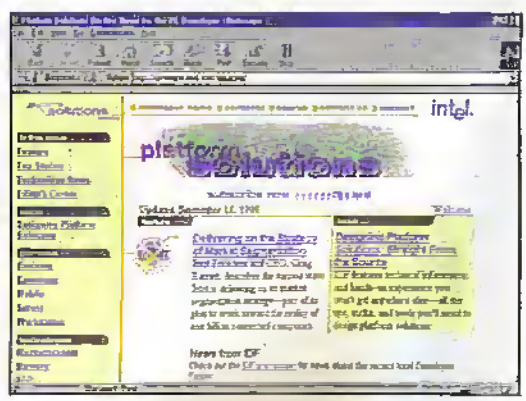
During a keynote at the Seybold Conference and Expo for the converging publishing, media and technology industries at the beginning of September, Apple previewed key features of Mac OS 8.5, a major upgrade to the Macintosh operating system. Billed as a 'must-have' upgrade for Apple's design and publishing customers, Mac OS 8.5 includes significant advances in Internet search capabilities with its new Sherlock technology, market-leading networking performance and advanced workflow automation.

Major software developers including Adobe Systems Inc., Macromedia Inc., and Quark Inc. also pledged support for Mac OS X, the next-generation evolution of Mac OS, expected to be available in the autumn of 1999. Demonstrating the fast-track development cycle that's part of Mac OS X, leading publishing solutions were shown running on the new operating system.

"Apple is delivering cutting edge technologies for designing and publishing in the digital age. The combination of Apple's new products and outstanding design and publishing applications from Macintosh developers firmly underscores Macintosh's place at the heart of the publishing industry," said Steve Jobs, Apple's interim CEO.

Mac OS 8.5 is slated for introduction at the end of this year. New features in Mac OS 8.5 include: Sherlock, a revolutionary new technology that allows users to search the Internet without using a browser and to conduct searches for documents on local hard drives based on their content; networking performance that's faster than Windows NT; and fully native PowerPC AppleScript that automates simple tasks or complex workflow operations at lightning-fast speeds.





New Products from NUMBER 1 SYSTEMS

MultiRouter for Windows 95

MultiRouter is a family of powerful shape-based multi-pass autorouters for Easy-PC that can help you produce perfect single, double-sided and multi-layer layouts in record time. MultiRouter combines the latest routing technologies to ensure that your tracks get through where other autorouters fail. Gridless routing handles difficult components like D-connectors and surface-mount packages, making the maximum use of available space. Shove-aside ensures that design rules are obeyed, while Rip-up and Re-try keeps trying problem areas until a solution is found. Multi-pass routing refines the layout, mitring corners, removing unnecessary track segments and vias, with the option of fattening tracks wherever possible. MultiRouter will complete most designs in minutes, saving you days of layout design time, and is available in three different versions:

MultiRouter II for single and double layer designs	LD54J	£346.52
MultiRouter IV for up to four layers including power planes	LD56L	£699.12
MultiRouter VIII for up to eight layers including power planes	LD59P	£1116.25

Upgrade versions are available

Multirouter up to Multirouter II for Windows	LD55K	£88.12
Multirouter IV for Windows up to 4-layer Autorouter	LD56L	£699.12
Multirouter IV up to Multrouter IV for Windows	LD57M	£111.62
Multirouter II for Windows up to Multrouter IV for Windows	LD58N	£353.50
Multirouter VIII up to Multrouter VIII for Windows	LD61P	£111.62
Multirouter II for Windows up to Multrouter VIII for Windows	LD62S	£769.62
Multirouter IV for Windows up to Multrouter VIII for Windows	LD63T	£417.12

Easy-PC for Windows 95/NT

Easy-PC for Windows 95 and NT is a new 4th-Generation advanced printed circuit board and schematic design system that combines a simple and intuitive user interface with a set of powerful features normally found only in the most expensive packages. The use of technology files (like style sheets in a word processor) makes it easy to configure new designs in a matter of seconds and allows you to impose a 'house style' on your designs if you wish to. The technology file also contains all the manufacturing information relating to the design minimising the chances of costly errors occurring when the board is made. Easy-PC is shipped with a full set of component libraries, and new components can quickly and easily be added to you own libraries.

Easy-PC can be linked to a full range of optional circuit simulators including Analyser and Pulsar for linear and digital circuits, and our revolutionary electromagnetic simulator, Layan, can even be used to simulate the electrical effects of the actual physical layout itself. Easy-PC can manage complex design projects including Multi-sheet schematics, copying and renaming all the associated files automatically if a layout or schematic is saved under a different name. This makes it very easy to re-use older projects as templates for new designs.

Easy PC for Windows	LD50E	£699.12

Upgrades versions are available

Easy PC Prof XM to Easy PC for Windows	LD51F	£411.25
Easy PC Prof to Easy PC for Windows	LD52G	£528.75
Easy PC to Easy PC for Windows	LD53H	£611.00

Layan for Windows 95/NT

Layan is a powerful electromagnetic simulation program that synthesises an equivalent lumped circuit to mimic the physical conductor areas on a printed circuit board or other circuit substrate. Until now, many engineers working in RF design have been unable to reap the full rewards of the recent advances in circuit simulation techniques. Even when a theoretical circuit has been simulated, prototypes often fail due to unforeseen coupling effects between the conductors linking the components. Moreover, many RF and microwave designs now make intentional use of layout elements in implementing inductors, stripline filters and coupling components. Until now, it has only been possible to simulate circuits using these structures by using expensive software packages running on Unix workstations.

Layan is the result of over 20 man-years of development, and bridges the gap between theory and practice, enabling simulation of the complete circuit including all the parasitic resistances, capacitances, inductances and both inductive and capacitive couplings introduced into the circuit by the PCB or other substrate on which it is assembled. Layan runs on a standard PC and produces results in a fraction of the time taken by some earlier generation software.

Layan is designed to integrate with Easy-PC and Analyser, taking a physical layout and theoretical circuit schematic designed in Easy-PC and passing the resulting equivalent circuit on to Analyser for simulation.

Layan	LD67X	£518.12

An upgrade version is available

Layan to Layan for Windows	LD68Y	£88.12

Number 1 Systems Software

Pulsar for Windows 95/NT

Pulsar for Windows 95/NT is a Digital Logic Circuit Simulator program that can completely eliminate many of the expensive and time consuming aspects of digital design. Pulsar allows you to test your designs without soldering a single component, and without the need for expensive test equipment. With Pulsar, you could even skip the bread boarding stage altogether and go directly from design concept to PCB! The program features fully programmable signal sources, adjustable component models and a printable logic analyser display that can catch glitches down to one picosecond. Pulsar can be used from within Easy-PC for Windows 95/NT or stand-alone with its built-in netlist editor.

Pulsar for Windows	LD74R	£287.87

Upgrade versions available

Pulsar Professional to Pulsar for Windows	LD75S	£88.12
Pulsar Standard to Pulsar for Windows	LD76H	£170.37

Filtech for Windows 95/NT

Filtech is an extended filter circuit synthesiser and is available in upgrade versions.

Filtech for Windows	LD77J	£287.87

Upgrades versions are available

Filtech Professional to Filtech for Windows	LD78K	£88.12
Filtech Standard to Filtech for Windows	LD79L	£117.50

Other Number One Systems Products

Practical Simulation of PCBs Book	LD69A	£58.75
Z Match Professional	LD70M	£287.87
Z Match	LD71N	£170.37

Upgrade

Z Match to Z Match Professional	LD72P	£117.50

RF & Microwave Designer

This extensive package is an integrated suite for RF and microwave design and contains Easy PC for Windows, Layan for Windows, Analyser for Windows and Z Match Professional.

RF & Microwave Designer	LD73Q	£1468.75

EMC Video

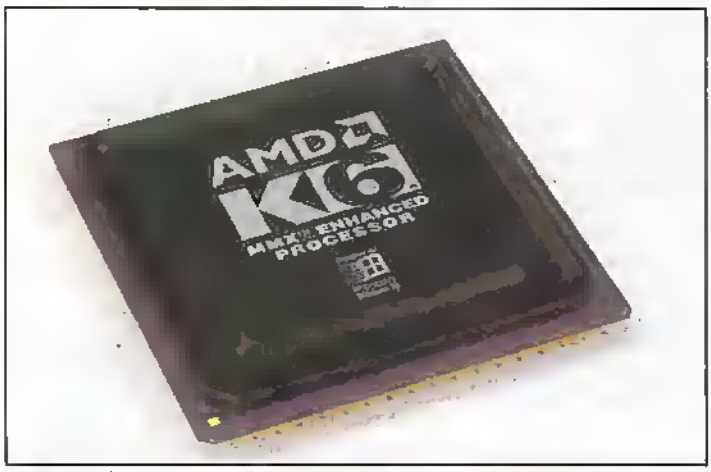
This video provides an informative and very watchable way to get to grips with the technicalities of EMC, and is produced by the EMC Distance Learning Centre at the University of Hertfordshire.

EMC Video	LD60B	£117.44

Processors

CHIPS WITH EVERYTHING

Intense competition is ruling the processor market at the moment. Intel is struggling to keep control whilst a host of competitors are snapping at their heels - AMD, Cyrix and IDT Winchip are catching up fast. Simon Peers, Maplin Product Group Manager, looks at what's ahead.



Faster and better technology at a higher price has always been a driving force behind the huge success of Intel. In the past year the company has experienced setbacks as the sub $1000 PC using rival manufacturers clones have flooded the market. The AMD processors are now estimated by AMD to have grabbed a 30% market share for PCs using budget processors, typically 200, 233, 266MHz. This is because of the Intel policy of withdrawing from the market quickly. Similar to Microsoft's turnaround on the Internet, Intel is now combating the clone makers with improved versions of its entry level Celeron range.

The computer industry has a penchant for codenames and Intel is not an exception. Traditionally Intel has named its forthcoming releases after rivers and mountains e.g. Klamath was the codename of the first Pentium II, Covington for the first two versions of the Celeron, and Mendocino for the cache enabled Celeron. Also, there are the various projects such as the Geyserville project which was a low power mobile platform for increasing battery life, and the Whitney project intended to integrate graphics and audio into the chipsets.

Intel - What Lies Ahead

Intel's road map is key to the development of the future, with the following planned developments:

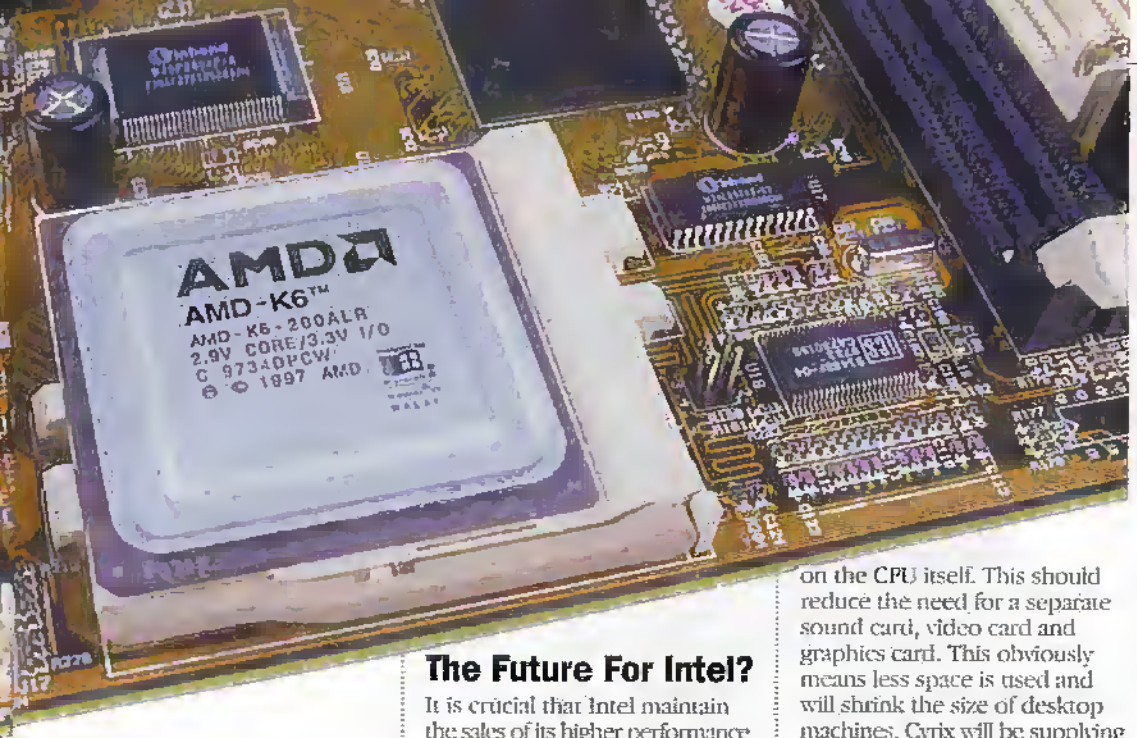
- **Budget Celeron** - The Celeron will get faster and faster. The 366MHz Cache version is due in the first quarter of next year. The budget range will reach 400MHz by the second half of next year.
- **Desktop Range** - The 450MHz has just been released and Maplin is stocking this item - order code PV84F. The next Pentium II offering is likely to come with MMX enhancements when 500MHz arrives in the first quarter of next year, with 533MHz and 600MHz versions in the second part of the year.
- **Katmai** - This is Intel's next major launch processor and features an enhanced version of MMX, giving the CPU 70 more instructions. The new instruction set will make the 500MHz processor better at using multimedia data, particularly 3D CAD/CAM and games software. Intel is planning to release Katmai in the first quarter of 1999
- **Xeon** - The Xeon is Intels entry into the highly competitive workstation market. Two products are planned a 450MHz version and a 500MHz version codenamed Tanner in 1999

Notebooks

The market for notebook processors is much more complicated and is running behind the desktop market but faster and faster processors are on their way typically starting from 266MHz, MMX to PII. Before long 250MHz and 400MHz versions will be available.

The Future

There are a few technologies, like 3D graphics, speech, handwriting recognition, which will drive the demand for more computing power and more memory (all of which is available ex stock from Maplin). The new applications will push the requirements for processing power further and into Intel's hands



What's Happening Now?

Generally, customers, particularly the corporate type, are realising that they no longer need to order the very latest PC, and as a consequence, sales of many midrange and high end PCs are not as good as they used to be. Consequently, companies like Intel are getting less revenue for each PC sold, which is further aggravated by the speed at which the price of the higher end processors falls as AMD and Cyrix bring out clones. The upshot of it is that hardware generally both memory and processors is advancing faster than the software requires. Most software development is now heavily Internet web based. Apart from games software, there are few popular applications which will run badly on a standard 133MHz *Pentium, or equivalent.*

The Future For Intel?

It is crucial that Intel maintain the sales of its higher performance processors as this is where the bulk of its revenue is found and profit margins are greatest. The processors aimed at the sub $1000 machine account for around 35% of Intel's sales, but they contribute only 15% to Intel's revenues due to the lower selling price. Intel's performance desktops on the other hand are about 50% of its revenue but 60% of its profits. Intel is the market leader and will comfortably remain so for the foreseeable future. Maplin have several versions available from Intel.

Cyrix

Cyrix has traditionally followed Intel with clones but are now integrating more and more devices on the same wafer - a system on a chip. It cannot be long before the sub £300 PC is around ! Cyrix have integrated many of the new requirements, for example 3D Graphics engines, increased memory bandwidth to the new 100MHz standard and MPEG-2 and DVD on the CPU itself. This should reduce the need for a separate sound card, video card and graphics card. This obviously means less space is used and will shrink the size of desktop machines. Cyrix will be supplying vendors of 'information appliances' for example DVD players, Web servers and the latest Web TV. Maplin sell three versions of the Cyrix chip.

AMD

AMD will be launching processors with speeds of 400MHz later this year. Maplin's current offering includes the 3D Now Technology launched earlier this year.

Whats 3D Now ?

3D Now is a set of instructions built into AMD's K6-2 range. It lets the CPU do its work faster and gets the data to the graphics card faster, which is especially beneficial for work with complex web pages, multimedia presentations and 3D games. To take advantage of the 3D Now chip, software developers are optimising applications to use the new instructions.

IDT Winchip

IDT are a memory company and they have started to promote a range of budget, very low cost, basic processors.

Order Code	Type	Inc. VAT	Ex. VAT
PV81C	PII 400MHz Boxed	£411.99	£350.629
PV82D	PII 450MHz Boxed	£567.99	£483.395
PV83E	Pentium II 400	£409.99	£348.927
PV84F	Pentium II 450	£562.99	£479.140

Order Code	Type	Inc. VAT	Ex. VAT
PV68Y	Cyrix 233MHz	£39.99	£34.034
PV69A	Cyrix 300MHz	£69.99	£59.565
PV70M	Cyrix 333MHz	£119.99	£102.119

Order Code	Type	Inc. VAT	Ex. VAT
PV71N	AMD K6 3D 300MHz	£95.99	£81.693
PV72P	AMD K6 3D 333MHz	£119.99	£102.119
PV73Q	AMD K6 3D 350MHz	£186.99	£159.140
PV74R	AMD K6 300 Boxed	£102.99	£87.651
PV75S	AMD K6 350 Boxed	£194.99	£165.948
PV76	AMD K6 233 Notebook	£87.99	£74.885
PV77	AMD K6 266 Notebook	£160.99	£137.012

Order Code	Type	Inc. VAT	Ex. VAT
PV78K	IDT Winchip 200	£29.99	£25.5234
PV79L	IDT Winchip 220	£33.99	£28.92766
PV80B	IDT Winchip 240	£38.99	£33.18298

Congratulations!

Go to J. Hewitt, Llandovery; W. N. Heeley, Worcester; R. G. Hannis, Reading; M. Jamil, Birmingham; John Francis, Bognor Regis; R. M. Hardy, Co. Antrim; W. F. Mills, Havant; Alan Jones, Swansea; T. Johns, Devon; S. J. Robinson, Maidstone who all will receive a copy of Electronics and Radio Facfinders from Newnes.

To R. G. Halls, Stockport; Ron Andrews, Chingford; M. McKinney, N.I.; Kay Walton, North Yorkshire; C. R. Spraggins, Mildenhall; K. Hurle, Crowborough who all will be receiving a copy of Ian Waugh's book Making Music with Digital Audio.

And finally to G. Cohen, London; F. Nutall, Herne Bay; R. Bridgen, Woodford Green; M. Moore, Chatham; D. W. Clark, Aberdeen; Dave Goleman, Hemel Hempstead who have all won a Gator Grip.

For those unlucky to win a Gator Grip, remember that this superb universal socket kit is available from Maplin (order code NF89W) at £24.99.

The socket uses a unique sprung pin system that will grip even rounded of nuts, and will instantly grip any size or shape of nut up to 20mm. I comes with a reversible ratchet and a power adaptor for use with drills or powered screwdrivers. A must for all tool boxes!

TECHNOLOGY WATCH

with Martin Pipe

At this years Live 98 exhibition, held at Earls Court at the end of September, digital was very much the buzzword. Sure, the same was true of the last Live event two years ago, but then virtually everything at the exhibition was focused on the Internet, with various equipment manufacturers and service providers occupying many of the stands. This year, there was not quite as much Internet focus. The biggest Internet presence was that of service provider AOL. At its stand, you could receive tuition and coffee! That said, consumer electronics retail giant Dixons took the opportunity to launch its new Internet service, which it calls Free Serve. As the name suggests, there is no monthly charge – unlike Demon and its ilk. All you pay is the cost of call charges to points of presence when you are on-line which are local-rate numbers of the type employed by conventional ISPs anyway!

So what's the catch? On the face of it, the only disadvantage is the cost of technical support, which is charged at 1p per minute. The way in which the service is primarily funded, however, appears to be through its relationship with Energis, the company that provides its telecommunications facilities and backbone connectivity. Dixons gets a slice of the call revenue that Energis makes. Interestingly, Energis – which routes most of its cabling alongside powerlines (hence the companys name) – supplies telecoms services to many conventional ISPs. Hmmm. Although its probably unfair to say that the more established ISPs have been ripping us off for years, the arrival of FreeServe could put a competitive bomb under the Internet provision market – which is rapidly becoming ever more mainstream (witness the arrivals of Branson and Tesco, which were also present at Live '98).

Hands up those who remember the Commodore 64! For the benefit of younger readers, this was an early 8-bit home computer that launched many into programming – and games – during the mid 1980s. If you could afford more than the Sinclair Spectrums asking price, and wanted an alternative to the BBC Micro then you could have gone for one of these. The C64 was very popular in its day, and indeed emulators and software can be found in the Internets nooks and crannies. Despite many attempts at resuscitating Commodore and its Amiga computer (the 64's successor) – including one by the ill-fated Escom chain – it looks like the corporate undertaker was called in some time ago. A shame, really – the Amiga was a fine PC in its day, and indeed many are still being used for graphics and video work. But, the Commodore name lives on, as an organisation known as Web Computers International. It has bought the C64 branding and applied it to a new network computer – essentially a stripped-down PC designed primarily with net-surfing in mind.

The latest incarnation of the C64 is somewhat more powerful than its illustrious predecessor, although like the original it uses the TV as a display device. C64 MkII, which resembles a notebook PC without the display, is based around a 32-bit AMD processor instead of a 6502, has 16Mb RAM compared to the originals 64k, and includes half-decent 16-bit stereo sound. The new C64 has an in-built V90 modem, and a floppy disk drive for loading programs and saving data (although slow by hard disk standards, it's a helluva lot quicker than the original machines cassette drive). Supplied software includes PC-DOS, Windows 3.1, TCP/IP stack, Netscape, Lotus home-office apps and – yes, you've guessed it – an emulator for the original 8-bit C64! For its £300 asking price, though, you could build a real PC if you shop around the various computer fairs and auctions. But hell, that sort of customer does not form the new C64's target market.

Most computer manufacturers were, however, conspicuous by their absence, the exceptions being Compaq and Psion. There was no Microsoft, and no Apple. Bearing in mind that the latter is targetting its sexy new iMac directly at the consumer, this is particularly interesting. Pace – the modem and set-top box manufacturer – demonstrated its new TV card. This product, which fits into a spare PCI slot (if youve got any left) gives you the opportunity to watch TV on your PC monitor. Features include the ability to receive Nicam stereo sound and teletext, and S-video/composite video inputs. Teletext pages can be saved to your hard disk, as can video and still image captures. If you have a camcorder, the Pace TV Card will also allow you to participate in videoconferencing across the Internet. Although products of its ilk have been available for some time, the Pace model is – at £80 – one of the cheapest around. It also appears to be one of the better-specified. A version with FM stereo radio will sell for £100 – myself, Id rather wait for a DAB model...

Which leads us nicely onto the undisputed main focus of Live 98 – digital broadcasting. First to launch is Sky Digital, which will offer as many as 200 channels (including the existing channels we know and love, as well as some new services such as near on-demand movie delivery. Sky Digital had a large very impressive stand that was occupied, at various points during the show, by sporting celebrities – including the footballers that its broadcast rights payments have helped to make multi-millionaires. Sky Digital launched on October 1st – although as a long-term Sky subscriber I'm still waiting for the information pack that I asked for over a month ago! I wonder how many other subscribers are in the same boat?

Although Sky Digital receiving equipment is being offered at a heavily subsidised price (£160) to existing subscribers, you don't actually have to subscribe to Sky Digital to qualify! I can see many people using their Sky Digital receivers to get half-decent reception of BBC, C4 and C5 – free services being carried via the same Astra 2A satellite (28.2° east). Lest we forget, some people can't currently get the terrestrial channels

The Commodore C64 re-born!

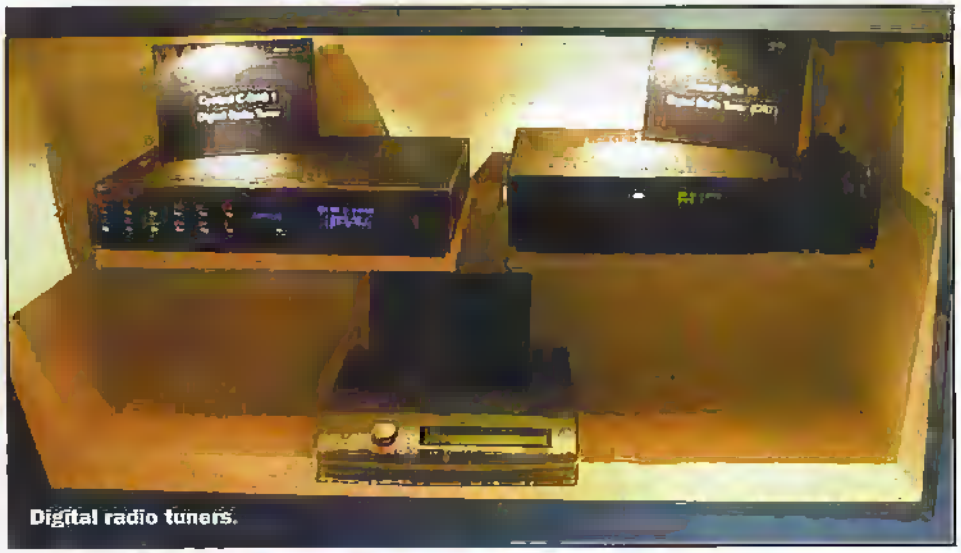
Sky Digital stand.

that most of us take for granted, and would you believe it, there are still some main terrestrial TV transmitters that carry BBC1/2 with mono sound, and not digital Nicam. So much for the BBCs digital revolution!

Ah yes, terrestrial. Which leads us neatly onto *onDigital*, as the terrestrial digital licensee is now known. This organisation, primarily a partnership between the Granada and Carlton ITV franchisees, showed itself to the public for the first time at Live 98. Although *onDigital* will not offer Sky Digitals sheer choice, most – but by no means all – UK viewers will be able to use their existing rooftoop aerials to receive the service. Plus they'll get a digital simulcast of ITV as well as a new ITV 2 channel. These free-to-air channels will not be carried by the Sky service, largely because theres insufficient capacity to carry every single ITV franchise. Like Digital Sky viewers, onDigital subscribers will also be able to access BBC 1/2, BBC Choice and BBC News24, in addition to C4, C5 and a new specialist subscription movie service from C4.

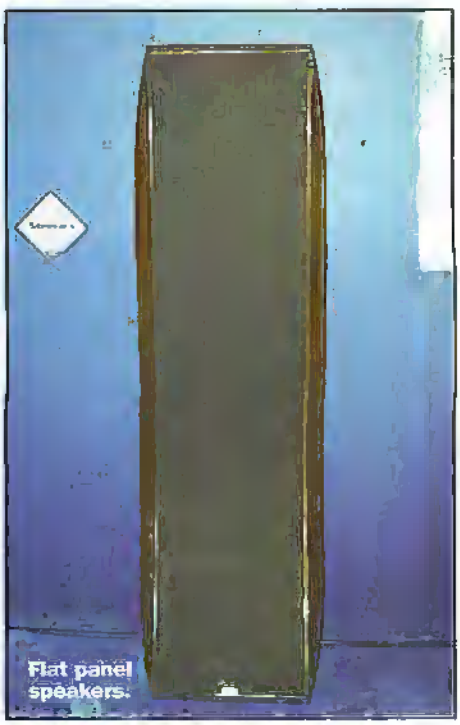
The set top box required for onDigital is similar to the ones needed for Digital Sky, and these were shown at the onDigital stand receiving test transmissions. Here, visitors could also be entertained by leading stand-up comedians like Lee Hurst and Ben Norris, and be treated to a history of television. onDigital plans to launch itself to the British public during the last quarter of 1998 – more specifically, some time in November. The set-top boxes will retail for around £200, but a subscription will be required. The basic package of 12 channels will cost you around £10 per month. It remains to be seen whether one or both of these digital broadcasters will survive in the long-term. Some pundits reckon that we have seen it all before with the Sky/BSB debacle, I could not, however, possibly comment! Digital TV set-top boxes for Sky and onDigital were also being demonstrated at the Nokia, Philips, Grundig, Pace and Sony stands.

BBC Digital had a large stand at Live 98, intended to promote its new TV and radio services. For many of us, Live 98 was the first opportunity to sample the new DAB at first hand. Production audiophile tuners from Arcam and Cymbol were on display at the BBC stand, in addition to a concept design from the BBC itself. Various car radios were also on display, and it was possible to hear these through loudspeakers or headphones. Comparisons with FM radio were also possible. Arcams tuner, the 800 Alpha 10, was also demonstrated on Arcams own stand. The DAB gear at Live 98 seemed somewhat overpriced, considering that its


Digital radio tuners.

essentially nothing more than a QPSK demodulator, MPEG audio decoder, DAC and control logic in a fancy box – it certainly makes the world of PC peripherals seem like good value. Indeed, in a recent Technology


The latest in-car audio.


Flat panel speakers.

Flat screen plasma televisions.

Watch we discussed Radioscapes plan to build a software DAB receiver for considerably less than £100.

Hi-fi and home cinema was well represented at Live 98 – Arcam apart, it was possible to see audiophile gear from the likes of Linn, KEF, Mission, Pioneer (what a horrible new logo!), Marantz, JBL, TEAC, Yamaha and Naim amongst others. At the Mission stand, you could hear the recently-launched x-Space NXT flat panel speaker, the underlying technology of which was discussed some time ago in this column. They sounded good overall, but were somewhat bass-shy – a subwoofer is essential in my opinion. Wharfedale also launched its own flat-panel speaker, the Flat Panel, at Live 98. One of the most ingenious audio products, however, came from Sharp. Its latest Network Audio midi system, the MD-X5H, will play music downloaded from the Internet, presumably as MPEG Layer 3 (MP3) files. The MPEG audio compression system is not unlike the ATRACS employed by the Minidisc digital recording format, which the MD-X5H also includes. A decoder able to handle both isn't out of the question. There was plenty of car audio on show, notably within various impressive demonstration vehicles.

At Live 98, flat TV screens were in abundance. How things change. A mere two years ago at Live 96, the only one that could be seen was the Sony Plasmatron – then a concept product. Sharp, Sony and Pioneer all had hardware on show. The drawback? Undoubtedly the price – you will not get much change from £10,000. Pioneers plasma model was considerably more expensive even than that. Although picture quality is good, it was not much better than the somewhat cheaper CRT-based displays. It will be some time before plasma screens, or flat displays employing an alternative technology, become available to a mass market. That's the display – but what about the source? Pretty much all of the major consumer electronics manufacturers present had at least one DVD player on show. There is now a portable model from Sony! Acceptance of DVD is steadily growing, thanks presumably to a growing base of affordable software. On which subject, MGM used Live 98 to launch its range of DVD titles. The first will be the Bond flick *Tomorrow Never Dies*, but the studio will be following this up with a range of releases that includes *Rain Man*, *Raging Bull* and *Midnight Cowboy*.

Live is very much a showcase for the kind of gadgetry that Bond sidekick Q would be proud of – and Live 98 didn't disappoint. Radar detectors, digital cameras and mobile phones with built-in PDAs were all there to play with and buy. Hondas solar-powered car was also on show, although you could not buy it. The only mobile phone networks with a direct presence were Orange (the Orange Shop) and One2One, which are aimed primarily at consumers. Cellnet and Vodafone were there indirectly, via a handful of retailers. Mobile phone manufacturers present were Nokia (complete with that new object of cellular techno-lust, the 8810), Ericsson, Philips and Sony. What no Motorola? Hmmm. Alcatel showed off a new videophone, primarily as a concept.

Most enduring image of the show? Undoubtedly the PlayStation stand, where the MC managed to cajoule the primarily-young audience into shouting Sony at the tops of its collective voice. Well, I suppose it's one way of assuring brand loyalty from an early age! The next show – the new millenium's first Live – is scheduled to take place between 21st and 24th September 2000 at the same Earls Court venue. By then, we will know who – if anybody – has won the digital TV war. Hopefully, the next show will also feature DAB radios and flat screen TVs that the man in the street can afford. And last of all, we hope to see Apple at Live 2000 – assuming that its still around of course...

E-mail your comments or suggestions to Martin Pipe at whatnet@cix.compulink.co.uk – Or look out for him online! His ICQ ID is: 15482544

Sony portable DVD player.

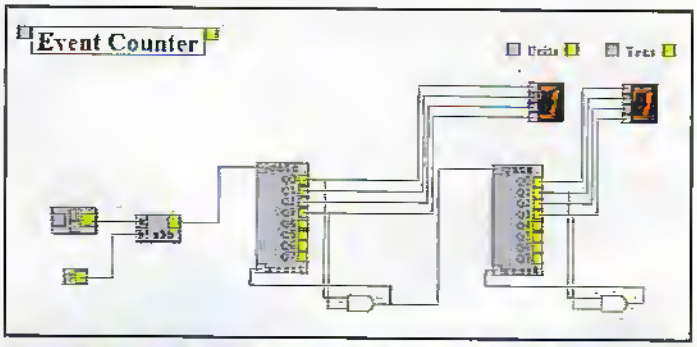
Honda solar powered car.

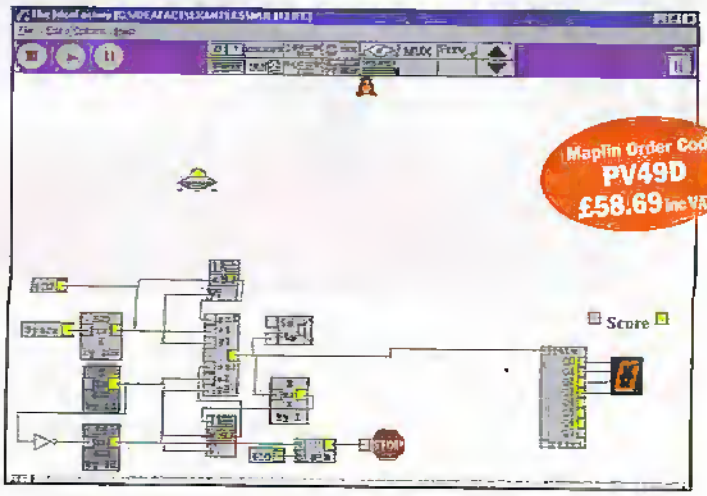
THE IDEAFACTORY

The IdeaFactory from Quickroute is a radical new product that lets you combine logic gates, switches, sliders, mathematical functions, 2D and 3D graphs, LED's, sounds and animation to model a whole range of scientific, electronic, mathematical and design/technology projects.

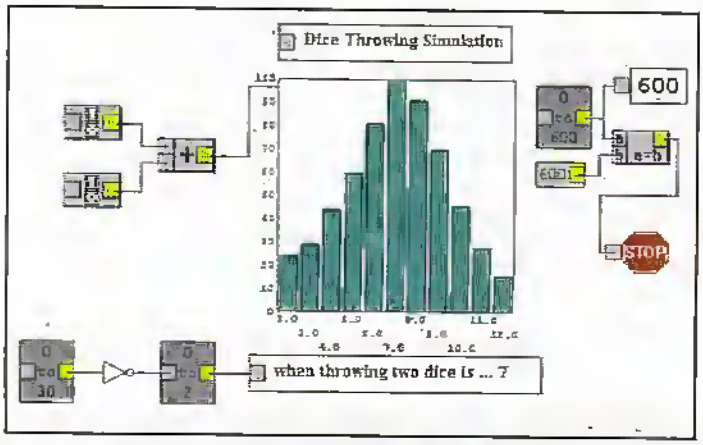
For example, to look at probability – simply drag a dice (random number generator) and wire it to a bar chart. Press the PLAY button and watch the numbers appear in the bar chart (above). Similarly you can model and plot the path of a projectile (right), create a UFO game with animation and sound effects (below), analyse a logic circuit (below), or create an animated lift under the control of buttons placed on different floors. You can also create worksheets and presentations using the built in text and animation facilities.

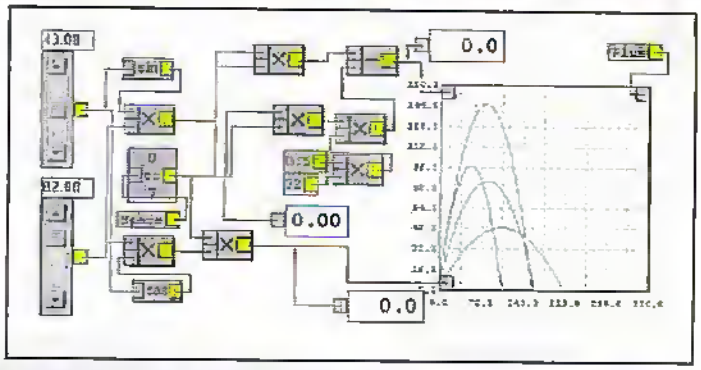
Much more than just a circuit simulator, The IdeaFactory gives you a vast range of modules many of which have a rich set of options. Modules include logic gates, LED's, 7-segment displays, switches, sliders, mathematical modules (plus, minus, multiply, divide, sin, cos, exp, power, 1/x, summation, etc), 2D (x/y) and 3D (x/y/z) graphs with triggered clear, 8 trace logic analyser, bar chart, chart recorder with 4 traces and gain/offset, animation, bitmaps, moving bitmaps (so you can create games, etc), triggered sounds, on screen keypads, keyboard triggering (eg space bar triggers an 'event'), number (start/step/stop) and random number generators, triggers, compartitors, sequencers, and much much more!





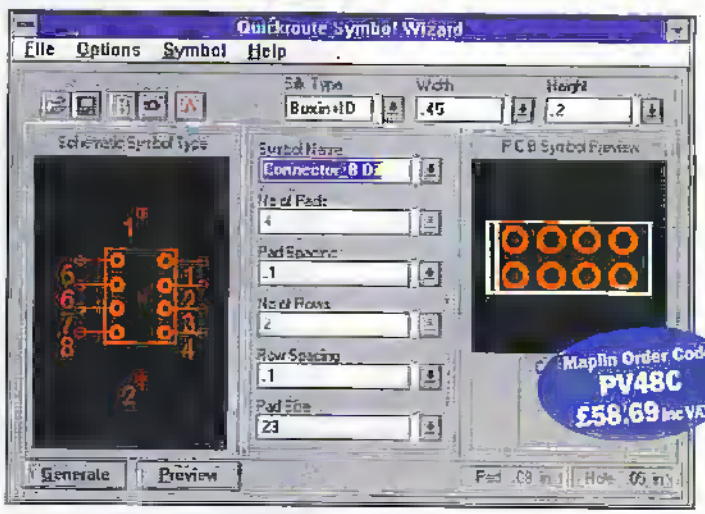
Maplin Order Code
PV49D
£58.69 inc VAT





SYMBOL WIZARD

This new PLUG-IN module for Quickroute 4 automates the creation of new symbols. Choose from over 100 predefined templates, customise pad size and dimensions, select from a range of silk screen styles, and SymbolWizard does the rest – automatically creating a suitable schematic & PCB design ready to be added to Quickroute's or your own custom libraries.



Maplin Order Code
PV48C
£58.69 inc VAT

SymbolWizard is fully customisable, and the symbols are shown 'live' as you alter the properties. Supplied with comprehensive documentation, SymbolWizard saves time, and ensures consistent results!

Templates supplied include a wide range of capacitors, connectors (DIL & SIL), diodes, fuses, integrated circuits, inductors, LED's, light sensitive devices, preset resistors, resistors, switches, crystals, etc. You can also create your own custom template designs.

PROJECT

Point Control System FOR MODEL RAILWAYS

In part 1, Ian King describes a point control system that can be operated using conventional push buttons or via a computer port under software control.

The ability to electronically control point motors (and similar electro-mechanical devices) has been appreciated for some time and the project presented here is a proven and reliable design that can be operated using a conventional set of push switches or via a computer port under software control.

Background & Block Diagram

This project does not use cutting edge technology!, but is the result of the development of a prototype which was originally controlled using push button switches. Today the project forms part of a computerised system which has the Maplin Z80 development system (order code LU01B) at its heart. It includes a multiplexed mimic panel for controlling and displaying the position of the points under software control and it is intended to add train position sensing and signalling in the future.

The project presented here, is flexible and can be as small/large or simple/complex as the constructor wishes. It can be used with a simple set of push to make or non-latching toggle switches (if the constructor wishes) or with the addition of the optional decoder board can be connected to the output of a PC/microprocessor data port. Of course with the addition of some simple logic (or gates) then simultaneous manual and automatic operation is feasible. Whilst the Z80 has been around for a very long time now, it still provides an excellent way to learn assembly language programming and hardware interfacing for those whose aspirations exceed the most versatile PIC!

The block diagram of a medium sized system is shown in Figure 1 and consists of up to 24 point control channels constructed on three similar circuit boards, each handling eight channels. The point motor PCBs are controlled directly by various types of switches (as indicated above) or from a computer port (in conjunction with a decoder board). Other options for connection to the outside world will also be discussed later.

A status monitor is also shown and the original purpose of this option was to show the state (set or reset) of each point channel by means of a panel of LEDs. Today a more sophisticated, multiplexed display is used for this purpose, but this option has been retained as it has proved to be very useful when undertaking software development remotely from the physical railway!. It means therefore that the electronics can be disconnected from the layout (usually in a shed or loft) and it is still possible to monitor which point channels are set/reset while de-bugging the software from the comfort of the indoor location of the PC!.

In theory there is no limit to the number of channels that can be controlled, except that the constructor will have to ensure that the power supply (detailed later) is of sufficient capacity to meet the switch-on current when all of the point output capacitors are charging at the same time.

No specific case details will be given for this project, as the dimensions etc., will very much be determined by the size of the system being controlled, but Photo 1 shows the original project incorporating the new eight channel point motor board (front, left) alongside the older version and the decoder and mimic boards towards the rear right hand side. The power supply can be seen rear left.

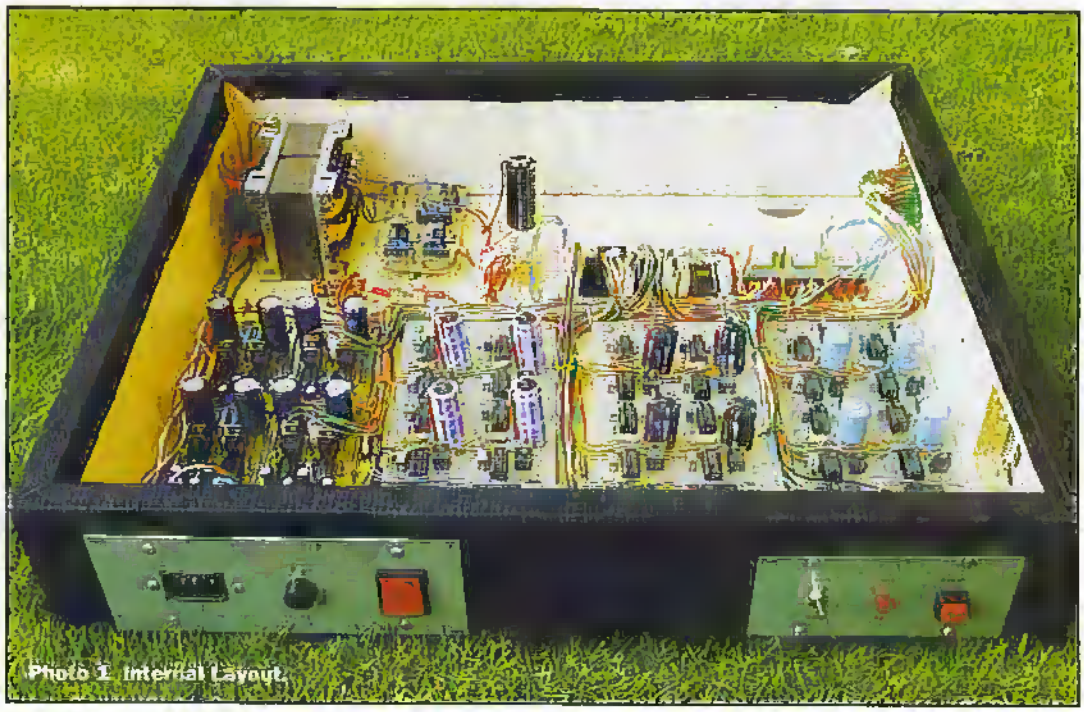


Photo 1. Internal Layout.

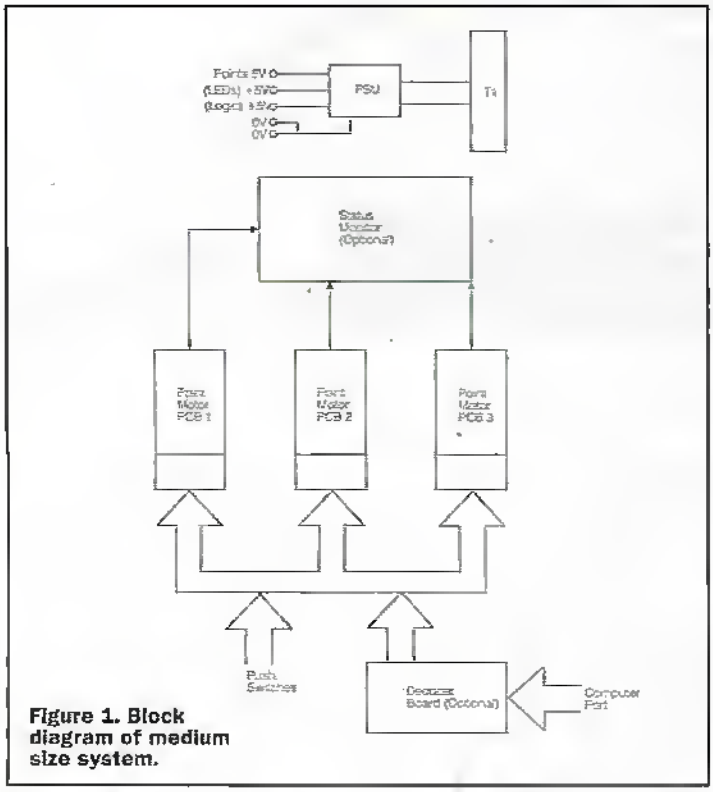


Figure 1. Block diagram of medium size system.

Point Motor Board

To operate electromechanical devices successfully, it is necessary to supply a large current for a sufficiently short length of time and the accepted method is by capacitive discharge which is used here. However, it is important to ensure that the current is not left on any longer than necessary as this will lead to the motors burning out and this is prevented by the current only being applied for a pulse of one second duration. Further, the possibility of a fault condition must be considered and a limiting resistor is included to provide additional protection, plus this also reduces the surge at switch-on.

For clarity the circuit schematic of just one channel of the point board is shown in Figure 2 as all of the other channels are identical. Each channel has two inputs (set and reset) which are connected to a standard set/reset latch via decoupling capacitors (C1 and C2). These are essential to prevent spurious operation (which can be a real problem), due to the model trains with which this circuit will be used, being very efficient producers of RF noise!. The output of the latch (Q0) passes simultaneously to the inputs of two monostables, one of which is configured with positive edge triggering, and the other for a negative edge. This neatly allows a single latch output to set a point when 'high' and reset it when 'low'. The latch output also provides a connection for driving an optional status circuit to be described later.

The monostable output pulse is determined by the product of R2.C4 (R3.C5) and the component values given result in a pulse of approximately one second (i.e. $10^5 \times 10^{-5} = 1$). This pulse drives the base of the Darlington transistor, which switches 'on' and allows the current stored in C7 to discharge through (and thus operating) the point motor. D1 and D2 protect the transistors from the back EMF generated in the solenoids with R7 the limiting resistor, through which C7 will recharge, to allow the point to be operated again after a short duration. This delay will not normally present a problem as the need to simultaneously set and reset a point twice within a few seconds will not exist. This also allows C7 to be 'shared' by the output transistors of both channels. R1/C3 and R4/C6 ensure that the latches and monostables enter their correct states when power is applied.

