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ELECTRONICS

and Beyond

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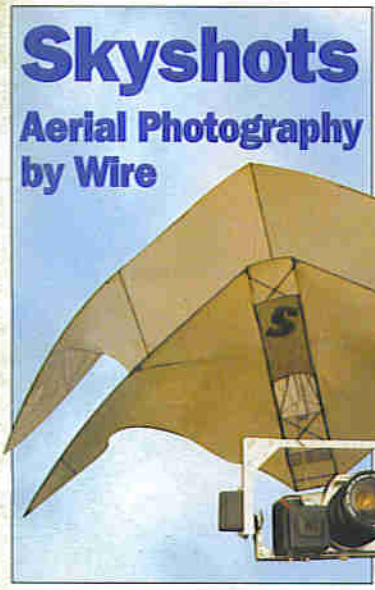

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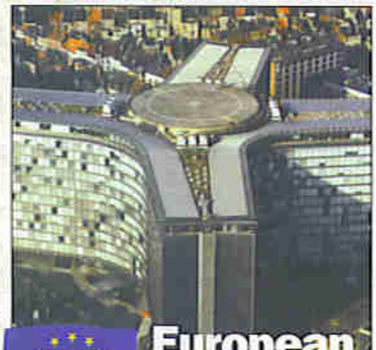
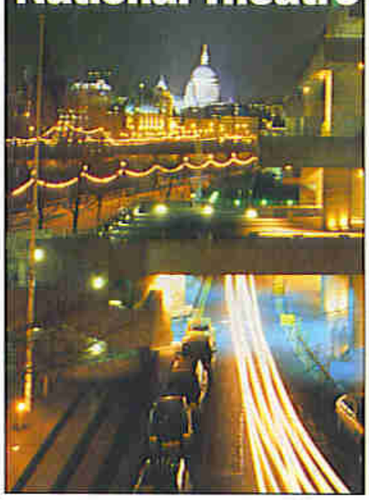


European Research

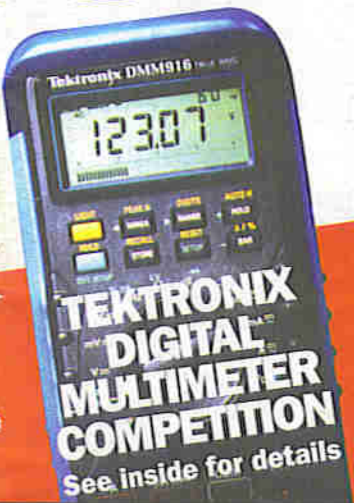
Technology on the South Bank

The Lights go up at the Royal National Theatre



Our Digital Economy

Part 1 Television Futures



TEKTRONIX DIGITAL MULTIMETER COMPETITION

See inside for details

PROJECTS FOR YOU TO MAKE

- Switch Mode Audio AGC
- Simple IR Remote Control Transmitter & Receiver
- Simple Iambic Keyer
- Storm Charge Detector

Britain's most widely circulated magazine for electronics!

THE MAPLIN MAGAZINE

ELECTRONICS and Beyond

September 1997 Vol. 16 No. 117

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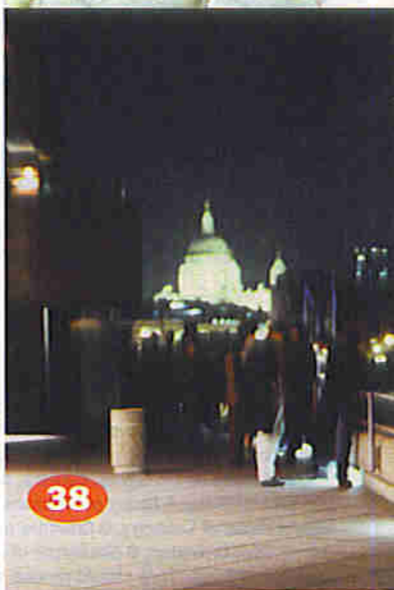
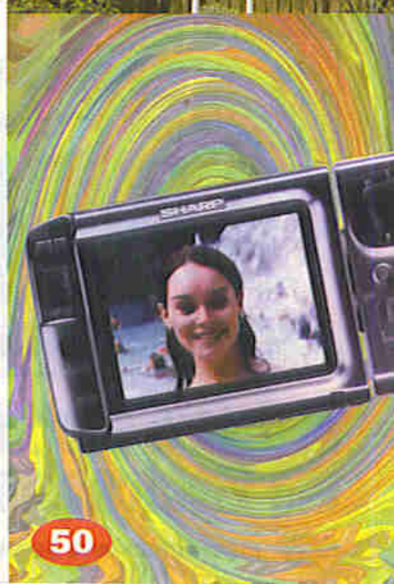




ELECTRONICS and Beyond

We feature an interesting storey this month about a photographer who wanted to solve a little problem of how to get a camera high up into the air at low cost. It is an example of someone who has thought about his own commercial requirements for his business. Realising there was no overall economic practical unit to carry out the job of taking remote aerial photos, he has thought out the system required and put it together with little knowledge of electronics. Innovative, clever and individual ideas displayed on paper provide an interesting read. It also stimulates other good ideas. Coincidentally, most of the modules required for his kite flying project were bought from Maplin Electronics.