Construction

A double sided PCB has been used to construct this project and to keep things simple and flexible the layout allows the construction of either 4- or 8-channel versions. The length of these options is 8in to allow them to fit onto the large double sided copper board supplied by Maplin (FA64U). A 2-channel board can also be easily implemented using the same PCB foils but it would be better to build the 4 channel version and have 2 spare channels for future railway expansion!.

For this section I will assume a 4-channel board is under construction measuring 2 x 8in, and the PCB foils for the board are given in Figure 3 with an enlarged legend given in Figure 4. It can be clearly seen that the board can be split into three sections that is input suppression and latches to the left, channels 1 and 2 in the middle and channels 3 and 4 to the right. The detail has been left off the right hand side of

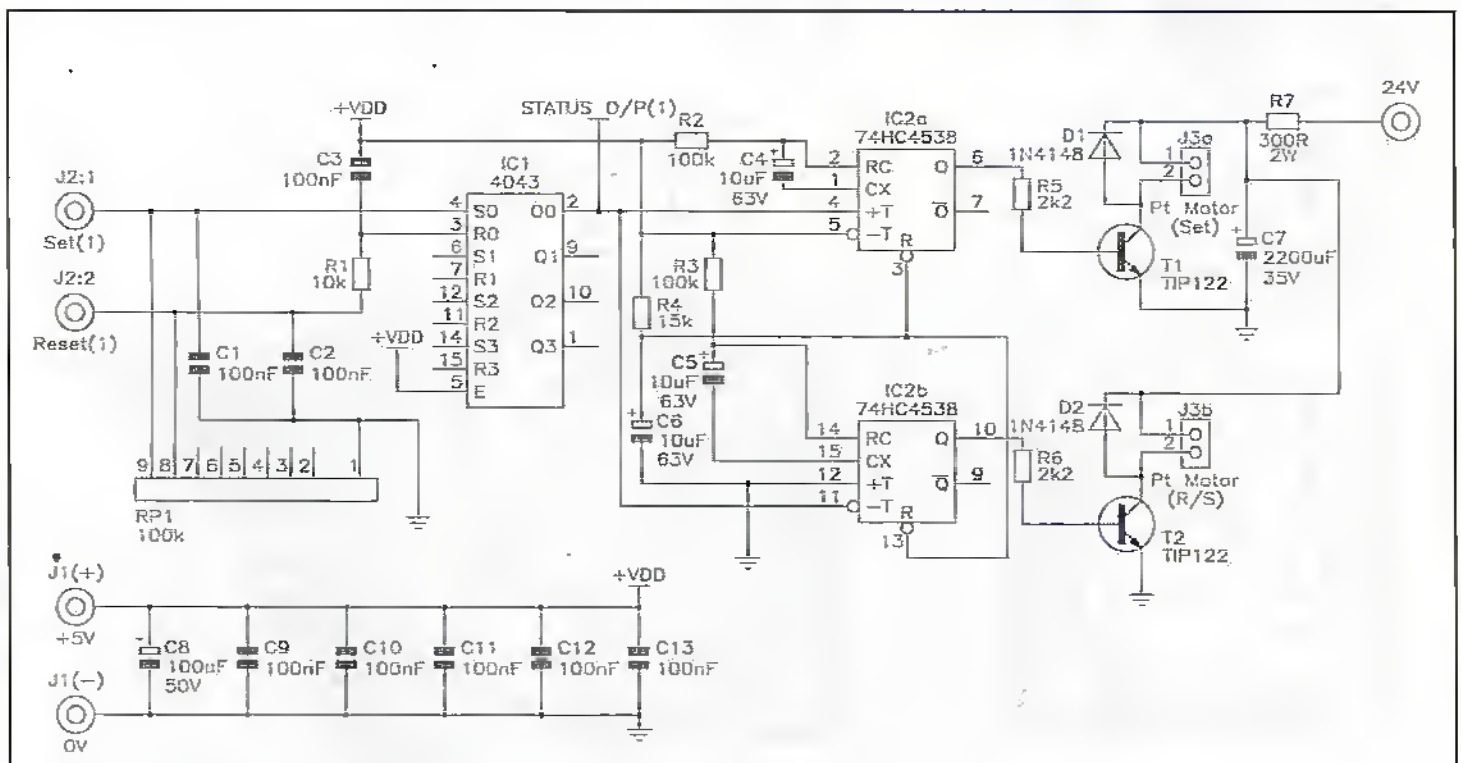


Figure 2. One channel of point board.

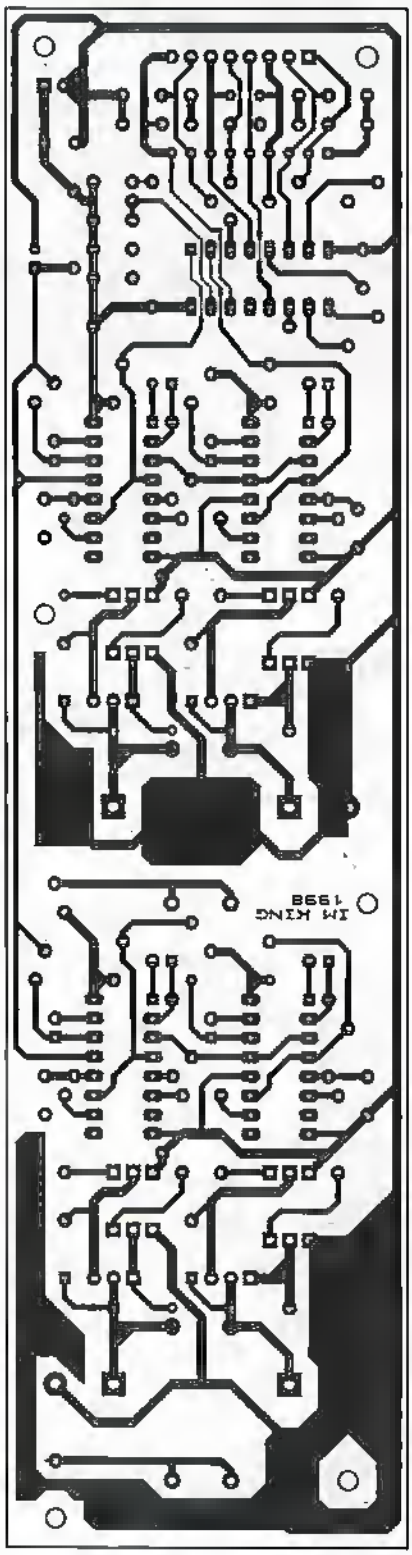


Figure 3a. PCB-Bottom.

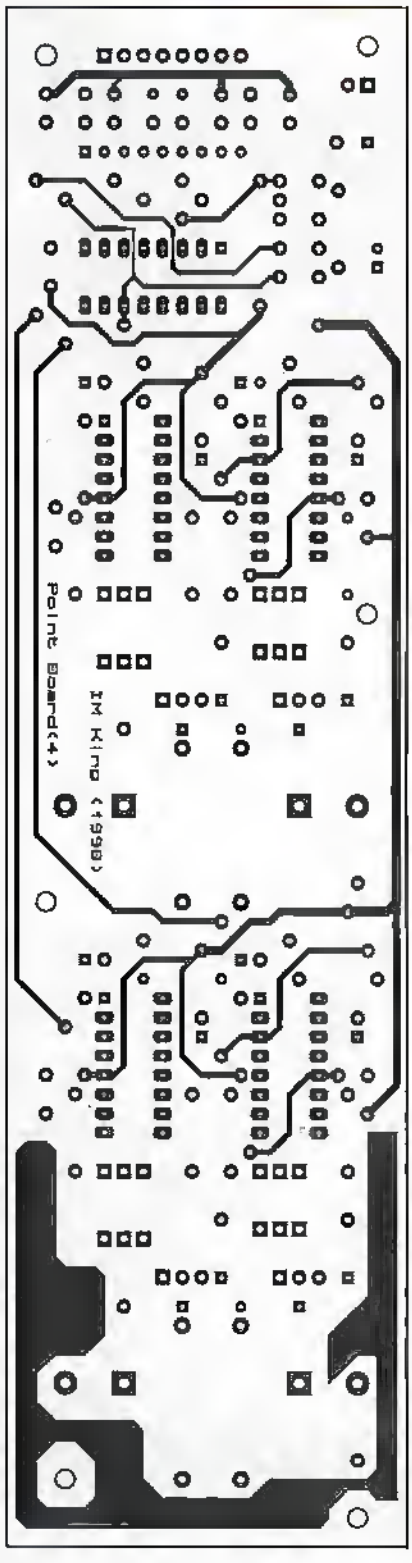


Figure 3b. PCB-Top.

the legend to allow the rest of the board to be shown more clearly and for channels 3 and 4 simply copy channels 1 and 2.

If an 8-channel board is desired (and this is most likely) then a PCB of dimensions 4 x 8in can be used by simply duplicating the 4 channel layout one above the other. This does lead to some component duplication, but this is minimal and flexibility was the desired aim.

Commence assembly by inserting and soldering the 19 track pins on both sides of the board, followed by the six Veropins (type 2145). Next insert the five IC sockets followed by the rest of the components starting with the smallest (diodes, resistors, ceramic disc capacitors and the Sil resistor pack) first. It should be noted with some care that several of the resistors and disc capacitors provide 'through' connections between the upper and lower sides of the board and should be soldered on both the top and bottom. The smaller electrolytics, optional PCB latch connectors (or pins) and transistors can be inserted and finally the 2W resistors and large electrolytics. Double check that the diodes, electrolytic capacitors and transistors are the correct way round. The long lead on the capacitor is positive with the negative indicated by the stripe on the case, the diode cathode indicated by a band and the transistors are correctly inserted when the metal tabs are furthest from the input end of the board. Do not insert the ICs' at this stage, to allow for testing later.

Power Supply

The circuit schematic for the PSU is shown in Figure 5 and comprises three sections. There are two regulated 5V sections in the original unit due to a need to supply the LEDs and the logic from separate supplies. This is a useful facility to retain as it allows for a supply to feed a mimic panel isolated from

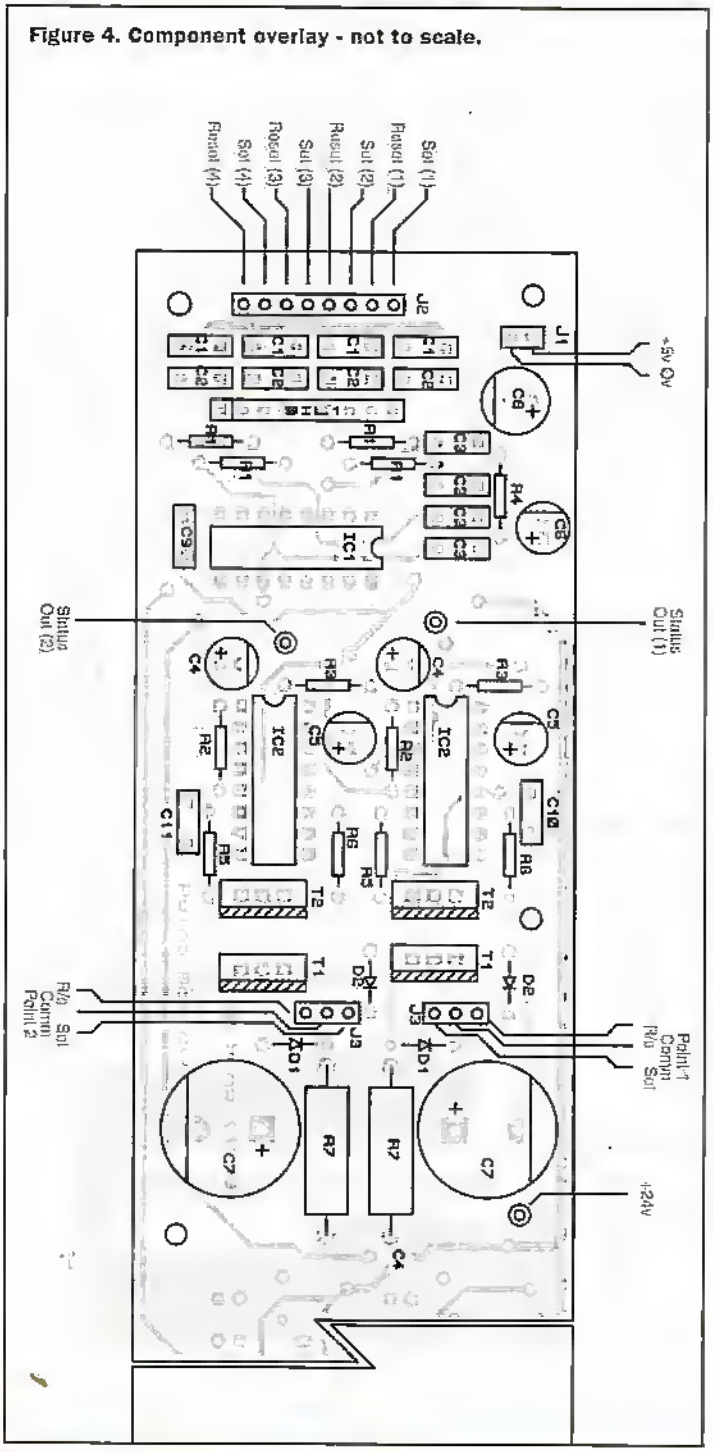
that supplying the point motor control logic, if the constructor should so desire.

The final section provides the unregulated supply to the points and a voltage of 24V dc was determined to be most appropriate in my application using Peco Point Motors (PL10), despite these being rated at 16V ac. These have suffered no ill effect and have proved very reliable over many years as the voltage is only applied for a short duration. It is desirable for this supply to be provided with an anti-surge fuse in view of the initial switch on currents and if required a front panel LED can be connected to this rail to indicate supply status as shown.

This supply has been designed for use with the larger layouts and thus utilises a large (and therefore expensive) multi-tapped transformer (WB22Y) with its 17V ac secondaries connected in parallel to maximise the current available. For the smaller layout, an alternative arrangement would be to supply BR1 and BR2 from two smaller but suitably rated transformers. Connecting the input of the 5V regulators to the +24V dc rail to save a transformer is not recommended as this will lead to a large power dissipation in the regulators (especially REG2) which would need excessive heat sinking etc.

The PCB foil and legend for the regulated supplies is shown in Figure 6, and construction is straight forward starting with the smaller diodes and resistors and progressing to the larger components ensuring that the correct polarity is observed for the diodes and electrolytics. A heat sink should be fitted to REG2 as this gets warm in use and a purpose made TO-220 vaned unit is ideal. If using the one specified in the parts list it will be necessary to drill another 3mm hole above the existing one to allow the regulator to sit fully on the surface of it. A slip of heat transfer compound should be applied if this is available. Note that the large can type capacitor (C1) and fuse holder are case mounted and tag strips were used to provide a means of connection (see Photo 2) for the many supply wires required. The connections between the PSU circuit board and ancillary components should be made using a heavier type of wire (eg 14/02) especially for the 0V and +24V ones.

Figure 4. Component overlay - not to scale.



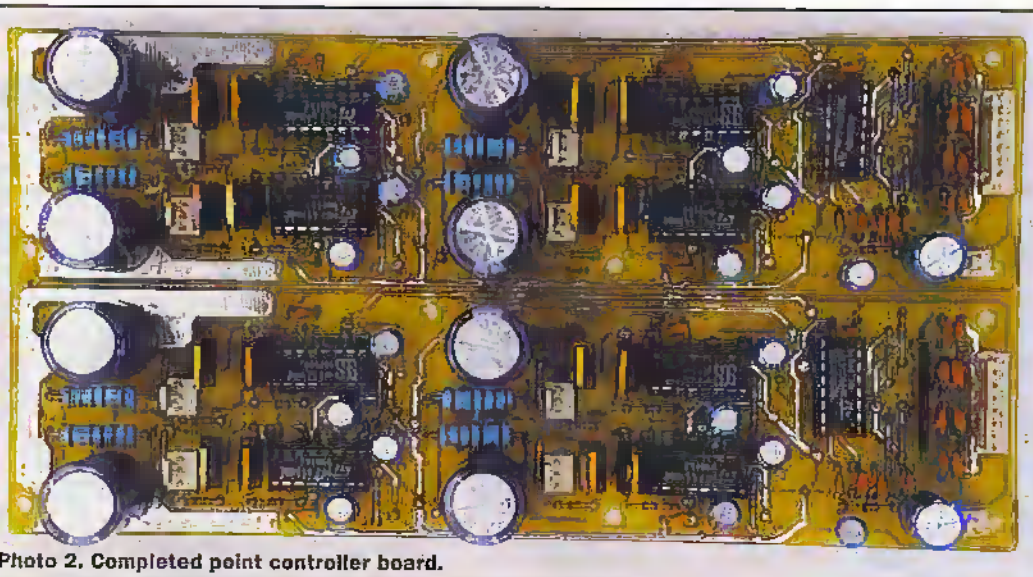


Photo 2. Completed point controller board.

Testing and interconnections

Whilst no precise case details are being given for this project, Figure 7 shows the layout used in the prototype and the interconnections required to get the project working with push button switches. It is a good idea to install, wire and test the power supply first ensuring that the specified voltages are on the appropriate tag strips. *Mains voltages are dangerous* and it is essential to ensure that all such connections to the transformer primary, the mains switch and fuseholder are protected with appropriate insulating sleeving. A purpose made 'boot' (FT35Q) is recommended to sleeve the fuseholder. Particular attention should be paid to the earthing of metal parts, and as shown, the mains earth should be bolted to the transformer case using a solder tag or similar. From this point a further earth connection should be made to the central 0V connection of the tag strip, which is bolted to the metal base of the case. If you use a metal case also be careful to ensure that the chassis fuse holder and other tag strip mounting bolts do not accidentally make contact with any other connections.

Assuming that the voltages are correct, the power can be applied to the Point Motor Board, and a check made for +5V across the supply pins of each IC socket. If this checks out correctly then the power can be removed and the ICs inserted, followed by checks of the operation of the latches by monitoring each output (pins 1,2,9 and 10) as a +5V pulse is applied to the corresponding

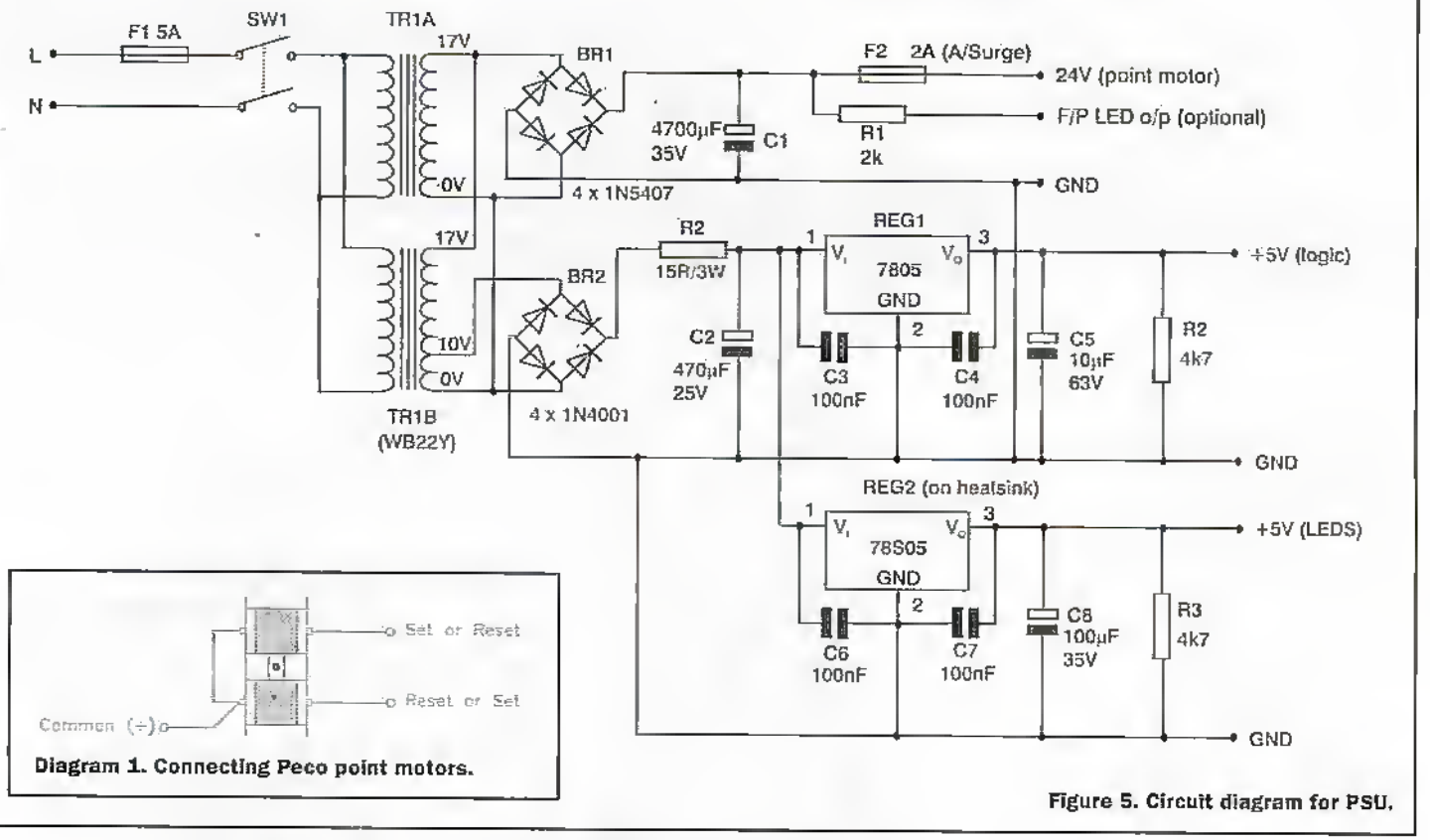


Diagram 1. Connecting Peco point motors.

Figure 5. Circuit diagram for PSU.

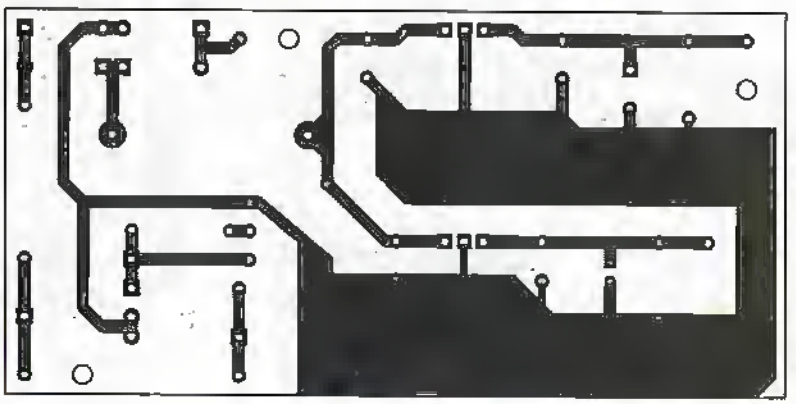


Figure 6. PSU PCB foil.

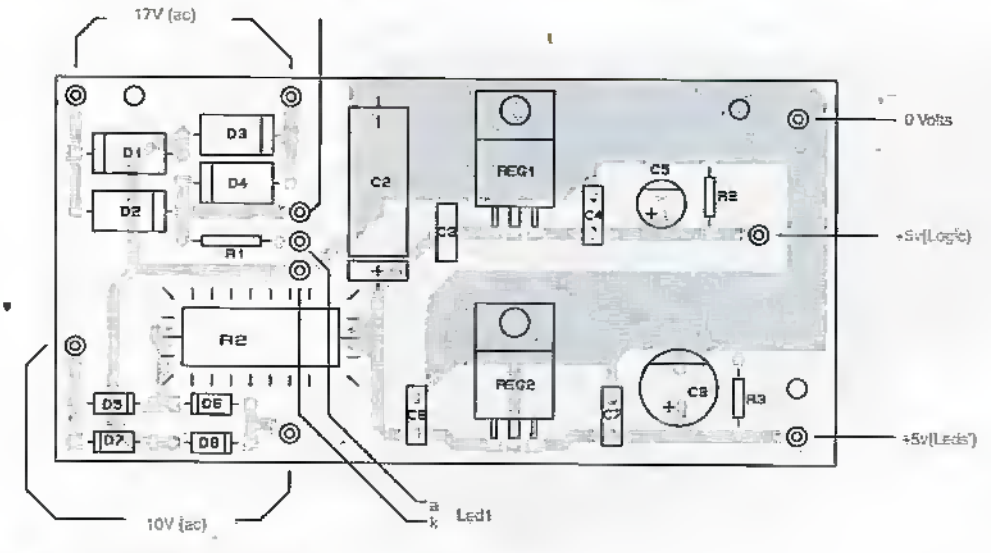


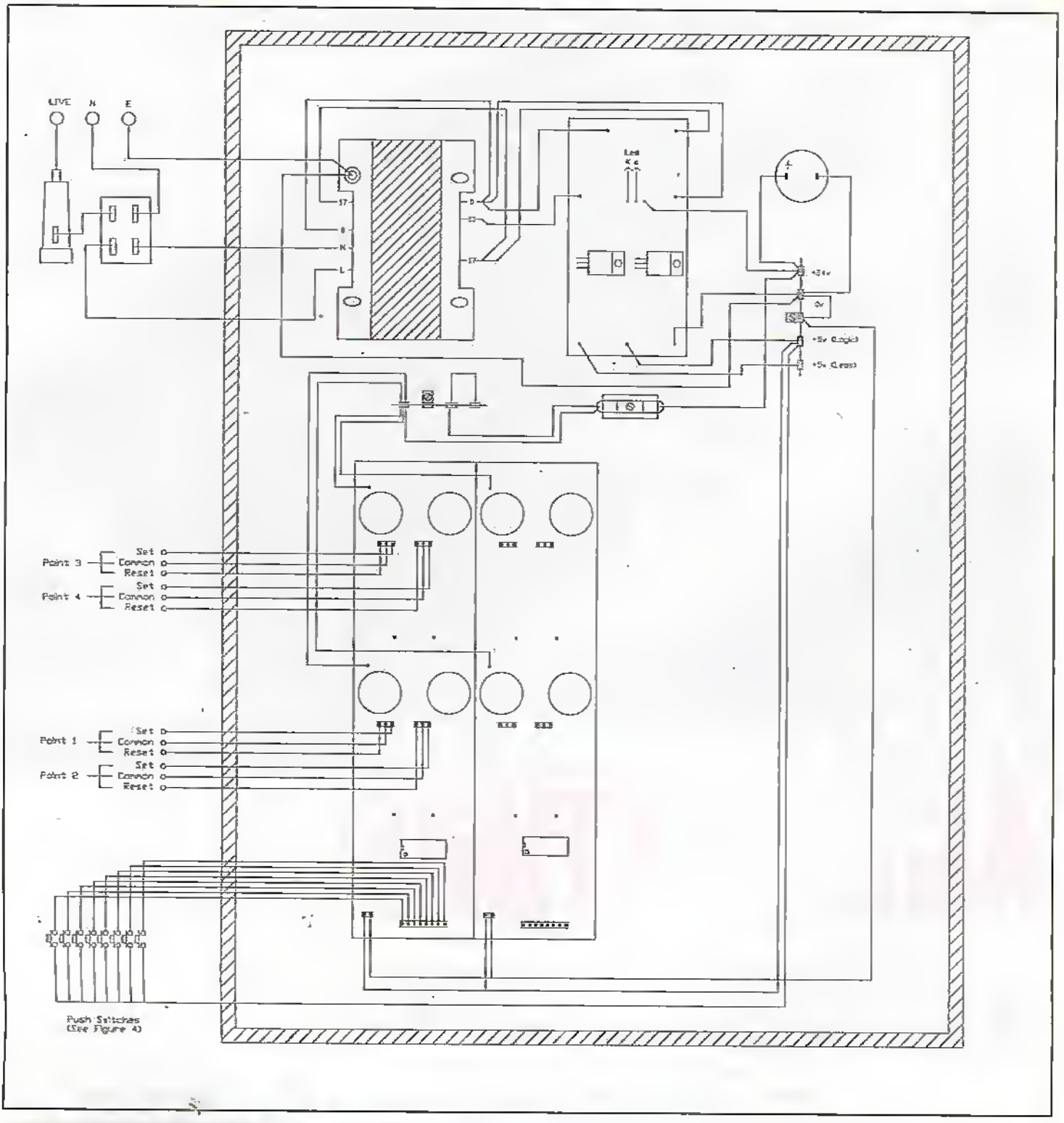
Figure 7. Component layout for PSU.

set/reset inputs. Next insert the IC2 (again after removing power to the boards) and check that a one second pulse is obtained on pins 6 and 10 as the set/reset inputs are respectively operated as above. All that remains after this is to connect a point motor to the appropriate 3-pin connector noting that the common central pin is the +24V line. The Peco motors (type PL10) are connected as per Diagram 1, and the simplest method of testing each channel is to connect the motor to a 3-way socket and plug this into each channel in turn.

If you have made it this far then congratulations, you should have a working system! However, if all has not gone to plan then re-check the PCB assembly with particular attention to component orientation, dry joints and for components not soldered to both the top and bottom pads of the PCB where required.

Next Month

At this stage the constructor should now have a working unit capable of point control using switch inputs. In the second and final part, the computer interface and status boards will be detailed and relevant software guidance given.



PROJECT PARTS LIST

MAIN BOARD (4-points) - for an eight channel board, double every quantity.

RESISTORS

Min Res 2k2	8 off	M2K2
Min Res 10K	4 off	M10K
Min Res 100K	8 off	M100K
Min Res 15K	1 off	M15K
2W 330R	4 off	D330R
Sil Pack 100k	1 off	RA32K

CAPACITORS

Disc 0.1µF	17 off	YR75S
Gen Elect 10µF 63V	9 off	AT77J
Gen Elect 2200µF 35V	4 off	AT64U
Gen Elect 100µF 50V	2 off	AT68Y

SEMICONDUCTORS

TIP122	8 off	WQ73Q
1N4148	8 off	QL80B
4043BE	1 off	QW29G
74HC4538	4 off	UF19V
DIL SKT-16	5 off	BL19V

MISCELLANEOUS

Track Pins	19 off	FL82D
PCB Pins	6 off	(FL24B)
PCB	(See Text)	

OPTIONAL

PCB Latch Pl 8w	1 off	YW13P
PCB Latch Pl 2w	1 off	RK65V
PCB Latch Pl 3w	4 off	BX96E
Latch Housing 8w	1 off	YW23A
Latch Housing 2w	1 off	HB59P
Latch Housing 3w	1 off	BX97F

POWER SUPPLY

RESISTORS

Min Res 2k	1 off	M2K
3W Wirewound15R	1 off	W15R

CAPACITORS

Can 4700µF 50V	1 off	FF27E
Axial 470µF 25V	1 off	AT15R
Disc 0.1µF	4 off	YR75S
PC Elect 10µF 63V	1 off	AT77J
PC Elect 100µF 35V	1 off	AT59P

SEMICONDUCTORS

1N5407	4 off	QL86T
1N4001	4 off	QL73Q
L7805CV	1 off	QL31J
L78S05CV	1 off	UJ54J
Heatsink TO126	1 off	JX21X

MISCELLANEOUS

68VA 17V Transfrmer	1 off	WB22Y
Panel Fuse 20mm	1 off	RX96E
5A Fuse 20mm	1 off	CZ81C
Boot for Fuse Holder	1 off	FT35Q
Chassis Fuse Holder	1 off	KC01B
2A A/S Fuse 20mm	1 off	CZ99H
PCB	(See Text)	
DPST Mains Switch	(As req'd)	
PCB Pins	10 off	FL24B

Photo 7 A modern high-speed tractor-mounted crop sprayer. (Photo courtesy of Knight Farm Machinery Ltd.)

Electronics in AGRICULTURE

PART 7

Crop Spraying

George Pickworth recalls the use of nicotine to organo phosphorous to improve crop yield.

Introduction

In pre-war years, crop protection was often uneconomic so low yields and poor quality produce was accepted. But, to survive the Second World War, yields had to be maximized and that was only possible through efficient control of pests and weeds. Indeed, it was during the dark days of the war that the foundations of a modern crop protection technology were laid and upon which an enormous international industry was built. Moreover, it is from spraying machines developed during those days that modern crop sprayers evolved – see Photos 7 and 11.

In part 6 we looked at innovations in weed control during WW2, and the immediate post war years. But pests presented a far more sinister problem and in this study we look at how aphids, which seriously threatened our meager food supplies, were brought under control.

There were of course other pests but control of aphids presented special problems as they were resistant to DDT. Fortunately they were susceptible to nicotine and during the war, Britain was able to obtain nicotine supplies from overseas. Nonetheless, even with supplies of nicotine, the control of aphids was only possible through technical innovations that are unique in crop protection history.

Aphids were a serious pest of vegetable crops and sugar beet; they multiplied at a phenomenal rate; they not only greatly reduced sugar beet yields, but were instrumental in the spread of the serious virus disease of sugar beet known as 'virus yellows'.

Early in the war, 'Pest Control Ltd.' (PCL) was given a government contract to protect the sugar beet crop against aphids. Furthermore, it was vital to protect the sugar-beet seed-crop to ensure that seeds were available for following year.

Nicotine spray was the standard control method, but being a contact insecticide, every aphid had to be hit by the spray. But, as aphids lived on the underside of the leaves they were shielded from the spray. So, even by drenching the crop with large volume of spray, the number of aphids hit by the spray was rarely better than 70-80% and the survivors rapidly multiplied. A much more effective control method was desperately needed and the idea came from the USA.

Vapour

In the USA, virtually 100% control of aphids on a variety of low growing crops had been attained by injecting nicotine vapour under an impervious sheet laid over the crop. The vapour diffused into areas impenetrable by sprays thereby giving excellent control. However, the vapour was produced by cumbersome equipment and both vapouriser and sheet had to be moved in stages across the field. See Figure 5.

In 1940 PCL developed a technique whereby nicotine vapour was injected under a large, light-weight, gas-tight sheet that was slowly dragged over the crop by an Allis Chalmers row crop tractor. The key to this mobile system was the simple method of vapourising the nicotine. See Figure 6.

Nicotine dripped by gravity onto the

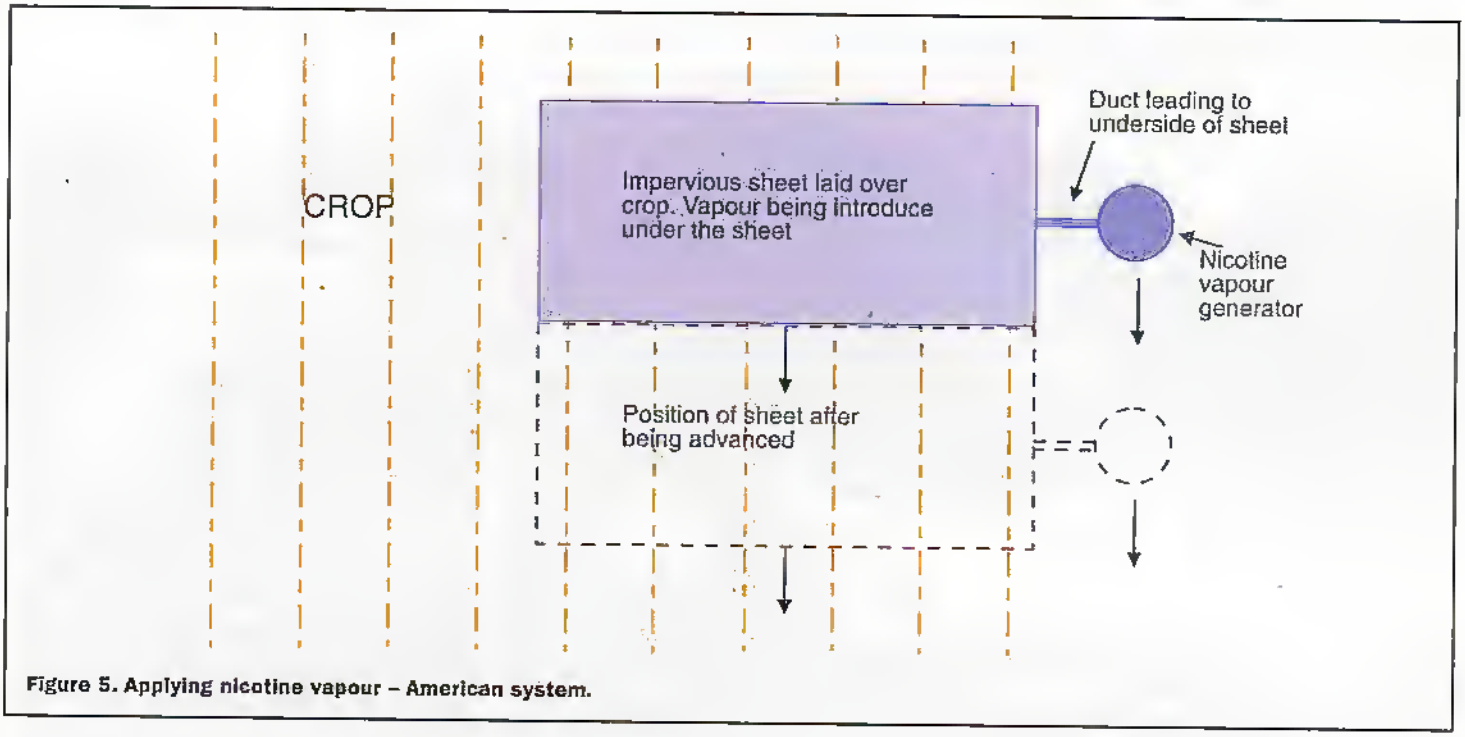


Figure 5. Applying nicotine vapour – American system.

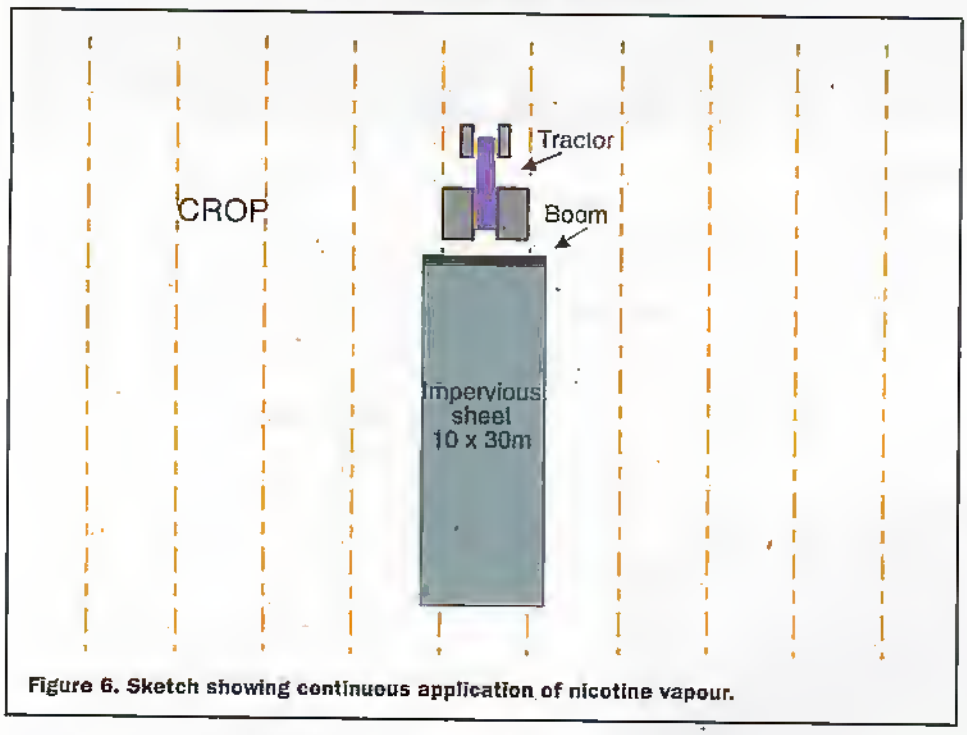


Figure 6. Sketch showing continuous application of nicotine vapour.

tractor's hot exhaust manifold where it immediately vapourised; flow rate was controlled by a needle valve. The manifold was encased by a sheet metal box with a fan at one end and a duct at the other end. The fan, driven by a shaft and 'V' belt, caused an air flow which carried the nicotine along the duct and under the sheet. See Figure 7.

The sheet, 10m wide and 33m long and was towed at a speed of 30m/min (approximately 1.0mph) so that the aphids were exposed to the vapour for one minute; this killed 99% of the aphids which fell to the ground and therefore did not contaminated the crop.

Ladybirds

Ladybirds, which are the natural predators of aphids, were unharmed by the vapour and quickly mopped up any survivors. Moreover, the vapour dispersed very quickly so there was no problem with residues in the crop which could be harvested almost immediately after treatment. Indeed, nicotine 'gassing' was probably the most environmentally friendly of all pest control methods.

Figure 7. Sketch showing nicotine 'gassing' of Brussels sprouts – note arrangement of nicotine reservoir and feed tube.

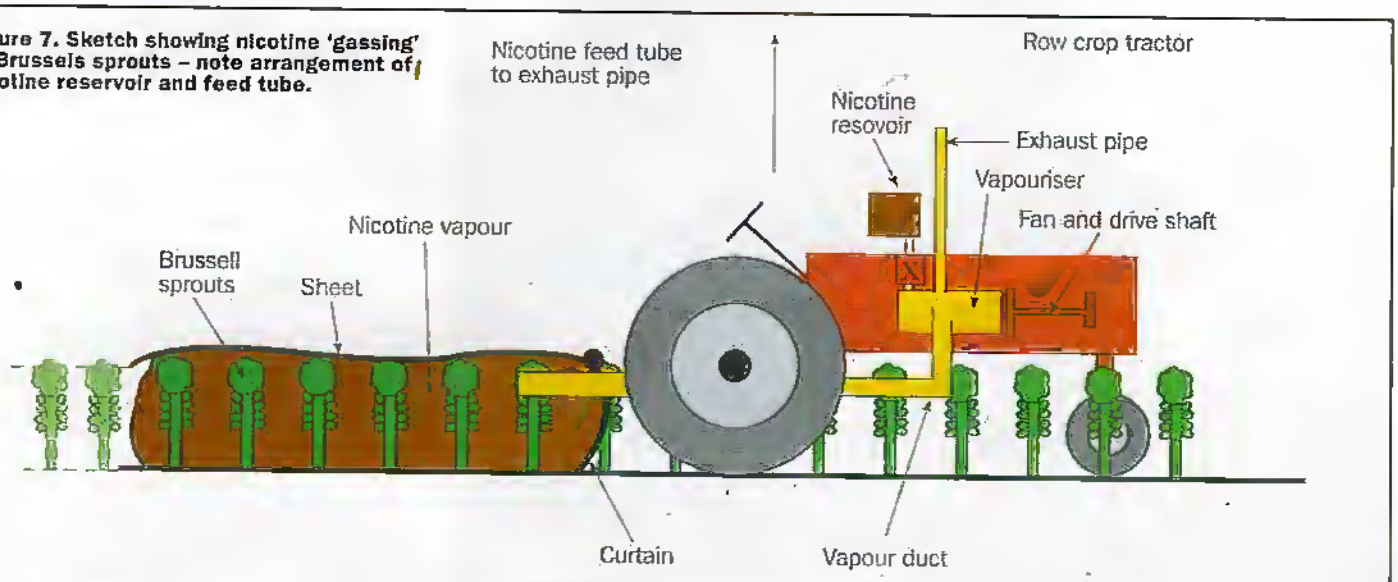


Photo 8. Car-on-stilts 1948 – treating strawberry crop with nicotine vapour. (Photo courtesy of AgroEvo UK Ltd.)

Two operators were normally needed to man-handle the sheet when turning on the headlands, and the tendency was not to wear respirators, but as the vapour rapidly dispersed they did not seem to experience any unpleasant effects. Occasionally however, sudden gusts of wind flipped the sheet on top of the tractor and whilst this was unpleasant for the driver, the effects were not serious. However, the driver normally wore a respirator.

Hazards

The most serious hazard was direct contact with nicotine concentrate, typically as a result of splashing – indeed unless immediately washed off with water, a splash less than 5.0mm in diameter made even heavy smokers vomit within seconds. A water tank complete with tap was therefore attached to the machine.

Fortunately, as far as I am aware, no fatalities resulted from nicotine 'gassing' but there were several serious cases where nicotine was absorbed and a doctor had to be called. The usual antidote was to drink plenty of fluids. Operators were issued with certificates saying that they had been working with toxic products and required landlords to provide liquid refreshments (non alcoholic!) at any time.

Photo 9. Successor to car-on-stilts, Zimbabwe 1948, with the author standing by the machine.

Car-on-Stilts

The Allis Chambers row-crop tractor was perfectly satisfactory with lower growing crops but much greater ground clearance was required for tall crops, particularly sugar-beet seed-crops. So in 1941, a high clearance machine was fabricated in PCL's Harston workshops, and was based on a 1935 Dagenham built FORD 'V8' car and became known as the car-on-stilts as shown in Photo 8.

The car's wheels were attached to legs about 1.5m long whilst an auxiliary gearbox fitted in series with the main gearbox, gave the machine the required 30m/min forward speed. However, the exhaust system of the V8 engine was not well adapted for nicotine drip feed so a small metering pump injected nicotine directly into the exhaust pipe of a small air-cooled petrol engine mounted on the rear of the machine. See Figure 8.

High Road Speed

A reasonably high road speed was essential when traveling from farm to farm. So, when on the road, the auxiliary gear box was put into straight through drive and the machine driven with the normal gearbox. I never drove the vehicle at more than 50km/hour but it was quite capable of 85km/hour! I well remember the look of utter amazement on the faces of other drivers who happened to meet me over the brow of a hill.

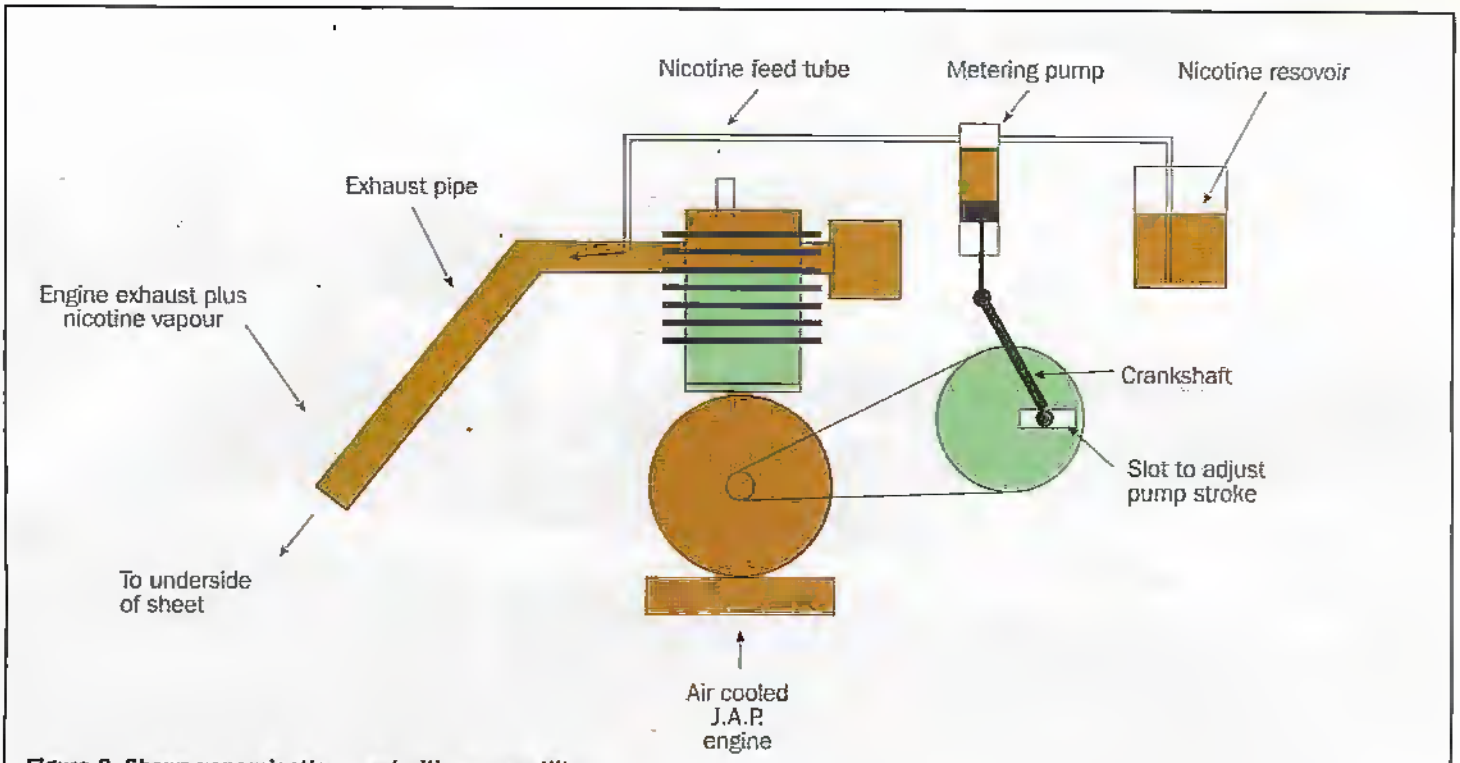


Figure 8. Shows vapourisation used with car-on-stilts.