Reader Survey

It's nice to see your reader survey comments are still flowing in. Please do fill in the reply paid coupon that appeared in last months magazine. It's not too late and it's not too late to win that Tektronix DMM as well. Speaking of which, you have another chance to win a Tektronix DMM this month. Turn to page 56 for more details. Good Luck!

Competition winners

March of the Machines, the book by Kevin Warwick is on its way to the following: J Hobson of Huddersfield, A Jones of Swansea, L Stevenson of Peterborough, F Neary from Warrington, T West from Coventry, P Stevenson of Belfast, V Heeley from Worcester, W Tortike from Wolverhampton, S Walton of Selby, C Davison of Felixstowe.

The winners of the Lights, Camera, Action competition are: S Walton of Selby, A Bailey of Waltham Abbey, R Andrews of Chingford, Miss H Desai of Coventry, G Cranford of Hutton Cranswick, Mrs W Packer from Orpington, G Mackenzie of Horley, S Ion of Lancaster and C Ashmore of Louth. They should receive tickets for the National museum of photography, film and television.

Paul Freeman-Sear, Publishing Manager

Britain's Best Magazine for the Electronics Enthusiast

NEWS REPORT

Intel Supercomputer Shatters Computing Records

Intel's parallel supercomputer built by Intel for the Sandia National Labs in New Mexico, continues to break computing records. The system on site at Sandia performed at 1·34 trillion operations per second, a 25% performance increase over previous records.

The Sandia supercomputer is well over 10,000 times more powerful than that Pentium processor-based system that's sitting on your desktop. With 86 cabinets, it's as big as a good-sized home. Its peak power consumption is 850kW, compared with a typical desktop system consuming 200W.

For further details, check: `www.intel.com`.
Contact: Intel, Tel: (01734) 403000.

NEWS BYTES

Dataquest Reports 300% Growth in Microprocessor Market

Global sales of microprocessors and microcontrollers grew by over 300% in 1996 and are forecast to grow by almost 50% in 1997.

Beyond this market, analyst Dataquest reckons sales into next-generation consumer electronics will mean the market grows to 150 million units by 2001.

Next-generation consumer products include digital cable set-top boxes, direct broadcast satellite set-top boxes, digital still cameras, digital camcorders, digital TV receivers, video CD players, DVD video players, and 32- and 64-bit video game consoles.

Over 56% of the 16-bit and above microprocessors shipped in the next-generation consumer electronics segment went into 32- and 64-bit video game controllers in 1996.

For further details, check: **www.dataquest.com.**
Contact: Dataquest, Tel: (0800) 716089.

FT Teams with Geoworks to Deliver News to Smart Phones

Geoworks has teamed with Financial Times Information to deliver targeted business, economic and political news and information to cellular operators for delivery to smart phone customers.

Under the partnership, Financial Times Information will utilise Geoworks' software technology to provide headlines and news story summaries about specific markets or regions to smart phone users.

Smart phones, such as the Nokia 9000 Communicator, integrate voice with additional communications features such as e-mail, paging, facsimile, and Internet access to online information and services.

For further details, check: www.ft.com.
Contact: Financial Times Information, Tel: (0171) 825 7765.

Toshiba Launches European PC

Toshiba Europe is set to enter the European desktop PC market with the introduction of its Equium range of business desktop PCs. At first, sales will be limited to the UK, France and Germany with plans to expand sales to other European countries later in the year.

For further details, check: **www.toshiba-teg.com.**
Contact: Toshiba Europe, Tel: +49 2131 158265.

Fog Generator Makes Everything Clear in Cleanrooms

Fog generators which produce a heavy, ultra-pure mist so that the movement of air in cleanrooms and fume cupboards can be monitored are now available from Alliance Sales. The Model 2000 Cleanroom Fogger is particularly useful for manufacturers of VLSI logic and memory chips, magnetic and optical disk drives and pharmaceutical products, where it can help to map airflow patterns around equipment, tools and operators in the cleanroom.

The fogger works by vaporising high-purity deionised water in a stainless steel boiler to form steam. This is then injected into a stainless steel Dewar containing liquid nitrogen. The hot steam causes the liquid nitrogen to vaporise, which then quenches the steam to form a room-temperature fog of deionised water droplets.