Weather

The drawback with 'gassing' was that work rate was somewhat less than 2.0ha/hour but actual working hours were severely limited by the weather. Gassing was only possible on perfectly still days – the slightest breeze lifted the sheet and released the vapour. Moreover, the vapour rapidly dissolved in any moisture present, so gassing was ineffective when there was a dew. Last, but far from least, the ambient temperature had to be above 16°C.

Only one example of the car-on-stilts was made and should go down in history as the machine that played a leading role in maintaining our 0.5lb per week sugar ration. However, in 1947 it was replaced by a number of high clearance machines based on ex army Ford WOT6 lorries as shown in Photo 9. These evolved into high clearance crop sprayers, also straddling machines used for moving timber and ultimately for moving containers.

Germany

Unlike Britain which had access to nicotine during the war years, supplies to Germany were cut off and the country had to search for an alternative. German scientists had already synthesized a number of organo phosphorous (OP) compounds as potential war gases and some, such as parathion and HETP (Hexa ethyl teraphosphate) were found to have excellent insecticidal properties.

The story goes that Dr. Ripper of PCI. covertly entered Berlin ahead of the Russians and returned to the UK with German OP formulas. Whatever the truth. PCI. was apparently able to manufacture HETP and parathion by the end of 1945, thus frustrating Russia, or indeed America, from seizing the formulas and cornering the world market. Unfortunately, Dr. Ripper vanished in the 1970's as far as I can recall, whilst flying alone over south east Europe

After the war allied intelligence teams indeed found that HETP sprays had been widely used by the Germans as substitute for nicotine on food crops as it degraded fairly quickly into harmless chemicals. On

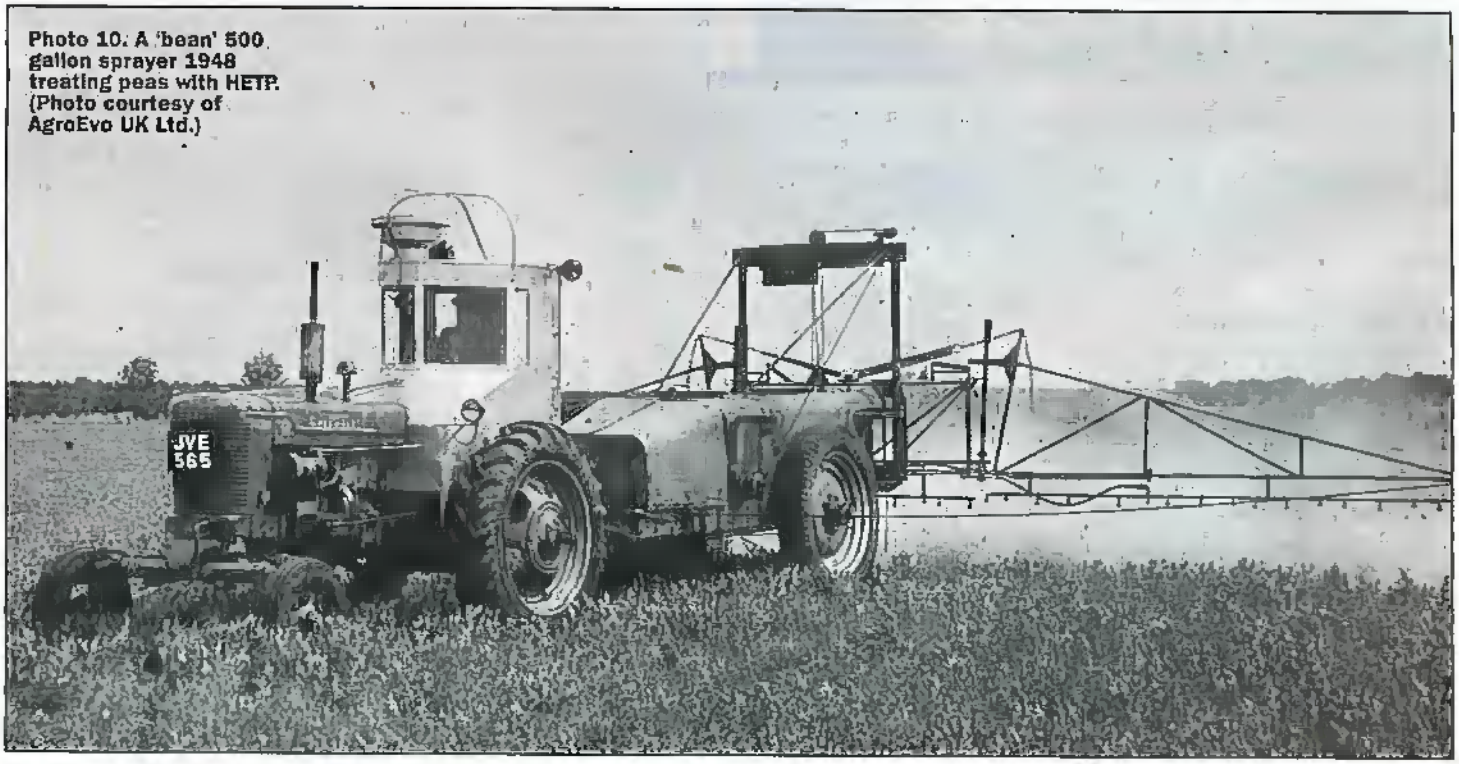


Photo 10. A 'bean' 500 gallon sprayer 1948 treating peas with HETP. (Photo courtesy of AgroEvo UK Ltd.)

Photo 11. A tractor mounted air assistance sprayer. (Photo courtesy of Hardi Ltd.)

the other hand, parathion, by taking several weeks to degrade, was considered to be too dangerous to be used on food crops.

The Americans were enthusiastic about parathion, particularly on non-food crops, as it's persistence gave prolonged control of aphids thereby neatly complementing DDT which as already mentioned was ineffective against this pest. The Americans also believed that parathion could be used on some food crops provided there was a long period between spraying and harvesting.

For biological reasons, long persistency was also necessary to control red spiders which were causing enormous damage to fruit trees in the UK; this pest had become resistant to all traditional insecticides. Fortunately, trials with parathion were successful and for the first time the there was an effective method of controlling this pest.

Home Produced

Meanwhile, Dr. Ripper had reasoned that as HETP had been widely used as an aphicide spray in Germany, there was no reason why it could not be used in the UK. Moreover, as PCL was already able to produce HETP, trials to control aphids were conducted on sugar-beet seed-crops in 1946. These demonstrated that spraying with HETP was equally effective and many times faster than applying nicotine vapour.

However, in 1946, the high efficacy of HETP was attributed to volatilization, but it was most probably caused by the chemical being absorbed by the plant and translocated via the sap which was then toxic to aphids and other sap-sucking insects. Translocation was later confirmed by Dr. Hubert Martin who coined the term systemic for the phenomenon. However, translocation was found to be more pronounced with some OP formulations than others.

The fact that by virtue of translocation, a spray would give virtually 100% control of aphids with a typical 75% coverage so had a profound effect on crop sprayer technology. Drenching the plants with spray was no longer vital. Yet the systemic effect does not seem to have been detected by the Germans

Not Selective

After the initial success with HETP on sugarbeet seed crops, further trials were made on food crops, including Brussels sprouts, cabbages and peas. Here again control was as good as with nicotine gassing but there were serious drawbacks.

Unlike nicotine gassing which selectively killed aphids and left ladybirds unharmed, HETP spray killed virtually every living thing that was either present in the field during spraying or entered a few days later. So, notices were posted telling people to keep out. Worse still, the crop remained extremely toxic until the HETP degraded.

Remarkably, during early trials, the only protection for the tractor driver was a respirator and protective clothing, but soon the tractors had air filtered cabs. See Photo 10. Nonetheless, HETP was so toxic that the minutest drop on the skin spelt sudden death, yet, it was originally supplied as a colourless liquid. Later the HETP was coloured deep blue so that any splashes would be instantly detected on the white "snow-suits" that operators were required to wear.

Critical

It was soon apparent that thanks to OP pesticides, control of aphids and indeed many other pests, could be increased to a level hitherto inconceivable. The government now had to decide if large scale application of OP insecticides could be justified in view of their high toxicity.

As it was, the government had little choice, for as we have seen, it was vital for the economy of the country to maximize crop yields and OP's provided the only route to this objective. Indeed, the promise of higher yields by using OP's was fulfilled and that was of enormous benefits to the country during the immediate post war years when the country was bankrupt and could not afford to import food.

Contact Service

During weed control spraying operations, PCL had acquired a fleet of large spraying machines and the expertise to handle highly toxic chemicals such as DNOC. So, in 1947, PCL began to use OP sprays on a large a scale for control aphids on sugarbeet and sugarbeet seed crops; this was complemented by treating horticultural crops on a large scale as an alternative to nicotine gassing.

Let us take Brussels sprouts as a typical example of what that early contract spraying with HETP involved. See Figure 7. Before setting off to work, all operators were given a freshly laundered 'snow suit' and required to take a number of vitamin pills plus halibut oil capsules, in front of the supervisor.

The sprouts were sprayed every three weeks, beginning in July and continuing

until September. The final spray had to be applied a month before harvesting, meanwhile the treated crops remained extremely toxic. Regrettably during the subsequent spraying, operators were disturbed by the number of dead creatures in the fields, hares in particularly.

Each time the sprayer returned to the re-filling site, both the sprayer and the tractor were thoroughly hosed down with the decontamination unit to make it safe enough for the support crew to refill the sprayer with water and add the chemical. The same applied before the machine was allowed on the road. During decontamination, the tractor driver normally stayed in the cab.

Return to Base

When the crews returned to base, they were immediately required to walk along a chalk line marked on the shed floor, directly towards the supervisor who then examined their eyes; typical symptom of OP poisoning was pin-point pupils. Any operator who deviated from the chalk line or had pin-point pupils was stood off work until the symptoms disappeared. However, drivers who exhibited these symptoms had already driven their vehicle back to base so it is not surprising that because of impaired vision, there were instances of vehicles ending up in the ditches.

Notwithstanding that spraying with OP's was faster and much less dependent on the weather than gassing, many growers still preferred gassing. Firstly HETP was far more dangerous to the operators than nicotine and secondly, as we have seen, nicotine vapour immediately dispersed leaving no residues. Furthermore, as the aphids fell to the ground the crop was uncontaminated and ready for marketing. So, under pressure from growers gassing continued to be used in some cases, particularly on Brussels sprouts and strawberries until 1950 when the car-on-stilts was brought out of retirement, see Photo 8, but economic pressure ultimately brought about its demise.

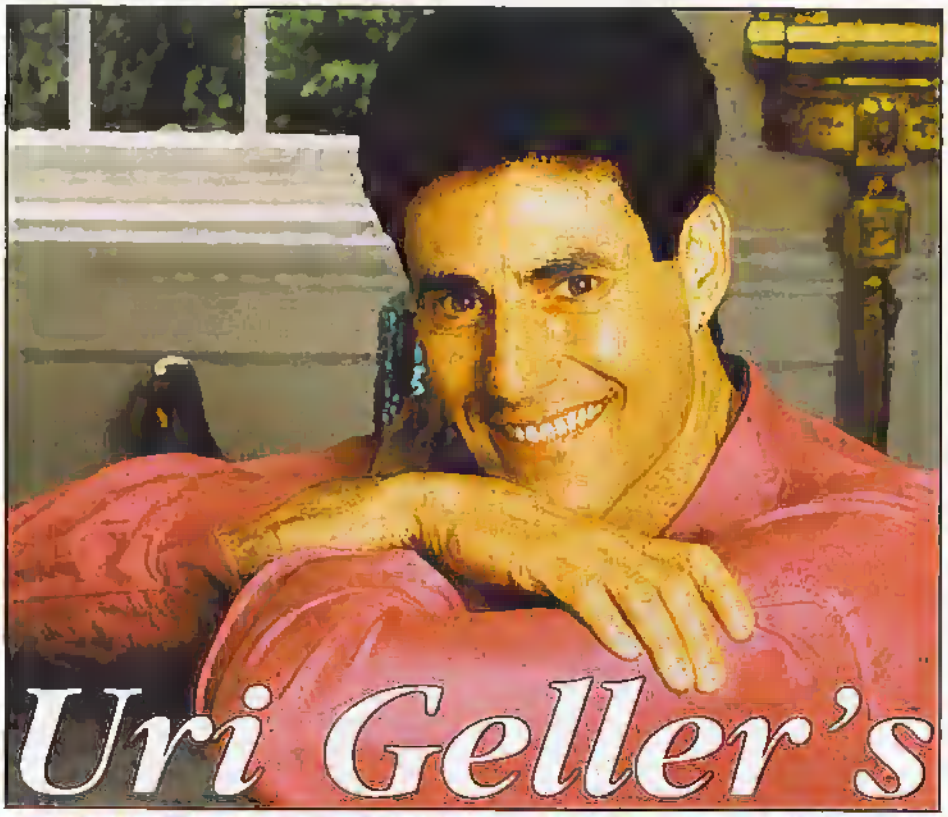
New

By 1947, HEPT was being complemented by a range of other organo phosphorous formulations; all were highly toxic but some more so than others; indeed, many could only be safely applied by contractors with the necessary technical expertise. So, 'safer' products were produced that could be applied by farmers with their own spraying machines; application could be made during critical periods thus overcoming the disadvantage of contract spraying and bringing about even greater efficiency in pest control

By 1950, farmers realized that crop protection was the key to consistently high yields and a healthy agricultural industry; this not only benefited farmers, vegetable growers and orchardists, but the country as whole.

Aphid control was soon extended to cereal crops and this ensured high yields even during years when aphids were particularly serious. In fact, there was no going back to the pre-war days when we depended largely on imported food and when, more often than not, it was uneconomic to control pests.

In part 3 we look at modern, computer-managed spraying machines.



Uri Geller's EXTENDED REALITY

Precognitive Dogs

How many people have the experience nearly every day of finding their dog or cat waiting for them by a door or window as if they know exactly when you are coming home? In a recent survey of pet owners in the north of England, nearly half of them reported just such an experience - more often with dogs than with cats.

Of course, if you get home from work at about the same time every day, and arrive in your car, your dog will know when to expect you and will recognise the sound of your car's engine. Nothing paranormal about that. But, suppose, like quite a few people, you come home at different times every day and sometimes you take the bus, get a lift in a friend's car, or walk? If you still find your dog sitting by the door whatever time you arrive, then that is more interesting.

Better still, if there is somebody who stays at home most of the time who tells you exactly what time the dog went to the door, and you notice that you decided to start for home at exactly the same time, that does begin to look more than normal.

Finally, suppose you leave a video camera running with a long play tape in it and view it when you get home, and find that your dog just slept or mooned around most of the time - maybe getting a bit excited if another dog or cat goes by the window but otherwise not doing very much - then seemed to leap into action and mount guard by the door at the time you set off. Now that does begins to look more like animal psychic powers at work!

Until quite recently, you might have wondered why no scientist ever seemed to have looked into the question of such powers. Luckily, at last at least one has, and he has come up with some pretty impressive evidence.

Rupert Sheldrake is a highly original scientist with a solid academic background in biology and biochemistry, and is one of those few who seem willing to explore areas other scientists prefer not to reach - or even admit exists. He has teamed up with a pet owner named Pamela Smart, from Ramsbottom in Greater Manchester, who might never have discovered the psychic powers of her lively mongrel terrier Jaytee if she had not been made redundant in 1993.

Up to then she had been working regular hours as a school secretary. Every day she would leave work at about 4.30p.m. taking up to an hour to get home. When she was out, Jaytee would be looked after by her parents. They lived in the flat next door, and it was they who first noticed that Jaytee always seemed to know when Pamela was on her way home, even though they often did not. So they began to keep written records.

Over a three-month period in 1994, they noted the times that Jaytee began to react and the times Pamela arrived home. They found that the dog seemed to pick up his owner's decision to set out for home no less than 27 times, and failed on only six occasions, making his hit rate an impressive 82%.

Now that Pamela no longer had a regular job, she no longer kept regular hours. She could go out at any time, coming home at any time from early morning to late evening. She could just go round the corner and come back almost at once, or she could drive (in a friend's car) several miles away and stay out most of the day. Oddly enough, Jaytee not only seemed to know when she was coming home, but also how far away she was. When she had a long journey ahead of her, he would spend longer at the window waiting for her, and when her homecoming trip was a short one, the dog adjusted his waiting time accordingly.

Between July 1994 and February 1995, records were kept of a total of 63 outings by Pamela Smart. Her pet seemed to pick up her homecoming a staggering 87% of the time. When he failed, he usually had a good excuse. He might be feeling unwell, he might have been distracted by another dog he could see through the ground floor picture-window, or he might simply have been sound asleep. Yet he only failed eight times out of 63.

All of this is on videotape, and in November 1994 things were taken a stage further when a team from the Austrian ORF TV station set up a split-screen experiment in which both Pamela and Jaytee could be seen at the same time, though obviously not by each other. It was the TV crew who gave the signal for Pamela to leave for home, and within seconds Jaytee got up, strolled over to the window, sat down and cocked his ears, waiting patiently. This was probably the first time that pet telepathy had been shown in action.

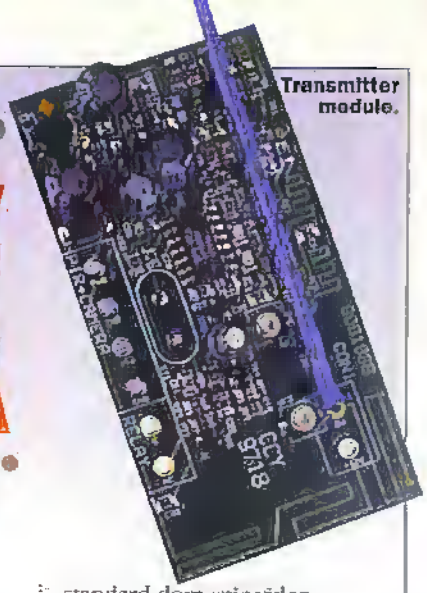
Of course, there were those who were not satisfied. (There always are, as I know only too well!). You may have seen the results of one of the experiments carried out by a sceptical scientist, Dr Richard Wiseman, shown in the Equinox programme called Secrets of the Psychics. Viewers were led to believe that Jaytee was rushing all over the place much of the time his owner was out.

What the Equinox spin doctors forgot to tell the viewers was that on this occasion Pamela's absence from home coincided with the visit of the local fishmonger's van, which brought every cat in the neighbourhood out on the trail of a stray sardine. This caused Jaytee to become quite agitated as he gave them a ferocious barking too, although he was still at his post when his owner came home. Rupert Sheldrake has kept going despite such criticisms. With the help of a grant from the Lifebridge Foundation of New York he has been able to devote himself full time to his pet research together with the other projects described in his fascinating book *Seven Experiments That Could Change the World*. Wouldn't it be great if the first Nobel prize for parapsychology was shared by Sheldrake, Pamela Smart - and Jaytee?

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

Uri Geller

1.3GHz Microwave VIDEO LINK


Transmitter module.

Gavin Cheeseman applies these video receiver and transmitter modules to practical applications.

In recent years the use of video surveillance in domestic premises has become considerably more widespread. Part of the reason for this is the introduction of CMOS camera technology, allowing systems to be installed at a more affordable price. Most systems use coaxial cable to connect between the camera and a monitor, video recorder or both. Often, the cable is necessarily long and moving the camera to a different location requires considerable thought and planning. Some of this inconvenience can be avoided by using a radio frequency link. However, not all types of RF link are suitable due to the relatively wide bandwidth required to transmit composite video. Also, there are often legislative restrictions on the modes of transmission allowed in a given frequency band. The microwave region is well suited to video transmission and specific frequency bands have been allocated for this purpose.

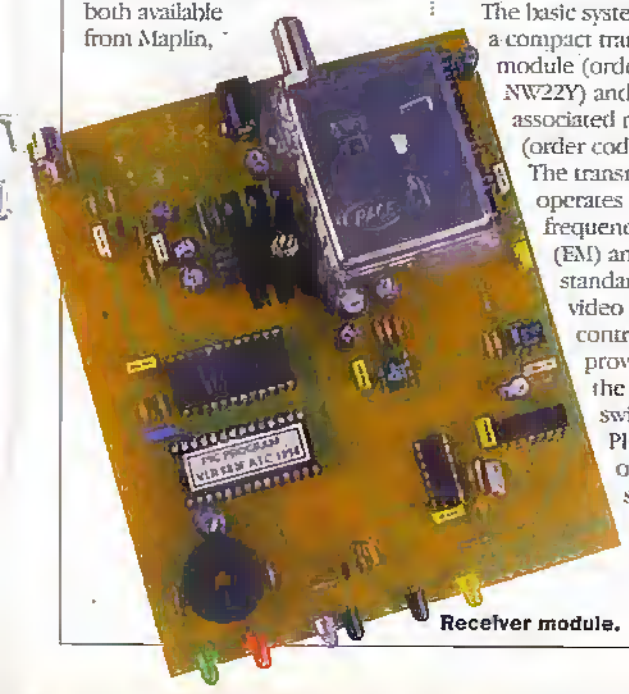
The ATC 'Supavision' video controller and receiver, together with the associated transmitter, both available from Maplin, provide an excellent method of transmitting a monochrome video image over a range of several metres. The transmitter is Wireless Telegraphy Licence Exempt and is compliant with MPT1349. The receiver unit also has the facility to automatically switch on a video recorder when a sensor connected to the transmitter is triggered.

As with most radio transmitting equipment, the video link is subject to strict legal requirements. The scope of these includes labelling, limitations regarding the maximum radiated power and operating frequencies. In order for the technical specification of the transmitter to remain within the requirements of the MPT1349 type approval, it is essential that no modifications are made to the transmitter module or the associated antenna.

The ideas proposed in this article are suggested from a purely technical viewpoint. Where necessary, readers should seek advice with regard to the legality of specific applications before proceeding.

A Brief Overview

The basic system consists of a compact transmitter module (order code NW22Y) and the associated receiver unit (order code NW41U). The transmitter operates at a nominal frequency of 1394MHz (EM) and accepts a standard composite video input signal. A control input is provided to allow the unit to be switched on by a PIR detector or other types of sensor with a dry contact (Volt free) output.


Receiver module.

The receiver detects and demodulates the microwave signal reproducing the composite video at its output. The output signal can be displayed on a monitor or recorded using an ordinary home video recorder. In addition to performing the receive function, the receiver unit also has an integral infrared transmitter. When suitably programmed the unit can be used to control a video recorder such that it starts recording when the video transmission is received and stops recording at the end of the transmission.

The ability to control a video recorder in this way offers several advantages over using a simple wired camera and home video recorder. Firstly, the video recorder only records if activity is detected by the PIR as opposed to recording continuously. This avoids recording long periods of inactivity and means that you can provide monitoring over extended periods with a standard domestic video recorder, without having to change the tape. It is also much easier to find any activity that is recorded on the tape as only the relevant events, where activity is present, are recorded. Using a simple camera and home video recorder it would be necessary to view the whole recording to find any relevant sections.

Installing the System

Figure 1 shows the connection diagram for the transmitter module. The unit requires a 12V DC power supply. A 12V regulated adaptor capable of supplying over 200mA such as Maplin order code MG81C (400mA) is suitable for this purpose. For ease of connection to this type of power supply, a suitable in line power socket may be wired to the transmitter module. The transmitter video input may be driven from a composite video source such as

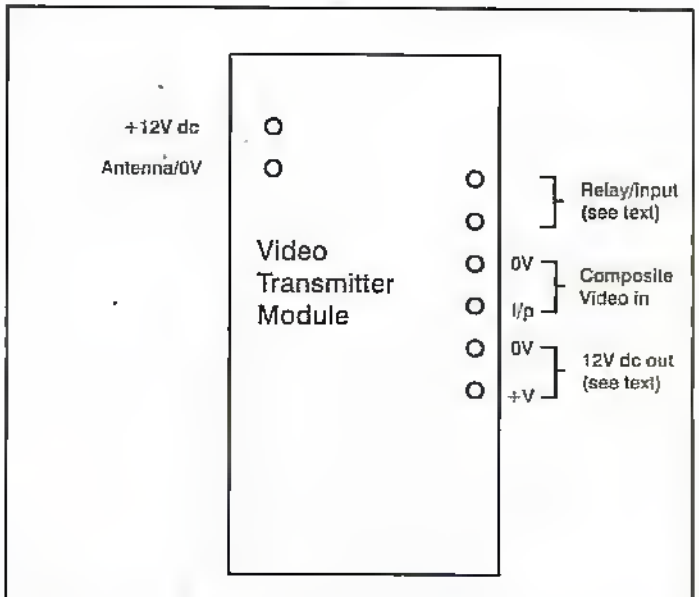


Figure 1. Transmitter module connection diagram.

a CMOS camera at a level of 1V peak-to-peak (75Ω).

Most types of PIR that provide a dry contact (relay) output may be used to switch the transmitter module. The output from the PIR is connected to the transmitter relay terminals. When the relay contacts are open the unit is active. When the contacts are closed, the transmitter is disabled.

It is important that the transmitter module together with any associated camera and/or PIR are protected against unsuitable environmental conditions. In particular the units must not be allowed to come into contact with moisture as this will almost certainly affect the reliable operation of the circuit and may result in damage. Excessively high or low ambient temperatures may also affect the operation of the circuitry, so take care to remain within the specification supplied with the unit.

A licence exempt label is supplied with the transmitter module. This is required as part of the license exemption requirements and should be attached to the transmitter installation in a clearly visible position.

The connection and layout diagram for the receiver is shown in Figure 2. The receiver will operate from a 12V DC power supply capable of delivering 100mA. A composite video output is provided via a phono socket. This can be connected to your video recorder or monitor using a suitable screened lead. The type of lead used will depend on the connector used at the monitor/video recorder. Ready made leads are available for most common types of connection including SCART, BNC and phono. If the output of the receiver is being fed to a domestic video recorder, the UHF output of the recorder can be monitored on a television receiver in the usual way. The receiver unit is suitable for indoor use only and should not be exposed to moisture or high levels of humidity.

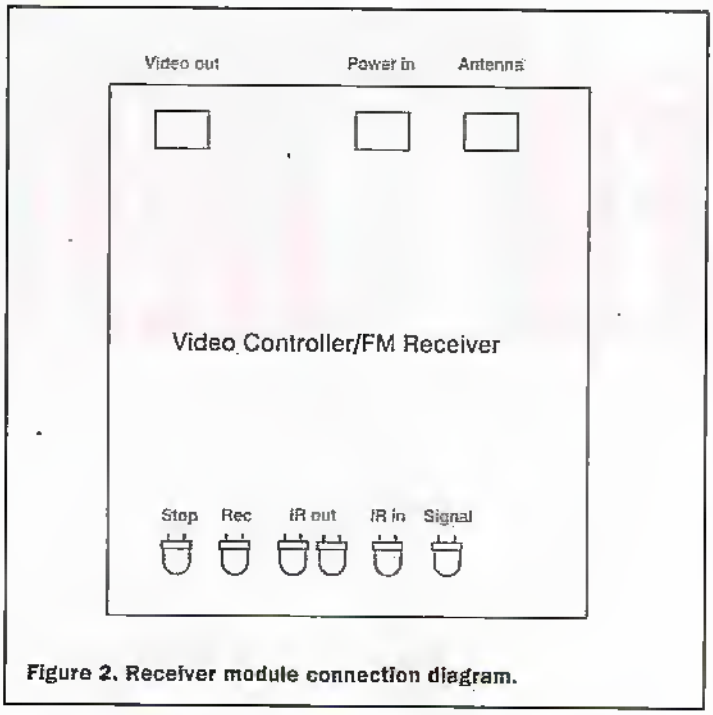


Figure 2. Receiver module connection diagram.

Programming the Receiver Module

As mentioned, it is possible to use the receiver to control the record and stop functions of many types of home video recorder if the recorder has an infrared remote control facility. This can be a particularly useful function. If you wish to control your video recorder using the infrared output from the receiver, it is first necessary to program the unit with the appropriate control codes using your video recorder remote control. This procedure is explained in detail in the instruction leaflet supplied with the receiver module. Programming the video link receiver entails placing your video remote control in front of an infrared photodiode located on the receiver and pressing the 'record' and 'stop' buttons when prompted to do so. To carry out the procedure reliably, it is best to hold the remote control unit relatively close to the photodiode. It is recommended that the infrared photodiode is not exposed to direct sunlight as this may affect the correct operation of the circuit and may prevent the receiver being correctly programmed.

The codes are held by the receiver unit only as long as power is applied. If power is removed the codes will be lost and it will be necessary to reprogram the unit. In practice this is not normally a problem but if you live in an area subject to regular power outages, you may wish to provide a backup battery supply.

Testing

Once the system is installed it is best to run through the functions to make sure that everything is working correctly.

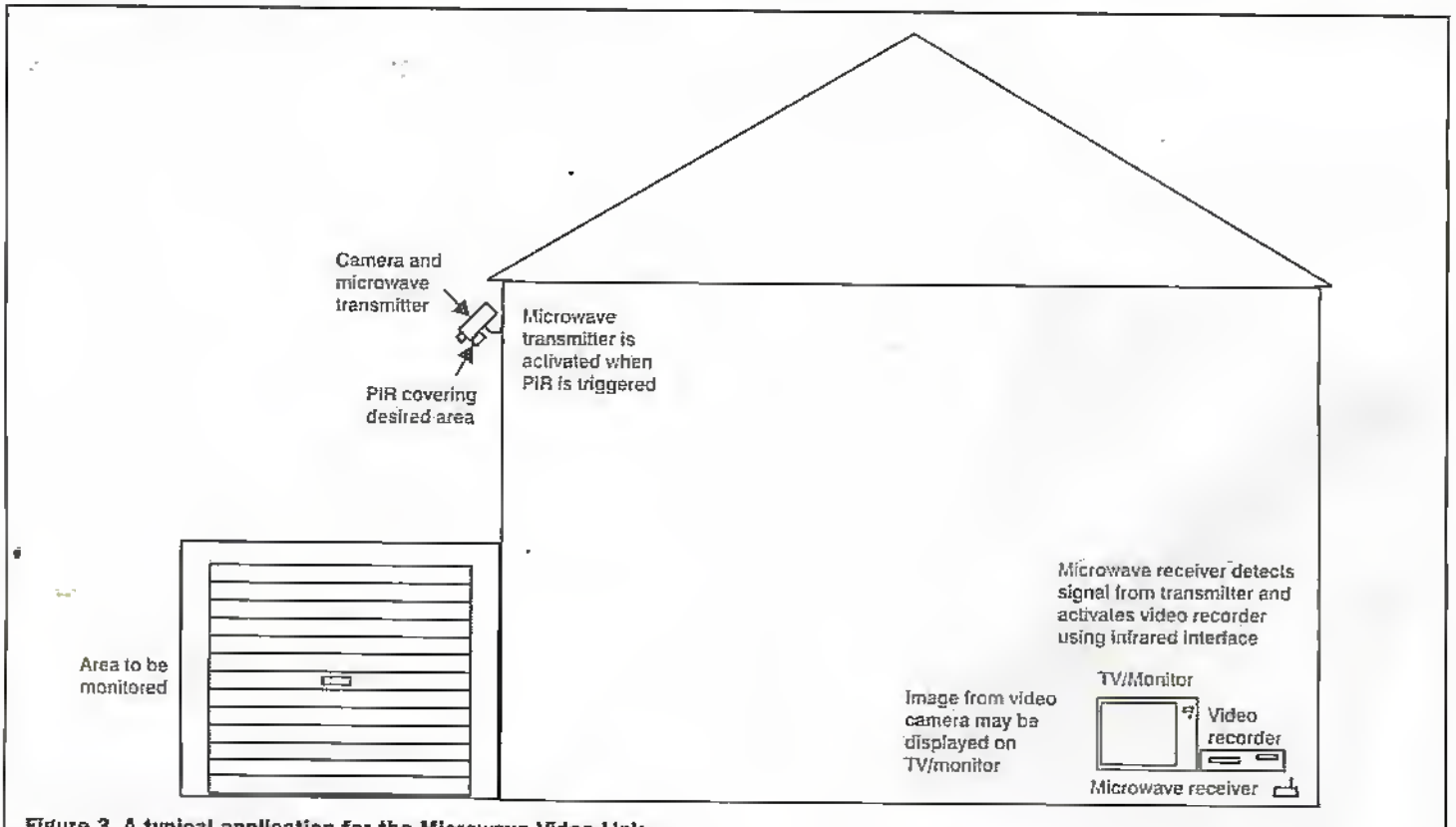


Figure 3. A typical application for the Microwave Video Link.

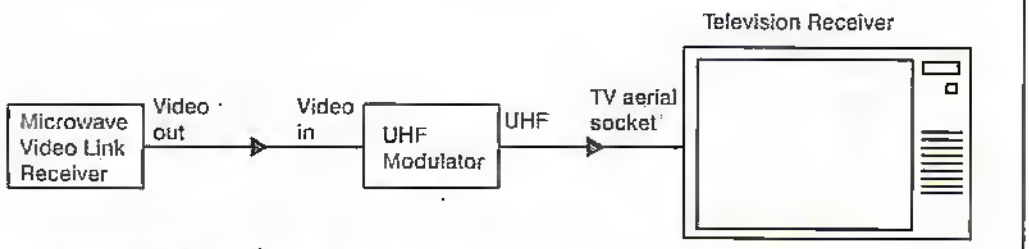


Figure 4. Using a UHF modulator to enable a composite video signal to be displayed on a standard television receiver.

The correct test procedure is indicated in the literature supplied with the unit. It is probably best to check the operation of the system before the transmitter is placed in its final position so that any unforeseen problems can be easily rectified.

Housing

A case is available for the receiver module (Maplin order code NW20W). The transmitter module may be mounted inside the same housing as a camera or housed separately. In either event the case must be made of a material which does not significantly attenuate the microwaves emitted from the transmitter module. For this reason metal enclosures should be avoided. Most plastic cases are suitable and some types can have the added advantage of providing additional protection against the ingress of dust and moisture. Where cables enter the case, further protection can be afforded by the use of suitable cable glands and silicone rubber sealant.

Security of Video Recorder

When using the system in security applications, to minimise the possibility of your video recorder being discovered by an intruder, who may remove it, it is recommended that the unit is kept out of sight as far as possible. Where possible, it is recommended that a dedicated video recorder is used with the system.

Applications

A typical application for the system is monitoring an area adjacent to the house. An example of this is shown in Figure 3. The camera, microwave transmitter and PIR module are positioned to cover a high risk area such as the garage. The receiver is connected to a domestic video recorder which it controls via the infrared interface. A standard domestic television receiver or composite video monitor may be used, both to display the images being recorded and to view playback of the video if necessary. In each case the power is taken from a local power source. It will be necessary to position the microwave receiver such that the video recorder has a clear view of the infrared transmission. This will normally mean placing the receiver in front of the video recorder, although in some cases, it may be possible to reflect the infrared transmission from a wall or other solid object.

The infrared transmission may also be used to control which channel is selected on your television receiver. It can be arranged that the TV switches to AV mode (or the video channel), displaying the image from the camera when the PIR detects movement, activating the microwave transmitter.

If you have a TV receiver that does not have a direct composite video input and do not wish to use a video recorder, the output from the microwave receiver may be displayed with the help of a UHF modulator as shown in Figure 4. An example of such a device is Maplin order code LU35Q which is supplied in kit form. The output of the microwave receiver is connected to the input of the UHF modulator. The modulator produces a UHF output which may be connected to the aerial socket of your television receiver using coaxial cable. The output from the modulator is normally centred around UHF channel 36 and in most cases may be adjusted to avoid intermodulation with other transmissions operating close to this frequency. A cheap portable monochrome TV set and a UHF modulator can provide an ideal low cost method of setting up a simple general purpose video monitor for use with the microwave video link.

Siting of PIR Detectors

When located indoors, PIR detectors can provide good performance and as long as they are not pointed at sources of heat are usually fairly reliable. If you are using a PIR detector in an outdoor location, it may be prone to false triggering. This effect may be caused by sudden changes in temperature or by moving objects that are at a different temperature to the surroundings. The problem can usually be kept under control (but sometimes not entirely eradicated) by correct sighting of the PIR unit so as to avoid problem areas. Many PIR detectors allow the angle and range of detection to be adjusted. Where possible, avoid pointing the detector at heating vents and other areas where sudden variations in temperature may occur.

Alternative Sensors

Of course, it is possible to use other types of detector with the microwave video link, although this may entail longer wiring runs than with a PIR detector which can often be mounted on the camera unit. Most types of detector that can be used with an intruder alarm are suitable for use with the microwave transmitter. Some types can be used without any modification, whereas others may require some additional circuitry for interfacing purposes. Here are a few examples:

1. Pressure mat: In some cases it may be possible to use these directly depending on the contact resistance. It may be necessary to use additional interface circuitry to provide a dry contact output and extend the trigger time.
2. Beam break detector: Beam break detectors with a dry contact output can be used directly. In some cases it may be necessary to use additional interface circuitry to extend the length of the trigger pulse but some units may already trigger for a long enough period.
3. Reed switch: These can normally be directly connected to the 'relay' input of the microwave transmitter.
4. Vibration sensors: These will normally require some additional interface circuitry as the output pulses are often of very short duration.

The microwave link may also be triggered by a doorbell push, displaying the image from the camera on a domestic television receiver. The system can be set up so that the TV changes channel to display the image from the camera when the doorbell is pressed. This can be useful where you want to add video monitoring to an existing door entry system, as it avoids the need for long additional wiring runs. If the system is set up with a video recorder, it will enable you to check whether anyone has called at your premises when you are out.

Extending the Trigger Pulse

In cases where the output from the sensor is of very short duration a simple arrangement such as the circuit shown in Figure 5 may be used. The circuit is fundamentally a timer which is triggered by the sensor. The output from the timer is used to drive a small relay which may be connected to the microwave transmitter. Using this arrangement, it is possible to ensure that the transmitter is switched on for an appropriate length of time, independent of the duration of the trigger pulse produced by the sensor. The circuit shown is purely intended as an example and it may be necessary to make modifications to suit your particular application. A parts list is given at the end of the article to provide a starting point.

The circuit is not particularly layout critical and may be constructed on matrix board with or without strips. As with any circuit take particular care that polarised components such as TR1, IC1, D1, C1 and C4 are connected observing the correct polarity. It is recommended that an IC socket is used for IC1 to prevent possible damage during soldering.

The circuit will operate from a 12V power supply. The supply is connected between terminals P1 (+V) and P2 (0V). Current consumption is relatively small

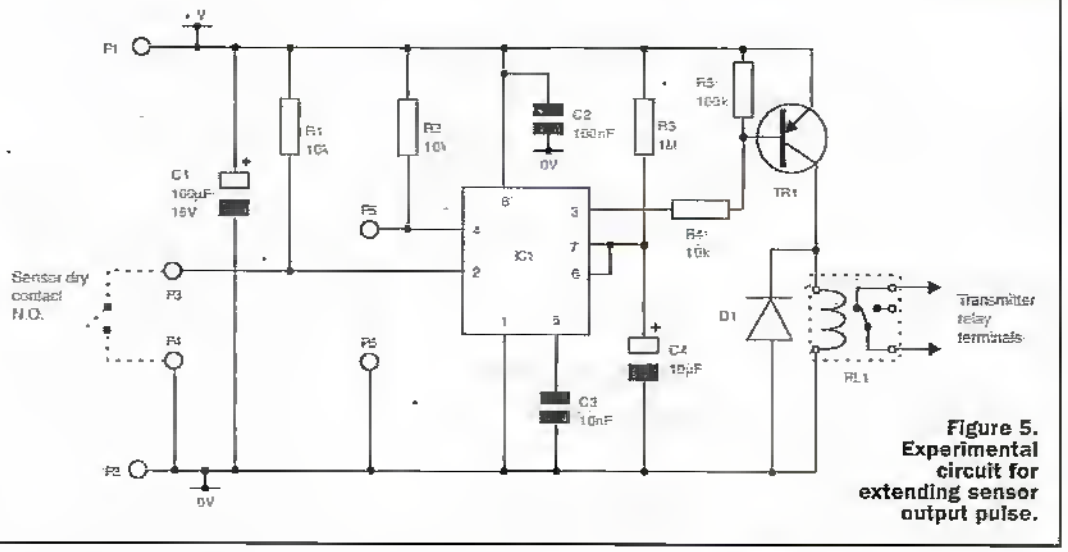


Figure 5. Experimental circuit for extending sensor output pulse.

and in most cases it should be possible to power the unit from the same 12V supply as the microwave transmitter module. However, it is always wise to check the total current consumption to make sure that it is within the capability of the power supply used.

The dry contact (relay) output from the sensor is connected to terminals P3 and P4. The monostable circuit is triggered when the contact is closed pulling P3 low. The timer may be reset by connecting P5 to P6. The normally closed contacts of the relay are connected to the relay terminals of the transmitter module.

The time constant of the circuit may be adjusted to suit individual applications by modifying the value of R3 or C4. It is recommended that the value of R3 is not reduced to less than 1k.

Remotely Controlling the Transmitter

You may wish to switch on the microwave link transmitter manually. To minimise additional wiring, the transmitter can be controlled over a second wireless link such as the licence exempt 418MHz systems discussed in *Electronics and Beyond* issues 127 and 128. This concept is illustrated in Figure 6. If set up correctly, it should still be possible to trigger the transmitter automatically from a PIR detector or other sensor in addition to the manual override. Using the system illustrated, the PIR would trigger the transmitter as usual but in addition it would also be possible to switch the unit on manually from the viewing position.

Experienced constructors may wish to experiment with a system using several cameras and microwave transmitters. The potential problem with this situation is that because the transmitters share the same microwave frequency, it is not possible to receive images from two or more transmitters operating simultaneously. It is therefore necessary to arrange suitable switching to ensure that only one transmitter is operating at any one time. There are several ways to approach this situation all of which require some form of feedback to the transmitter module. It should be possible to arrange that if one transmitter is triggered, this prevents other transmitters in the group from operating until the first transmitter has timed out. An alternative arrangement is to control the transmitters so that they operate sequentially, providing continuous monitoring of several areas. This idea is illustrated at a conceptual level in Figure 7. In both cases an encoded 'licence exempt' 418MHz system could be used to transmit the control information.

For more details regarding the construction of 418MHz wireless control systems, readers are referred to *Electronics and Beyond* issues 127 and 128.

Siting and Range

The maximum range obtainable from the system is very much dependant on where the transmitter and receiver are located. The greatest range will be obtained where there is a clear line of sight path between the transmitter and receiver. Because the system is operating in the microwave region, solid objects such as walls will normally result in reduced range and metal structures can have a marked effect. Due to the short wavelength involved even relatively small metal objects in close proximity to the transmitter or receiver can affect the operation of the unit. Therefore it is best to mount the units away from such objects as far as possible. The transmission is easily reflected and signals arriving at the receiver via two different paths may be out of phase creating a null and resulting in poor performance. Where this is the case a drastic improvement may often be obtained by slightly moving the transmitter or receiver unit. Also try adjusting the angle of the antenna on the receiver as there can be a reduction in received signal strength if the angle of the receiver antenna does not correspond with the polarisation of the incoming signal. It should be pointed out that these effects normally only manifest themselves to a marked extent when the signal is already weak due to the link being operated close to its maximum range. At closer range the transmission path is normally very reliable irrespective of position.

Under no circumstances should any attempt be made to modify the antenna on the transmitter module as this may invalidate the requirements of the MPT1349 licence exemption.

Other applications

In addition to the more obvious security uses, the microwave video link can be used to transmit video images in a whole range of other applications. These could include uses in connection with radio controlled models and robotics where the wire free mode of transmission can be a positive advantage.

Because no fixed wiring is required between the transmitter and receiver, an entirely portable monitoring system can be set up. This may be useful for anyone interested in zoology. When used with a suitable camera and infrared illumination the system could be ideal for monitoring nocturnal animals in your garden for example. PIR triggering could be as useful in this application as it is for security.

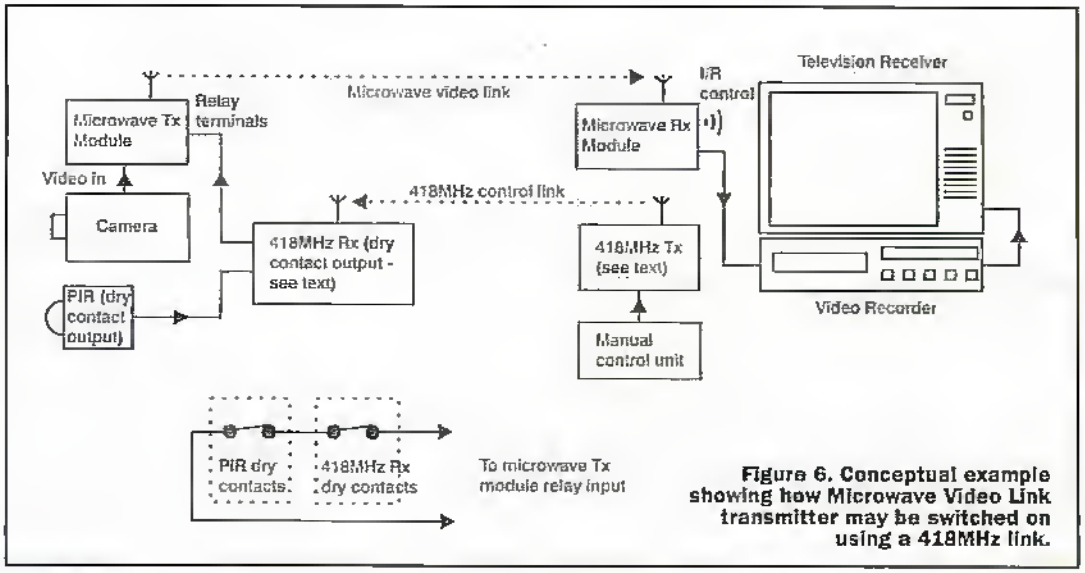


Figure 6. Conceptual example showing how Microwave Video Link transmitter may be switched on using a 418MHz link.