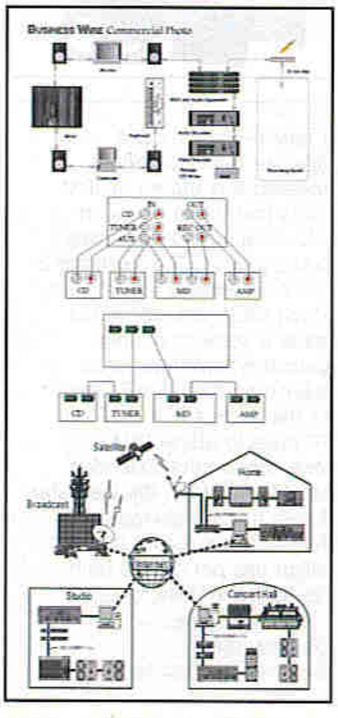
When injected into a cleanroom, this extremely dense fog will make the airflow visible and easy to record on video tape. A single nozzle fog injector can be used to create a dense stream of fog or a seven-nozzle rake can be used to generate a fog curtain for studying air flow in a larger area.

For further details, check: **www.european-business-team.com.**
Contact: Alliance Sales, Tel: (01794) 518 183.

Musical LAN

Yamaha's mLAN, a connection specification for electronic musical instruments, will simplify connections for linking audio and MIDI equipment for studio and concert performances. mLAN will conform to IEEE 1394, an internationally agreed standard for electronic equipment such as video cameras, audio equipment, and electronic musical instruments.

For further details, check: **www.yamaha.co.uk.**
Contact: Yamaha, Tel: (01908) 366700.



Leicester Radio Society (LRS) Associate Membership Discount Card

LRS is one of the oldest radio societies in the UK (formed in 1913), and now requires a move to newer premises with better facilities for training and operating – ready for the next millennium. LRS have negotiated a series of discounts with hotel groups and car rental companies within the UK. Anyone who needs to hire a car or book hotel rooms within the UK could benefit from the card and make savings – up to 35% for car hire. Companies include Avis Rent A Car Ltd., Hertz (UK) Ltd., EuroDollar Rent A Car, Stakis Hotels, Wayfarer Inns and Jarvis Hotels. It is not necessary to be a licensed Radio Amateur in order to obtain a card – it is available to anyone, anwhere around the world, who may visit the UK. Some car rental companies are also offering discounted rates within the USA and Europe. Every card sold increses the funds available for LRS's new premises, equipment and training. As the cards are taken up, LRS expect that other companies will offer discounts, broadening the range and type of savings that can be made – these will be updated onto LRS's new web site at **http://www.foobar.co.uk/dialin/lrs.**

The discount card has been priced at £10 (Sterling) and can be obtained using a Mastercard, Eurocard or Visa credit card. LRS intend that this modest cost is recovered very rapidly as bookings, and consequent savings, are made. An order form is on the web site; subscribers should allow 28 days for delivery. LRS is not a commercial company, but a reputable Amateur Radio Society seeking only to further Amateur Radio in general, and all monies raised will be used to this end.

Contact: John Alexander G7GCK, Leicester Radio Society, Gilroes Cottages, Off Groby Road, Leicester LE3 9QJ. E-mail: **lrs@jalex.easynet.co.uk.**

Monitor Suppliers Rally for Screen Size Standards

Members of the Computing Suppliers Federation (CSF) this month announced their adoption of new guidelines for describing monitor size. The new standards are based on the recommendations of the Consumer Electronics Manufacturers Association (CEMA) in the US.

The new guidelines are designed to help reduce end-user confusion over the difference between Visible Image Size (VIS), the actual amount of screen used, and the nominal external diagonal measurement, which generally includes about an inch of black border between the image and the case.

For further details, check: **www.csf.org.uk.**
Contact: Monitors Matter, Tel: (01905) 613236.

The Information ECONOMY

PART 1

Television Futures

by Stephen Waddington

In the past, text, sounds, still images and moving pictures have been disseminated independently of each other over separate media. But with the advent of broadband distribution, digital storage and digital compression, these individual channels are unnecessary and will no longer be sustainable.

We are already seeing the convergence of many media types. The majority of UK newspapers and weekly magazines, in addition to the traditional paper version, now publish on the Web, photographers edit and distribute pictures electronically, while television has become interactive with the advent of back channel broadcasting and Web television.

No longer do the separate media involve physical carriers with widely differing characteristics: all may be delivered over copper wire or fibre-optic lines. Consumers will no longer need to buy a video of a film; a soundtrack CD and the accompanying novel as all may be accessed together on a CD. Telephone, cable television, satellite and computer networks are becoming increasingly indistinguishable.

Over the next few months, Electronics and Beyond will examine the convergence of the media, telecommunications and information technology industries and examine how this is stimulating a reappraisal of the ways in which information and entertainment content is developed, distributed, manipulated and used.

We kick off this month with a look at the future of television. Articles over the coming months will examine the future of the print media, audio, media storage and transmission, the Internet and coping with information overload.