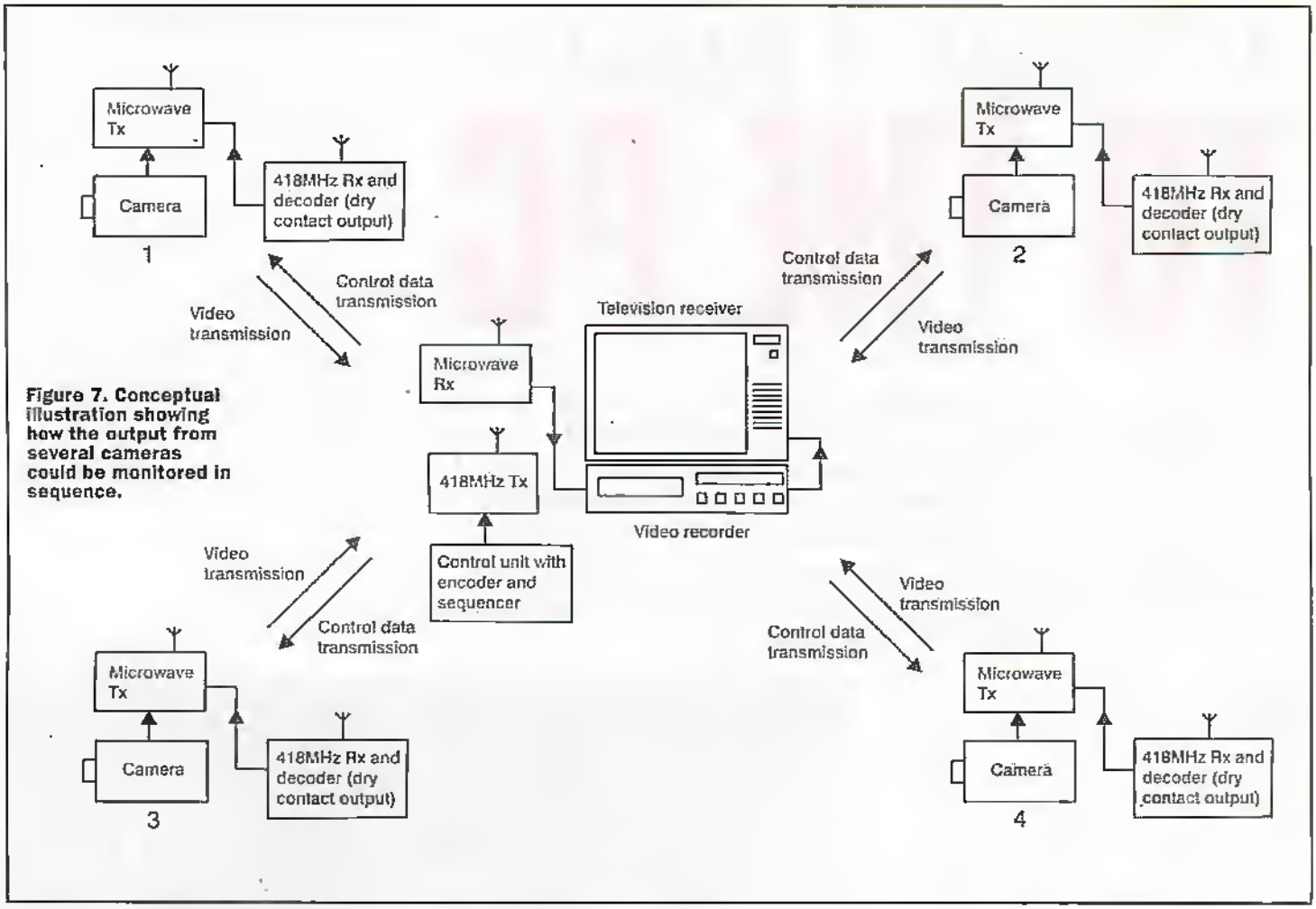


Figure 7. Conceptual illustration showing how the output from several cameras could be monitored in sequence.

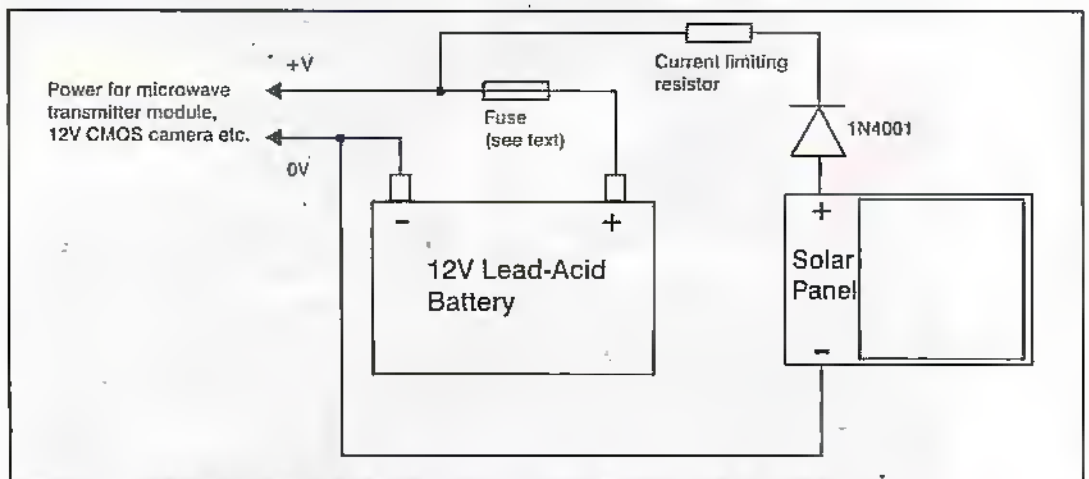


Figure 8. Typical example of lead acid battery supply charged by solar panel.

Alternative Power Supplies

Where the transmitter is not mounted in a fixed location, it will of course be necessary to power the unit from a portable battery power supply. The supply must be capable of supplying enough current to power both the camera module and the microwave transmitter. A 12V NiCd pack or a sealed lead-acid battery are both suitable for this purpose. If the system is not in continuous operation it may be possible to keep a lead-acid battery charged using a small solar panel. This may be a viable option where the mounting location is not easily accessible. A typical example of this type of system is shown in Figure 8.

Fusing

Correct fusing is always important but when using a high current power supply such as a battery, it is essential to prevent the very real risk of fire in the event of a short circuit. It is therefore recommended that all power supplies are suitably fused. The rating of the fuse should be chosen to be greater than the maximum current drain of the circuit but low enough to prevent serious damage in a fault condition. For simplicity the fuse can be installed in an inline fuse holder, such as Maplin order code RC70M. The fuse should be connected in series with the +V supply rail. A typical fuse rating for use with the transmitter module would be F500mA.

Finally...

The ATC video link really is a superb system capable of providing excellent performance when correctly set up. If you want to avoid those messy coax cable runs and a major headache every time you want to move the camera, why not give it a try?

TRIGGER PULSE EXTENDER PARTS LIST

RESISTORS			
R1, 2, 4	10k	3	M10K
R3	1M	1	M1M
R5	100k	1	M100K
CAPACITORS			
C1	GenElect 100µF 16V	1	AT40T
C2	Minidisc 0.1µF 16V	1	YR75S
C3	Ceramic 10000	1	WX77J
C4	Tant 10µF 16V	1	WW68Y
SEMICONDUCTORS			
TR1	BC558	1	QQ17T
IC1	TS555CN	1	RA76H
D1	1N4001	1	QL73Q
MISCELLANEOUS			
RL1	3A Min Relay	1	YX96E

From Paper TO THE PC

Whatever happened to the paperless office? It is an excellent concept that technology has failed to bring to fruition. Here Stephen Waddington takes a clutch of new optical character recognition (OCR) applications out for a test drive and discovers that while cost-effective text recognition for the printed word may finally be here, hand writing recognition is still a long way off.

A couple of months ago I examined the subject of voice recognition for *Electronics and Beyond* and reviewed a series of applications that enabled a PC to interpret spoken words. This month it's the turn of the written word. Using scanner technology to create an electronic image of a document and then character recognition software to transpose that image into an electronic text file, it is possible to literally get your computer to read documents.

The good news is that in many ways text recognition technology is relatively advanced. Many of the applications we look at in this article are on their second or third generation. The bad news is that the market is extremely hyped and while a host of highly efficient character recognition systems are available, none are able to cope with hand written documents.

Maybe such criticism is unfair, but in reviewing a number of applications it has struck me that it would be incredibly useful if a PC could read hand written documents. Instead the majority of the applications on the market today can only cope with printed or typed documents.

Familiar Characters

In the past, character recognition applications have suffered the same fate that voice recognition faces today. That is, the number of mistakes typically made by the software would weigh heavily against the benefits of the technology. But the technology has steadily improved. As we'll see, OmniPage Pro 8.0, one of the most popular Optical Character Recognition (OCR) applications on the market, has an almost 99% accuracy on print-quality documents.

One thing that can be said in the favour of character recognition is that it is relatively inexpensive. A decent flat bed scanner will cost £80 and a quality software package will cost anything between £30 and £100. Most scanners have a character recognition application bundled with them, but results from such packages are usually poor at best.

Photo 1. Using a flathed scannor to scan photo or document images.

Scanner Technology

It seems that it is possible to attach a peripheral to literally every orifice of a PC. These days, the standard mouse and keyboard is usually accompanied by a colour printer, modem and set of speakers. Alongside many of these devices, a scanner may seem like a less-essential peripheral – that is until you get one. Once that happens, you'll find a thousand reasons to use it. For starters, you'll be able to scan in photos for posting to friends via the Internet, and as we'll discuss in greater detail here, you can scan in documents and convert them into digital, editable copies.

Scanners are remarkably like digital cameras in terms of their operation. There is a light source, a subject and a charged couple device, or (CCD). Unlike a camera, most scanners don't snap a 'picture' of the subject. Instead, scanners combine a lamp with the CCD into one assembly for scanning the document.

When a document is placed in a flatbed scanner, the assembly moves across the document, simultaneously illuminating and

capturing a series of exposed areas. The aggregate of these exposures represent the entire document, with the quality of the final image determined by the resolution of the CCD pickup and the number of exposed areas, known as steps. Most consumer scanners are rated in dots per inch (dpi), while some higher-end units are measured by lines per inch.

Definition

The vertical resolution of the scanner is determined by how many steps the whole mechanism will move in an inch. While many scanners will specify the same vertical and horizontal resolution – 300dpi by 300dpi, for example – it has become increasingly popular to control the vertical movement in half-pixel increments, resulting in greater vertical resolution, such as 300 by 600dpi.

Many scanner manufacturers also claim an 'interpolated' resolution based on sophisticated algorithms that guess the colour of pixels between those that are actually scanned. This is fine for many document-scanning purposes, but unacceptable for high-quality photo and other print pre-processing.

Another characteristic of scanners is bit-depth. This determines how many bits the scanner will assign to each scanned pixel. Obviously, greater bit-depth results in a greater scannable colour range. Even low-end units today can be found with 36-bit colour scanning capabilities. But remember if you only need to scan black and white images you need not waste your time on reviewing colour features, a basic black and white scanner will suffice.

Flatbed versus Sheetfed

And so we come to different flavours of scanner. Do you want flatbed or sheet fed? Flatbed scanners are similar in operation to a photocopier. To scan a page, you pick up the cover, lay the page down, close the cover, and scan as shown in Photo 1. A sheetfed scanner meanwhile, works like a fax machine. You insert a page, and the scanner pulls it through.

So which to buy? Flatbed scanners let you scan bound materials, like pages in a book,

Photo 2. Scanned image of the example News Report page.

which can't fit through a sheetfed unit. But sheetfed scanners take up less space on a crowded desk. In terms of cost, there's little in it, though the flatbed colour will be slightly more expensive, typically costing £80 to £150.

All for One – One for All

Multifunction printers are recent entrants to the PC peripheral market. These products serve double or triple duty as fax machines, scanners, and copiers, and can make a good all-in-one solution if budget is tight, or space limited. Most all in one units will include a low cost black and white sheetfed scanner. This is ideal for character recognition, but will be no good if you later decide you need to scan colour documents such as photos or brochures.

Software Solution

Hardware is only part of the solution. In an era of cheap hardware and bundled software, it is important to think about the software functionality required. A standalone bundled application may be sufficient for pure character recognition, but it is likely that you will require some form of document management scheme.

Here we come to different types of software application. There are essentially three types increasing in terms of cost and functionality.

1. Bundled Applications:

The bundled application, which is included with the majority of scanners, is the most basic option. The real benefit is that it is usually free, but the downside is that accuracy and flexibility will usually be poor compared with commercial character recognition systems

2. Dedicated Character Recognition Applications:

Dedicated character recognition systems such as Textbridge and OmniPage provide the greatest level of accuracy. Here the application runs alongside and often integrates with a scanner and will often work as a macro with popular wordprocessor and text editing applications.

3. Office Management Systems:

A character recognition application often forms an element of a more complex integrated office management system. Here scanned photos and documents can be archived and sorted enabling the documents to be subsequently searched using free text and key word searches.

Dedicated Applications

Not even the best OCR program on earth can deliver – or even promise – 100% accuracy when it comes to turning printed material into digital text, OmniPage certainly comes the closest among the desktop OCR packages now available.

The OCR program from Caere is expensive, but it is highly accurate, especially when working with less-than-perfect originals. The new version also offers a number of other useful enhancements, including support for colour, more accurate handling of multi-language documents, a better proofing system for checking document accuracy, enhanced HTML export options and support for more scanners.

OmniPage still offers a simple, uncluttered interface that takes you smoothly through the process of scanning, recognising and proofing documents. You can manage the process one step at a time – first scanning a document, running it through the OCR engine, checking the results and finally saving it to the word processing format of your choice – or you can set up the program's AutoOCR Toolbar to move through the whole conversion process with one click.

Laboratory Conditions

OmniPage includes a new recognition engine, which provides a great leap forward in OCR accuracy when compared with more tradition systems. Test results confirm that OmniPage offers the highest level of accuracy among significant desktop OCR applications. These readily reproducible and statistically significant results are valid for currently shipping products as of today. The test images and error analysis tools were provided to Caere by the Information Science Research Institute (ISRI) of the University of Nevada, Las Vegas (UNLV). ISRI is an industry leading research facility in OCR technology and publisher of OCR research results since 1992.

The test images provided by ISRI came from 1,885 pages, all of which were used, in ISRI's two most recent Annual OCR Technology Assessments. The test deck comprises the full set of English-language pages that ISRI made publicly available in its most recent release. The test results show that OmniPage produced 20% fewer errors on average than the second best performer. Further details of the tests are available at www.caere.com/news/omnipage.htm.

Tests using the same images and error analysis tools confirm that OmniPage's new recognition engine reduces the number of errors by 62% over the previous version. For example, a page processed using the previous version that resulted in 10 errors would have on average only four errors when processed using version 8.0. The accuracy increase is provided without compromising speed performance.

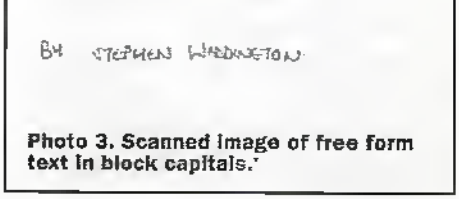


Photo 3. Scanned image of free form text in block capitals.

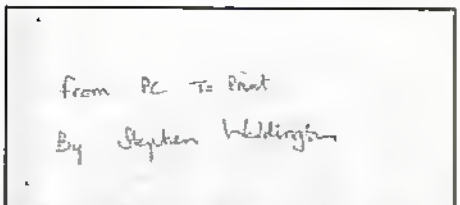


Photo 4. Scanned image of free form text in joined-up writing.

Photo 5. Transferring magazine text to electronic document using Textbridge.

Furthermore, the new engine provides even higher accuracy improvements on 'trouble' documents like those that are severely degraded or skewed as well as those documents that contain very small text, tables, lists and multiple languages. As a result, more and more pages cross the threshold of acceptable accuracy with the new Cuere technology.

OmniPage is the first desktop OCR program to utilise multithreading, which takes advantage of 32-bit Windows' ability to perform more than one task at a time. Multithreading permits a user with a multiple-page document to scan, recognise, and edit pages simultaneously. This greatly improves overall throughput – the amount of time it takes to get a document from paper to electronic format – and lets the user work more efficiently by eliminating the need to wait for each process to complete before moving on to the next. Previously, users with multi-page documents to process had to wait until all the pages were loaded and recognised before any modifications to the document could be made.

Integrated Applications

Pagis Pro 2.0 is a suite of scanning programs that includes everything you need to produce top-quality scans, translate text on paper into electronic text using OCR, organise the family photos you've digitised, and find and retrieve any image, or any document, on your computer.

For users who rarely store documents more than a few pages long, Pagis Pro 2.0 could be just what the doctor ordered. The latest version of this popular package combines the proven OCR capabilities of TextBridge Pro 98 with MGI Software Corp.'s MGI PhotoSuite. New support for forms enables the users to scan a form into Pagis Pro and then fill it out onscreen.

Thanks to its reliance on TextBridge Pro 8.0 for OCR – which incidentally can be purchased as a stand alone application – Pagis Pro 2.0 provided the widest image-conversion support of any product reviewed, as well as great support for indexing different text-file formats.

Pagis provides an easy-to-use scanner driver interface that automatically adjusts the colour and brightness levels so the image is picture-perfect. Pagis also sends scans directly to any of the 150 applications it supports. So once you have scanned a typed sheet of paper, for instance, just drop the scanned image file onto the icon for, say, Microsoft Word, and Pagis uses its OCR software to convert the text and open the document. If you've scanned a photo, you can open and edit it with the included photo/image editor, PhotoSuite.

Pagis Pro 2.0 is expensive, and, for families who scan sporadically, its overkill. But when you scan like mad – or if you need to organise a large library of images and text for work-at-home or home office jobs – Pagis is as professional as they come.

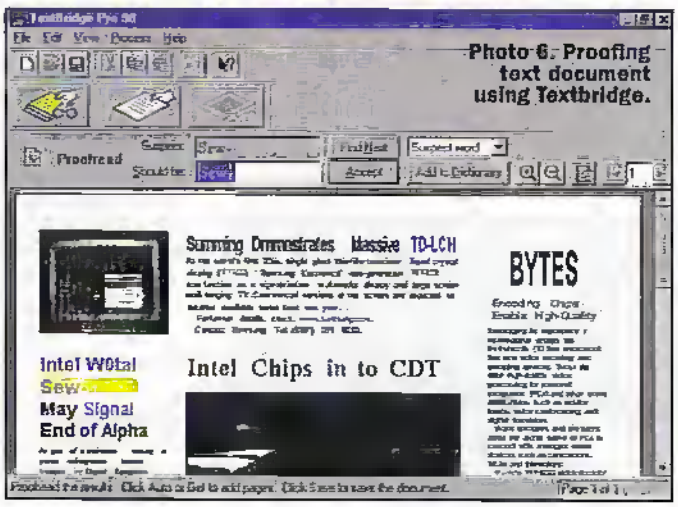


Photo 6. Proofing text document using Textbridge.

Hey Presto

Presto! Page Manager 98 is another integrated suite. In this instance the application includes PageManager 98, Presto! Forms 3.0, and ImageFolio 4.1.5 in an integrated package that intuitively leads users through each step of the scanning process. The integration of this package is its most useful feature.

When scanning in an image the user is kept waiting while the scanner lamp warms up. Then the machine scans the source material. Once the initial image is acquired, the document can be previewed or rescanned. Next you have a bunch of options. You could apply the OCR package to the file; annotate the image or document; or print, copy, fax, e-mail, or send the object to another application such as Word or Photoshop.

Presto! Page Manager 98 is a serious application for office rather than personal use. An individual user would realistically use less than 20% of the applications functionality. For example, Presto! Forms 3.0 allows users to scan a form for immediate use, such as posting on a Web site or e-mail distribution. This eliminates the time and cost of using paper or designed forms. Nice touch if you're down to your last expenses form, but not something for a home user to get excited about. Similarly ImageFolio 4.1.5 is a way to quickly design and dress up your images. There are many different templates available to quickly create cards or posters.

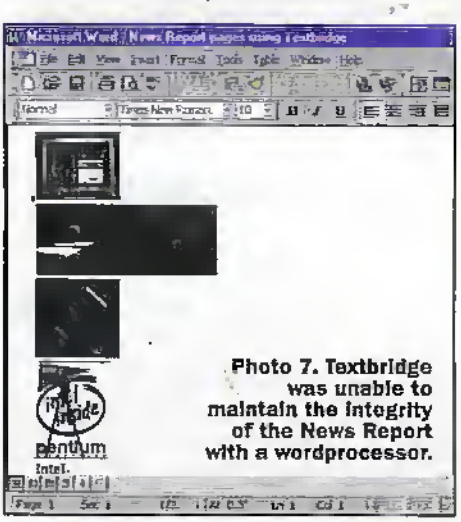


Photo 7. Textbridge was unable to maintain the integrity of the News Report with a wordprocessor.

Text under Test

So how do these applications stack up in reality? As a conclusion to this article we tested both OmniPage and Textbridge on a News Report page from an old copy of *Electronics & Beyond* and a handwritten note. The note was drafted in both block capitals and handwritten text. The test pages are shown in Photo 2, 3 and 4.

To test the applications to the limit we used the poorest scanner we could find, a £40 black and white sheet feed scanner called the SICOS DMS 2000. The theory being that if it was possible to get good results using a poor scanner, then a flat bed colour scanner would produce excellent results. Both Textbridge and OmniPage recommend setting the scanner at 400 dpi to achieve best results, although both applications claim that scans at 200 and 300 dpi would produce reasonable results.

The raw documents can be inputted for processing in a number of ways. The most obvious approach is to manage the process from within the OCR application. An alternative approach is to submit a pre-scanned electronic version of the document to the OCR application. A third technique allows the user to call up the OCR application from within a wordprocessor or text editor.

For the purposes of the test exercise the document was submitted to each of the OCR applications in electronic format to ensure that both applications had a

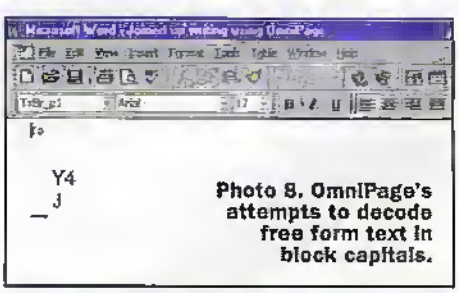


Photo 8. OmniPage's attempts to decode free form text in block capitals.

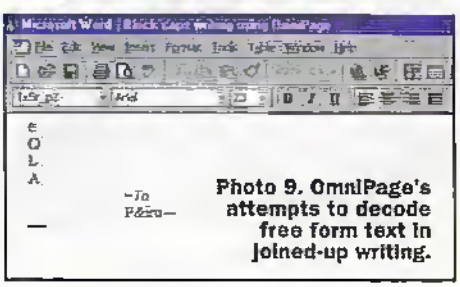
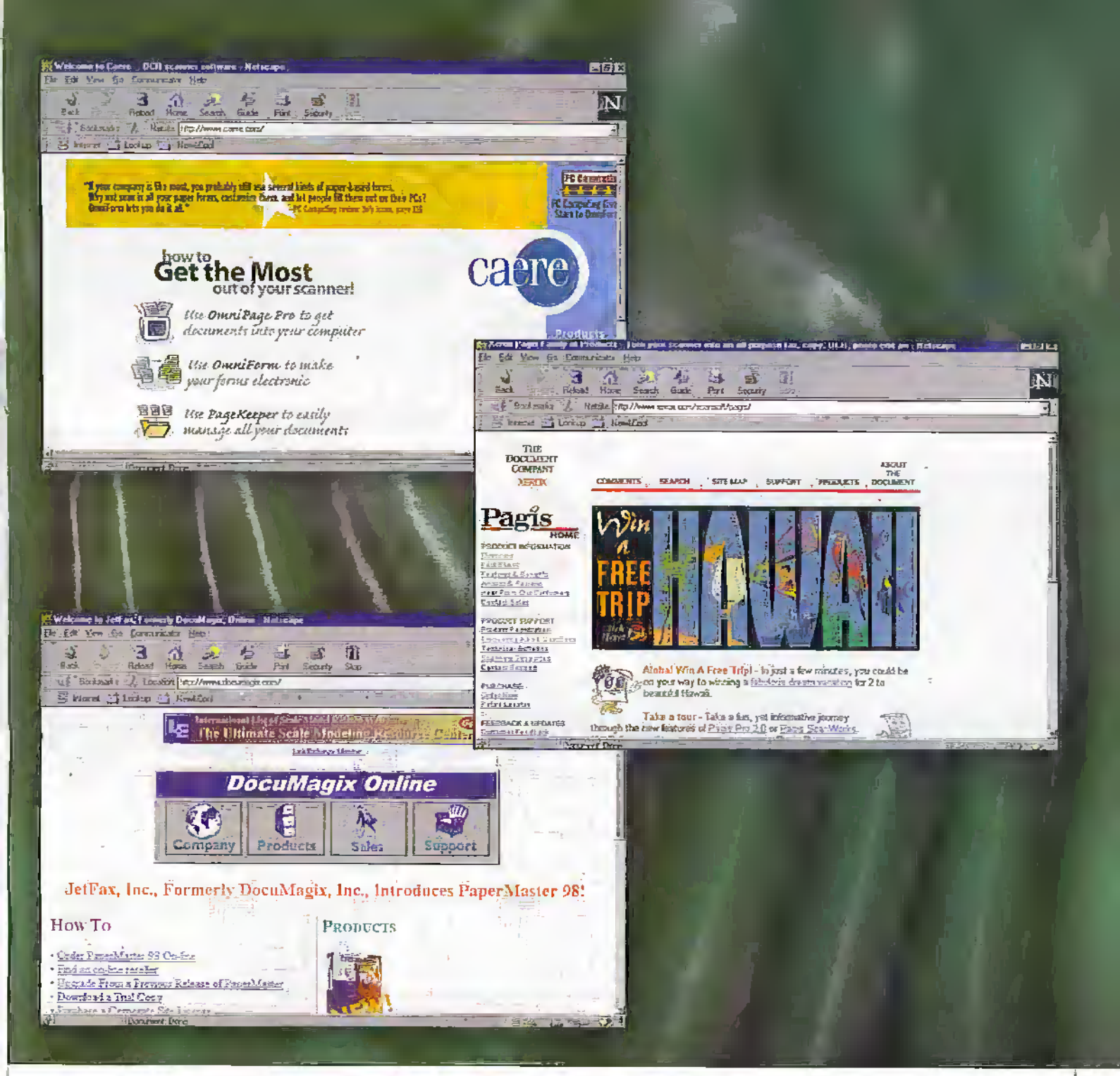


Photo 9. OmniPage's attempts to decode free form text in joined-up writing.



consistent input. This process requires the documents to be scanned and saved as TIF files, and in the case of both OmniPage and Textbridge, opened from within the OCR application. Photo 5 shows how this approach takes place using Textbridge.

From here the applications do the rest – or at least that's the theory. On the printed text, results were reasonable. OmniPage converted the News Report page within 15 seconds; Texbridge took almost twice as long. In terms of accuracy, OmniPage made five errors, while Textbridge made 12 as shown in Photo 6. Given that the document was approximately 500 words long this gives an accuracy of 99% for OmniPage and 97.5% for Textbridge.

Error Rate

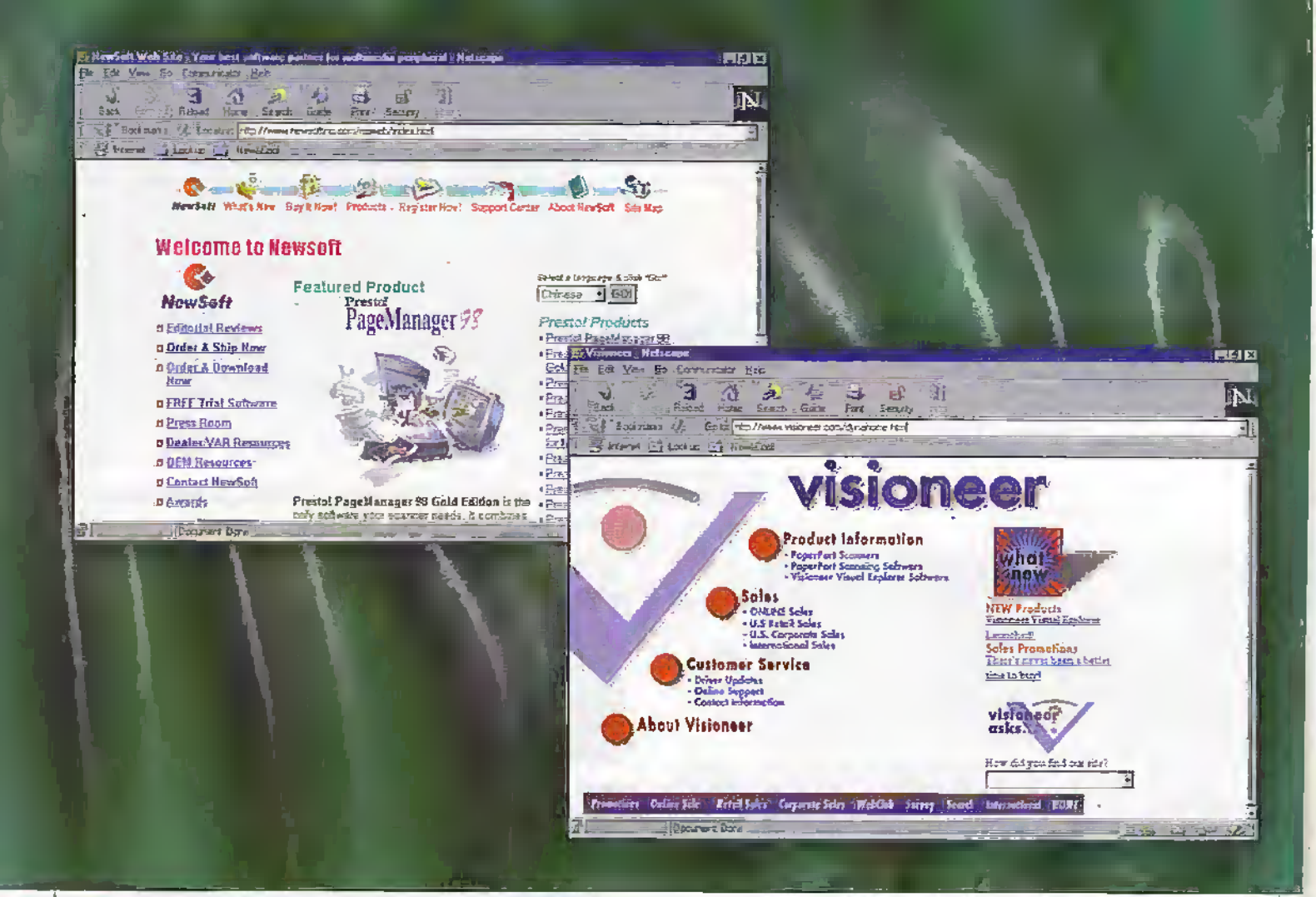
All errors were identified by the proofing or spell check option, although Textbridge failed to identify the News Byte logo as a logo and ignored the 'News' image, but converted the 'Byte' element into text. Proofing took two minutes for Textbridge and less than half that time for OmniPage.

Both applications handle proofing reasonably well. After a document has been transposed into text, the applications offer a spell check option. This takes you through any words that the application has been unable to identify. In each instance the application suggests the most likely word in the much the same way as a wordprocessor spell checker works.

Unlike voice recognition, OCR applications will always identify something even if is unable to determine the nature of the actual character. In this case, the application will insert a special character, which is usually a tilda or hash, although this can be changed by the user.

Once the document has been proofed it can be saved in any number of different file formats. The main wordprocessors such as Word and Wordperfect are supported. Results here were disappointing. After all the hype about maintaining the integrity of the original document, only OmniPage saved the text and images from the original document in the correct format. Textbridge stacked all the images at the front of the document irrespective of the wordprocessor selected, as shown in Photo 7.

It is likely that Textbridge screws up the formatting because it saves documents in a generic rich text format (RTF). No one at Textbridge UK was able to provide any further insight. Both OmniPage and Textbridge saved successfully to the Adobe Acorbat PDF format, but then you'll need a copy of Adobe Acrobat to edit the document, which is out-of-reach cost-wise for most home users. If you just want to look at the document, or print it out, you can download an Acrobat reader for free from the Adobe Web site.



Soak Test

So it's fair to say that text recognition works, and it works well. Bear in mind that the images we used were scanned using the crudest condition possible. It's likely that a colour flatbed scanner could pick up greater definition and would definitely make a better job of handling the contrast between different colours – which is where some of the errors occurred.

Finally, what about handwriting recognition? Put simply, it just doesn't work. Admittedly, none of the applications we've reviewed here claim to be able to handle hand-written text. Photos 8 and 9 show how OmniPage coped with the hand-written documents shown in Photos 3 and 4 respectively. It's not good is it?

If you are prepared to spend the time tuning up your scanner and OCR package then you'll get reasonable results using even the crudest black and white sheet feed scanner. If you intend scanning heaps of documents or photos, it is probably worth investing in a document management system. As for hand writing recognition, it might be available as part of the operating system for a bunch of handheld computer devices, but we're a long way off from seeing technology that enables your desktop PC to literally reach documents.

Product Overview

This table outlines the major OCR and document applications available on the market. Check Web site for further details of functionality and UK availability.

OmniPage Pro 8.0

Caere
Web: www.caere.com
Requires: Pentium; 35MB hard drive space; Windows 95
Cost: £250 to £350

OmniPage is the world's most accurate desktop optical character Recognition (OCR) software available. This world's best-selling OCR software quickly and easily converts paper documents into computer-editable documents with better than 99 per cent accuracy for printed text.

Pagis Pro 2.0 ScanSoft

Xerox
Web: www.pagis.com
Requires: Pentium or faster; 24MB RAM (32MB recommended)
Cost: Under £100

Designed for the Small Office Home Office (SOHO) user, Pagis Pro is the ultimate scanning suite for both photos and documents. More than high quality colour scanning, Pagis Pro offers time-saving features like visual filing, Pro OCR, photo-editing, colour copying, faxing, forms fill-in, annotations and e-mailing of colour photos.

PaperMaster 2.0 98

DocuMagix
Web: www.documagix.com
Requires: Pentium; 15MB hard drive space; Windows 95
Cost: UK pricing to be announced.

PaperMaster leverages the file cabinet paradigm and intuitively stores paper from virtually any source into personalised 'file cabinets', 'drawers' and 'folders'. Version 2.0 features surpass traditional filing by allowing users to create and share file cabinets over a network or any removable media. This means personal information can now be shared locally or sent to remote locations.

PaperPort Scanner Suite

Visioneer
Web: www.visioneer.com
Requires: Pentium; 40MB hard drive space; Windows 95
Cost: £150 to £200

PaperPort ScannerSuite brings together the leading applications for scanning, organising, converting and sharing documents and images – all in one cost-effective, easy-to-use bundle. ScannerSuite includes PaperPort Deluxe, the complete solution for sharing and managing paper, and ProOCR100, the industry-beating OCR product for real-world documents. Visioneer ProOCR100 features SuperCharged OCR for your scanned documents.

Presto! Page Manager 98

NewSoft
Web: www.newsoftinc.com
Requires: Pentium; 100MB hard drive space; Windows 95
Cost £100 to £150

Presto! Page Manager 98 includes Presto! OCR Pro 3.0 an application that is able to accurately recognises documents with complex layouts and translates them into text documents that can be edited. It not only retains the original layout of a document including the graphics; it also generates true-word processor tables and columns, making it easier to edit the output files.

COMMENT

by Keith Brindley

Three things have happened recently which suggest that Microsoft's dominance of the computer industry is about to wane. The first is self-evident, and pretty well known. The second and third things, however, are not so well known, and take a moment or two to ponder before you put two and two together to predict that Microsoft could be knocked for six. Let's look at the three things in turn.

First, Microsoft is in quite deep trouble with the US government. Most readers will be aware that this has resulted in the US government taking Microsoft to court in an attempt to prove that Microsoft has used its weight as a computing giant to prevent other computer companies being as successful as they might otherwise have been. In effect, it's well known that Microsoft has a monopoly stranglehold on the computer industry worldwide - not just in the United States - and has allegedly used this stranglehold to prevent other companies from selling products, or being as popular as they might be. The first such example of this has been quoted as being the fact that Microsoft gives its Web browser Internet Explorer away for free with its Windows operating system, while the other major Web browser Netscape Navigator was a freestanding paidfor product until Internet Explorer came along. By bundling Internet Explorer with Windows, the US government feels that Microsoft has effectively crippled Netscape. In perspective, of course, and in the shortterm, bundling of products might be better for consumers in that it appears cheaper, but in the longterm it defeats its own aim, kills off competition, and eventually leads to a noncompetitive marketplace comprising one vendor, wherein no further technical advances are made and any price can be charged. Cheapness always comes at a cost.

As time goes on and the US government finds more and more evidence to support its case, it's beginning to look like Microsoft is going to find it very hard to refute these allegations. There seems to be an evergrowing number of companies with something to say in this respect, and as they come crawling out of the woodwork it's looking more and more like they weren't prepared and were even frightened to say anything except for the US government subpoenas being served on them - in itself, almost proof of the allegations of bullyboy tactics. More and more areas have appeared in the investigation to support the case against Microsoft, and while it's impossible to judge the final outcome, it doesn't take a legal genius to see that Microsoft has its work cut out in defending its position.

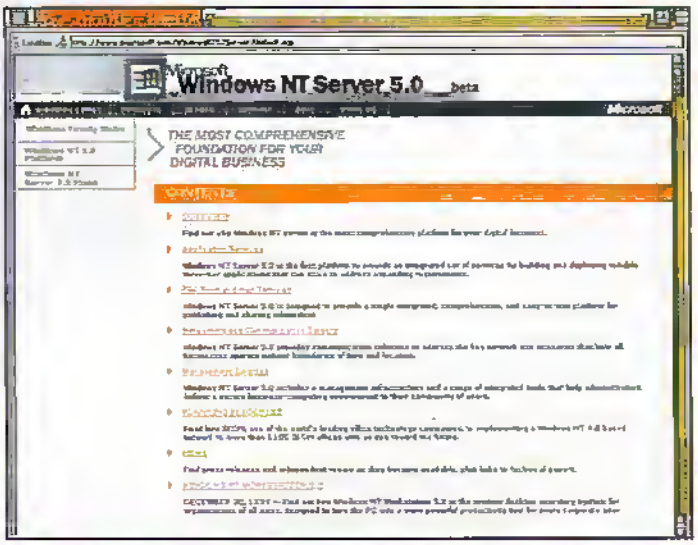
The second thing that's happened recently to make me feel Microsoft is about to meet its match, is that its longtime partner in the computing business Intel, appears to be hedging its bets with respect to Microsoft. Over the last fifteen years, Microsoft and Intel have been very much stable partners in the computing industry: Intel makes the integrated circuits that are put into PCs, while Microsoft writes the operating system that drives most of them. Originally, the operating system was DOS, latterly it's been one or other version of the Windows operating system.

Yet, Intel's not too blinkered to not see that in the longterm things might change. There are other operating systems that run on Intel PCs, but by putting all its eggs into a Windows basket, Intel might be leaving the door closed on them should things go awry with Microsoft in the future. Recently, for example, Intel has invested in a rival company to Microsoft, Red Hat Software. Red Hat makes an operating system called Linux, which runs on not only Intel PCs, but also on other major computer platforms such as Sun, Hewlett Packard and Apple. The fact that Intel has invested in Linux might not be critical in any problems that might befall Microsoft, but it certainly is an interesting thing for Intel to do. For reference, Linux is currently considered an engineers' and programmers' operating system, but there are some eight million users worldwide, and the fact Intel invests in it should cause Microsoft no small alarm. Most consumers of personal computers get carried away with the thought that Windows is the *only* operating system for personal computers, but with eight million Linux users, twenty million Sun users, and thirty million Apple users, it's sobering to remember that Windows isn't necessarily as dominant as the highstreet PC bargain basements would have us believe.

Finally, the third thing that has happened recently which suggest that Microsoft's dominance of the computer industry can't get any greater is the very fact that it, technically at least, simply can't get any greater. A few weeks ago, Microsoft became the company with the largest market capitalisation, overtaking the previous topdog General Electric. Microsoft has some 2.4 billion shares, valued at around $105, making the company a capitalisation of around $260 billion.

As such, Microsoft is, quite literally, on the top of the world. It's the number one company in the whole world. It simply can't get any higher. Quite a performance from a company that started just a few years back in a garage. As an aside, Microsoft's head, Bill Gates, owns 22% of the company's shares, putting his personal wealth due to the shares at something like $57 billion.

Of course, all these things might not mean a thing. Microsoft is a resilient company and will no doubt adapt to suit any new situations that might arise due to recent and future happenings. After all, some might say that any company that can become the world's biggest company on the back of Windows must be pretty resilient. Joking aside though, Microsoft may find that being on top of the world is great, except that it's easy to fall off. When you're the biggest, after all, there is only one way to go and that way is down. There's no rush, and it's not going to happen overnight, but it's not too hard to believe that for the company that brought us the millennium bug, time could be about to run out.



Virtual STUDIOS

Reg Miles looks at how computers are used in the studio to create an illusion.

Since the advent of colour television thirty years ago increasing use has been made of techniques that combine images to create an illusion of actors or presenters being somewhere other than in a studio. This avoids both the practical and economic disadvantages of working on location. Recently these techniques have been developed to the point where a complete studio set can be generated by a computer in real-time – a virtual studio.

This virtual studio concept has taken another step forward with the announcement by the BBC of its new optical marker tracking system called 'Free-D'. This provides a relatively simple solution to the problem of allowing cameras to move without causing odd motion effects between real and virtual images.

Chromakey

This arises because of the way in which the images are created – by a process known as chromakey (or sometimes colour separation overlay [CSO] or blue screen). A foreground image from one camera is combined with a background image recorded from a second camera – or generated by a computer – to produce a composite picture. If the foreground camera moves then that image will appear to be floating over the background image, or if the lens is zoomed in or out the foreground image will appear to grow or shrink. These are sometimes deliberately used as effects in cheaply produced programmes; but otherwise it is a serious creative restriction because it will shatter the illusion.

In the chromakey process the foreground image is produced by having the action take place in front of a plain coloured screen. This will normally be blue, because it is the furthest from white skin; but if the actors are black or wearing black clothes then green is preferable. Whichever it is it becomes the key colour; and from this an electronic key signal is derived that shows where the change from key colour to foreground image is on each of the 575 active TV lines. Switching between the foreground and background signals is done automatically in a keyer, and wherever the key colour is detected it is replaced by the background image - the colour effectively becoming transparent (Figure 1).

Obviously there must be no key colour present in the foreground image or that too would disappear – this includes eyes, as well as more obvious things like clothes and props. The size of the keying area will depend on its use: a small panel behind a newsreader, a somewhat larger backing for weather forecasts, or a large set for a virtual studio.

This last application will consist of a key colour cyclorama or plaster-coved wall, with the floor sharing the key colour. The 'real' studio will be just like any other, with a size suitable for the action.

Chromakey Problems

However, the use of chromakey does cause some problems not associated with conventional shoots. Aperture correction used by video cameras to enhance image boundaries so that details stand out and look sharper can cause black edges around foreground images, particularly when green is the key colour, unless the correction is carefully applied. With 'real time' virtual systems there is a delay between the action occurring and the composite picture appearing on the monitors – currently 2-6 frames (80-240ms); obviously this necessitates the same delay being applied to the audio signal if lip-sync is to be achieved on the programme output. There is also a requirement to use component video, with the signal comprised of luminance and colour difference (R-Y and B-Y), for the ease with which it can be manipulated. Ideally in digital form, for even easier manipulation coupled with robustness. These days this is not much of a barrier because component, particularly digital component, is taking over.

Chromakey also presents inherent problems. In order to generate a strong key signal with low noise it is necessary to have the coloured area brightly and evenly illuminated. This can be difficult to achieve over a large area. And, because the lighting will be determined by the technical requirements of key generation, it can be difficult to achive the desired artistic effect – particularly when operating at low light levels. In that circumstance, light scattered from the coloured area can spill onto the actors and props giving them an unnatural tint. Lastly, areas of dark shadows, such as under tables, do not provide a clean key signal. Incidentally, shadows cast by foreground action are reproduced by a variation of the luminance of the key colour signal which is used to darken appropriate areas of the background image.

One solution to the problems afflicting chromakey has been to replace the blue cyclorama with a retro-reflective material – like that used in road signs, and combine it with coloured light. If that light source is situated on the same axis as the camera lens, by using a semi-silvered mirror, then the retro-reflective material will direct the light straight back into the lens (Figure 2). There will be no spill and no constraints on

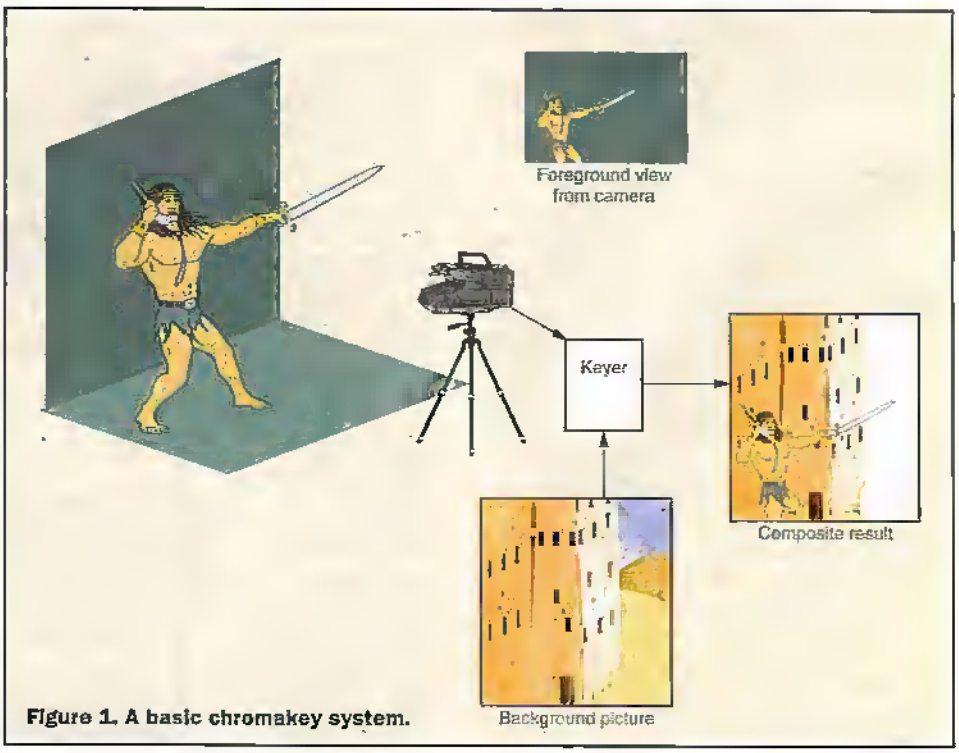


Figure 1. A basic chromakey system.