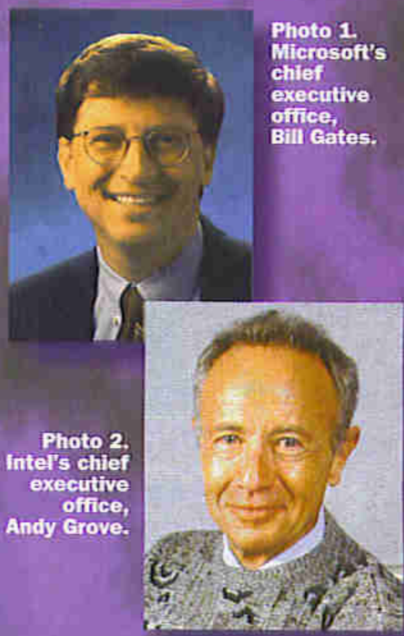


Photo 1. Microsoft's chief executive office, Bill Gates.

Photo 2. Intel's chief executive office, Andy Grove.

The development of a high definition television (HDTV) standard in the US, Europe, and Japan was thrown into complete confusion in April when Microsoft, Intel and Compaq together announced a new standard for digital broadcast. In the light of this, what is the future of television?

Bill Gates, shown in Photo 1, chief executive officer of Microsoft (`www.microsoft.com`), is a man with tremendous nerve. In April this year, Andy Grove, shown in Photo 2, chief officer executive of Intel (`www.intel.com`), Eckhard Pfeiffer, chief executive officer of Compaq (`www.compaq.com`) and Gates hijacked the National Association of Broadcasters (NAB) annual convention in Cannes. In the US, NAB is the leading event for broadcasters and television manufacturers attended by over 100,000 industry executives – see Photo 3.

Having been invited as guests of honour at NAB this year, Gates and his digital mates from Intel and Compaq upstaged their hosts

Photo 3. The National Association of Broadcasters (NAB) Web site.

Photo 4. Microsoft, Intel and Compaq Digital Television alliance Web site. (dtvsite.bmp)

by announcing their opposition to the digital broadcasting standards agreed by the US Advanced Television Systems Committee (ATSC). And if that were not sufficient to ensure the trio aren't invited back next year, they went on to announce a rival set of standards that would be implemented on personal computers (PCs) regardless of opposition for the rest of the industry.

For more than a decade, the television establishment has been pinning its hopes for the future on high definition television (HDTV). The basic concept behind high definition television is not to increase the picture definition per unit area as is commonly believed, but rather, to increase the percentage of the visual field contained by the image. However, with a proposed aspect ratio of 16:9 and picture size of 1,920 × 1,080 pixels, consumers would have to invest up to £3,000 – at today's cathode ray tube prices – in a large screen television to benefit from the quality improvements.

Digital Trio

At NAB, the Microsoft, Intel and Compaq gang described a broad vision of digital television in which high-resolution video and high-fidelity audio is married to the interactive content of the PC and the Internet.

Under the guise of the Digital Television (DTV) Team as shown in Photo 4, the three companies outlined technical recommendations, based initially – it has to be said – on a subset of the ATSC specifications, that it claimed would accelerate the transition to digital television in the US. They also announced plans to equip millions of future PCs to receive transmitted digital video and data as soon as October 1998.

There are two key elements to the new proposal for digital television. The first is a reduced screen size of 720 × 1,280 pixels, but maintaining the proposed aspect ratio of 16:9. The second element is the use of progressive scan screen technology in place of interlaced pictures, which cause conventional television screens to flicker. Microsoft reckons the reduced screen resolution will mean that its proposals are substantially less expensive than the full ATSC HDTV implementation, adding less than £100 to the price of a PC.

But Gates faces widespread opposition for the plans that he and his digital team are striving to bulldoze over existing standards. "With the HDTV ATSC standard set, and the needed digital channels allocated by the US Federal Communications Commission (FCC), the digital television movement has entered its most perilous era-commercialisation while merging with the computer. This likely merging has raised the most divisive questions in DTV since Europe went off with their own HDTV production standard. A monumental war is being waged between the massive computer and television industries using, once again, technical differences to divide and conquer", said Dale Cripps, Publisher of the HDTV Industry newsletter.

"How could this happen at the end of a nine year open FCC sponsored contest? At the last minute, the computer industry has tried desperately to gain complete control of the standard setting process. To gain all advantage, they stepped forward to propose new technical standards – those more 'friendly' to them – and then pledged to move ahead with or without broadcasters' participation", added Cripps.

Free Market to Decide

Let's go back in time. In December 1996, following discussions between the television and computer industries, the FCC issued a standard that allows for transmission of digital broadcast signals. Digital formatting provides cinema-quality pictures and CD-quality sound – a much higher-quality picture than the current analogue format. However, the FCC agreed not to dictate which video formats were to be used in transmissions for digital television, saying that the free market should make that determination. Clearly, the digital television team does not agree, which is why it has put forward its own proposal.

The three companies believe they can accelerate the time when digital television products are as commonplace as today's analogue television sets. "PCs and converged digital devices represent a key element of the television industry's future

Photo 5. The Microsoft Campus in Redmond, US could become the global centre for broadcasting standards.

revenue growth", Gates said. "The computer industry will deliver millions of 'digital sets' to the marketplace – as many as 100 million by 2005. In this time frame, hundreds of millions of sets and digital devices will be capable of receiving digital television signals – a ready-made audience. We believe the television industry will want to make sure it is reaching these viewers."

Here, perhaps, lies the key motivation behind the trio's desire to break into the television market. Cynics claim that Intel, Microsoft and Compaq are not rooted in a desire to promote technical excellence but are striving to continue their growth. The advent of digital television will lead to the replacement of millions of television sets in the US and Europe. Inevitably, they are keen to seize on this market opportunity and line their own pockets. The PC TV is a Trojan horse that could see Microsoft's dominance extended further into the home – see Photo 5.

PC TV Historically a Flop

When the concept of a PC TV was first mooted 18 months ago, analysts were quick to defend the position of traditional television. In a report entitled 'TV And PC: Never The Twain Shall Meet', European analyst, INTECO, poured cold water on the idea that the television set and the PC might one day come together in a single home consumer product for all the family.

"The television industry is pre-occupied with a single issue, multi-channel television and the resultant erosion of advertising revenue, while the PC industry is focused on building ever more functionality into its products. Meanwhile, the consumer sees them as fundamentally different devices", says Miles Thistlethwaite, senior vice president of INTECO.

Thistlethwaite is spot on. The television is essentially a passive device, serving a social need and, in 85% of households, is to be found in a family room. By contrast, the PC is a highly interactive device and, in 74% of households, is located in a study, office, or bedroom for solitary use.

The Electronic Hearth

And there are fundamental ergonomic barriers that militate against them ever coming together. The television viewer sits at a distance of more than three metres from the set. The PC user has to read small fonts and interact with the machine close-up, or less than a metre away. And while the television has remained essentially unchanged for decades at a price that is relatively low and reasonably constant, the PC is a highly dynamic product, undergoing rapid change, all in a direction that is adding to specification and increased capability.

"The PC is a relatively expensive, business-driven product, with an average price of around £1,000", said Thistlethwaite. "The evidence says that it has reached the point of minimum diversity and that developments such as CD ROM and memory-hungry software, such as Windows 95, are counteracting the downward pressure on prices that has been a characteristic of the past few years." There would be a continuing gentle decline in PC prices, he said, but in consumer terms, the PC would remain a very expensive product.

Marketing Hype or Television Future?

We could dismiss Microsoft's claims as little more than marketing hype, were it not for the fact that the company acquired WebTV Networks, as shown in Photo 6 (`www.webtv.com`) in the US on the same day as its digital television announcement. The 20-month old company went public last year, providing Internet services through a regular television via a set-top box. The £300 box made under license by Philips and Sony plugs into the phone line and allows users to browse the Web and check e-mail using a remote control.

The emergence of Web television has got some broadcasters worried. While the PC may not make it into the living room, a video-recorder sized-box that brings a interactive edge to television has the potential

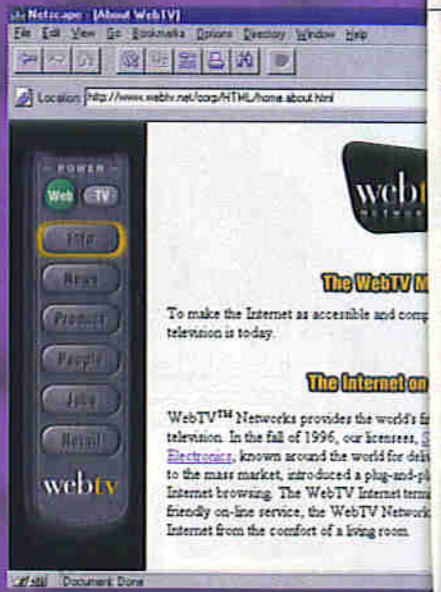


Photo 6. Microsoft has demonstrated its commitment to television with the acquisition of set-top box manufacturer, WebTV.

Photo 7. WebTV enables consumers to check out a Web sites such as the Spice Girls Web site and other Internet services whilst watching television.

Photo 8. VivoActive is a video over Internet plug-in.