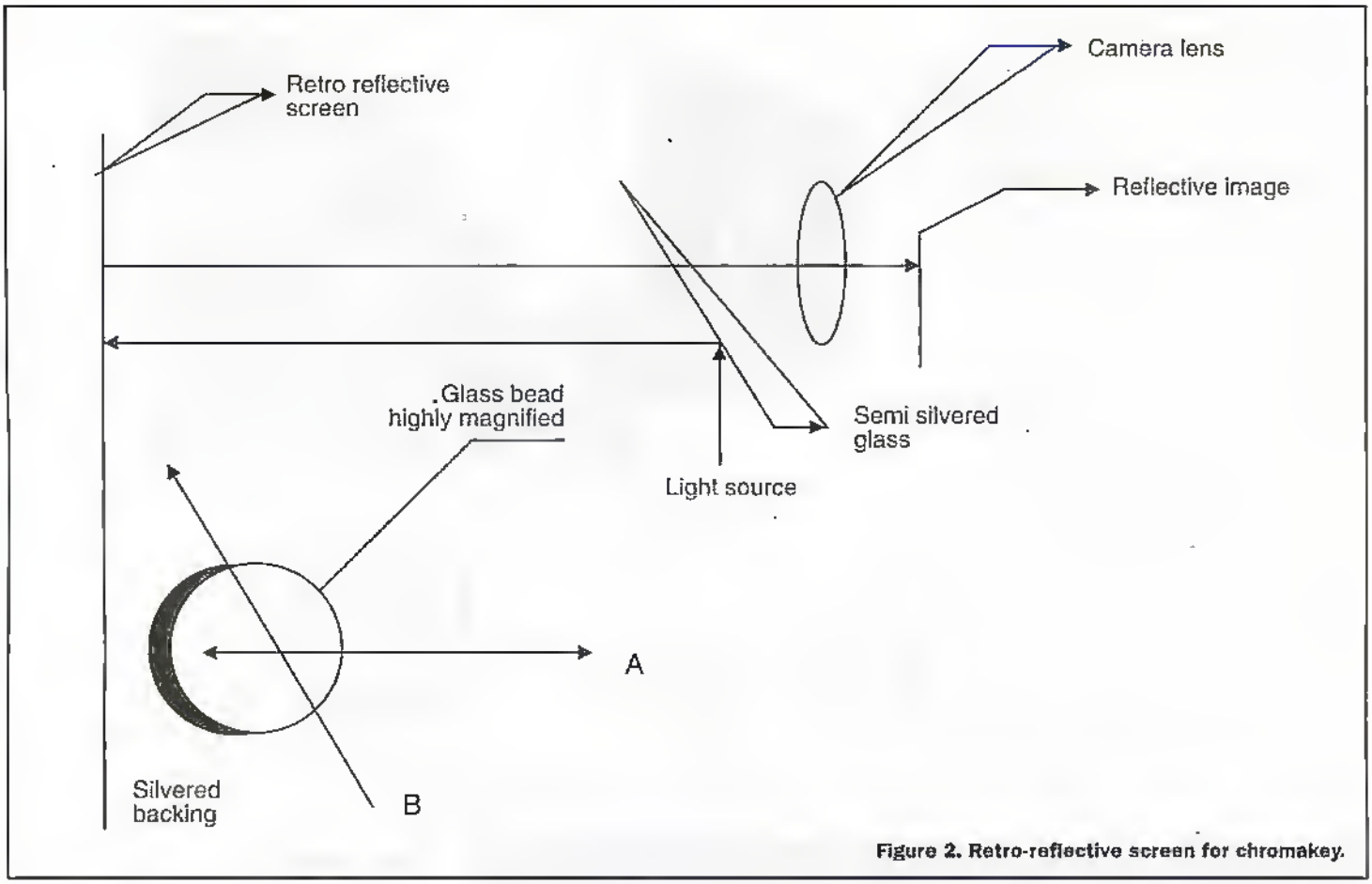


Figure 2. Retro-reflective screen for chromakey.

scene lighting. However, if the camera/light are at an angle of more than 40° to the material the light will be poorly reflected, and so it cannot be used on floors. To overcome this the BBC has developed a new keying method called *Truematte*. This utilises a new retro-reflective material that trades-off maximum gain for an increase in acceptance angle (Figure 3); and illuminates it by a ring of bright, coloured LEDs around the camera lens. The key colour can therefore be changed just by swapping the LED ring.

Creating a Virtual Studio

A virtual studio can be achieved by using one of three basic background methods to create the illusion: pre-rendered graphics, 2D and 3D. In all cases the camera movements in the foreground must be reflected by appropriate movements of the background, or the illusion will be lost.

You can see pre-rendered graphics at work by watching the BBC's main news bulletins. The backgrounds are created beforehand and stored on a video disk. These are then replayed to match the moves of a robotic camera. The obvious advantage is the low cost. Also the quality can be photo-realistic because it does not have to be rendered in real-time. The disadvantage is that changes to shots cannot be made without lengthy adjustments. And a robotic camera can only cope with a static newsreader.

Camera movements are usually fairly limited in television productions, however: research by the BBC showed that as much as 90% of them were only pan (side to side), tilt (up and down) and zoom to follow the action. In many cases, therefore, it is unnecessary to have a supercomputer constantly rendering the full view of a set because unless the camera mount is moved the illusory view of the background will not change, and neither will the perspective.

This realisation led the BBC to develop a 2D system that has a 'window' representing the camera view of the background that moves within a pre-rendered wide angle shot (Figure 4). As the camera pans right the window moves right, etc; as the camera zooms the window changes in size (over a ratio of 8:1). This image manipulator is basically a Digital Video Effects (DVE) unit. It is linked to the camera pan and tilt head and to the lens' zoom and focus controls. Information from these sensors is fed to the control computer, which tells the image manipulator how to move and size the 'window'. The sensors are usually optical encoders, to allow resolutions to something

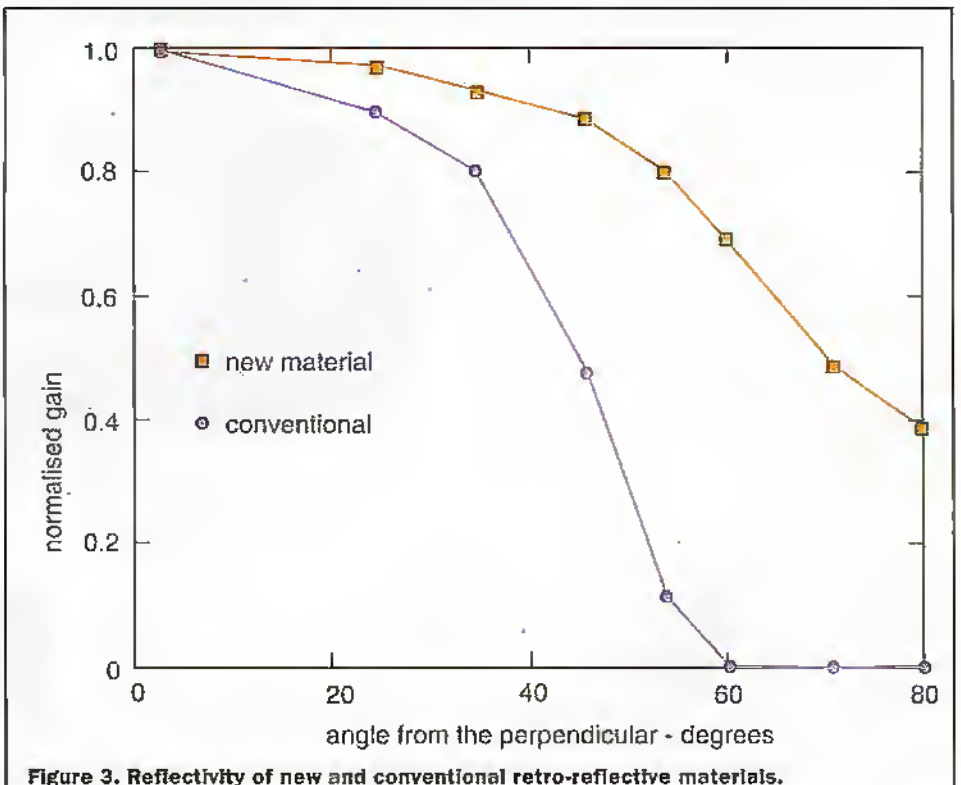


Figure 3. Reflectivity of new and conventional retro-reflective materials.

like 1/100th of a degree. And there will probably be more than one camera. Several image manipulators may also be combined to allow moving foreground mattes (that can be replaced by images); garbage matting (cutting out unwanted parts from a foreground image); or producing layers of image, like cells in animation, to give the illusion of depth. Live video can also be inserted into the image and panned around with the image. The system is now manufactured by Radamec Broadcasting under the name *Virtual Scenario* – see Photo 1.

D-Focus

Radamec also manufacture another of the BBCs developments – D-Focus. As the name implies this hardware allows selective defocusing of planes within the composite image to increase the illusion of depth. A supercomputer can also simulate a degree of defocus in real-time, but it does take a lot of processing power to do so. The alternative is to pre-render and then mix between sharp and soft versions of the image.

Enhancing depth is also important for 3D systems, because when viewed on a TV the Z-axis is nothing more than an illusion. Surprisingly, 3D technology was the first to be developed, being demonstrated in 1994. Essentially, the foreground camera controls a virtual camera in the computer that mimics the changes of view and position by producing changes in perspective in the virtual background. To achieve this in real-time requires a supercomputer that can produce an image of a computer model to match the PAL 50Hz field rate. The computer is normally a Silicon Graphics Onyx with Infinite Reality graphics engine. However, even this cannot produce a photo-realistic background in real-time, so texture maps are used to give the background a more realistic look. The background model will be designed to use the minimum number of pixels or polygons that it is possible to get away with: surface texture, for example, will be minimal except in an area which will be zoomed in on. Other, less expensive, computer systems have recently become available – but are less powerful.

In a multi-camera studio each camera will normally need its own computer, making the process expensive. However, if a full composite is not continuously required for each camera then computers can be shared; but with the added complexity of switching the tracking information to the computer in advance of cutting to that output.

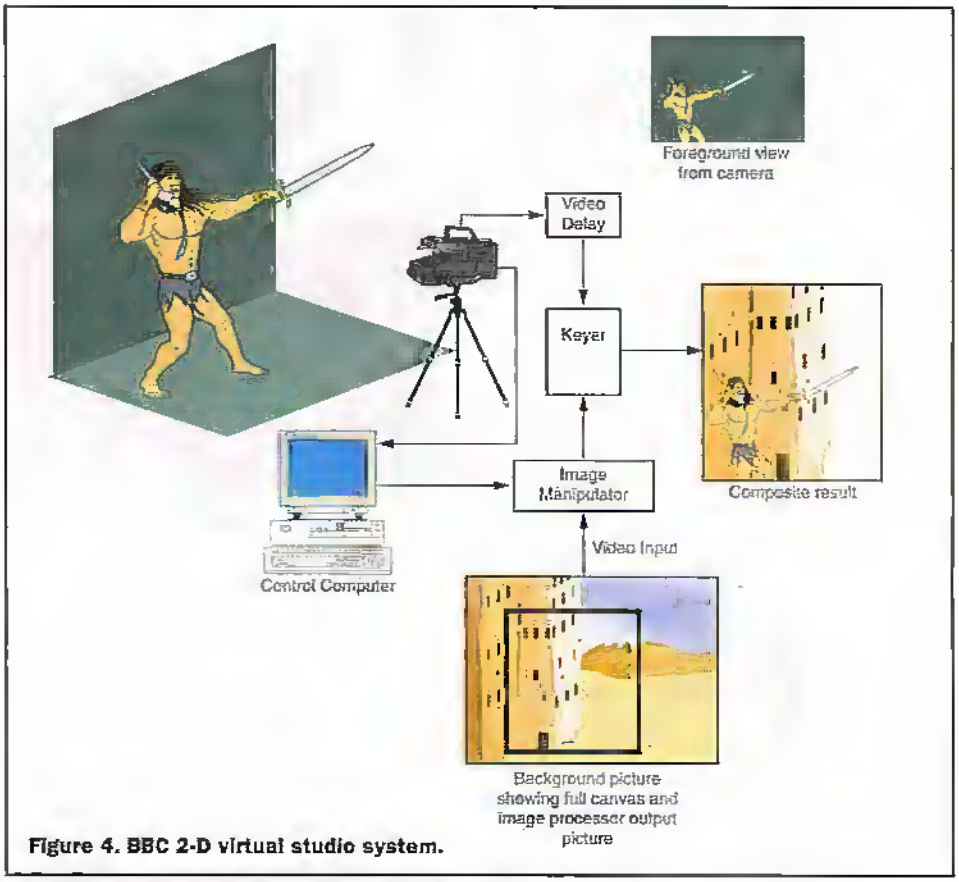


Figure 4. BBC 2-D virtual studio system.

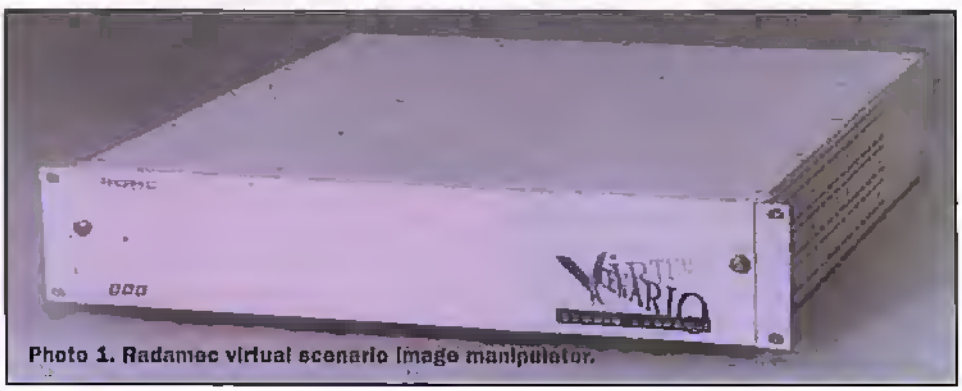


Photo 1. Radamec virtual scenario image manipulator.

Tracking

In order to act as a virtual camera the computer must obviously know all the moves that the real camera is making. For this reason the camera has sensors fitted to all its axes of movement. The computer must also know exactly where the camera is in the studio. The different virtual studio systems use different methods for this purpose: barcodes on the wall, magnetic stripes on the floor or, more commonly, mounting the camera on a track (Figure 5) with sensors that determine its exact position on the

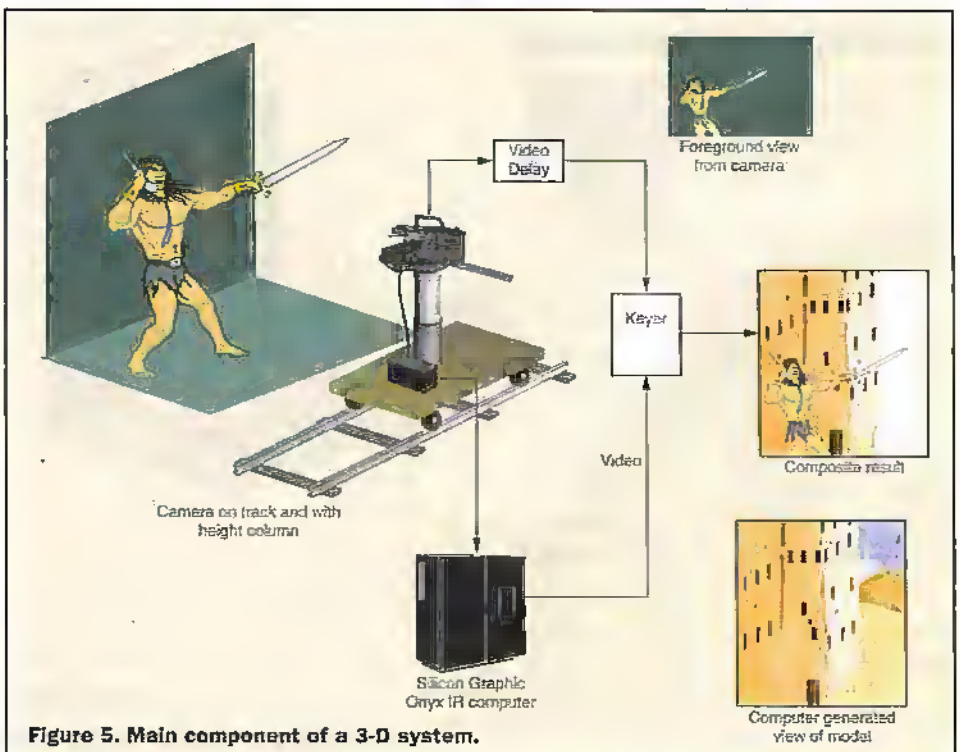


Figure 5. Main component of a 3-D system.

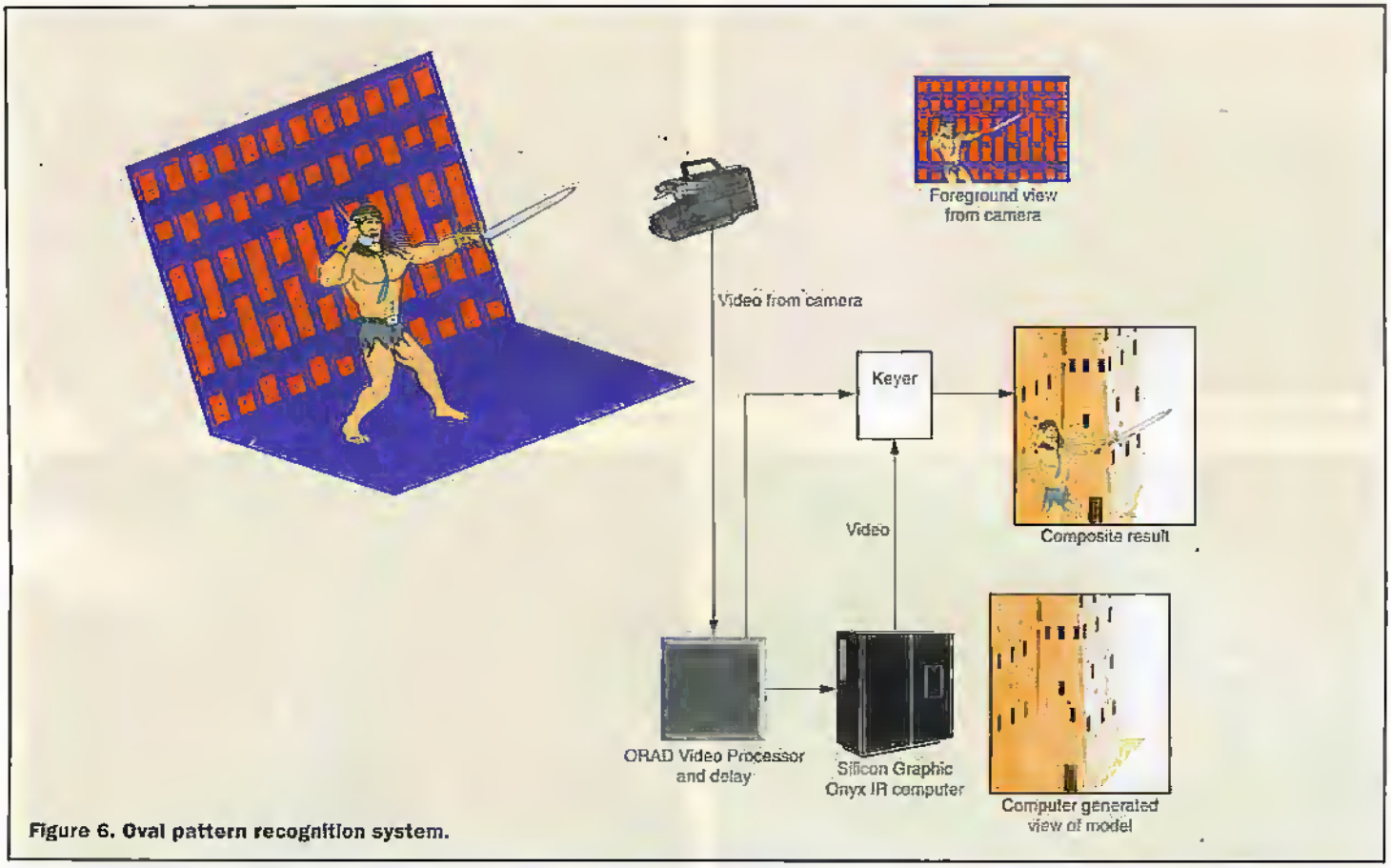


Figure 6. Oval pattern recognition system.

track. All the methods take rather a long time to set up, and any necessary changes to the settings will also be time consuming.

Added to which there will be some 'slippage' occuring during the working day, requiring a return to a datum point. Some systems have the camera mounted on a robotic, motorised pedestal in preference to laying a track. This gives greater flexibility, but because it is following pre-programmed moves it always requires actors to get exactly to their marks, and there is no scope for varying the camerawork without re-programming.

3D Virtual Studio

Then in 1995 Orad Hi-Tec Systems launched a 3D virtual studio that freed cameras from such constraints. Instead of sensors it uses pattern recognition. The key colour consists of a mathematically designed pattern produced in two shades of blue, and capable of being scaled to any size (Figure 6). In operation the foreground image is sent to the video processor where the pattern is compared to a stored reference pattern and a match is made that enables the processor to determine what translations have occurred to the pattern and, therefore, the present camera position. It was the first system to allow a handheld camera to be used. However, because at least some of the pattern must be imaged it places constraints on both the size of the studio in which it can be used and the chromakeying.

Which brings us back to Free-D. This uses optical markers (or 'targets') out of the way on the ceiling, which are imaged by an auxiliary camera mounted on the foreground camera, and from this its position is accurately determined (Figure 7). Any number of cameras can share the markers—including hand held versions. There are no

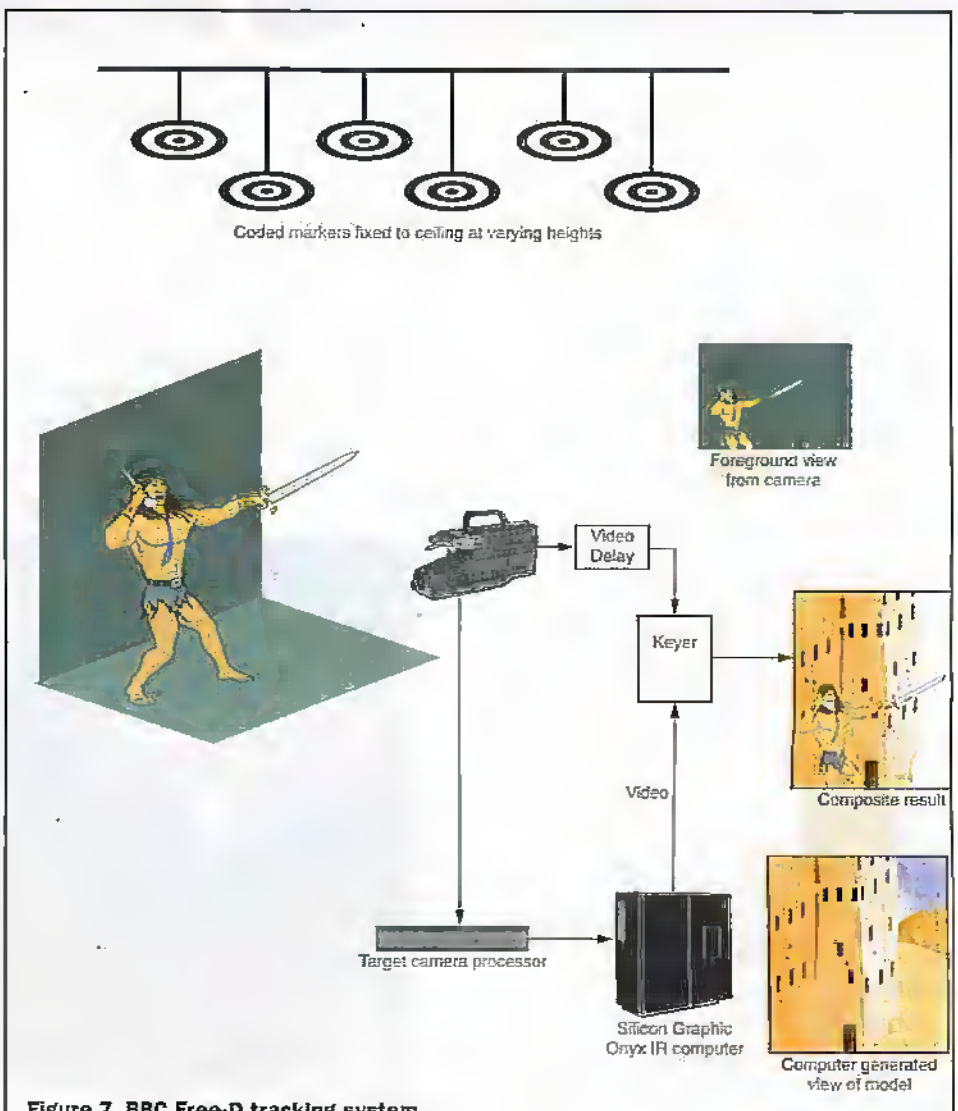
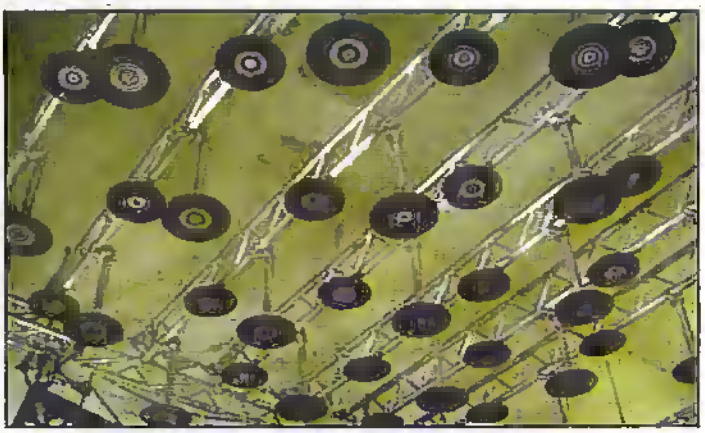


Figure 7. BBC Free-D tracking system

Small hand-held cameras with bright LEDs around the lens.



Ceiling markers.

constraints on the studio size – or 360° pans; and virtual characters and objects can interact with the real set because no information is needed through the foreground camera lens.

The markers are essentially barcodes, about 20cm in diameter, each with a unique code number. The auxiliary camera consists of a mini video camera with a cluster of bright LEDs around the lens to illuminate the markers. The use of a retro-reflective material for the white rings makes them clearly visible despite the studio lighting. The serial digital video signal from the camera is analysed by the processor which identifies the individual markers, measures their position to sub-pixel accuracy, and reads their barcodes (Figure 8). The foreground camera's zoom and focus are measured by conventional sensors, and this information is multiplexed onto the auxiliary camera's signal to the processor.

Setting up is reasonably straightforward; and need only be done once if the markers are rigidly mounted. The position of each marker needs to be measured to an accuracy of ±1mm. But this is not as daunting as it sounds because they need only be set to within 10cm; then the auxiliary camera is moved around the studio and the processor analyses the images and refines the measurements to the necessary accuracy itself. The markers should also be mounted at varying heights to maximise performance. And at least four markers must be within the image for sufficient positional accuracy.

For the production version of Free-D the auxiliary camera has been reduced to a small cube that fits on top of a foreground camera. The launch will be anytime now; and, again, will be from Radamec.

While the technology continues to improve, the actors and camera operators are still faced with a largely bare studio that somehow has to be navigated. All moves are rehearsed, with the benefit of planning software that can print out camera positions and floor plans – or just cardboard models. But without some guidance avoiding the invisible would be well nigh impossible. For a simple set there can be simple marks on the floor. An alternative is to shine a blue light on the floor to show the next position. Or, more comprehensively, project an image of the set on the floor. Although, with chromakey in use, neither aid can be very bright. Once the actor has found his way around it is possible to 'touch' virtual objects. This requires the keyer to be informed of both the depth of the virtual set and the real depth as seen by the foreground camera. And, of course, the position of the actor (currently achieved by wearing infrared transmitters). But its accuracy is limited.

The suggestion that everything will be virtual in the future – not just the locations, but also the actors – delights some and appals others. It probably will come about. But the necessary realism is not going to be easily achieved.

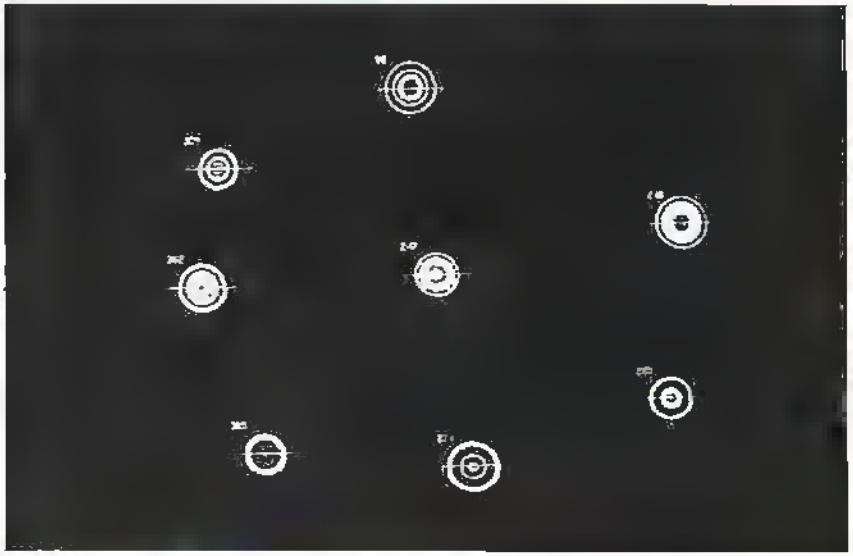


Figure 8. Image of ceiling markers

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

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

What's in a Name?

Dear Sir

I found it interesting to read the reply to Mr Gregg from Mr John Draper, of Kodak, in particular the last word in the final paragraph 'Origin'. I wonder if he knows the origin of the Registered Trade Mark KODAK? The late founder of the Eastman Kodak Company, namely George Eastman, used the initial letter 'K' from his wife's first initial. The letter 'O' from the lens shape, and the 'DAK' from the noise made by the shutter.

Frank H. Thomas
Penhow
Monmouthshire.

What a pleasant piece of history, thank you Frank for your letter.

Is this a Psychic Mistake?

Dear Sir

I have been a subscriber for more than 10 years, and have found your magazine both informative and useful during this time. I have never before put pen to paper to write to you, but feel compelled to do so after seeing the new series on 'psycho kinetics' by David Aldous.

I am disturbed to see a serious technical journal such as yours devoting space to 'pseudoscience', and hope that you will reassure me that this was a mistake which will not be repeated (I note that the articles did not appear in the April issue, so I assume that you were not joking!). High street newsagents routinely carry several times as many magazines devoted to the paranormal as they do magazines of serious science, and I would not like to see the Maplin Electronics journal crossing the divide. The supposed increase in interest in such matters as PK, flying saucers, astrology or the 'X' files may reflect a lamentable lack of real science by a gullible public, but does not reflect the views of those with a serious interest in science and technology.

I was also surprised to note that you allowed the author to include an entire page of bibliographical references to the outer reaches of pseudoscience, something I do not recall you doing for more serious topics.

Graham Marett
Rickmansworth, Herts

The article/project in question is not a mistake. It is in fact an honest piece of research, and a constructional project, designed primarily to help prove, or otherwise, the existence of such phenomena.

The purpose of printing such a detailed bibliography was to show that David Aldous had spent many years involved in this field, and was not someone who had just started to dabble. One would hope that all scientists, technologists, engineers etc., would have an open mind about such matters, at least until proved otherwise. If not, then perhaps we would still believe that the sun goes round the Earth and that our planet is flat.

Your reference to many magazines devoted to paranormal events is surely an indication of the many, many people who are interested in the topic for a variety of reasons, and I am sure not all, are believers, but are at least prepared to read and have an open mind about the subject. What we would like to do is to help find a satisfactory explanation by supporting the use of accurate measuring instruments in any investigation. Instruments that in some cases may be either too expensive or not available at all. As we know science relates to measured, repeatable experiments. Repeatability is central here. If an event only happens once, or even occasionally - do we deny its existence? I think not. We must broaden our knowledge to establish the truth and indeed the cause. Any equipment to aid that process will be featured in this magazine. - Ed.

David Aldous will reply next month

Fruity Batteries?

Dear Sir

I enjoyed Mike Bedford's Battery Guide Article (Issue 131, page 64), and it is well worth keeping for future reference when choosing batteries.

However, I think that the strawberry battery deserves to have more of its advantages mentioned. Although its output is small, it is enough for stand-by mode for most small CMOS ICs, and its cost is low. It is extremely eco-friendly and completely non-toxic, and it scores over most other types of battery in being 100% recyclable. The electrode screws can be reused over and over again, and the main body is delicious with a little cream and sugar. Much nicer than the potato battery and simpler to recycle, as it needs no recycling equipment, no oven, saucepan or chip-pan!

Roxi Cook, Frome, Somerset

Glad you enjoyed the article, but I feel the shelf-life of the strawberry battery may be rather limited, possibly just days, unless you keep it deep frozen!

Hi Fi Gullibility

Dear Sir

An interesting point about sound quality is raised by Mike Bedford (Audiophile Hi-Fi, issue 130, page 42). If you want to upgrade, "...you can get a separate CD transport to replace the original..."

• The CD transport, in contrast to other system components, produces a digital output. There is nothing analogue to judge good or bad as the digits are either correct or wrong. This is an objective measurement. If correct, the error checking ability of the medium should pick this up.

If the same CD medium were to contain a computer program rather than digitised audio, then only perfect playback would be acceptable. Otherwise the computer would crash when running the program! We all know that does not happen.

Maplin's LQ93B CD-ROM drive will faithfully render data from a CD for under £50, so what is there to be gained by upgrading a hi-fi CD transport? Are we gullible enough to boost the manufacturers' profits, or is there really some hidden benefit?

Dr. G. L. Manning
Edgware
Middlesex

Mike Bedford replies.

I had exactly the same thought when I first came across the claim that CD reproduction depends, in part, on the quality of the CD transport. In preparing the article I discussed this question with a number of manufacturers and present a quick summary of their response here. It appears that what differentiates a good CD transport from a poor one isn't the values of the data extracted from the disk but the accuracy at which it is clocked into the DAC. The correct operation of computer software usually doesn't depend on timing but the quality of music reproduction does. And, of course, unlike the value of the data which, as you point out, must be either right or wrong, with the timing we're into the analogue domain with the possibility of degrees of quality.

You may still remain sceptical as, indeed, I do to a degree. After all, in simplistic terms, I would have thought that it should be very simple to derive an accurate clock to control the transfer of data from the transport to the DAC. But the question of gullibility which you raise is an interesting one. If you were to go out and buy a £2,000 CD transport on the basis of these claims alone then yes, you would indeed be gullible. Don't forget, though, that audiophile manufacturers will only sell their kit through specialist hi-fi shops who have facilities for prospective buyers to audition equipment. So, although, as a technically minded reader you're understandably interested in why something works as it does, as a music lover you'd only pay for an improved CD transport if your ears told you that it was money well spent.

Words of SCIENCE

PART 4

The Entertainment Game

In part 4, Gregg Grant looks at entertainment before the wonders of the electronic age.

Introduction

It's no exaggeration to say that present-day entertainment is almost entirely electronic. This, however, is a fairly recent development, for the word *Electronic* didn't appear in any dictionary before 1940. So what passed for entertainment before the 'wonders' of the electronic age?

Until the turn of the present century, 'entertainment' was hardly a massive affair at all. True, there were fairly crowded public events such as Derby Day, the larger London theatres and Music Halls and – of course – the odd, illegal bare-knuckle boxing contest. In general, entertainment was a small group or individual affair. However, all that changed when technology became involved.

The Cinema

Moving Pictures or the 'Cinema' – illustrated in figure one – was first introduced in 1895, and would indicate the way ahead in entertainment for the new century. The word is an abbreviation of *Cinematograph*, from the Greek *Kinema* meaning motion. The expression 'Moving Pictures' is a later American and/or Canadian phrase for the latter term, now universally abbreviated to 'Movies.'

This early form of mass entertainment introduced a number of new words and phrases into the language such as *Animated cartoon, Close-up, Fade-out, Feature, Film* and *Scenario*. As the century and technology progressed, considerable improvements were made in cinematic techniques. The first major improvement was the addition of sound, synchronised to the moving images. Electronics had entered the entertainment business.

The first 'movie' with synchronised sound was The *Jazz Singer*, a 'talkie' that created a sensation on its opening in 1927. Among the equipment needed to provide this form of entertainment were *Projectors, Reels* and, of course, *Screens*.

The act of going to see this form of entertainment in itself sparked off new self-explaining compounds such as *Picturegoer, Picture House* and *Picture Palace* as well as simply *The Pictures*. This last – in its day – was the equivalent of today's more ironic *Telly*, when referring to TV.

The majority of these pictures houses had exotic, foreign-sounding names such as *Gaumont, Odeon, Trocadero* and *Astoria*. How were they arrived at? Odeon was derived from the Greek *Odeione*, meaning an amphitheatre. The name had been suggested to Oscar Deutsch, the film promoter, who subsequently founded the Odeon Cinema chain in 1930. Gaumont on the other hand was another classic example of a Common Word being derived from a Proper Name. Leon Gaumont was a late nineteenth century French film pioneer, who founded the Gaumont Company.

Trocadero, originally, was a fort near Cadiz, in southern Spain, which had been captured by the French during the revolt of 1823. This victory was later celebrated by the building of an entertainment centre on Paris's Place Trocadero. The name shortly crossed the Channel with the building of the music hall in Piccadilly Circus called, rather grandly, the Trocadero Palace of Varieties.

Astoria was another example of a Common Word being derived from a Proper Name, this time that of the fabulously wealthy American Astor family. This particular name was chosen for its obvious association with wealth, distinction and a sense of style, as indeed were the other names given to movie theatres such as Ritz, Savoy and Regal.

The sound system that had been used in The Jazz Singer was the *Vitaphone* system, which had been developed by Warner Brothers in 1926. The Twentieth Century Fox studios had also been working on a sound system, which they termed *Movietone*.

They first used this development in 1927 to record the reception for the American aviator Charles Lindberg, and a speech by the Italian dictator Benito Mussolini. The success of the system led the studio to create Movietone News, to make regular sound newsreels. Their creation would enjoy considerable success until the advent of TV brought the world's news into almost every living room on the planet.

It was in the film image itself that the major developments took place, producing a number of new words which have long ago entered the mainstream of our speech. One good example is *Cinemascope*. Invented as long ago as 1928, by the French physicist Henri Chrétien, this is an *anamorphic* process, from the Greek anamorphoun, meaning 'to transform.' It is a wide screen projection which an image of approximately twice the usual width is squeezed into a 35mm frame and then screened by a projector having a complementary lens.

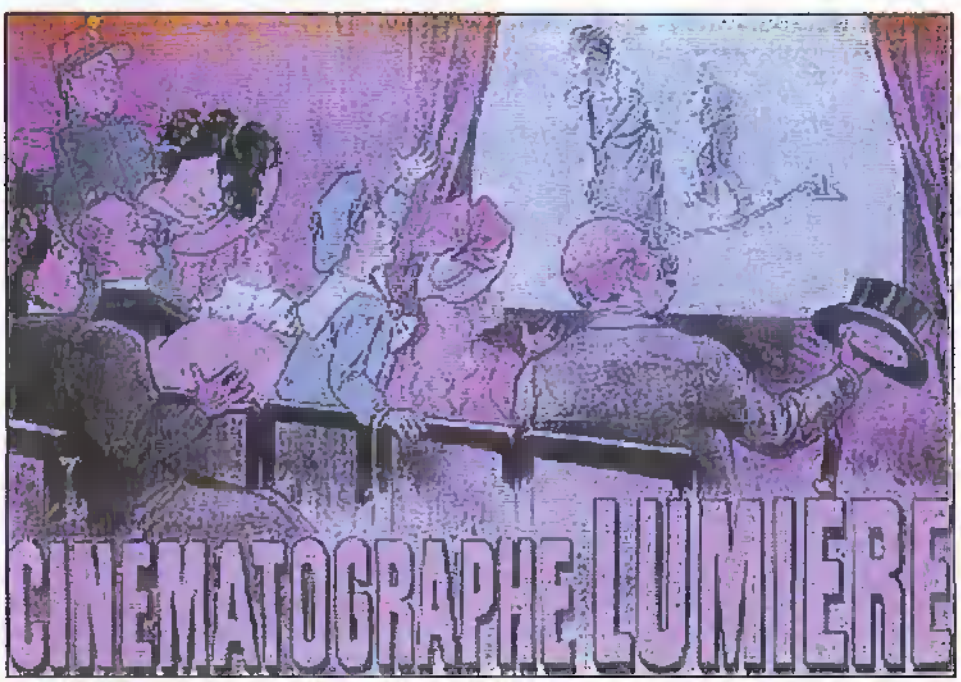


Figure 1. A early advertisement for the new form of entertainment – the Cinema.

The Twentieth Century Fox Corporation acquired the rights to the process and introduced it to cinemas in America in 1953. The system had been ignored until the increasing incursion of TV into film production in the 1950s had threatened cinema audiences. An early indication of just how powerful electronic entertainment would become!

The system uses a three-track stereophonic sound system, and other film studios use basically similar processes under different names such as *Superscope* and *Panavision*.

Technicolour on the other hand, as a process for colour film, has become so common that nowadays it is rarely heard of. Perfected in 1932, technicolour was a process which used dye transfer techniques to produce colour prints. A beam-splitting optical cube, combined with a camera lens, was used to expose three black and white films.

The light beam was split into three parts as it entered the camera, one beam favouring the red area of the spectrum, the second – say – the blue area and the third the green. Each image was captured simultaneously on a separate band of black and white film. The three strips were then developed separately and, after printing, were passed through their appropriate coloured dyes. When laminated together, they gave a tolerable representation of natural colour.

Cinerama is yet another large screen presentation system. Invented by the New York photographer Frederick Waller, it uses either three separate 35mm projectors or one 70mm projector to produce an image on a large, deeply curved screen. The first film made using this technique, 'This Is Cinerama,' was screened in New York in 1952. Another cinematic introduction at this time was 'Three Dimensional' projection, or simply 3-D. With this system cinema-goers had to wear special polarised spectacles, and so its popularity was brief. The expression however, especially in its abbreviated form, is still much used.

It was with the further development of electronics however, that the future of mass entertainment lay. And this future began with the *Phonograph* or – as it was known in Britain – the *Gramophone*.

The Phonograph

The original phonograph was invented by Thomas Edison in 1877 and was the beginning of Acoustical Information Storage, or AIS. A decade later the German-born American inventor Emile Berliner had improved Edison's creation out of all recognition. He replaced the original drum and up-and-down needle with a flat disk and a stylus which moved from side to side in a spiral groove. Berliner gave his improved record player the trademark Gramophone in 1894. This trademark became generic for phonograph in Britain.

In time, Berliner's small company became the massive Victor Corporation, which began celebrity recordings on its Red Seal label from 1905 onwards. Such were the prestige of these recordings that they influenced the corporation's other products. One result was that the *Victrola* became as generic a name for the phonograph in America, as the gramophone had become in Britain.

Over the last century the equipment in this field has become increasingly sophisticated and, as a result, has made the general public aware of words such as *Stereophonic* and *Quadrophonic*. Added to this are such technical terms as *Tweeter, Woofer, Tape Deck, Four-Channel* and *Reel-to-reel* and *Crossover Network*.

Broadcasting

The introduction of radio broadcasting brought another tranche of new, or modified, words into the language. *Radio* itself, in the sense of a receiving station, dates from around 1925, although radio communication had been an established method of sending and receiving information for over 20 years.

Since many of the terms from radio broadcasting were applicable in the later development of TV, a common vocabulary of broadcasting developed. Among the technology's many additions to the mother tongue are *Aerial, Antenna, Broadcast* itself, *Lead-in, Loudspeaker* and – more recently – *Solid State*. This last dual element derivative was, initially at least, used to denote an electronic device made of semiconductor material in which current flow took place through the solid substance rather than across a vacuum. Nowadays of course it's part of everyday speech, heavily used by advertisers, public relations people and others, who have no idea as to why it was coined in the first place!

Some words such as *Announcer, Microphone* – frequently abbreviated to 'Mic' – *Reception* and *Transmitter* have acquired meaning other than their original, technical, interpretations. More recently still *Cable TV, Autocue, Telethon* and *Videotape* have become part of the language.

Many such words and expressions, although modern, have in fact been derived from Latin in the present century. Two of the most common examples are audio and video. The latter stems from *videre,* meaning 'to see' whilst the former is a development of *audire,* meaning 'to hear.' *Telethon* is yet another compound formed from two different elements, this time *Tele* and *Marathon*.

It usually denotes a lengthy programme, broadcast for a express purpose, such as raising money for charity in Britain or for Public Service Broadcasting in America.

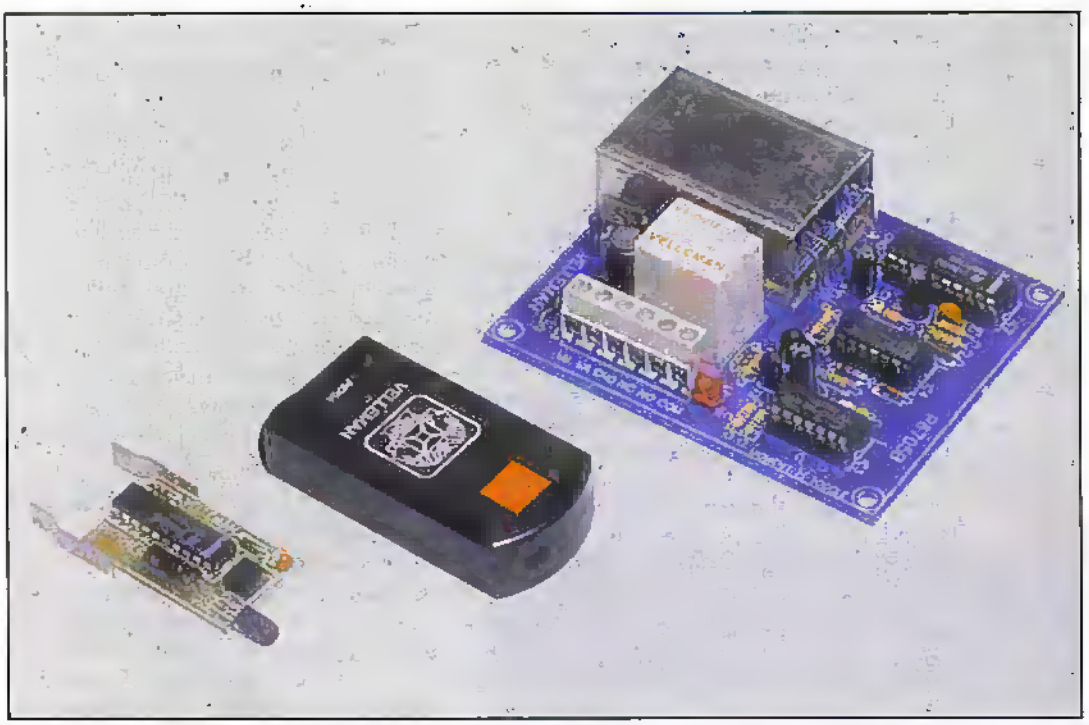
Teleprompter and *Autocue* began life as trademarks, the former American and Canadian, the latter British. As their names imply, they are electronic prompting devices, where a prepared script is enlarged, line by line, for the speaker or announcer. They remain unseen by the viewer.

Electronic technology is so pervasive, currently, that some of its descriptive words and phrases have assumed the status of *Buzzwords*. Next month, we'll look into this world of near-alternative language, in an attempt to discover how – for example – technical terms such as *Input* came to mean something rather different than an RF, IF or AF injection signal.

REVIEW

SINGLE CHANNEL INFRA-RED CODE LOCK TRANSMITTER/RECEIVER

Construct from a kit or design and build from scratch using cannibalised components? Here Stephen Waddington tries the kit route as he builds and reviews the Velleman Single Channel Infra-red Code Lock Transmitter/Receiver.



FEATURES

- Single channel coded infra-red link
- Over 8,500 possible codes
- Transmission distance of approximately 7m
- 10 pulse or changeover relay contact
- LED on/off indicator
- LED indicator of reception strength

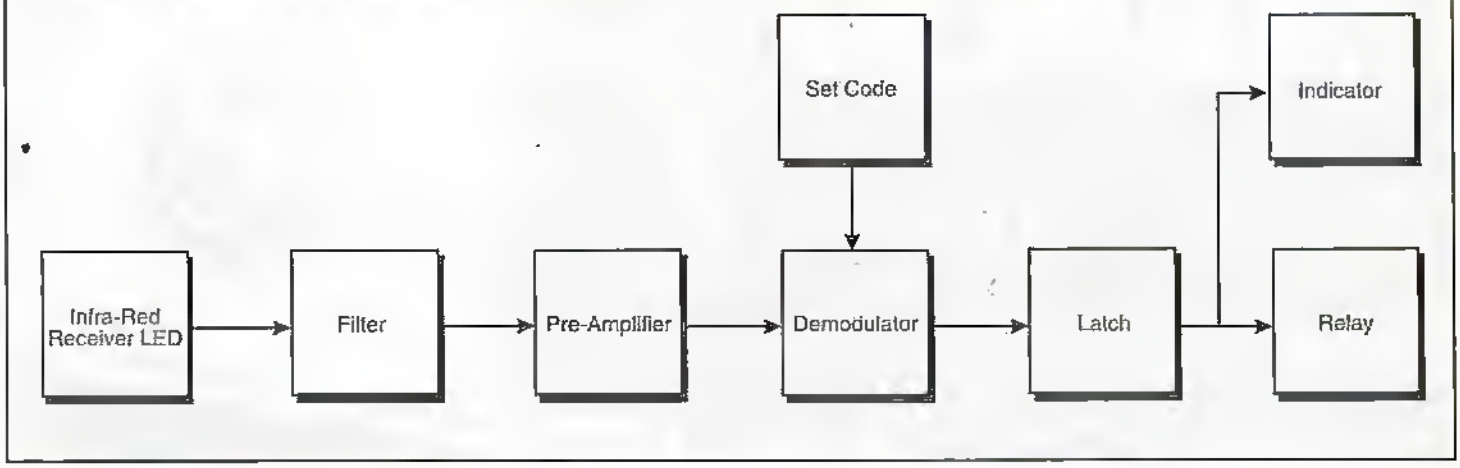
I've always been deeply suspicious of Velleman kits. I think it harks back to my days at high school. There was a kid in my electronics class who always had the latest Velleman kit. I meanwhile, had to make do with building circuits from components cannibalised from scrap circuit boards, bought for next-to-nothing at radio fairs.

I was always shocked by the cost of the smart kits in their shiny clear boxes. Velleman kits always look so professional, with their silk screen-printed cases and plastic moulded boxes. But surely building a kit isn't what real electronics is about?

Infra-red Code Lock Kit

I recently got the chance to confront my prejudices. A colleague wanted an electronic security lock to protect a garage door. Could I help him out? As I was digging around for possible solutions, I came across the Velleman Single Channel Infra-red Code Lock Transmitter and

Figure 1. Block diagram of the transmitter



Receiver. It wasn't the cheapest option, but quicker than building something from scratch, offered over 8,500 combinations, a 10A changeover contact for the heftiest of solenoid locks and would certainly look professional.

The infra-red receiver allows both momentary and latched relay outputs. It also provides a battery status indicator and a signal strength indicator to show when it is receiving an incoming infra-red signal indicator. The transmitter includes a push button switch, transmit indicator and two miniature infra-red LEDs.

I called Maplin and paid my £39.98 by credit card, for the two kits (receiver and transmitter come as separate kits) and waited for the next day's post. When the kits arrived they were each packaged in their own clear plastic box. The transmitter kit contained instructions, a PCB, components and a tiny pocket-type remote control box for the completed circuit. The receiver contained largely the same, in this instance there was no case to house the completed unit.

How it Works

Block diagrams for both the transmitter and receiver are shown in Figures 1 and 2 respectively. There are two elements to the receiver, namely a pre-amplifier and a main PCB. The infra-red LED receiver and preamplifier is housed within its own earthed aluminium cocoon, presumably to fend off any nasty noise or stray signals. The main PCB contains the decoding electronics, a series of latches, the relay switch and a strip of screw-tag connectors to facilitate connection to the outside world.

The pre-amplifier is a series of operational amplifier designed to filter and amplifier the incoming infra-red signal and output the modulated data stream. The transmitter/receiver combination uses the UM3758-120A and UM3758-120A modulator/demodulator chips to handle coding and decoding respectively. The code is selected on both the receiver and transmitter by making a series of up to nine connections to earth, giving a binary combination of up to 8,748 options.

The selected binary code is modulated onto the outgoing infra-red signal. When the infra-red carrier component is stripped out by the pre-amplifier at the receiver end, the code becomes the input for the demodulator. If the codes match then the device will output a 'high' signal.

A series of receiver latches enable the constructor to select either toggle or momentary relay action for an incoming infra-red signal. The selection is made by completing the appropriate wire link on the PCB. When an infra-red signal containing the correct modulation code hits the infra-red receiver, the output relay will either latch or lock momentary depending on the option selected.

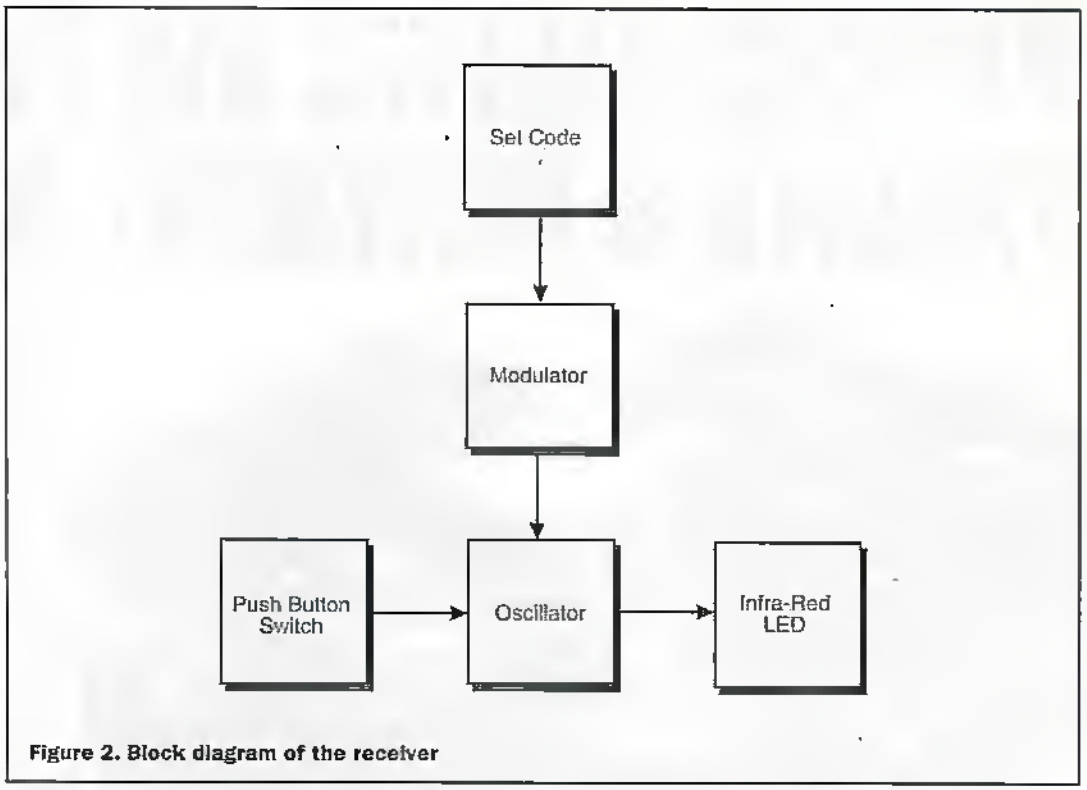


Figure 2. Block diagram of the receiver

Construction

If you are competent with a soldering iron, you will have no problem with this kit. The construction of both the transmitter and receiver is straightforward. On the receiver you have to watch the polarity of the infra-red receiver LED, and you also need to be careful that you don't burn out the tiny amplifier transistors. The cased pre-amplifier sits on the main PCB on its own earthed footprint. A nut and bolt is used to hold the small box in place.

On the transmitter be careful how you site components, because the circuit board must fit within the remote control box. Unless you follow the instructions religiously, the LED and switch will not line up inside the case. The transmitter uses a 12V cigarette lighter battery, although I used a 9V power supply to test the device, which worked adequately. The batteries are an unusual size, but can be purchased from Maplin (JG91Y), priced £0.75.

Testing

The transmitter/receiver combination takes a couple of hours to build. Once completed you must ensure that the code on the two PCBs matches prior to testing. As artificial light contains a large component of infra-red, avoid shining light directly at the receiver. The specification for the receiver module states that a 12V 100mA supply is required. I found a 9V Ni-Cd worked fine during testing.

I'm happy to report that both circuits worked well first time they were powered up. But then don't be surprised. The Velleman instructions supplied with both kits are very clear and the clearly labelled components, coupled with the well laid-out PCBs means that it would have been difficult to make an error.

Under test, the transmitter functioned to a distance of 5.5m. This was later increased to 6.5m using the correct 12V battery for the transmitter, and likewise a 12V power supply at the receiver end. There are a couple of indicators on the receiver that can be used to help test the receiver and transmitter combination. The on/off indicator show when the power supply is good, while a separate LED indicates signal strength.

Evaluation

The momentary latch was ideal for a solenoid latched Yale lock. I built a low-cost power supply for the receiver and mounted it alongside the main PCB in a die-cast box. The same supply also powered the receiver. The good news on the transmitter front is that you can purchase the kits individually. My colleague has made up three transmitters, one for each of the people that need access to the protected garage door.

So have I over come my prejudice? In short - I think so. At almost £40 for the transmitter/receiver combination, the Velleman kits are expensive - but not that much. I reckon you could save maybe 50% by purchasing the components individually. And that doesn't include the PCBs or the transmitter case. Velleman kits may cost a little bit more but they are high quality, have a professional finish and best of all, are straightforward to construct.

Buyers Details

Description	Code	Cost
Velleman Single Channel Infra-red Code Lock Transmitter	VF80B	£14.99
Velleman Single Channel Infra-red Code Lock Receiver	VF81C	£24.99

PSYCHO-KINETIC BIO-FEEDBACK TRAINER & MOVEMENT DETECTOR

Photo 1. Complete Unit

PART 3

In part three, detailed circuit descriptions and construction are discussed by David Aldous.

Detailed Circuit Descriptions

Referring to Figure 2, the high power driver and FM receiver/demodulator circuit. This covers the main drive oscillator, associated mode switching, the high power drive amplifier and the main signal processing circuits. Considering the drive oscillator first. The TL081 FET op-amp operating as a Wein bridge oscillator produces a pure sine-wave. The reason for choosing this circuit is that all other oscillator drivers normally used to drive ultrasonic transducers (the original design concentrated exclusively on this frequency range) proved to have insufficient long-term frequency stability, as well as producing some of the most atrocious and harmonic-ridden waveforms imaginable!. Most of them were based on the use of the ubiquitous 555 timer chip or its variants and required so much decoupling to tame them, they had to be abandoned. Having used the Wein bridge oscillator as a teaching circuit incorporating a few design tricks of his own, the author had several part-built units to hand as a legacy of his teaching days and simply completed one of them by building it into a standard 'black box' – which is an interesting way to acquire test gear! This provided a satisfactory waveform and after upgrading the design to use more stable frequency determining components (e.g. close tolerance polystyrene capacitors), the long-term stability was also found to be quite acceptable. The flexibility of the Wein bridge and it's easy frequency adjustment by means of a simple dual-gang linear potentiometer, now led to the consideration of perhaps being able to utilise other frequency ranges in the mid to high audio band. Experiments using a small loudspeaker and microphone were successful and it was decided to design-in this feature to enhance experimental flexibility. Admittedly, this makes the design of the P-K Trainer more complex, but it is intended to be a research and experimental tool and not just another 'gadget'. A cut-down and simplified version could also be built later, either for economy, or for more specific tasks.

Wein Bridge Circuit

The frequency determining network is made up of what are in reality two inter-locking filter circuits – a series connected high pass, and a parallel connected low pass – both of which use identical component values. Studying the diagram (see Figure 2a), it can be seen that as frequency rises, the impedance of the series-connected network R1/C1 will fall, thus increasing signal level at pin 3, the positive feedback terminal, whilst the parallel connected network of R2/C2 will simultaneously fall, thereby causing signal level at pin 3 to fall. Since component values are identical, it does not take much imagination to realise that there will only be one frequency at which a maximum level signal will develop across C2/R2. That frequency will be the one at which both networks display equal reactance in C1 and C2 and also that this reactance will be equal to the resistance of

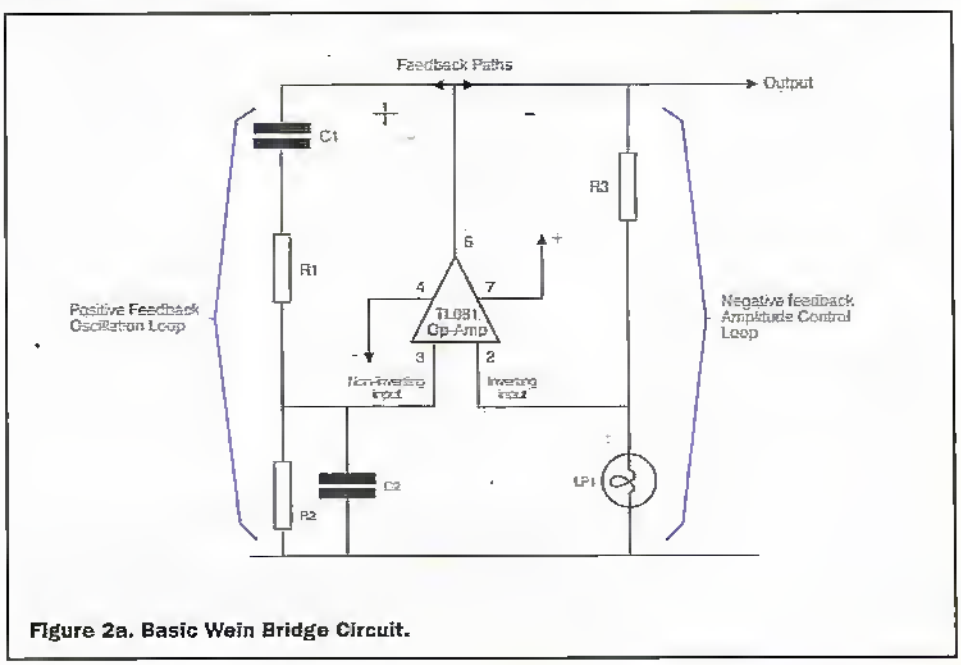
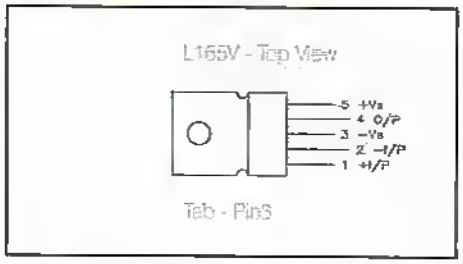


Figure 2a. Basic Wein Bridge Circuit.



R1/R2. The voltage across R2/C2 will also be lower than the input and it can be shown that this will in fact be only 1/3rd of the input value. To get oscillation, any amplifier or 'gain block' one uses must have a gain of at least three to overcome this loss. At any frequency above or below this, the signal level at pin 3 will be lower than this peak. The actual change in level is quite small and so in theory it should provide a rather poorly defined frequency point. In practice, since gain is tightly controlled at a critical level, the frequency is very accurate and the stability excellent. The other way is to consider that each resistor/capacitor pair acts as a phase-shift network. R1/C2 having a phase lead characteristic because of the series-connection, and R2/C2 a phase lag characteristic, due to the parallel connection (see later explanation of these terms). At one particular frequency, these phase shifts will be equal, the voltage across R1/C1 will be at minimum, and the voltage across R2/C2 will be at a maximum, thus giving effectively zero phase shift and so maximum possible positive feedback. Since positive feedback causes oscillation, the negative feedback loop formed by R3 and LP1 stops it from running out of control and letting the output alternately hit the +Ve and -Ve supply rails. The operation of this loop is critical and determines not only if sufficient gain is left for oscillation to take place, but exactly what level the output will stabilise at. R3/LP1 operate as follows: When the output from pin 6 rises, an increasing level of signal is fed back via the +Ve feedback network and tends to drive the output even higher (polarity isn't important at this stage). Simultaneously, more signal is fed back via R3 and this tends to counteract the +Ve feedback by reducing gain. LP1 now comes into play. This is a small filament lamp and as more current flows in the filament, the resistance begins to rise, thus allowing more negative feedback to take place. Evidently, if the output at pin 6 then started to fall as a result, then less current would flow in LP1 and so its resistance will fall back again, thus tending to counteract this change. It is because of this inherent tendency to self-correct the amount of negative feedback applied in response to changes in average output level, that the stabilising circuit of R3/LP1 can control gain to just exactly that needed to sustain oscillation and no more. As all lamp filaments have a delay (called thermal lag) between the application of a change in current and the development of a corresponding brightness, this is the equivalent of using a long-time constant filter in this position and so rapid changes in output are not observed. In practice, LP1 never receives sufficient current to actually light up, as the operation depends on the fact that LP1 displays positive temperature characteristics (e.g. resistance rises as current rises). Many different lamps are suitable, but one having the ratings shown is about the optimum. Because of the critical dependence of this gain control network on the feedback current, the value of R3 is critical. Values ranging from 47Ω to 120Ω are encountered, but in order to use the Maplin lamps available, the value of R3 was determined experimentally at 62Ω.

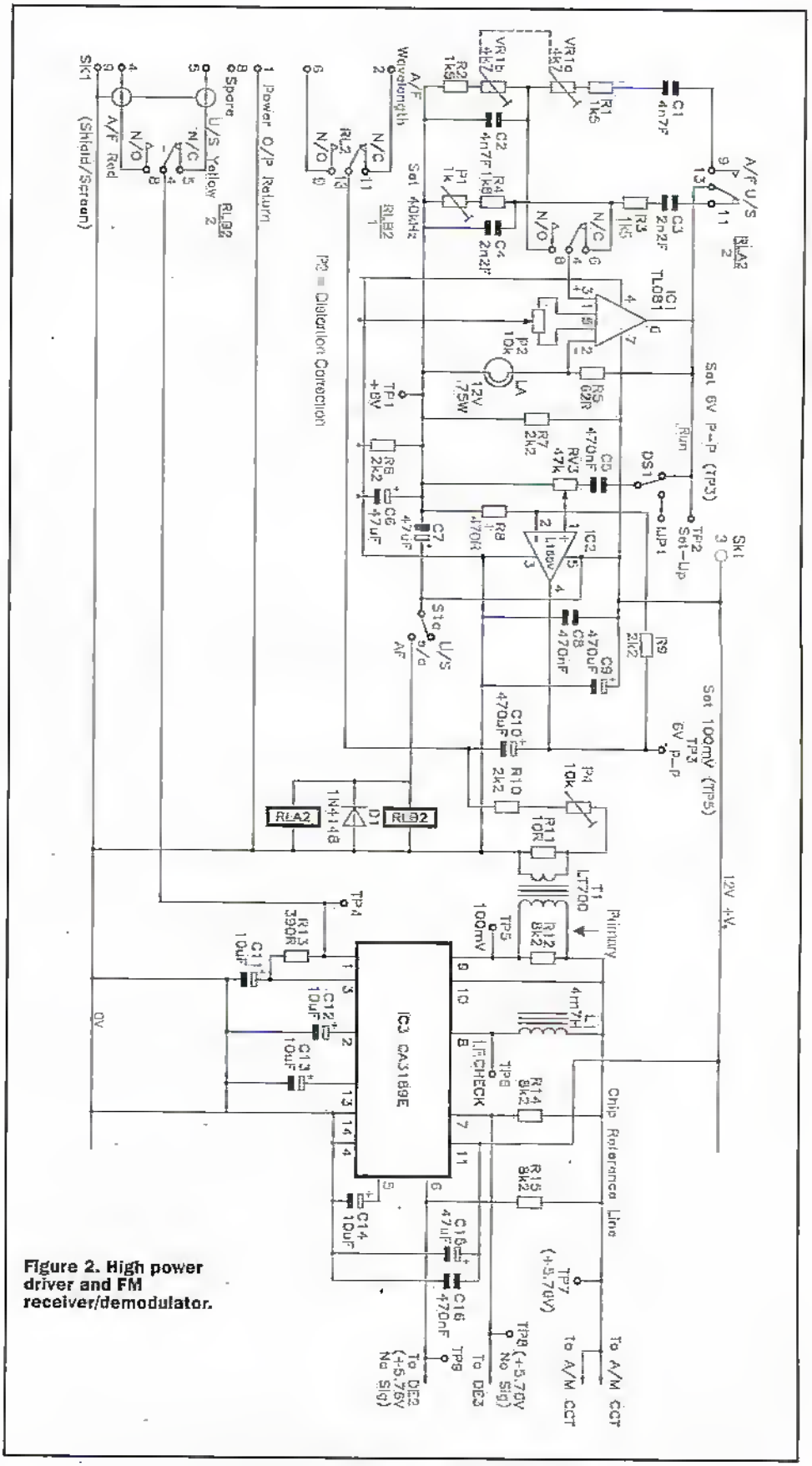


Figure 2. High power driver and FM receiver/demodulator.

The circuit uses two independent frequency determining networks, the selection of which is carried out by means of a special signal level relay (RLA2) controlled by the panel mode switch. The reason this approach was chosen is simply to avoid the indeterminate effects of stray coupling and/or capacitance – particularly at high frequencies – which would otherwise occur using a panel switch and wiring loom. Instability was also a consideration, since any change in 'stray' capacitance could seriously disturb the operating conditions

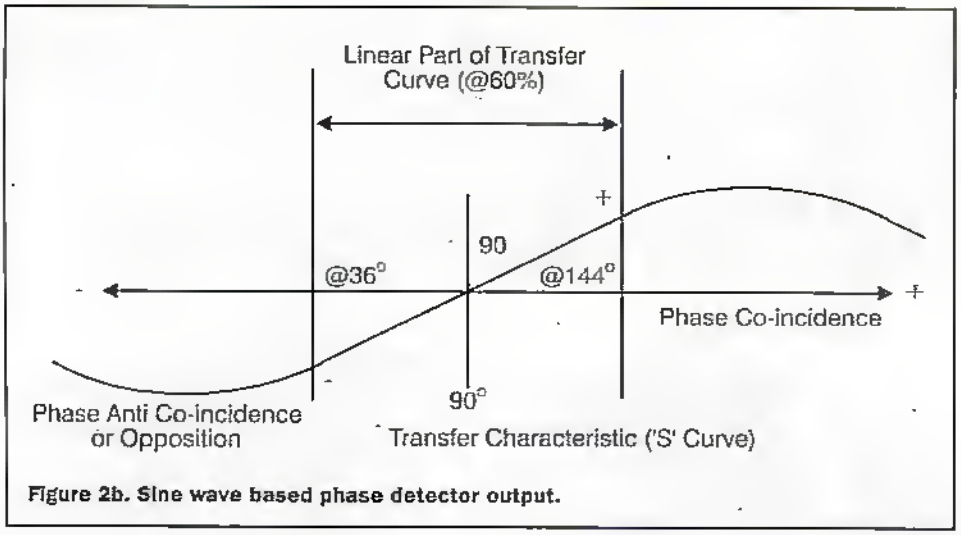


Figure 2b. Sine wave based phase detector output.

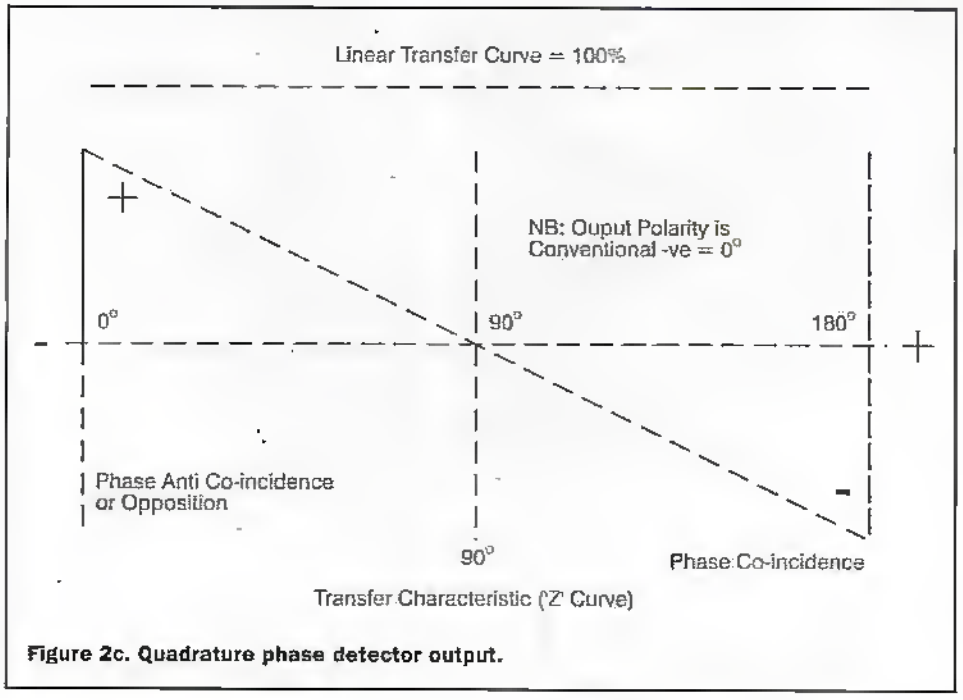


Figure 2c. Quadrature phase detector output.

and trash an experiment. For the ultrasonic mode, the network C3/R3 and C4/R4+P1 is used. *P1*, the *Set 40kHz* pre-set, is provided to take out component tolerances and allow exact adjustment of operating frequency to 40kHz (or whatever frequency the individual transducer pairs may actually operate at in this range). For the A.F. mode, frequency determination is achieved via C1/R1/VR1a and C2/R2/VR1b. VR1a & b are the two parts of a dual gang 4k7 linear potentiometer, whilst R1 & R2 are chosen in value as range limiting components to set the upper frequency limit. For the values shown, the operating range is approximately 5kHz to 21kHz. VR1a & b form the AF wavelength control and are so wired that a clockwise rotation of the control (as seen from the panel) increases the resistance and causes frequency to fall. Wavelength thus increases in accordance with the 0-10 scale marked on the control, so allowing calibration. Before leaving the drive oscillator, the operation of P2, the *Distortion Correction* pre-set, needs explaining. This is an addition of the authors. It is simply the normal offset null trimming control as used with most op amps of this type, but the difference here is that it functions as a distortion balancing control. Most Wein bridge circuits seen by the author do not use it and as a result, can suffer slight but significant distortion in what should be a pure waveform. Adjustment of P2 requires the use of a good oscilloscope. To set this up, simply observe the waveform at TP2 at a large display amplitude on the 'scope, then *very carefully* adjust P2 until one observes a marked distortion *just* set in on one or other peak. Stop, note the position of P2. Now turn P2 in the opposite direction until the same effect is observed on the other peak. Stop, note the new position of P2. Now adjust P2 to exactly half way between the two points noted. Check the waveform and it should now be a pure sine wave. That's all there is to it.

Moving on now to the power amplifier, IC2. This is a type L165V power op amp. which is actually a general purpose type intended for use in power servo systems. It is needed solely because of the incorporation of an AF signal range in order to drive the HF tweeter loudspeaker when operating in AF mode. The output drive signal is set to provide 6V pk-pk (4.2V rms.) into 8Ω, which corresponds to a power of approximately 2.2Ω. The choice of the L165V for this function was only made after investigating several alternative output circuits, starting with the power amplifiers used in car radios, and discrete transistor power amplifier types. Eventually, and applying only a basic 'rule-of-thumb' restriction on layout (keep everything close to the op amp), the L165V produced a superb performance. Taming it is fairly simple and is achieved by nothing more than two capacitors (C8 & C9) wired directly across the power pins as close to the amp as possible. C8 provides HF bypass, whilst C9 provides decoupling at all other frequencies. Gain adjustment is provided by P3, the *Set 6V pk-pk* pre-set, acting as a simple 'volume' control. The maximum gain is set by selecting two resistors, R8 & R9, the ratio of which, since the configuration is that of a non-inverting amplifier, sets the gain according to the formulae:

$$G = 1 + R9/R8.$$

This gives a practical gain of approximately $1 + 2.2/.47 = 5.75$ times where R is in kilo ohms, and is more than enough to allow setting up the 6V pk-pk output with P3. Output coupling is ac via C10, 470μF. Signal routing to either the ultrasonic transmitter, or the tweeter, is effected by means of signal relay RLB2 and contact set 1.

A portion of the output signal is fed to the input of T1, a reverse connected LT700 small audio output transformer. The reason for operating it in reverse mode is two-fold:

(i) It acts as a low impedance input step-up transformer, and is thus current-driven from IC2 via R10 and *P4*, the *Set 100mV* pre-set.

(ii) Both windings are deliberately heavily damped by the addition of R11 (10Ω) across the 'official' secondary and R12 (8k2) across the 'official' primary, in order to flatten the response over the whole audio and ultrasonic band. This works very well and no frequency dependent output changes have been detected. The function of T1 is to act as a 'floating' reference signal injection device for the quadrature detector inside IC3. The most acceptable compromise level was found to be 100mV. Setting this 100mV level is carried out by P4, the Set 100mV pre-set, whilst observing the signal at TP5. Input signal selection to IC3 of ultrasonic or AF signals is also effected by RLB2, but this time by contact set 2.

Turning now to IC3, the FM/IF IC, the selection of a CA3189E was not a problem and carried the added bonus of the chip using a double balanced quadrature detector, therefore giving two independent, simultaneous outputs. The availability of this second output then gave rise to ideas on how to indicate that an object had moved by more than just the small amount corresponding to the calculations set out in part 1 of this article. The solution proved quite simple – just count how many times the second output went through a full level change, each of which corresponds to a full phase excursion, then add-on the measured movement from the FM channel. It was then realised that some form of data-tape storage would be an advantage for those experiments where immediate feedback might not be required (or possible) and so a way had to be found of making the signal recordable. The solution was to amplitude modulate an AF tone acting as a 'carrier' signal. This led to the selection of a

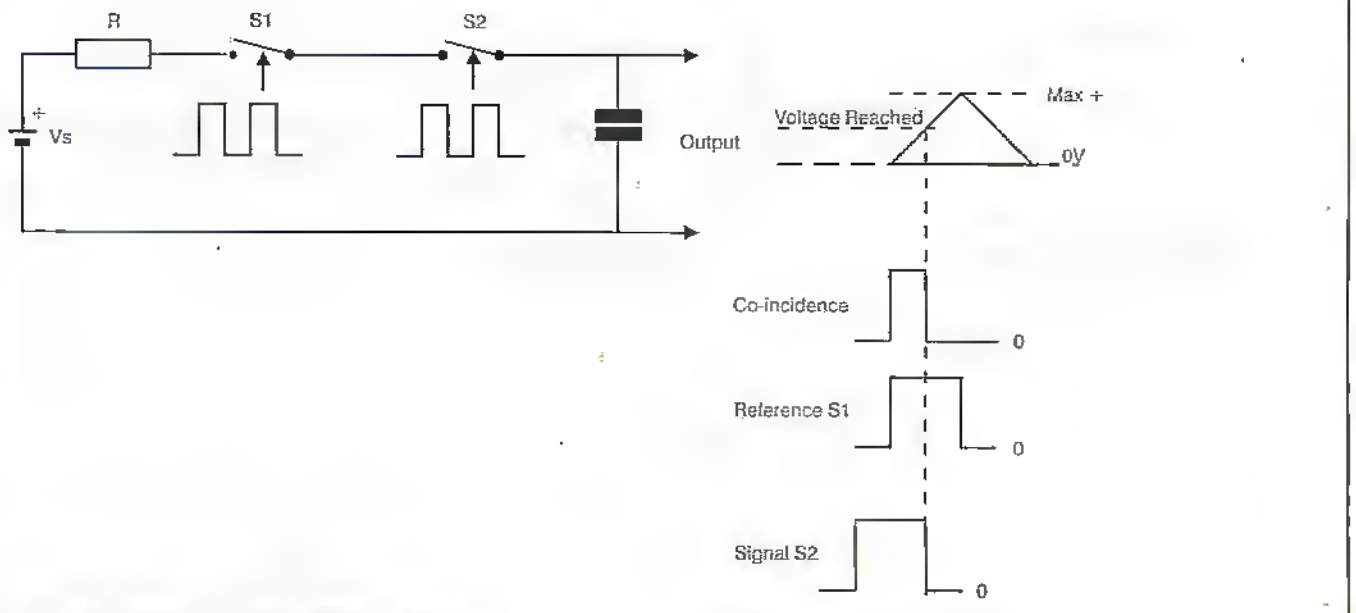


Figure 2d. Basic operation of a quadrature detector.

transconductance op amp for this function and another Wein bridge oscillator being built as a carrier-tone generator. The idea was a total success and I will deal with this in my description of the AM and FM channels. Back to IC3. The CA3189E is an interesting chip, who's quoted characteristics, such as it requiring only some 2μV of signal for full amplitude limiting, a very simple, single point phase reference signal injection method and, as already noted, it having two independent phase detector outputs, made it ideal for the job. A test rig was set-up on a Maplin breadboarding system and it was found that some 8V pk-pk signal could be obtained for a full scale phase change. This proved to be a very useful feature in that other than buffering to prevent loading effects on the detector outputs, little or no gain was required to drive the two processing channel electronics, all of which enhances the stability of the whole system.

What's Limiting?

Limiting is the act of deliberately restricting the amplitude of a signal to no more than a pre-determined level. This is made use of in the quadrature detector and is one of the features that makes it a more efficient phase detector. The quadrature detector compares both the reference and signal waveforms after they have been converted into clipped square-waves. Strictly speaking, the input signal is actually clipped in the IF amplifier by deliberately over-driving it into saturation at a very low signal level by means of a high gain amplifier. Internal diode junctions are also connected across the internal amplifier devices (as per data on other chips of similar structure). The reference signal is treated similarly in the reference signal amplifier, but this needs less gain as it operates (normally) on the already amplified IF signal from which it is usually derived via a 90° degree phase-shifting network (normally a coil/capacitor combination). In the authors design, this reference signal is instead supplied separately via T1, and the optimum value found to be required was approximately 100mV. Comparing reference and signal waveforms in this way is inherently more efficient that simply comparing two sine waves. With a simple sine-wave driven circuit, the output level depends not only on the degree of phase coincidence (or not), but also varies with the amplitude of the two signals and at the extremes of phase difference because of their non-linear waveform, thus inherently being uncertain. This is unsatisfactory where only a phase-dependent output is needed, or essential. Figure 2b shows the resulting output transfer curve of a sine wave-based phase detector. The most linear portion of the curve extends only for about ±60% of the total characteristic. This is fine for radio, where the frequency deviation fits within this portion of the curve, but not for other purposes like true-phase comparison, where accurate output is needed over the whole 180° range. Any attempt to use the curve shown beyond about ±60% will result in severe distortion of the output.

What's a Quadrature Detector

The quadrature detector comes into its own in terms of efficiency and linearity as a phase detector, since it is really comparing two square waves, both of which have fixed amplitudes and are compared in all four quadrants. It is actually only comparing the true area of overlap and the resulting output will now have the transfer curve shown in Figure 2c. This could also be considered a 'Z' curve, since it more resembles a Z than an S. It also shows that a linear input/output relationship is maintained over the full 180° degree maximum range, the output falling (or rising) sharply at the fall-off points where a new comparison starts. The output polarity can be reversed simply by the use of an inverting amplifier. The very large output (8V pk-pk) available is due to the high-level of amplification given to both reference and signal frequencies to drive the clipping/squaring circuits prior to comparing their phase. The 'average' dc component of the compared output is often used for frequency correction purposes in order to maintain local oscillator lock when receiving a station, whilst the alternating component is in fact the recovered frequency modulated audio. In a double, balanced, quadrature detector, most if not all of the comparing circuitry in the chip is doubled, which results in two equal amplitude, simultaneous outputs. This type is used in the CA3189E chip, which makes it possible to dedicate each output to a single task and to optimise component values for those tasks, one to the AFC function, the other to recovering the demodulated audio signal. In the authors design, full advantage of this dual output has been taken, hence the twin channels of AM and FM signals, which when the data from each is combined, can give not only information on which way an object may be moving, but also how far, even though any movement may exceed the very sensitive measuring range available from the FM channel alone.

It is at this point the author would like to throw out a challenge to other *Electronics And Beyond* readers. It is this: Given that the AM channel will give one full cycle of output, for each full-range movement of an object, also that the FM channel will give information on which way (towards or away from the sensing head) an object is moving, and the measured distance before another measuring cycle is started, then the task is to devise a way of combining these two sets of data to give a readout (your choice of format) of this information. Bear in mind what was said in part two, about the way in which the sensitivity of the unit was four times greater than originally envisaged. Several solutions are possible, including software-based ones. All however, will require a small amount of hardware. The editor and the author would like to hear of your solutions with a view to possibly publishing the best one(s). The author has his own ideas, but this interactive approach may turn up some novel solutions – so go for it!

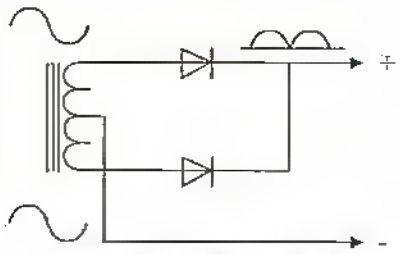


Figure 2e (i) Basic full wave rectifier analogy.

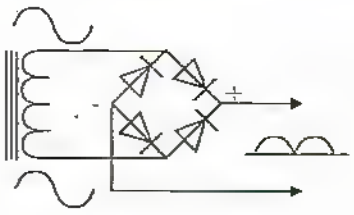


Figure 2e (ii) Full wave bridge analogy.

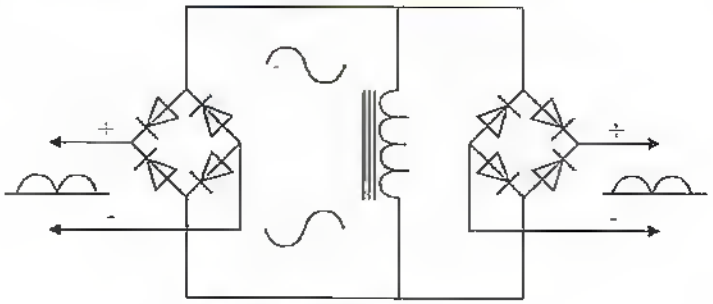


Figure 2e (iii) Double balanced bridge analogy.

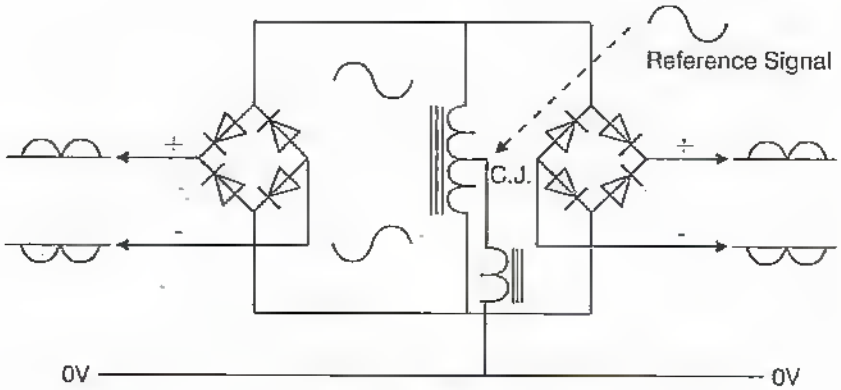


Figure 2e (iv) Double phase detector analogy.

Basic operation of a quadrature detector

The basic operation of a simple quadrature detector can be simulated with the circuit shown in Figure 2d. The two switches represent the reference and input signal sources, whilst R and C form a low pass filter. If one switch is off and the other on, no output will occur. If both switches are on, then maximum output will be present. If both are operated cyclically at the same speed, and at some point they are both on, then C charges up (integrates the output) to a level dependent on the time constant of R and C, also the degree of overlap in time (phase). Longer overlap periods give greater output, whilst shorter periods give less, thus the output is proportional (very roughly) to the degree of phase co-incidence involved. The quadrature detector uses electronic switches (e.g. semiconductor elements [transistors]) and is thus more sophisticated, but not fundamentally different in action.

In summary, a quadrature detector detects phase differences by comparing input and reference waveforms after they have each been converted to a constant-amplitude, square wave format and thus gives an output which is proportional only to the degree of phase co-incidence. A basic quadrature detector is actually a kind of high-speed switching circuit. It is roughly analogous in function to a simple full-wave rectifier using a centre tapped transformer and giving only a single output as in Figure 2e(i). A balanced quadrature detector is roughly analogous to a full-wave bridge rectifier as in Figure 2e(ii), in that it operates on all four quadrants of the input signal and is thus more efficient, whilst a double, balanced quadrature detector is roughly analogous to feeding two bridge rectifiers from the same source as in Figure 2e(iii) in order to obtain two (relatively) independent outputs. The reference signal is common to both detection circuits. If one fits a centre tap to the transformer secondary feeding these bridge rectifiers as in Figure 2e(iv), it is then possible to inject a reference signal in series with this centre-tap and each rectifier circuit can then actually perform as a phase comparator! It's one possible way of producing a simple, sine-wave phase comparator, and has actually been used in some commercial circuits requiring this function.

Frequency Modulated Output Circuit

The frequency modulated signal processing channel, see Figure 3, takes the output signal from pin 7 of IC3. This output is the one normally dedicated to AFC control when IC3 is used in its normal role of an FM radio IF and demodulator chip. In the author's design, the normally long time-constant applied here is modified into a five position switch selected arrangement to allow the output response speed or damping, to be optimised for different experiments. If only slow movements are expected and any rapid fluctuations are present, due to (say) the unit's sensitivity to very small vibrations, then position 1 would be selected. This places a 10µF capacitor into circuit, thus creating a long time-constant filter. If small and rapid movements are being examined, then position five would create a much shorter time-constant filter. The intermediate positions allow other settings to be tried so as to optimise the experimental set-up. IC4a is one quarter of a TL074 quad FET op-amp and functions as both a buffer amplifier and inverting amplifier. In fact, since the required output at pin 1 is less than the level available from IC3, it has a gain of less than unity. The gain is set by P5, the *Set Deviation* pre-set and this is adjusted to give a ±1kHz frequency deviation above and below the centre frequency of the channel output centre frequency of 2kHz. IC4b is also a part of the same quad op-amp and functions as a unity gain dc amplifier with its inverting input fed with an adjustable bias voltage to allow the output of IC4c to be offset positively from the 'phantom ground' level of +5.76V which is actually taken from IC3 reference voltage output. This bias voltage is provided by *P7, the Set 10V Bias* pre-set, which is buffered by IC4d and is adjusted to give exactly 10V at TP10, the input of IC5 the NE566N voltage controlled oscillator which provides the channel output signal. IC5 is actually a single chip function generator, which is also characterised as a highly linear voltage controlled oscillator, hence its use here. *P8* is the *Set Centre Frequency* control. The setting up of this channel requires that DIL switches DS3 and DS4 be placed in their set-up positions. Adjustment is first made to P7, the Set 10V Bias pre-set, to give 10V at TP10, then P8, the Set Centre Frequency pre-set is adjusted to give exactly 2kHz at TP11. Finally, DS4 is set to its next position and a dc voltage of alternately ±4V is injected between IJP2 & IJP3 (an 8V pk-pk 1Hz square wave may be used instead) and P5 adjusted to give a ±1kHz shift at TP11. At this point, *P6, the Set FSD* pre-set, may also be adjusted to give +/- full scale deflections on the centre zero meter. The output of IC5 is buffered by the complementary emitter follower pair of transistors, TR1 & TR2. These remove any loading on the output of TR5 and as the signal is a square wave, no

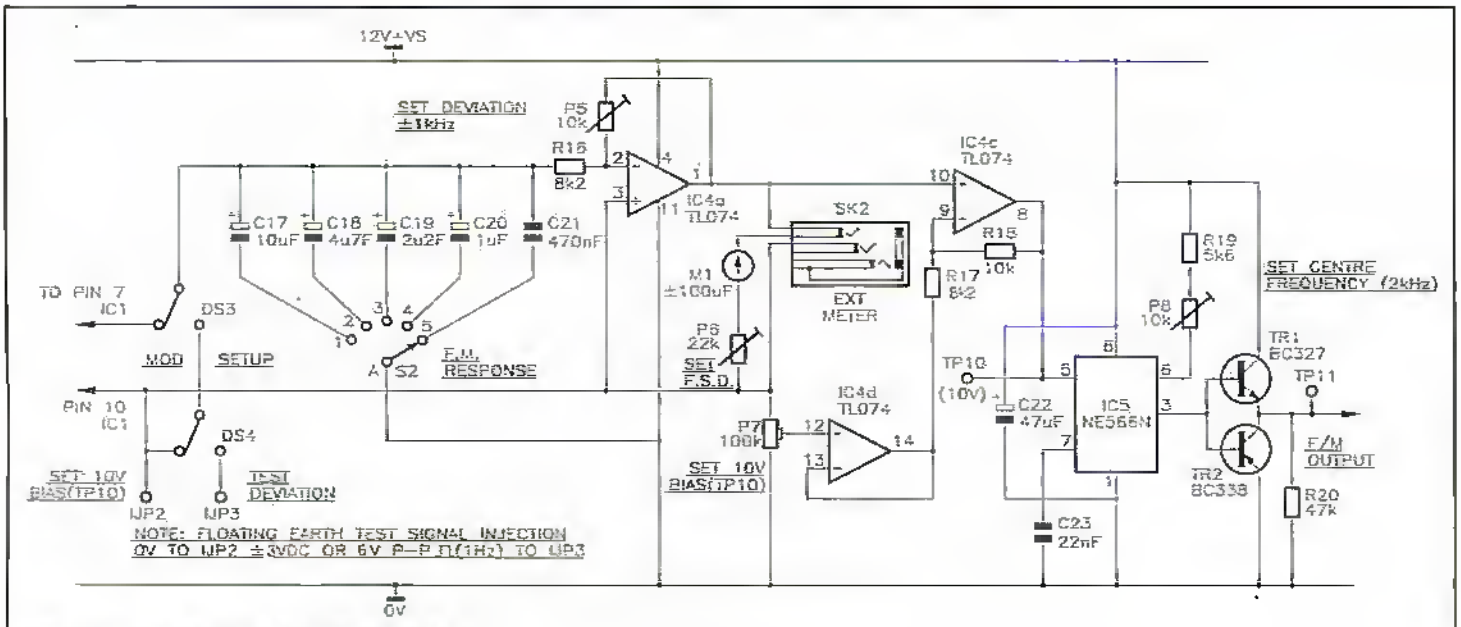


Figure 3. Frequency modulated channel.