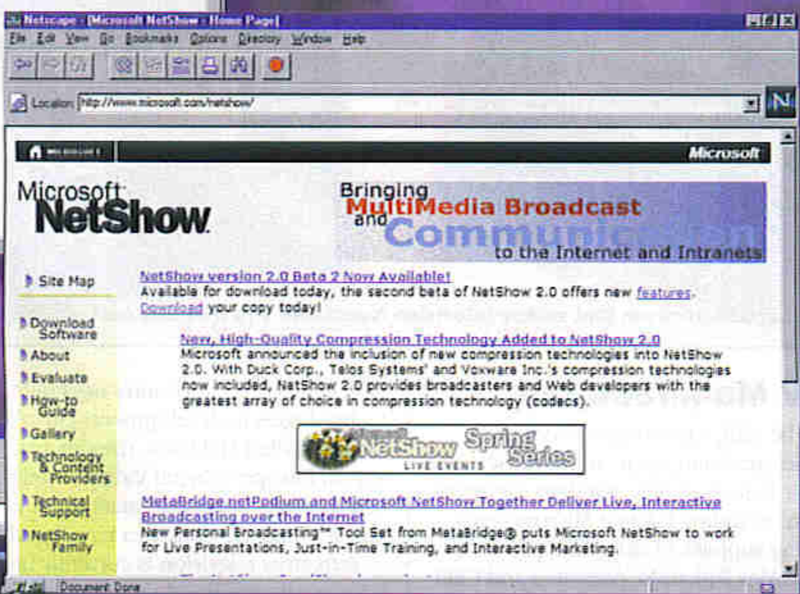


Photo 9. Netshow is Microsoft's video over the Internet browser plug-in.

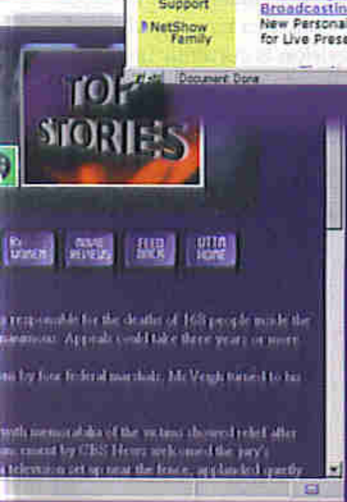


Photo 10. The CBS 'Up to the Minute Web site' includes VDOLive video clips.

to knock conventional television off its throne. They needn't be too concerned. WebTV supplements traditional television, but could never be a replacement.

Interactive discussion, e-mail and the ability to view a Web site are neat. The concept of a 'picture in a picture', means that you could check out the Spice Girls Web site, as shown in Photo 7, while you're watching *Top of the Pops*. But video is a different proposition. To understand why, you need to go and check it out.

Video Over the Internet

There are currently a handful of Internet video formats. VDOLive from VDO **(www.vdo.net)**, VivoActive from Vivo shown in Photo 8 **(www.vivo.com)** and NetShow 2.0 from Microsoft, shown in Photo 9, **(www.microsoft.com/netshow)** are the key contenders. Assuming you've downloaded the free video plug-in from VDO, try the CBS 'Up to the Minute' news Web site at **www.uttm.com/vdo/welcome.html**, shown in Photo 10. A small video window appears in the top right hand corner, showing a news clip. Its dull audio and jerky moving images are far from impressive.

It is not VDO's software that's at fault, it is the bandwidth of the Internet. Even using a high speed 33·6k-bps modem, which due to the bandwidth constraints of the Internet, will probably be running at 60% of optimum speed, it is not possible to deliver streaming video. It can barely handle postage stamp images, let alone full screen. And while video over the Internet might have 'cool gee-whiz' appeal, not many consumers would put up with it. Coronation Street would never be the same again.

Computer Vendors Digital Television Specification

Maybe this is the reason that Microsoft, Intel and Compaq have stepped centre stage into the HDTV debate. Their proposal recommends a starting point for digital television based on a practical subset of the ATSC-specified video formats. The companies will work with the television industry to support higher resolutions, including 1,080 pixel progressive scanning and above, all without causing any initial receiver to become obsolete.

"This proposal represents a practical way for the television industry to initiate digital television service while providing a growth path to higher resolutions in the future, including 1,080 pixel progressive scanning. In this way, the early investment of broadcasters and consumers is protected", Gates said. "The proposal is well-matched to the cost-effective availability of equipment such as encoders, receivers and displays."

Specifically, digital broadcasts would be initiated using a high-definition 720 × 1,280 pixel progressive scan format for film-based

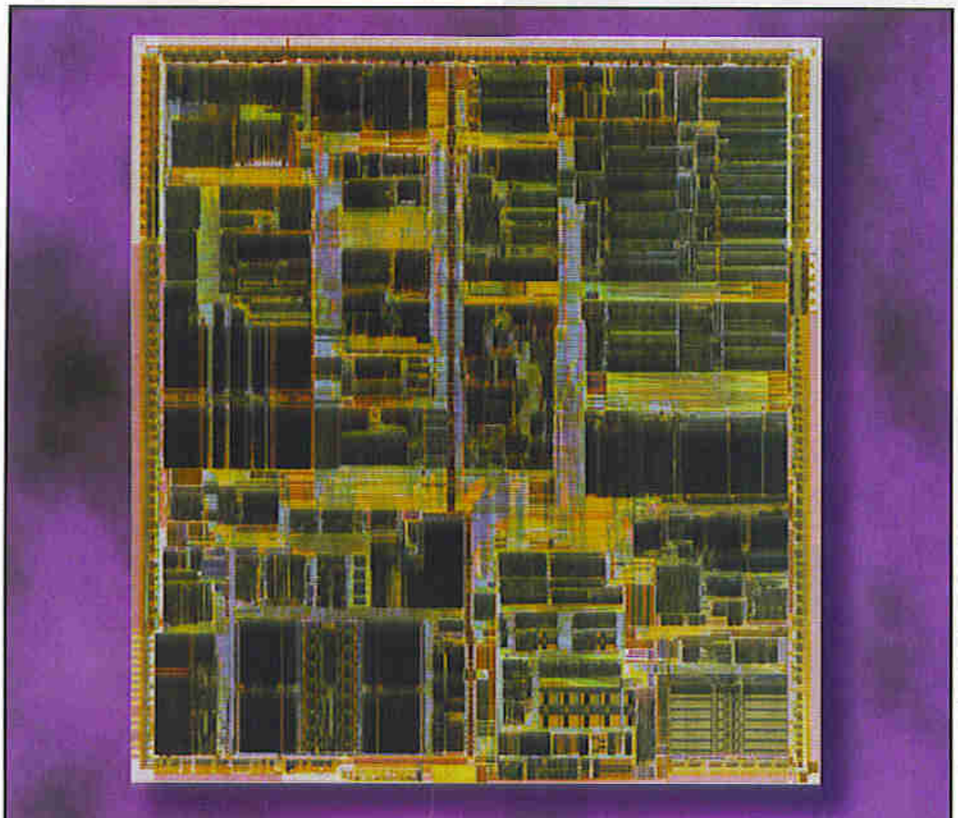


Photo 11. HDTV may eventually be built directly onto future generations of Intel chips such as the P6.

of C-Cube, said, "This initiative marks an extraordinary step in accelerating DTV across multiple platforms and furthering the adoption of digital video world-wide. Anticipating demand for DTV systems, our DiviCom subsidiary is preparing to offer broadcasters the capability to make the transition."

The current plan is that Intel will produce the hardware sub-system, Compaq will make the commercial products and Microsoft will provide the software support for the specifications in future versions of Windows 95, Windows NT and Windows CE. Microsoft is also working on NetShow – mentioned earlier – a server for delivering video over Internet protocol-based connections. Eventually, it is believed that television functionality will be built onto Intel chips such as the P6 or MMX, shown in Photos 11 and 12.

Television Industry

Meanwhile, where does Microsoft's plans leave the rest of the television industry? And what is the future of HDTV? In a mess, is the short answer – see 'Television Futures: Quote – Unquote'.

A number of different regions have developed HDTV formats. Japan, Europe, and the US are the leaders in the HDTV

materials, as well as standard definition formats in both interlaced and progressive modes. With advances in processor power, compression technology and display technology, it would be practical to enhance this initial 'base layer' to offer 1,080 progressive resolution and even higher resolution over time.

The DTV Team claim that television receivers would be substantially less expensive using this approach compared to sets using the full ATSC specification. "Because this approach aligns closely with the current generation of video decompression hardware and display technology, digital television sets could be offered at price points close to today's analogue sets, compared to the £1,800 to £3,000 HDTV sets that the traditional television manufacturers are planning", said Intel's Grove. "We think this makes more sense for the millions of consumers. The incremental cost of adding DTV reception to PCs will likely be around £100."

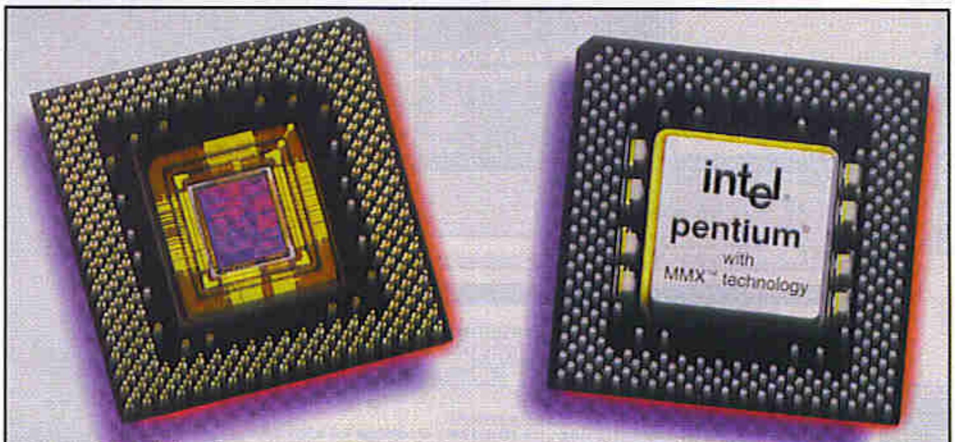


Photo 12. Intel reckons that adding television functionality to a PC will cost around £100.

PC TV Manufacturing

It has to be said, a growing number of companies are lining up to support the computer industry's new standard for digital television, including C-Cube Microsystems, the leading supplier of video compression solutions. Alex Balkanski, president and CEO

systems race. Each country uses different technologies in development; Japan's HDTV system, called Hi Vision, uses an analogue signal, Europe's Digital Video Broadcasting (DVB) project uses part analogue and digital signal, while the US uses a true digital signal.