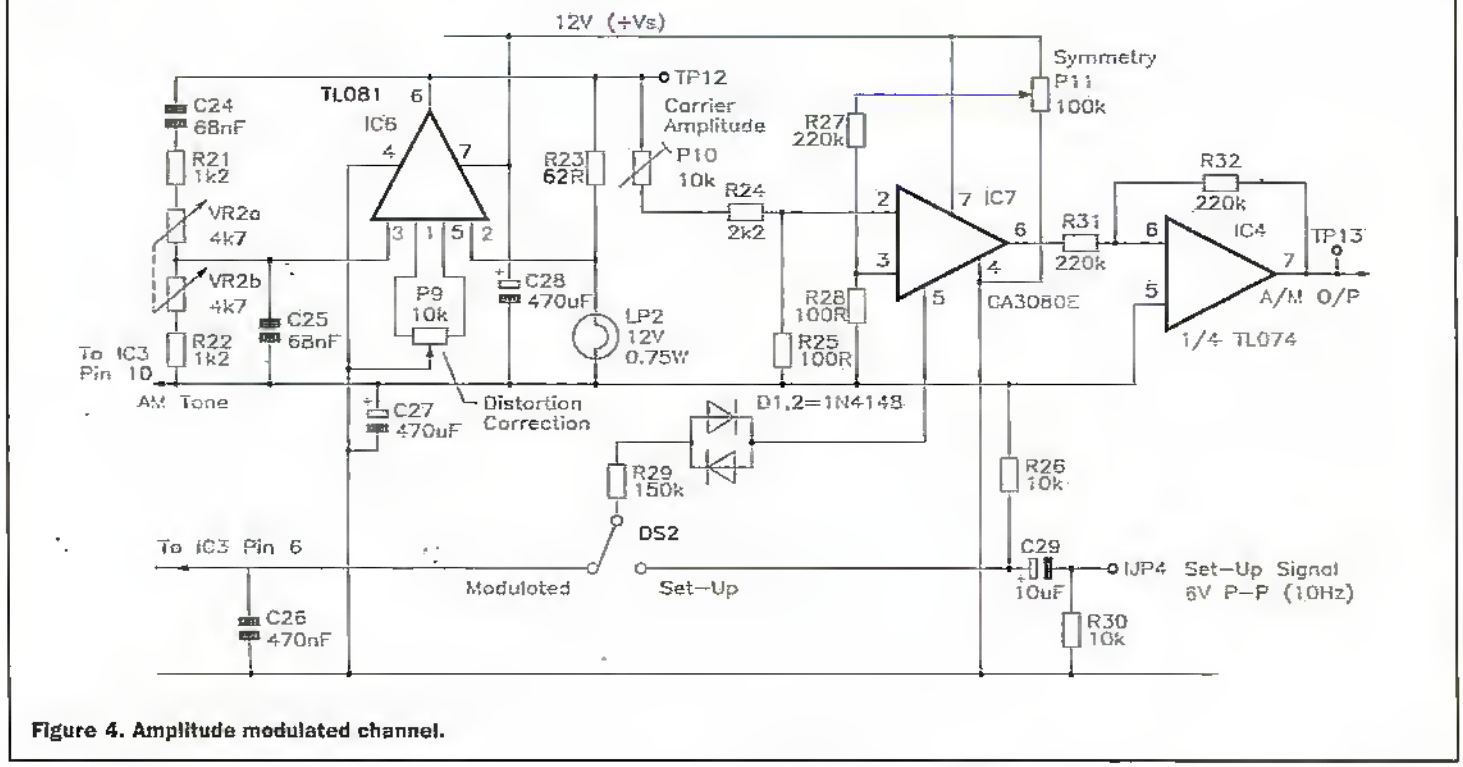


Figure 4. Amplitude modulated channel.

crossover compensation is needed. R20 is there simply to provide a discharge path for the output coupling capacitor at switch-off (See Figure 5) and plays no part in the operation of the circuit. When set up is completed, DS3 and DS4 are returned to the operating positions shown.

Amplitude Modulated Channel

The AM signal processing channel, see Figure 4, uses a Wein bridge oscillator as a carrier tone generator onto which channel data is amplitude modulated. IC6 is a TL081 FET op-amp and functions in exactly the same manner as the Wein bridge oscillator described in Figure 2. The component values are adjusted to give a frequency range of about 365Hz to just under 1kHz and the frequency is manually set by adjusting VR2a and VR2b. Adjustment is at the operators discretion and a wide range of 'musical' tones can be set up to ease listening fatigue. The main difference lies in the fact that instead of a phantom ground being set up by a balanced pair of resistors as for the range oscillator circuit, this makes use of the +5.76V dc reference voltage provided by IC3, the FM demodulator/detector chip. The reason is that reliable, symmetrical amplitude modulation of this tone can only be achieved if the zero voltage line temperature tracks accurately the second output from pin 6 of IC3. Although the circuit would operate, any changes in supply voltage would introduce unbalances in operation of the modulation chip, IC7. To avoid channel cross-modulation, the + 5.76 volt reference voltage is heavily decoupled by C27 and C28 (470µF). In operation, the signal from IC6 is fed via P10, the *Carrier Amplitude* pre-set and its associated limiter resistor R24, to pin 2 of IC7, A CA3080E transconductance op amp. A DC bias is also fed to pin 3 of IC7 via R27 from *P11*, the *Symmetry* pre-set. P11 is used to set up equal amplitude '+' and '-' modulation envelope areas. Note that the type of op-amp used here does not necessarily produce an output voltage, but rather an output current, which is proportional to the voltage difference between the two inputs and is called the 'transconductance transfer characteristic'. The 100Ω resistors from each input to ground ensure that only very small voltage differences can appear at the inputs and, in effect, both inputs remain virtually at ground potential. The output of IC7 is fed via R31 (220k) to the inverting input of IC4/2, which functions as a unity gain inverter and also is part of the TL074 quad

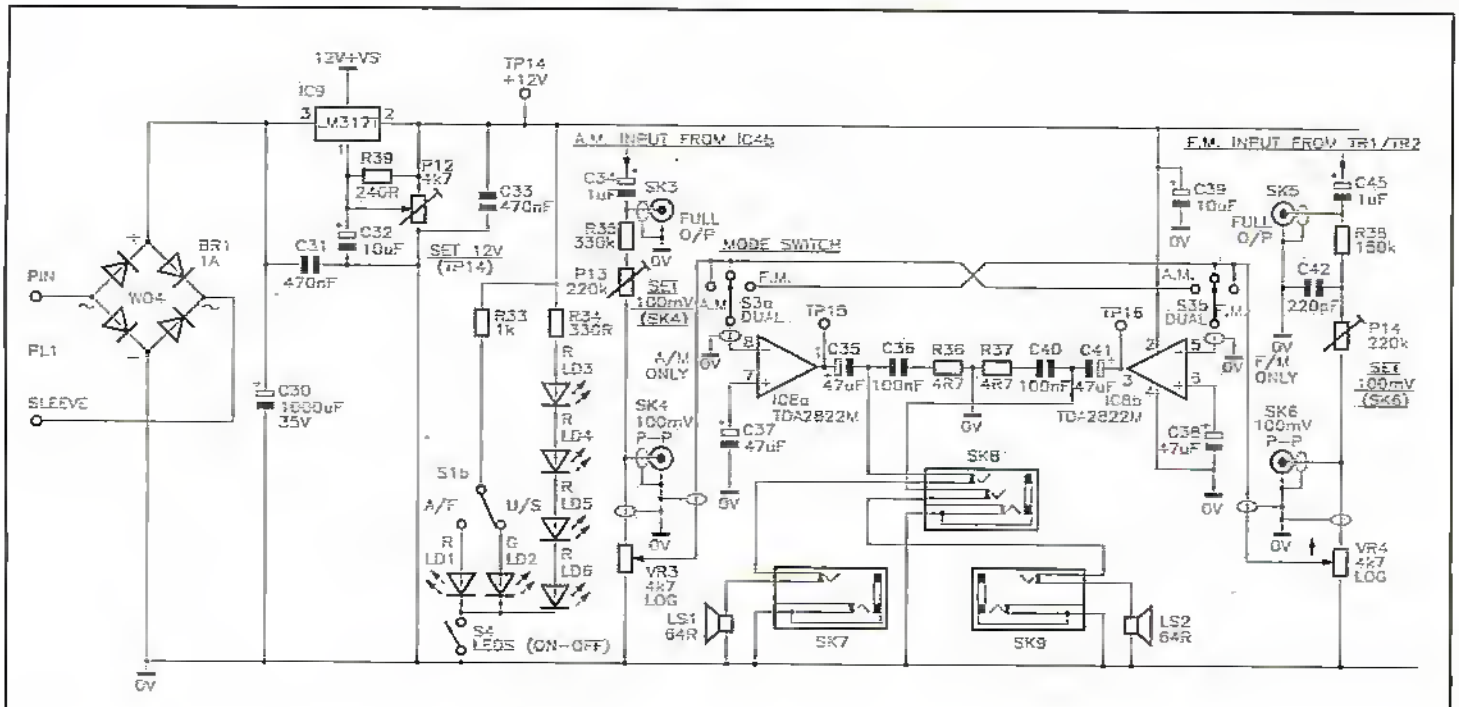


Figure 5. Power supply and output amplifier circuit.

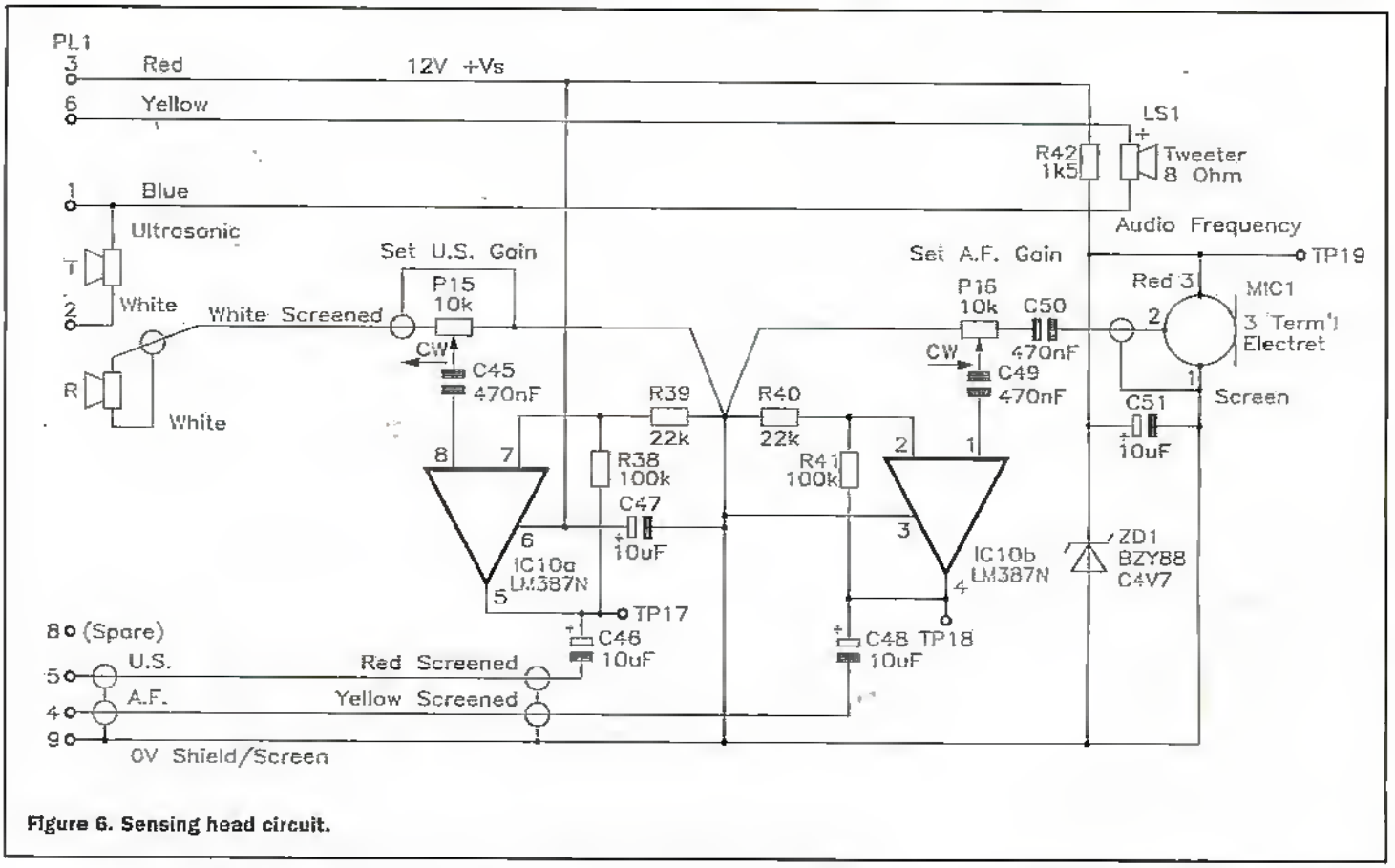


Figure 6. Sensing head circuit.

op-amp, the rest of which is used in the FM signal processing channel. The other input to IC7 is a gating signal. This is applied to pin 5 and can be used to vary the gain of the circuit, either by a fixed amount depending on the DC potential, in which case it can be used as an electronic attenuator or variable gain amplifier depending on the exact potential applied. If an AC signal is fed to this pin, as in the authors design, then the gain varies in sympathy with this signal and the chip functions as an amplitude modulator. With the component values shown, modulation is approximately 98%. Increasing R29 will reduce this level and some constructors may wish to do this. Very roughly, if R29 is doubled, then modulation should decrease to around 50%. The two back-connected diodes in series with R29 allow offset levels in the chip to be overcome to avoid distortion of the modulation envelope. Setting up the circuit requires an oscilloscope and is effected by placing DIL switch DS2 into the set-up position. With no input to IJP4, this results in a steady gain in IC7 and *P10*, the *Carrier Amplitude* pre-set, should be adjusted to obtain a 4V pk-pk signal at TP13. If a sine-wave signal of 8V pk-pk and about 10Hz is injected into TP13, then the output at TP13 should display a near 100% modulated waveform of 8V pk-pk amplitude. When completed, DS4 is returned to its original setting and the circuit is ready to operate. This completes the description and setting up of the AM channel.

Power Supply and Audio Amplifier/Output

Dealing with the power amplifier section first, as shown in Figure 5. The two audio signals from the FM and AM. channels are fed to the two halves of a stereo audio amplifier chip, IC8a & IC8b a TDA2822M chip via the coupling capacitors C34 & C45, attenuator network R35, P13, & the volume control VR3 for the AM channel, and R38, P14 and VR4 for the FM channel, also function switch S3a & S3b. IC8a is the output amplifier for the AM channel, whilst IC8b performs the same function for the FM channel. To facilitate flexibility, both signals are switched via S3a & S3b, so that the output obtained can be either AM only, FM only, or both simultaneously (Dual position). In the FM channel, an additional circuit is used to reduce the high harmonic content of the square wave signal. This is C42, a 220pF capacitor connected as a low-pass filter. Both outputs are available on phono sockets, SK3 and SK4 for AM and SK5 and SK6 for the FM channel. SK4 and SK6 are the line-out sockets and when everything is operating normally, 100mV should be available to drive an external amplifier, or to feed to a tape recorder. Note that these levels are set up by *P13*, the *Set 100mV* pre-set for the AM. Channel and *P14*, the *Set 100 mV* pre-set for the FM channel. In the case of the AM channel, the output should be set to give 50mV with no signal applied to the modulator, IC7 (DIL switch DS2 in Set-up position). This rises to 100mV on application of a test signal to JP4. Output sockets SK 3 & SK 5 are provided to give access to the raw data from each channel and are full-level outputs.

The two amplifiers inside IC8a and IC8b share a common power feed and in the authors design, this caused a problem which was only solved by chance. The author could not get rid of an annoying output of the carrier tone from both channels. On investigation, it was found that the -Ve return from Pin 4 of IC6, the AM carrier tone oscillator, had been connected into the earth line from IC8. Removing this link and transferring it directly to the main ground plane stopped this completely. Moral, never let any oscillator wiring near your amplifier earth return! The only remaining item is the output switching carried out by the three jack sockets. SK8 is a stereo headphone socket and allows private listening. The switched outputs of this socket are each taken separately to two further (mono) switched sockets, the contacts of which are so arranged that an internal speaker is connected to each channel in the absence of any plug being inserted. Speaker impedance is 64-80Ω and headphone requirements are the usual 16Ω per channel. External speakers can be any impedance from 8 Ohms to 80Ω. Gain of the two amplifiers is fixed and only required the use of capacitors C37 and C38 to operate at maximum gain. Outputs are capacitively coupled via C35 and C48, whilst the outputs are stabilised by the Zobel networks (C36/R36 & C40/R37) across each output.

The Power Supply

This is a conventional design using an LM 317T 1A regulator in IC9 position. The circuit is perfectly standard and *P12* is the Set *12V* pre-set. NB: Before setting up the unit, all ICs except IC9 and IC2 should be removed, then with P12 set to give minimum output (slider towards 0V end of travel), and a DVM on a suitable range connected to TP14, turn on the power and adjust P12 until exactly 12V is observed at TP14. Use of the LM317T was dictated by the need to keep output voltage constant despite load/line variations. The input to the regulator is via a bridge rectifier/capacitor combination and is designed to operate on a wide range of supply voltages. The caption gives the anticipated range of voltages from which the unit will operate.

LED Circuit

The front panel LEDs require a little explanation. LD1 and LD2 are the mode indicators for ultrasonic and AF operation respectively. LD3, LD4, LD5 & LD6 are the cursor indicators and apply to the two volume controls (VR3 & VR4) respectively, also the *AM Tone* and *AF Wavelength* controls. In operation, the unit may sometimes have to be operated in a totally darkened room and so a LED on-off switch, S4, has been provided. Power for the LED's is taken from the 12V line and is via R33 for the mode LEDs and R34 for the cursor LEDs. This completes the description of the power supply.

The Sensing Head

This part of the system, as shown in Figure 6, is detachable and can be operated in two ways.

1. It can be plugged onto the back of the main processing unit and is held there by means of a rubber strap. This allows the unit to function as a compact single unit for simple experiments and also testing/setting up.
2. It can be connected to the main processing unit by mans of a 16 foot long extension cable. This enables the sensing head to be placed in a different environment to that of the processing unit and also allows fully screened operation should the need arise. The circuit is very simple and consists of a stereo pre-amplifier IC10a/b, type LM387N. This functions as a head pre-amplifier with IC10a acting as the ultrasonic channel amplifier and IC10b as the corresponding amplifier for the AM channel. Gain control for the two channels is by means of pre-sets P15 and P16. Overall gain is set by the pair of resistors R38/R39, plus the gain in feedback. P15 & P16 are Set Gain pre-sets to optimise the channel sensitivity. Overall gain is therefore set at 5.5

Output from the ultrasonic receiver, R, is coupled directly to P15, the *Set U.S. Gain* pre-set via a short length of miniature screened cable. P15 is 10k and this presents an optimal value load to the receiver. Coupling to pin 8 of IC10a is via C45, a 470 nF miniature block capacitor. The ultrasonic transmitter, T, is fed directly from pin 2 of

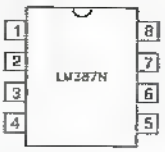


Figure 7. Pin-out LM387N.

PL1, the 9-way D-connector plug, via a separate feed line selected by RLB2 in the main processing unit. The AF side of the sensing head is made up of a small, 8Ω tweeter loudspeaker, used as an AF transmitter, which is driven from pin 6 of PL1 via a separate feed line also selected by RLB2 in the main unit. The ultrasonic transmitter share a common return line on pin 1 of PL1. This return line is taken back via a separate lead in the extension cable and terminated on the ground plane close to SK1, the corresponding 9-way socket. This is done to avoid spurious signal coupling that would otherwise occur if only the screen of the extension cable were used. The screen carries the low-level -Ve supply for the sensing head, and is also signal ground return for both ultrasonic and AF signals. These connections are made to pin 9 of PL1. Mic1 is a miniature 3-terminal electret insert of 9.5mm external diameter, and is a comfortable push-fit into the directional shroud, held there by a small amount of polyurethane foam packing. The shroud is actually a Weller soldering iron receptacle, which the author happened to have available. A 3-terminal insert was chosen as it meant that power and output connections could be kept separate. Power for the microphone is derived from the main 12V line via R42 and ZD1, a 4.7V Zener diode, and this is also the recommended optimum voltage for the insert. ZD1 is decoupled by C51, 10μF, to remove the inevitable zener noise. Output from Mic1 is via a short length of screened cable to C50, a 470nF small block capacitor to provide dc isolation for Mic1 output, and thence to *P16*, the *Set AF Gain* pre-set. Coupling to pin 1 of IC10b is via C49, another 470nF miniature block capacitor. In operation, the settings of P15 and P16 are not very critical and in the authors unit, were set to about two thirds rotation, which corresponds to an effective overall gain of approximately four. Other settings may be employed as determined by the individual constructor and the conditions under which the unit is operated. Outputs from both pre-amplifiers are ac coupled via C46 for the ultrasonic section and C48 for the AF section. Both are 10μF miniature electrolytics. Feed to the main unit is via pin 5 of PL1 for the ultrasonic section and pin 4 for the AF section. Both pre-amplifier outputs are linked to PL1 via a short length of dual screened cable. 12V power is supplied to the sensing head via pin 3 of PL1. Full constructional details of the sensing head and main processing unit will be given in Part 4 of this article. This completes the technical description of the sensing head and also all the main diagrams.

LED CHASER/ SEQUENCER CIRCUITS

Ray Marston presents a selection of practical 4017B-based LED chaser or sequencer circuits in this special feature article.

The so called chaser or sequencer is one of the most popular types of LED-driving circuit and is widely used in advertising displays and in running-light 'rope' displays in small discos, etc. It consists – in essence – of a clocked IC or other electronic unit that drives an array of LEDs in such a way that individual LEDs (or small groups of LEDs) turn on and off in a predetermined and repeating sequence, thus producing a visually attractive display in which one or more ripples of light seem to repeatedly run through a chain or around a ring of LEDs.

The 4017B CMOS IC is probably the best known and most widely used LED-driving IC used in chaser/sequencer applications. This article looks at a variety of practical circuits based on this particular IC.

4017B Basics

The 4017B is a member of the popular '4000B' family of CMOS digital ICs and can use any DC supply voltage in the 3V to 15V range. It is actually a clocked decade counter/divider IC with ten fully decoded short circuit proof outputs that can each be used to directly drive a simple LED display. If desired, various outputs can be coupled back to the IC control terminals to make the device count to (or divide by) any number from two to nine and then either stop or restart another counting cycle. Numbers of 4017B ICs can be cascaded to give either multi-decade division or to make counters with any desired number of decoded outputs.

The 4017B is thus an exceptionally versatile device that can easily be used to chase or sequence a basic LED display of virtually any desired length.

Figure 1 shows the outline, pin notations, and basic functional diagram of the 4017B, and Figure 2 shows the waveform timing diagrams of the IC, which incorporates a 5-stage Johnson counter and has CLOCK, RESET and CLOCK INHIBIT input terminals. The internal counters are advanced one count at each positive transition of the input clock signal when the CLOCK INHIBIT and RESET terminals are low. Nine of the ten decoded outputs are low, with the remaining output high, at any given time. The outputs go high sequentially, in step with the clock signal, with the selected output remaining high for one full clock cycle. An additional CARRY OUT signal completes one cycle for every ten clock input cycles, and can be used to ripple-clock additional 4017B ICs in multi-decade counting applications. Note that the 4017B counting cycle can be inhibited by setting the CLOCK INHIBIT terminal (pin 13) high, and that a high signal on the RESET terminal (pin 15) clears the counter to zero and sets the decoded '0' output terminal (pin 3) high.

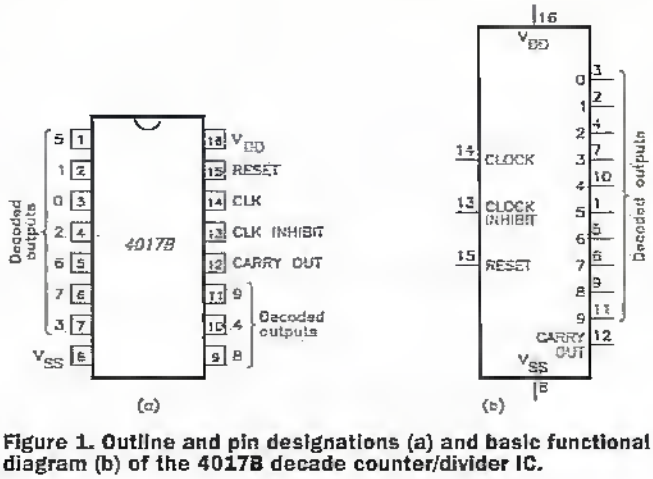


Figure 1. Outline and pin designations (a) and basic functional diagram (b) of the 4017B decade counter/divider IC.

4017B LED Driving Test Circuit

The 4017B is a versatile and easy-to-use IC and (like most 4000B series ICs) has short-circuit proof outputs that exhibit slightly surprising characteristics when driving LED-type loads. Figure 3. shows a practical 4017B test circuit that can be used to demonstrate the ICs basic actions and output driving characteristics. The circuit is best built on a 'plugblock' type of breadboard unit, in which components and wires are simply pushed into the unit's sprung-contact blocks.

In Figure 3, the 555 timer IC (IC1) is used as a variable-frequency asymmetrical squarewave generator that feeds clocking signals to the CLK input terminal of the 4017B IC (IC2). This output waveform is normally high but briefly flips low once per cycle and drives LED5 on; the 4017B's internal switching actions are initiated as this signal flips high again and LED5 switches off.

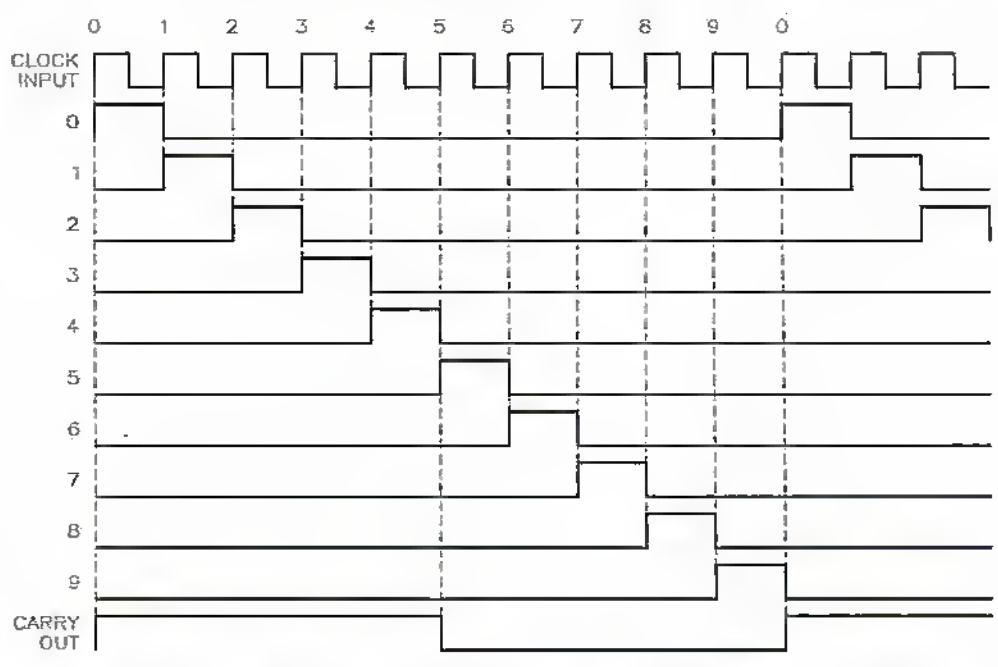


Figure 2. Waveform timing diagram of the 4017B with its RESET and CLOCK INHIBIT terminals grounded.

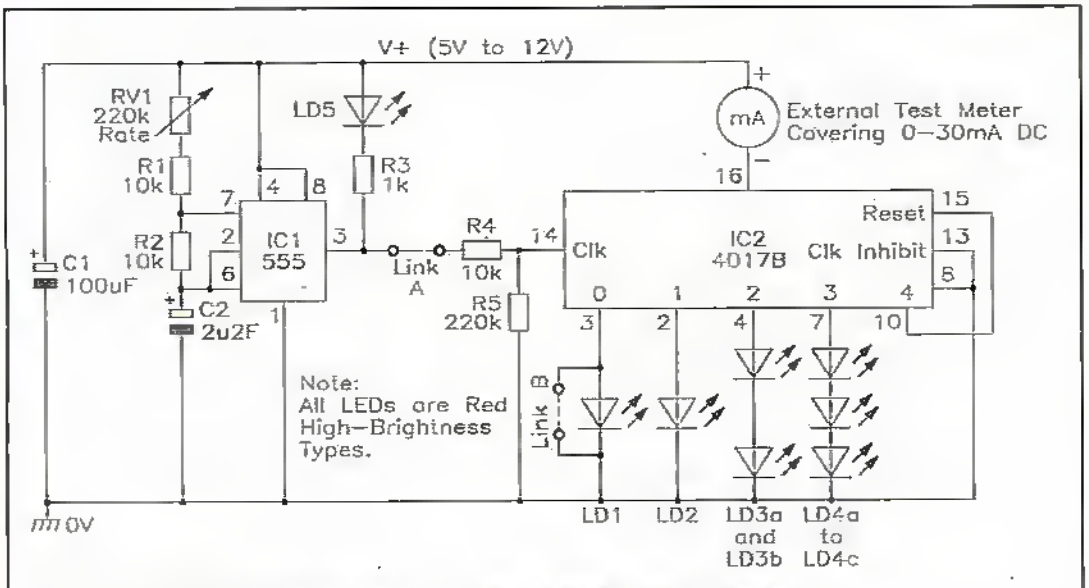


Figure 3. A 4017B LED chaser/sequencer test and demonstration circuit.

Note that the clocking signal is fed to the 4017B IC via removable Link A, and can thus be physically interrupted whenever required; R4 and R5 protect the 4017B's input against damage when Link A is open or IC2's positive supply connection is broken.

In Figure 3, the positive dc supply line is connected to pin16 of the 4017B IC via an external multi-range dc current meter that (since IC2's quiescent current is negligible) gives a direct readout of the current drawn by the IC's currently active output load. The 4017B is wired (via pins 10 and 15) in the 'divide-by-four' mode and sequentially drives four sets of output loads, which are notated '0' to '3'. Output '0' takes the form of a single LED when Link B is open, or a short circuit when Link B is closed. Output '1' takes the form of a single LED. Output '2' takes the form of a two series connected LEDs. Output '3' takes the form of a three series connected LEDs. All LEDs are red high brightness types.

When construction of the Figure 3 circuit is complete, close Link A, open Link B, connect the meter in place, and connect the unit to a 9V dc supply. Adjust RV1 to give a slow clocking rate, noting that LED5 gives a brief flash during each cycle, and that all other LEDs or groups of LEDs activate sequentially. You will probably be surprised to note that all of the display LEDs (LEDs 1 to 4) operate at almost equal brightness, and that all output loads produce fairly similar current readings on the test meter.

When testing the Figure 3 circuit, you can check the individual load currents by waiting until the load activates and then 'freezing' the display by opening Link A. When load '0' is active, the load current is typically 17.5mA with Link B open or 19mA with Link B closed; the load '2' and load '3' currents are typically 16mA and 12.5mA respectively. Thus, when using a 9V supply, the load current is typically 19mA when driving a short circuit, or 12.5mA when driving three series connected red LEDs. The graphs of Figures 4 and 5 help explain this circuit action.

Figure 4 shows the typical forward current/voltage graph of a high brightness red LED. Note that large variations in forward current produce relatively small variations in forward voltage. Thus, when the current is increased from 10mA to 30mA, the forward voltage increases by only 0.22V, and in this case the LED thus acts like a pure voltage (zero impedance) load in series with an 11Ω impedance; in practice, this impedance varied between 10Ω and 15Ω over most of the LED's working current range.

Figure 5 shows the typical supply voltage versus output current graph that applies to each output of the Figure 3 circuit when driving different types of load. Note that each CMOS output stage acts like a loosely controlled constant current generator that has its short circuit output current determined by the supply voltage value but has its LED driving current value influenced by the actual Vout value of the stage.

Figure 3 circuit, when using a 9V supply, Vout is zero when driving a shorted output, and under this condition 9V is developed across the output stage, Iout is 19mA, and 171mW is thus dissipated in the output stage. When, on the other hand, the 9V circuit is driving three series connected LEDs, Iout is 12.5mA, Vout is 5.85V (see Figure 5), 3.15V is developed across the output stage, and less than 40mW is thus dissipated in the output stage.

Note that most 4000B series CMOS data sheets list the maximum permitted dc power dissipation values of the 4017B IC as 100mW per output stage and 500mW per package, and these figures should be kept in mind when experimenting with the Figure 3 test/demonstration circuit.

Practical 4017B Chaser/Sequencer Circuits

Figure 6 shows the practical circuit of a 4017B 10 LED chaser in which IC1 acts as a variable rate clocking generator and the 4017B IC is wired into the decade counter mode by grounding its CLOCK INHIBIT

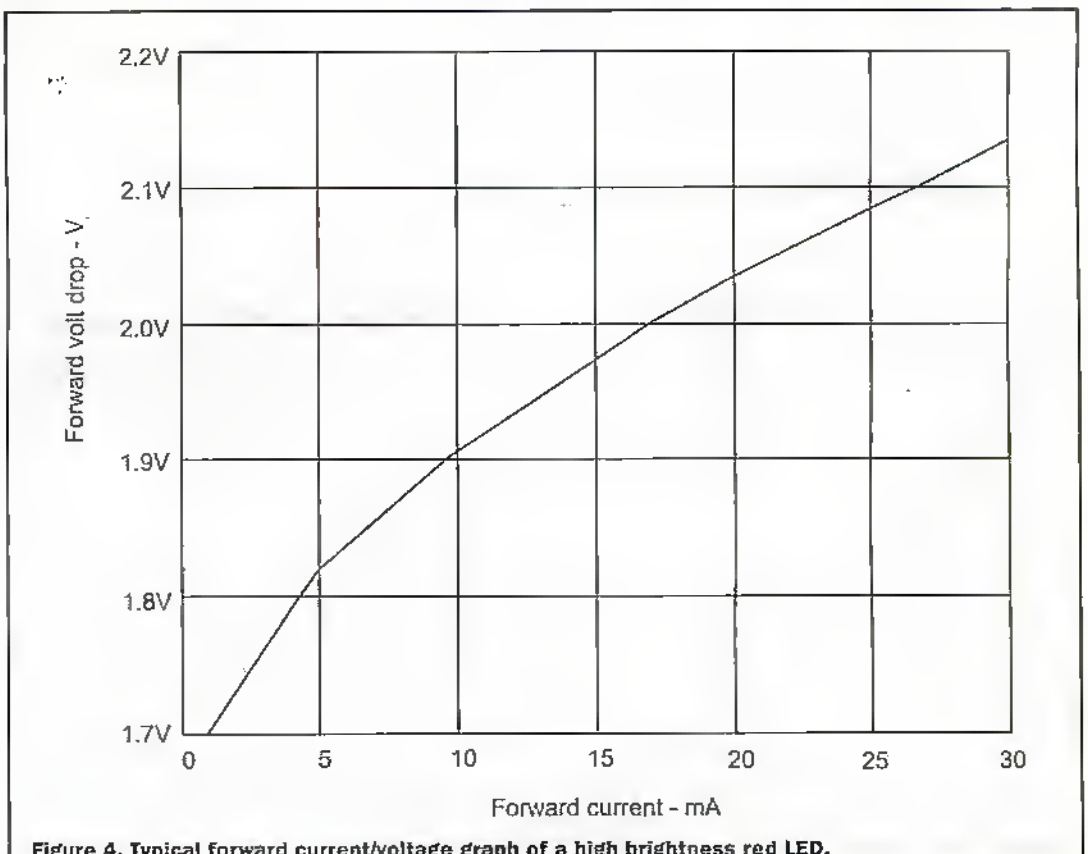


Figure 4. Typical forward current/voltage graph of a high brightness red LED.

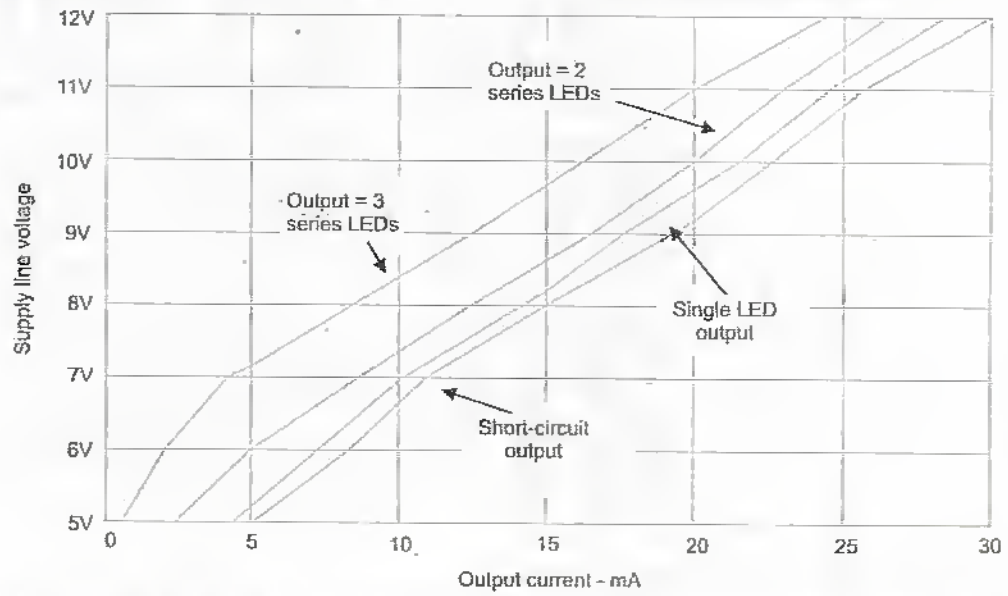


Figure 5. Typical supply voltage versus output current graph of the Figure 3 circuit when driving different types of load.

(pin 13) and RESET (pin 15) control terminals. The circuit action is such that the visual display appears as a moving dot that repeatedly sweeps from the left (LED0) to the right (LED9) in ten discrete steps as the 4017B outputs sequentially go high and drive the LEDs on. The LEDs do not, of course, have to be connected in a straight line; they can, for example, be arranged in a circle, in which case the circle will seem to rotate.

Note that the Figure 6 circuit relies on the internal action of the 4017B to limit the LED currents to safe values, and this circuit can thus be safely used with supply voltages up to a maximum of only 8V without risk of exceeding the IC's 100mW per output stage power dissipation limits.

Figure 7 shows a modified version of the above circuit, in which a current limiting 470Ω resistor is wired in series with each LED to help reduce the IC's power dissipation to a safe level. This circuit can use any DC supply in the 6V to 15V range.

Figure 8 shows a circuit variant in which the LEDs share a single current limiting resistor (R3) and which can be used with reasonable confidence at supply values up to 12V maximum. Figure 9 shows a possible equivalent of this circuit when it is powered from a 15V supply and which illustrates the limitation of the design. The action of the 4017B is such that, when a given LED is on, it effectively grounds the anodes of all other LEDs; R3 thus causes the 'off' LEDs to be reverse biased. Because of the low reverse voltage ratings of LEDs, this action can cause one or more of the 'off' LEDs to zener at about 5V, thus giving the results shown in the diagram and possible causing a power overload in the IC's active output stage.

Thus, when the 4017B is used to drive simple '1-LED-per-output' displays in the moving dot mode, the LEDs can be connected directly to the IC outputs if supply values are limited to 8V maximum, but at supply voltages greater than 8V the LEDs must be connected to the IC outputs via current limiting resistors. A variety of alternative types of 4017B LED display circuits are shown in Figures 10 to 15.

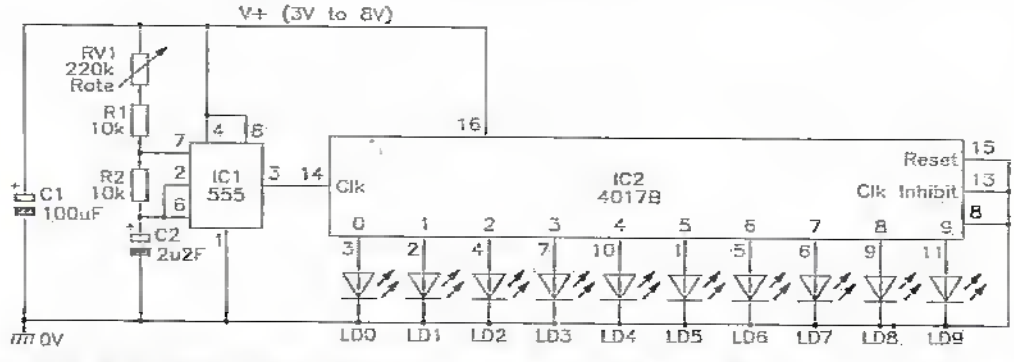


Figure 6. 10 LED chaser/sequencer can be used with supply voltages up to only 8V and produces a moving dot display.

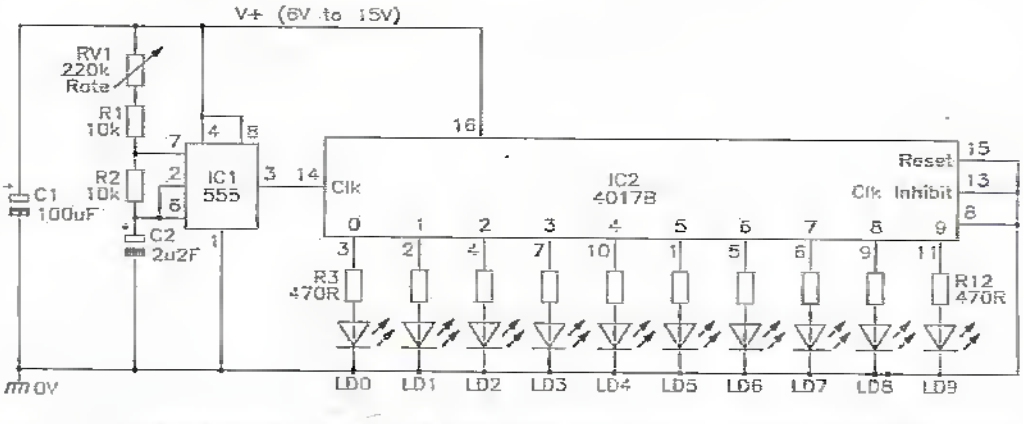


Figure 7. This version of the 10 LED chaser can be used with any supply up to 15V.

Alternative LED Displays

The output stages of the 4017B can source or sink current with equal ease. Figure 10 shows how the IC can be used in the sink mode to make a moving hole display in which nine of the ten LEDs are on at any given time, with single LEDs turning off sequentially; if the LEDs are wired in the form of a circle, the circle will seem to rotate. Note that, since all LEDs except one are on at the same time, each LED must be provided with a current limiting resistors, to keep the IC power dissipation within safe limits.

In practice, moving dot displays are far more popular than moving hole types. If desired, moving dot displays of the Figure 6 type can be used with fewer than ten LEDs by simply omitting the unwanted LEDs, but in this case the dot will seem to move intermittently, or to scan, since the IC takes ten clock steps to completely sequence and all LEDs will thus be off during the unwanted steps.

If a continuously moving less than 10-LED display is wanted it can be obtained by wiring the first unused output terminal of the 4017B to its pin 15 RESET terminal, as shown, for example, in the 4-LED circuit of Figure 11. Alternatively, the circuit can be made to give an intermittent display with a controlled number of OFF steps by simply taking the appropriate one of the unwanted outputs to the pin 15 RESET terminal. In

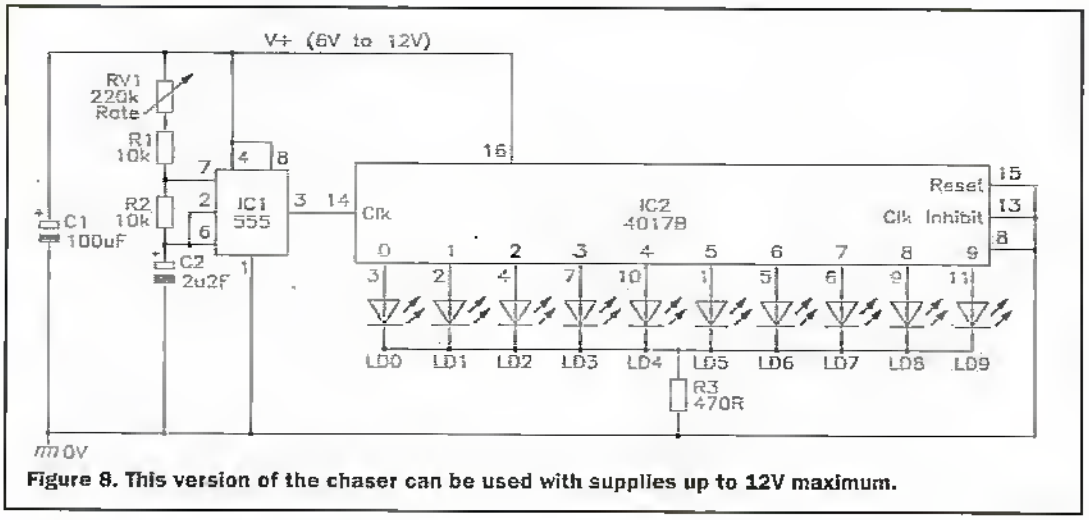


Figure 8. This version of the chaser can be used with supplies up to 12V maximum.

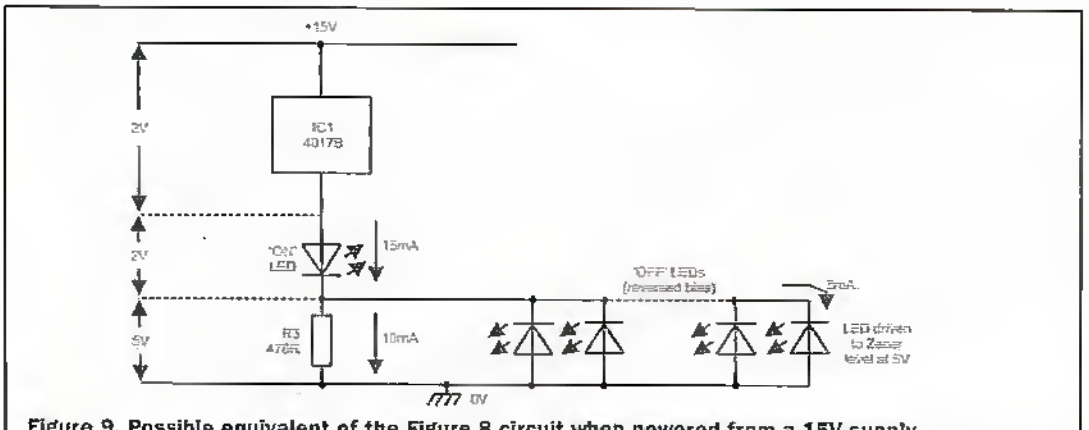


Figure 9. Possible equivalent of the Figure 8 circuit when powered from a 15V supply.

Figure 12, for example, the LEDs display for four steps and then blank for four steps, after which the sequence repeats, thus giving a moving dot display with a 50% blank period.

Figure 13 shows a rather unusual and very attractive 4-LED, 5-step sequencer in which all four LEDs are initially on but then turn off one at a time until eventually (in the fifth step) all four LEDs are off; the sequencing details are given in the table of Figure 13. Note in this circuit that the LEDs are effectively wired in series and that the basic circuit can not be used to drive more than four LEDs.

Figure 14 shows another unusual and attractive LED display. In this case the 4017B runs through a 10-step sequence, with LED1 on for steps 0 to 3, LED2 on for steps 4 to 6, LED3 on for steps 7 and 8, and LED4 on for step 9. The consequence of this action is that the visual display seems to accelerate from LED1 to LED4, rather than sweeping smoothly from one LED to the next. The acceleration action repeats in each switching cycle, and the cycles repeat ad infinitum.

Finally, Figure 15 shows the circuit of a 4-bank, 5-step, 20-LED chaser that can be used as the basis of a variety of attractive LED displays. Note that a bank of four LEDs are wired in series in each of the five used outputs of the IC, so four LEDs are illuminated at any given time. Roughly 2V are dropped across each ON LED, giving a total drop of 8V across each ON bank, and the circuit's supply voltage must thus be greater than this value for the circuit to operate. A greater number of LEDs can be used in each bank if the supply voltage value is suitably increased.

One of the most attractive and popular LED sequencer displays is the 'light rope' type, and figure 16 shows the basic method of constructing a 5-strand, 20-LED light rope display that can be driven by the Figure 15 chaser circuit. Here, each group of four series connected 'step' output LEDs of the Figure 15 chaser circuit forms one 'strand' of the light rope. There are five strands, and each one must be colour coded to enable it to be connected to the correct output pin of the 4017B IC. In each strand, the four LEDs are evenly spaced apart, but are offset relative to the other four strands, so that there is an equal spacing between all twenty LEDs when the five strands are wrapped together (as shown at the bottom of Figure 16) to form the complete

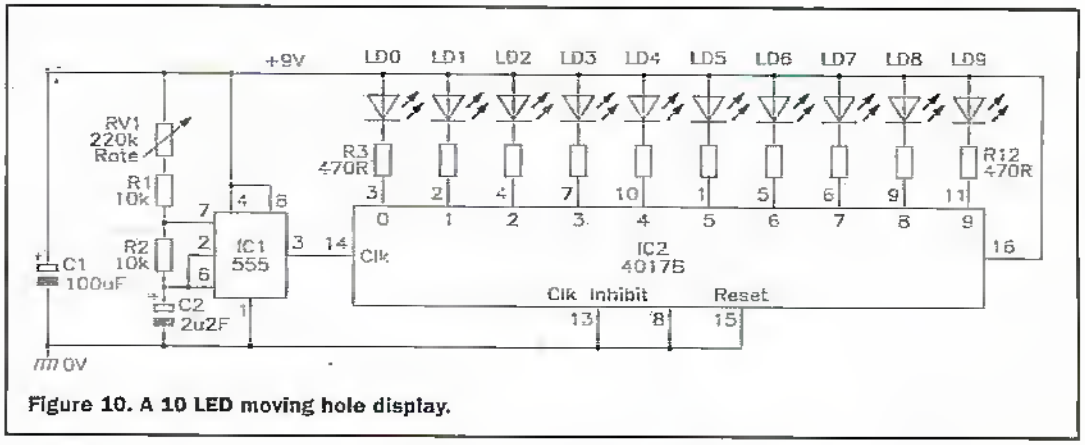


Figure 10. A 10 LED moving hole display.

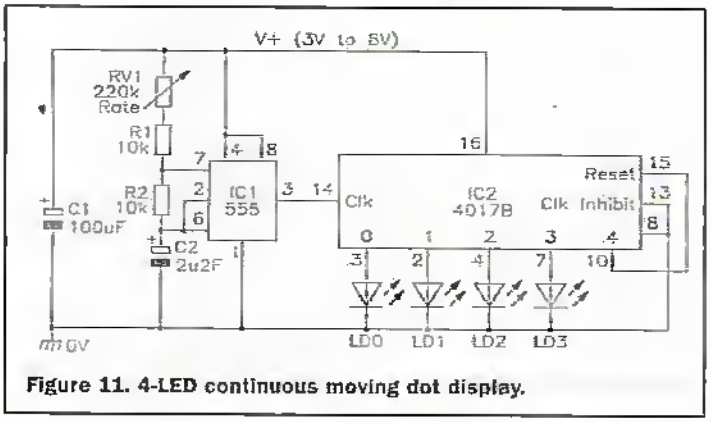


Figure 11. 4-LED continuous moving dot display.

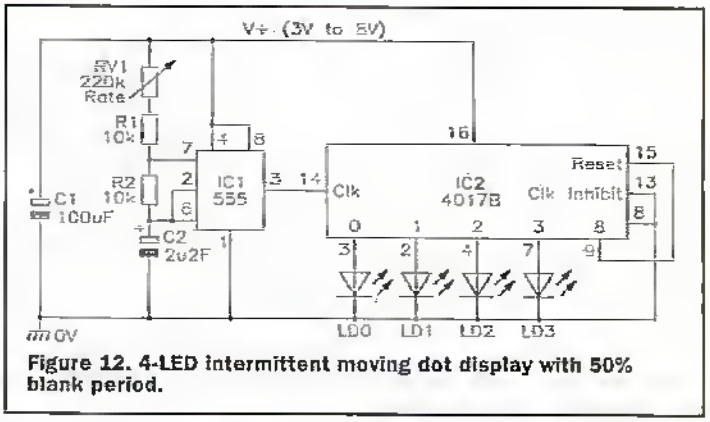


Figure 12. 4-LED intermittent moving dot display with 50% blank period.

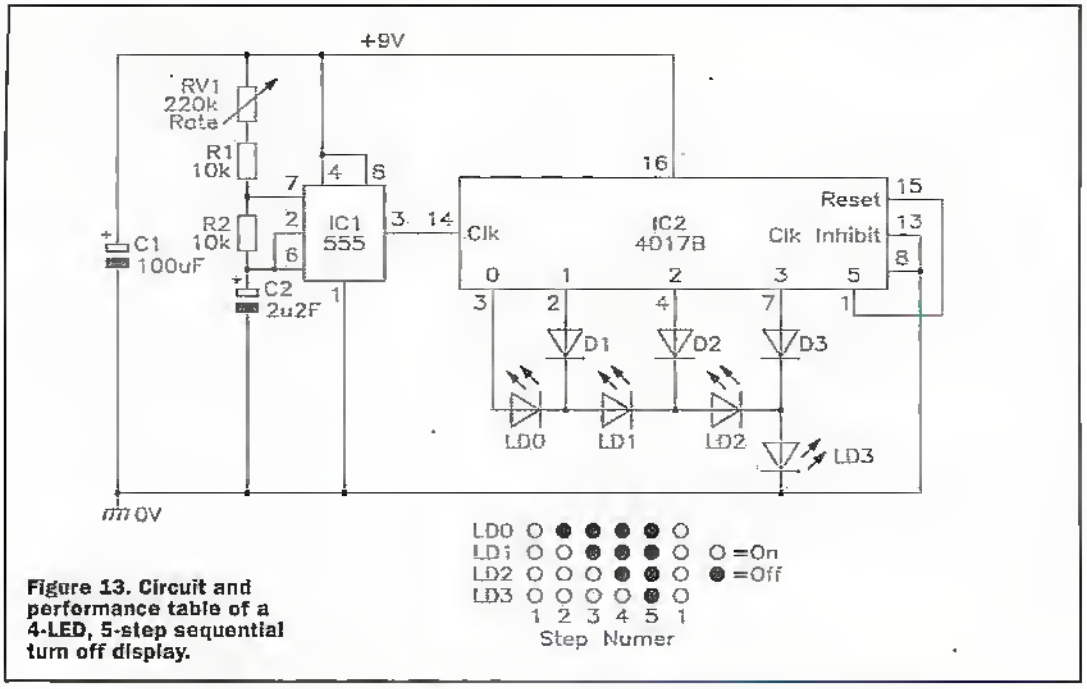


Figure 13. Circuit and performance table of a 4-LED, 5-step sequential turn off display.

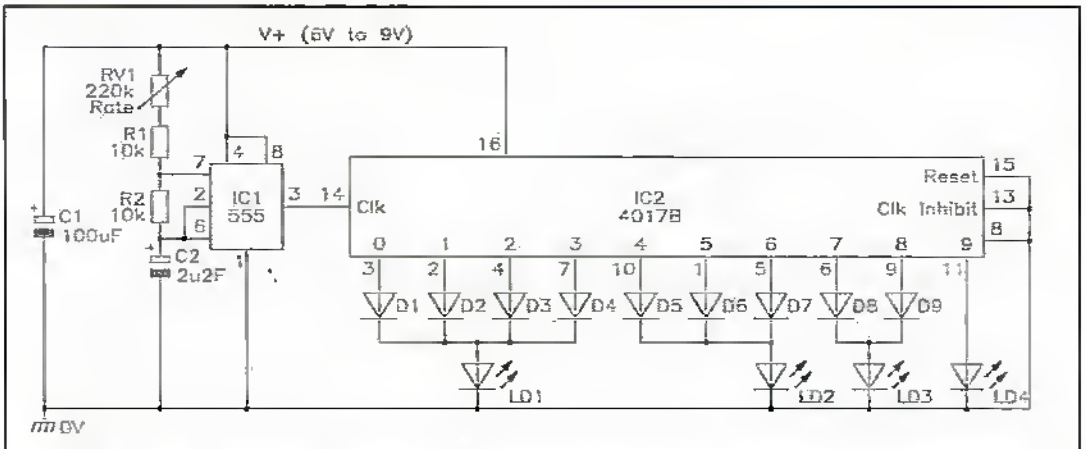


Figure 14. 4-LED continuous accelerator display in which the pattern seems to accelerate from left to right.

light rope, which is usually threaded through a length of protective clear plastic tubing.

If a light rope of this type uses a fixed spacing of (say) five inches between its LEDs, it will have a total length (allowing for a few unused inches at each end) of about eight feet. When the display is active, four evenly spaced ripples of light seem to run continuously along the length of the light rope, which is driven directly from the output of the Figure 15 chaser circuit.

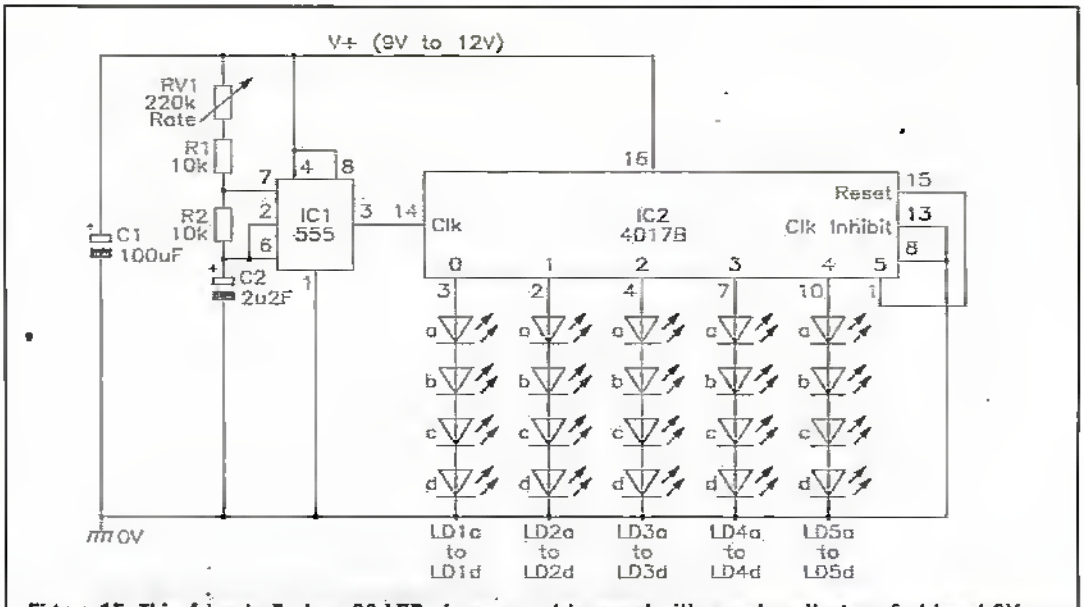


Figure 15. This 4-bank, 5-step, 20-LED chaser must be used with supply voltages of at least 9V.

Display Multiplexing

The basic action of the Figure 14 4-LED 'accelerator' circuit is such that the light display seems to repeatedly accelerate from left to right, taking a total of ten clock cycles to complete each sequence. Figure 17 shows how the circuit can be modified to give an intermittent display in which the visual acceleration action occurs for ten clock cycles, but all LEDs then blank for the next twenty cycles, after which the action repeats. The circuit action is as follows.

The 4017B has a CARRY OUT terminal on pin 12. When the IC is used in the normal divide by 10 mode, this CARRY OUT terminal produces one output cycle each time the IC completes a decade count. In Figure 17 this signal is used to clock a second 4017B (IC3), which is wired in the divide-by-3 mode with its '0' output fed to the base of gating transistor Q1. Consequently, during the first 10 clock cycles of a sequence the '0' output of IC3 is high and Q1 is biased on, so IC2 acts in the basic manner already described for Figure 14, with its LEDs turning on sequentially and passing current to ground via Q1. After the tenth clock pulse, the '0' output of IC3 goes low and turns Q1 off, so the LEDs no longer illuminate even though IC2 continues to sequence. Eventually, after the 30th clock pulse, the '0' output of IC3 again goes high and turns Q1 on, enabling the display action to repeat again, and so on.

The Figure 17 circuit is a simple example of display multiplexing, in which IC3 and Q1 are used to selectively enable or disable a bank of LEDs. To conclude this article, Figure 18 shows another example of a display multiplexing circuit. In this case the display consists of three lines of six intermittently sequenced LEDs, and these lines are sequentially enabled via IC3 and individual gating transistors, with only one line enabled at any one time.

Note that the basic Figure 18 circuit can easily be expanded to control up to ten sequentially activated lines, which can each have up to ten LED driving outputs. The expanded circuit can thus be used as a chaser/sequencer with up to one hundred LED driving outputs.

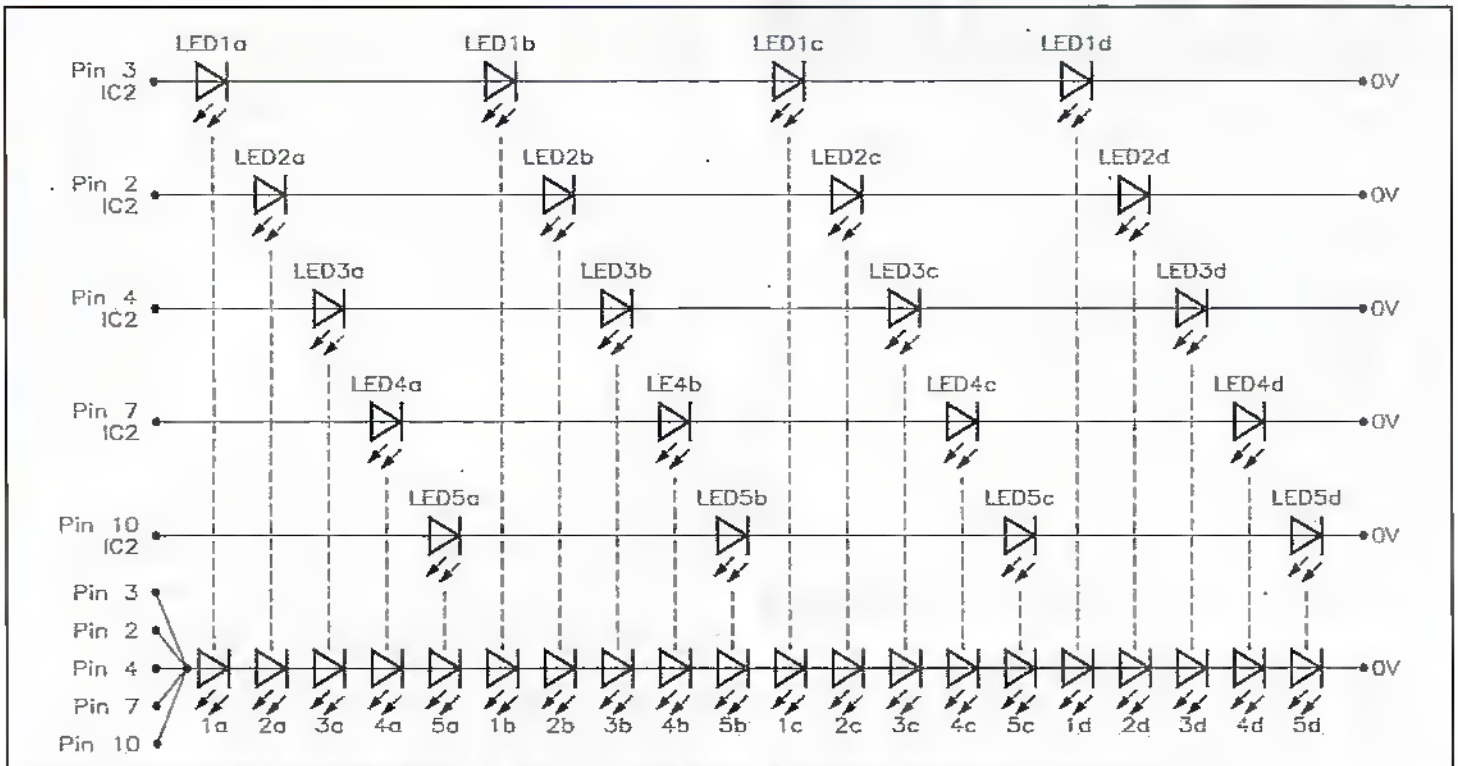


Figure 16. Basic method of constructing a 5-strand, 20-LED light rope display for use with the Figure 15 circuit.

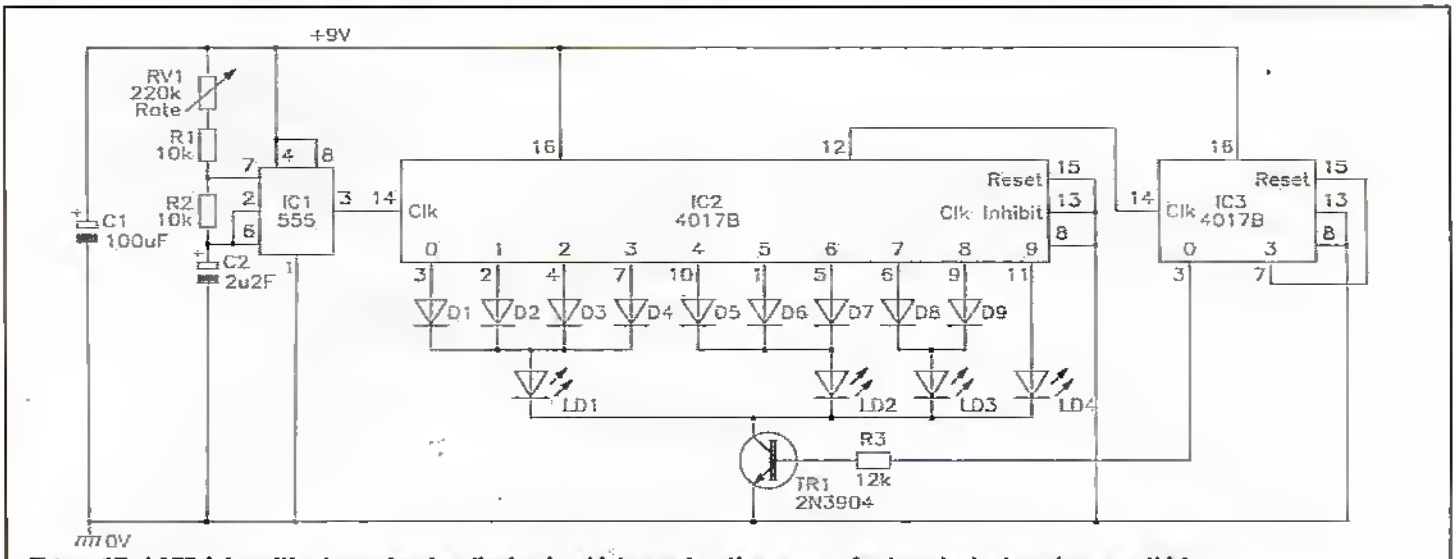


Figure 17. 4-LED intermittent accelerator display in which acceleration occurs for ten clock steps in every thirty.

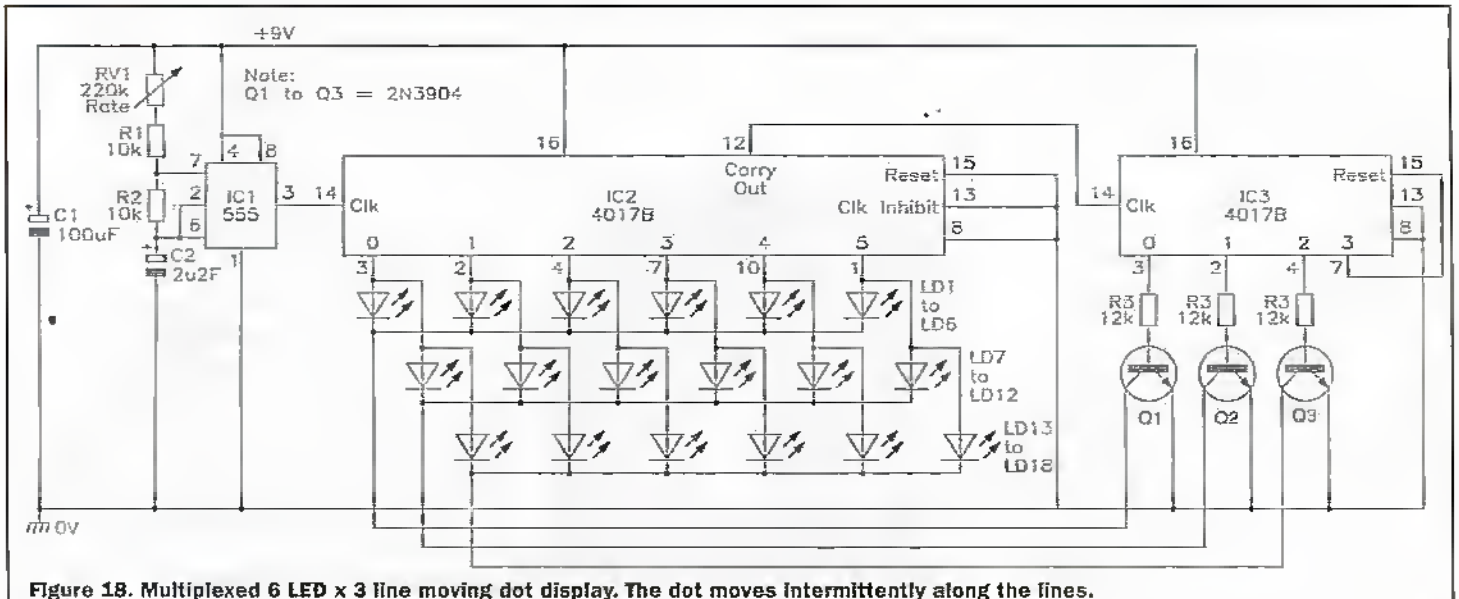


Figure 18. Multiplexed 6 LED x 3 line moving dot display. The dot moves intermittently along the lines.

@Internet

Another free email service

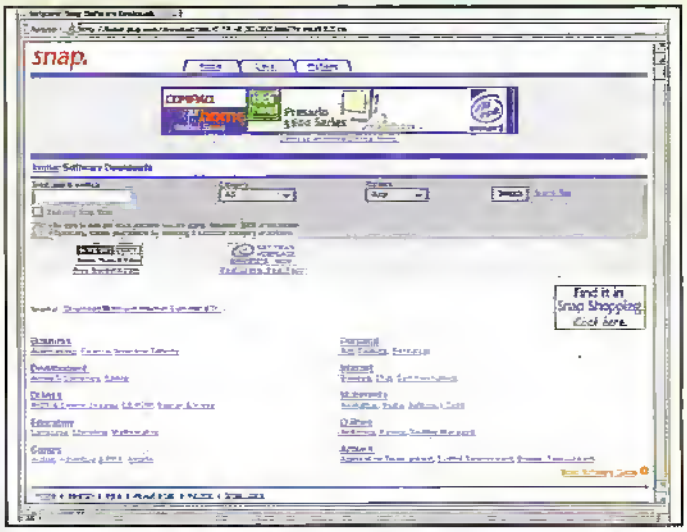
Another one of those free email services has just started up. You know the kind, offering free email to and from a fairly prestigious address. The only drawbacks are that you need an existing connection to the Internet with an Internet service provider, so are probably already paying for email facilities anyway, and when you're logged on to read and write email (hence using telephone time and, of course, money) you are presented with a certain amount of advertising.

Still, the idea of having an address as neat and cool as yourname@email.com may easily outweigh these disadvantages. You can choose to have any email to that address automatically rerouted to another address, probably your more usual (and non-prestigious) address – you know the one: 02345.456@a.boring.old.email.service.co.uk The free email service is based around the new Search Engine we showed you last month — Snap, and you can get to it either by accessing Snap at <http://www.snap.com> and following the email hyperlink, or by going straight to <http://www.email.com>, where you'll be asked to register. Make sure you use the registration page for non-US residents.

Using a free email service like this can give several advantages. First, as we've said, it can give you quite a prestigious and easily remembered email address. Addresses are allocated on a first-come-first-served basis, so sign-up quick if you want the best. Second, if you belong to an Internet service provider that allocates only a small number of email addresses per subscriber, it's a useful way of gaining extra email facilities. Third, though, is the ability to check your email through any Internet connection with a Web browser. Thus, you can travel anywhere in the world and access your email as long as you can log on to the Internet. Fourth, any other email accounts you already have can be routed to an email.com address (to do this, the email account must have POP3 access).

Free for All

While free email service is one thing, a completely free Internet service provider is another. Nevertheless, it looks like it could finally be feasible. Dixons has linked with Internet service provider Planet Online, and is using the existing Energis telecommunications backbone to provide a free service called Freeserve. Like free email services such as email.com's, free Internet service providers must rely more-or-less totally on advertising to function. A few have been around for a while, but none yet have been able to succeed to any great level. The problem is a sort of

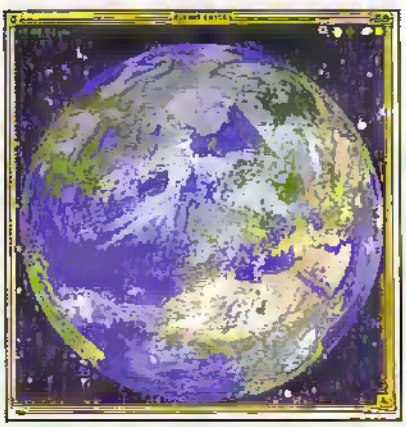


chicken and egg situation. Advertisers aren't likely to advertise unless they get their rewards – loads of consumer interest, and resultant sales of products. A prerequisite, therefore, is a large number of existing users to advertise to. Internet service providers, on the other hand, can't generally afford to provide free services to attract users to a new service, in the hope that advertisers will come along and provide funding quickly.

It will take someone the size of Dixons, say, before sufficient finance exists to fund such a free service in the interim between new users taking up the service and advertisers fully sponsoring it. Obviously, we'll keep readers updated on the new Freeserve service. In the meantime, while it's difficult to predict in such a volatile market, it seems that Dixons might just have got it right.

Planet Earth

One of the nice things about the Internet is that data on it is freely available to anyone. All you need is a means of accessing the format of the data, and representing it in a usable way. Take weather information, for example. There are several weather information databases on the Internet, but accessing this data isn't always the easiest thing in the world. A new utility to monitor weather information and display it in a simple format is now available – at least for Macintosh users. Planet Earth is a small shareware program from Lunar Software that downloads weather data and displays it as realtime three-dimensional model of the Earth with current cloud information. Night and day shadows are updated continuously and you can rotate the earth and zoom in and out to view any spot you wish. It's a freely downloadable and unrestricted piece of shareware — registering and paying the shareware fee of $15 merely removes the shareware reminder dialog box. Download it from the usual Mac shareware sources, or directly from <http://www.lunarsoft.com>.



Bill and Monica Jokes Wreak Cyber Havoc

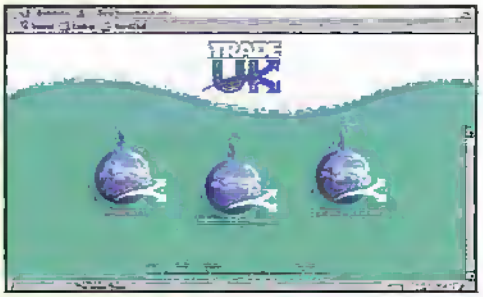
A plague of Bill Clinton and Monica Lewinsky jokes and attachments sent over the Internet has put corporate IT defences to the test, according to Content Technologies. The MIMEsweeper vendor has revealed customers have reported a massive surge in email quarantined by MIMEsweeper. This has been due to the explicit nature of Bill and Monica jokes and graphics being sent across the Internet, since the Starr report was published.

Further information about MIMEsweeper is available from <www.mimesweeper.com>.

Trevor Palmer, groupware infrastructure manager at Gartmore Investment Management told *Electronics and Beyond*, "The publication of Kenneth Starr's report on the Internet has led to an explosion of obscene Clinton/Lewinsky material. There were attempts to email obscene images to Gartmore but this was detected and blocked by MIMEsweeper."

"Employers simply cannot turn a blind eye as there are serious issues over productivity and misuse of company IT. Although most people see the funny side of these jokes, if one person is offended by an email or attachment, that is one person too many. Organisations need to draw the line between what is acceptable office banter and what is not appropriate," said Chris Heslop, marketing manager at Content Technologies.

DTI Delivers Exports Desktop Sales Assistance



The Department of Trade and Industry (DTI) has unveiled a new Internet service to enable British embassies abroad to give UK companies instant access to sales leads worldwide.

The new export sales leads service, part of TradeUK, was launched by Brian Wilson, the Minister for Trade, and Dan Wagner, CEO of the Dialog Corporation plc, the DTI's contractor for TradeUK. TradeUK includes a National Exporters Database (NED) which went live in July. It is the first official Government database, which can be used by anyone in the world to identify UK suppliers.

Launching the service, Brian Wilson said, "I see TradeUK as a very dynamic product and one which will provide a significant boost to UK companies looking to develop their business overseas. The whole TradeUK package harnesses the potential of the Internet to put buyers and sellers in touch - people overseas, including embassy staff, can use the NED to get details of UK suppliers for goods and services in their market.

Any UK firm on the NED can register to receive sales leads, free of charge. Embassy staff are a major source of sales leads for UK exporters. They can now e-mail details of leads, market pointers or public interest information onto the service. Each lead is automatically matched to the profiles of UK companies held on the system and e-mailed to appropriate businesses, enabling them to respond quickly to these export opportunities.

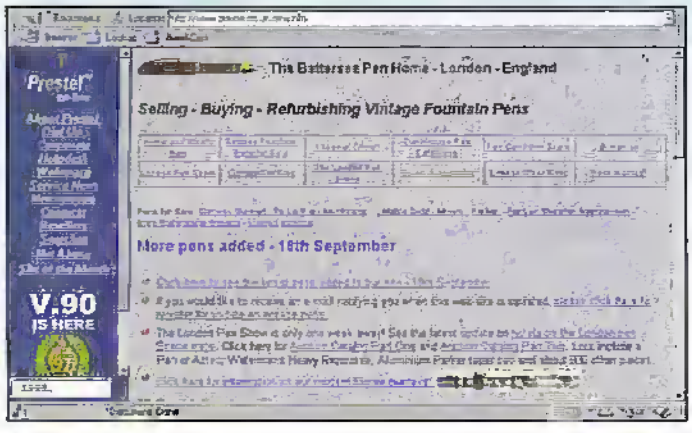
The new TradeUK Export Sales Leads Service went online at the beginning of September and can be accessed at <www.tradeuk.com>.

Small Companies Get Net-Smart

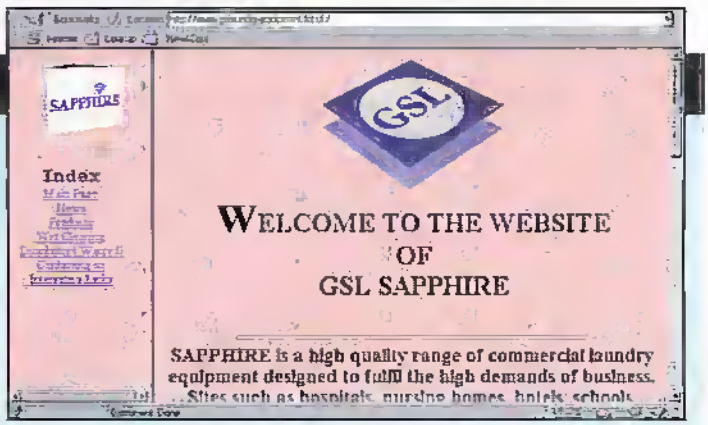
Niche companies are starting to realise the benefits of doing business over the Internet according to Prestel Online at <www.prestel.co.uk>. In the past year, Prestel has noted a 100% growth in businesses with less than 50 employees going online. This trend has arisen as companies strive to target new audiences and maintain a competitive edge.

These findings tally with a Durlacher report into 'Internet Usage Amongst SMEs', which found that this is the largest growth area for Internet penetration.

The Battersea Pen Home at <www.penhome.co.uk>, a specialist dealer in vintage pens, has been one of the first to realise the potential of the Web. It set up an account with Prestel On-line two years ago to reach previously inaccessible markets. It has generated 60% more sales, raising turnover to £250,000 a year.



Speaking to *Electronics and Beyond*, Simon Gray, director of the Battersea Pen Home said, "Our experience has shown that small, specialist companies are ideal for Web marketing. It is easy for potential customers world-wide to find us on search engines. The global nature of the business is evident - only 2% to 3% of our customers are based in the UK."

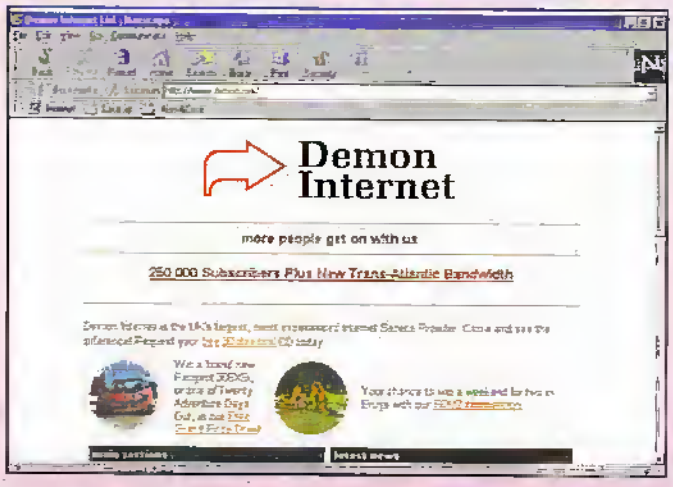


Sapphire Laundry Equipment at <www.gslaundry-equipment.ltd.uk> is another Prestel customer reaping the benefits of the Net. It imports products from the US, Italy and Germany, and resells in the UK and overseas. Sapphire set up its Web site a year and a half ago to cut costs and grow its customer base. It now has its full catalogue on the site, allowing instant access to information, and eliminating the expense of couriers.

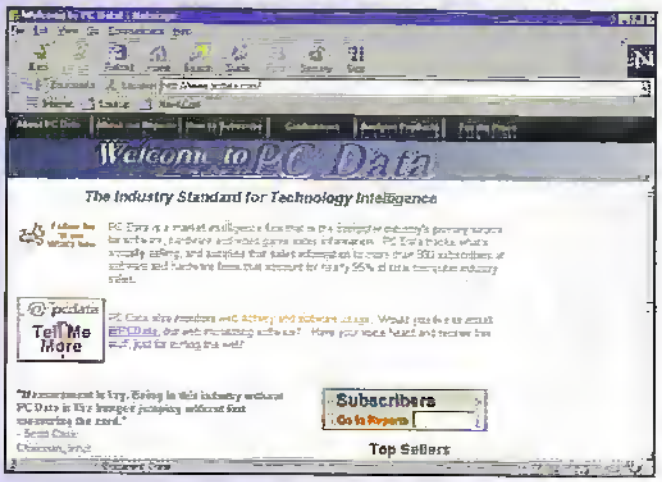
£20M Infrastructure Investment Supports Demon Subscriber Figures

UK Internet Service Provider (ISP), Demon Internet at <www.demon.net> has reached 250,000 subscriber accounts. This latest milestone coincides with a major investment in infrastructure worth over £20m - reassuring Demon Internet's customers that they remain part of the largest ISP in the UK as well as serviced by a provider that can offer the fastest, most reliable Internet service available on the market.

This latest investment will more than triple the bandwidth available to Demon Internet customers enabling faster and more effective connectivity to Web sites hosted in the US. Customers will therefore experience faster download and transfer times. This new transatlantic link follows a similar groundbreaking investment in infrastructure by the company in 1996.



@PCData Launches Monitoring Service



In response to the growing demand for accurate Web and PC software usage information, PC Data at <www.pcdata.com>, the industry standard for technology intelligence, has launched @PCData, the first market research tracking service to solicit open public participation for a reliable reflection of individual computer usage.

Information is gathered by the @PCData applet, a free download from the @PCData Web site at <www.atpcdata.com>. The information will be compiled into reports for software and Internet companies to track frequently used Web sites and programs, software error messages and typical hardware configurations.

Individuals receive incentives and a guarantee of confidentiality in exchange for participation. The first @PCData reports are expected to be available to subscribers in the fourth quarter of 1998.

INTECO Asks How Do People Choose ISPs?

INTECO at <www.inteco.com> recently conducted a series of in-depth focus groups with home and workplace Internet users to understand issues facing the home Internet access market, such as: why people subscribe; how they choose and why they change their ISP; what they expect from an ISP; and for what new services they are prepared to pay.

INTECO's research reveals that, for the majority, the original choice of ISP was not a well-researched decision. The top three factors affecting home Internet subscribers choice were: free trial discs, magazines, and word of mouth.

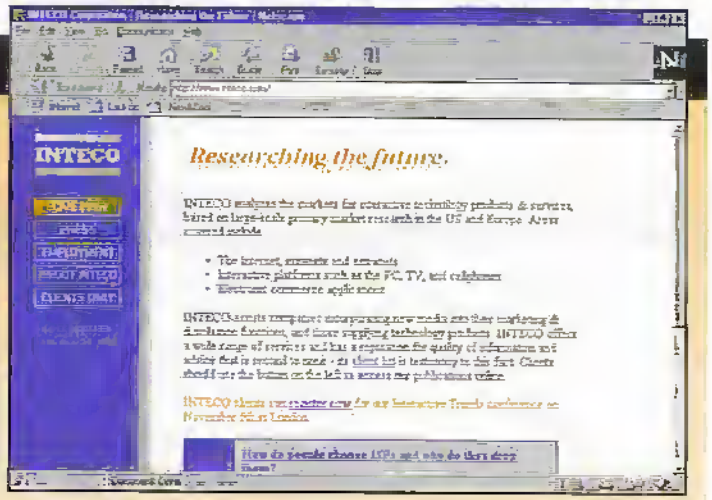
Considerable scepticism was expressed about free trial discs: many people had experienced, or heard about, difficulties in cancelling the subscription at the end of the free period; others were wary of giving their credit card details; and others thought that the value of the free trial was minimal in comparison with other factors – such as reliability of service and overall subscription price.

Some people felt that their Internet subscriptions were being used to finance extravagant marketing campaigns rather than quality of service. Despite this, free trials emerged as the single most important factor affecting choice of original ISP.

The general opinion of magazines was low; they were seen as biased and presenting a different recommendation every month. Nevertheless, they are a natural source of information and advice, and various people mentioned that they had looked at comparative tables of providers in Internet magazines – particularly when choosing their second ISP.

In contrast, those who used the Internet at work, but had not yet subscribed at home, expected their choice of ISP to be a carefully-researched decision. They were suspicious of free CDs, thinking their had to be a catch and thought that magazines and friends would be a more likely sources of information.

Well-known brand names were more important for the less technically-competent



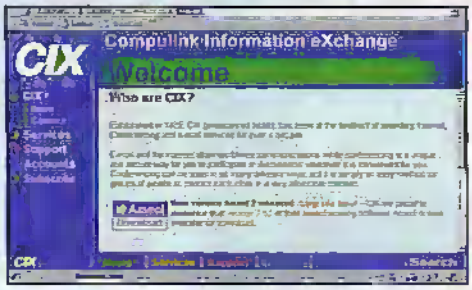
respondents, but this diminished as confidence and competence increased. If an unknown brand offered services to meet their particular needs, confident users said they would consider switching from a 'household name' ISP.

In two of its focus groups, INTECO deliberately targeted 'Internet churners' for interview; that is, those who had changed their home ISP. The majority had changed within six months of first getting access at home and more than half of those dropped their ISP before their free trial ended.

Some had changed because they didn't like the interface provided, some had switched to an ISP offering a flat-rate tariff once their usage had increased. By far the largest group changed because of negative experiences with their ISP: very slow access or engaged lines, poor help-lines, or other technical problems.

The idea of supermarkets, like Tesco, becoming ISPs met with positive responses. Though some said that an e-mail address ending in @tesco.net was a 'bit naff', respondents had an expectation that the service would be good value for money and reliable.

CIX Dramatically Improves Customer Service



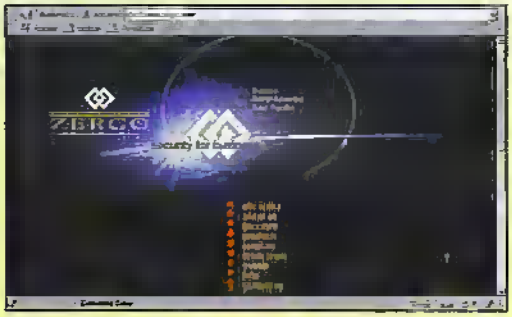
Compulink Information eXchange (CIX) at <www.cix.co.uk>, the UK's longest-established online conference provider, has made significant improvements to its range of online services. These improvements include a quadrupling of the bandwidth provided by CIX in a deal with network operator INS, the adoption of the V.90 standard from 3Com, new national access numbers and the announcement of new tariffs for CIX users.

The deal with INS will quadruple the bandwidth of CIX's backbone network, giving CIX subscribers a 2Mbps dedicated transatlantic link to New York, and dividing European traffic between the UK and the continent. With this increased capacity CIX will only be using around 30% of its available bandwidth. This will allow it to rapidly roll out new products and online services to a growing customer base.

Zergo Assure Tamper-Resistant Security for E-Business

Zergo Assure at <www.zergo.com> is a new cryptography product designed to help systems integrators and OEMs reduce development time when incorporating security into applications for e-business. Its introduction has attracted the interest of a number of organisations, especially in the financial sector, and has already resulted in a £60,000 contract to supply Zergo Assure to a major UK bank.

Designed to work in standard PCs, Zergo Assure comprises the DataSafe API (applications program interface) software and the Zergo HSP 4000 high-performance cryptographic co-processor card. Together, they provide a wide range of cryptographic functions, based on industry standards, facilitating the design of many different secure systems. These functions include encryption and digital signatures, the enabling techniques of secure e-business.



Site Survey

The month's destinations

The Snap Search Engine is definitely a cool product, and a light relief after some of the more ungainly Search Engines on the World Wide Web, but it's also a useful means of finding downloadable software. You can locate software with a keyword search, or you can burrow down through its layers to find what you're after. It's definitely worth going to: <http://www.snap.com> and clicking the Software Downloads link.

UK specific information isn't always that easy to find, but Britannia, at <http://britannia.com> aims to make it a little easy by compiling information relating to Great Britain on one Website. With a keyword search facility, as well as a fairly decent departmentalised selection facility, Britannia is a nice change to the usual UK-add-on-extra-to-a-US-Website thing we're used to.

The Department of Education and Employment has been funding a £5,000,000 pilot scheme to find out how teachers' use of IT can benefit when they have a multimedia portable computer. The project has recently been completed, with some 1150 teachers being given a portable computer for their own use, and the results are available to see at the managing agency's Website, at <http://www.becta.org.uk/projects/emportables2/evaluation/>

Finally, we couldn't resist this little gem. The Web page has probably been changed by the time you read this, but the screengrab at least gives us absolute proof that Microsoft designs in incompatibility to its products. The Microsoft Windows NT Server 5.0 beta page at <http://www.microsoft.com/WindowsNT5/Server/default.asp> shows that even Microsoft's own computer system has the Millennium Bug. Check the date at the bottom of the window, and you'll see that the Windows NT Workstation 5.0 release date is December 30, 1899. Yes, that's right, 1899, not 1999! That's quite a fall behind schedule, Bill! Maybe you should use a Macintosh – they've been millennium compliant for 14 years already!

in the pipeline

ELECTRONICS and Beyond

Don't miss another great assortment of entertaining and easy-to-make projects and essential electronics information aimed at the novice constructor.

Issue 133 on sale Friday 4th December

PROJECTS

IBUS Serial Port Adaptor
LED Message Display
Digital Pots
Railway Points Controller
Psycho-Kinetic Bio-Feedback Trainer & Movement Detector

FEATURES

Solar Cells
Computer Managed Crop Sprayers
Science & Language
All about LEDs
Electronics In Cars

PLUS Free LED Xmas Tree PCB Project

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:

Simple to build and understand and suitable for absolute beginners. Basic of tools required (e.g., soldering, side cutters, pliers, wire strippers, and screwdriver). Test gear not required and no set-up needed.

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.

Average. Some skill in construction or more extensive setting-up required.

Advanced. Fairly high level of skill in construction, specialised test gear or setting-up may be required.

Complex. High level of skill in construction, specialised test gear may be required. Construction may involve complex wiring. Recommended for skilled constructors only.

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Kits, components and products stocked at Maplin can be easily obtained in a number of ways: ❶ Visit your local Maplin store, where you will find a wide range of electronic products. If you do not know where your nearest store is, telephone (01702) 554002. To avoid disappointment when intending to purchase products from a Maplin store, customers are advised to check availability before travelling any distance; ❷ Write your order on the form printed in this issue and send it to Maplin Electronics PLC, P.O. Box 777, Rayleigh, Essex, SS6 8LU. Payment can be made using Cheque, Postal Order, or Credit Card; ❸ Telephone your order, call the Maplin Electronics Credit Card Hotline on (01702) 554000; ❹ If you have a personal computer equipped with a MODEM, dial up Maplin's 24-hour on-line database and ordering service, CashTel. CashTel supports 300-, 1200- and 2400-baud MODEMs using CCITT tones. The format is 8 data bits, 1 stop bit, no parity, full duplex with Xon/Xoff handshaking. All existing customers with a Maplin customer number can access the system by simply calling (01702) 552941. If you do not have a customer number, telephone (01702) 554002 and we will happily issue you with one. Payment can be made by credit card; ❺ If you have a tone dial (DTMF) telephone or a pocket tone dialler, you can access our computer system and place your orders directly onto the Maplin computer 24 hours a day by simply dialling (01702) 555751. You will need a Maplin customer number and a personal identification number (PIN) to access the system; ❻ Overseas customers can place orders through Maplin Export, P.O. Box 777, Rayleigh, Essex SS6 8LU, England; telephone +44 1702 554000 Ext. 376, 327 or 351; Fax +44 1702 554001. Full details of all the methods of ordering from Maplin can be found in the current Maplin Catalogue.

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If you get completely stuck with your project and you are unable to get it working, take advantage of the Maplin 'Get You Working' Service. This service is available for all Maplin kits and projects with the exception of: "Data Files"; projects not built on Maplin ready etched PCBs; projects built with the majority of components not supplied by Maplin; Circuit Maker ideas; Mini-Circuits or other similar "building block" and "application" circuits. To take advantage of the service return the complete kit to: Returns Department, Maplin Electronics PLC., P.O. Box 777, Rayleigh, Essex, SS6 8LU. Enclose a cheque or Postal Order for the servicing cost (minimum £17) as indicated in the current Maplin Catalogue. If the fault is due to any error on our part, the project will be repaired free of charge. If the fault is due to any error on your part, you will be charged the standard servicing cost, plus parts.

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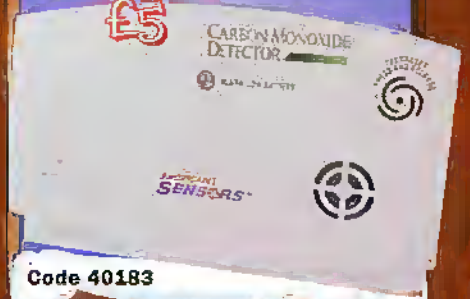

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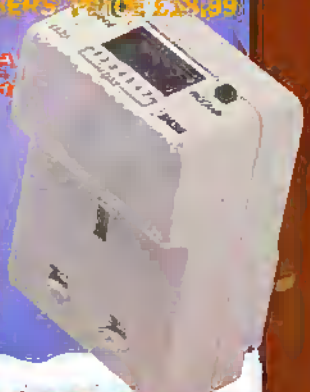

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