Terrestrial television is currently broadcast on an analogue signal that transfers only

Name	Region	Screen	Total Lines	Active Res.	Vert. Res.	Horiz. Res.	Aspect Ratio	Vert. Field (°)	Horiz. Field (°)	Freq.
HDTV	US	Progressive	1,050	960	675	600	16:9	23	41	8
HDTV	Japan	Interlaced	1,125	1,080	540	600	16:9	17	20	20
NTSC	US	Interlaced	525	484	242	330	4:3	8	11	4·2
NTSC	US	Progressive	525	484	340	330	4:3	12	16	4·2
PAL	Europe	Interlaced	625	575	290	425	4:3	10	13	5·5
PAL	Europe	Progressive	625	575	400	425	4:3	13	18	5·5
SECAM	US Europe	Interlaced	625	575	290	465	4:3	10	10	6
SECAM Europe	US Progressive	625	575	400	465	4:3	13	18	6	

Table 1. Key television standards in existence across the world today.

single information packets. By comparison, digital technology uses a signal composed of binary information that will allow for the transfer of multiple packets of video and audio information. This is what gives HDTV systems their picture and sound clarity. Up to four multiple packets of the same information are broadcast. When received by the HDTV set, a decoder compares the data packets. Any data that is not on all the packets is discarded by the system, giving clear uninhibited pictures and sounds. This will eliminate many of the problems with current analogue televisions, such as snow and image shadow.

Terrestrial? Satellite? Cable?

Advocates for HDTV systems fall into two major categories. There are those that feel that these systems will ultimately be successful outside the conventional channels of terrestrial broadcasting. Equally vehement, are those that think HDTV can and must use traditional terrestrial broadcast channels. Table 1 outlines the key television standards in existence across the world today.

History again. In 1987, the US FCC issued a ruling indicating that the HDTV standards to be issued would be compatible with existing NTSC service, and would be confined to the existing VHF and UHF frequency bands. In 1990, the FCC announced that HDTV would be simultaneously broadcast and that its preference would be for a full HDTV standard.

The Grand Alliance

After a good deal of cross-industry debate, a standard was submitted to the FCC by a group of television manufacturers called the Grand Alliance. The Grand Alliance was formed in May 1993 by seven organisations. The former competitors turned allies were: AT&T, General Instrument (GI), Massachusetts Institute of Technology (MIT), Philips Consumer Electronics, David Sarnoff Research Centre, Thomson Consumer Electronics, and Zenith Electronics.

But even in the US, HDTV could be some time off. Currently, the FCC has given television stations 9 years to adopt and conform to the new format standards. While networks have until 2006 to convert to HDTV, broadcasters have voluntarily set up an accelerated 18 to 24 month timetable to deliver HDTV to up to 40% of US households.

Commercial Broadcast

The first public television station in the US to broadcast in the FCC's digital transmission standard was KCTS in Seattle. KCTS turned on its experimental transmitter in January this year and two further television broadcasters installed transmitters in March.

The FCC has assigned temporary channels for digital broadcasts until most viewers have digital receivers. Under the new timetable, the old analogue channels will go off the air and be given back to the government for possible auctioning in 2009.

The table of channel allocations adopted in April is the third one released by the FCC. Its second try, in summer 1996, tried to cut down the television band and squeeze in 1,900 additional channels at the same time, making it hard to give good coverage areas to every broadcaster. Public television, like other broadcasters, urged the commission in November 1996 to use the full television band and also took the opportunity to push for wider coverage areas for currently limited UHF stations.

Some public broadcasters have already begun raising funds for the new transmitters, antennas and other equipment needed to put a digital channel on the air, but the field expects to need federal assistance in making the transition mandated by the FCC. Equipment costs for public television – such as that shown in Photo 13 – alone are estimated to come to £650 million.

Photo 13. Philips is one of the television manufacturers at the forefront of HDTV development.

The European Market

Europe has a troubled history when it comes to HDTV. In the 1980s, a great deal of collaborative research went into the development of digital and high-definition standards such as D-MAC and HD-MAC standards for satellite broadcasting. But European broadcasters, which perceived no desire from consumers to step up from the 625 line PAL standard if it meant buying costly new receivers and set-top decoders, have largely ignored the D-MAC and HD-MAC standards.

The DVB project is the current European standard bearer for HDTV. A consortium of more than 200 broadcasters, manufacturers and regulatory organisations in more than 30 countries, is currently in the process of preparing HDTV guidelines to be published later this summer.

The European DVB Project

The story of the European DVB Project begins in the closing months of 1990. European Union (EU) experimental projects such as SPECTRE showed that the digital video compression system known as 'Motion Compensated Hybrid Discrete Cosine Transform Coding' was highly effective in reducing the transmission capacity required for digital television. Up until then, digital television broadcasting was thought to be impractical to implement in Europe because of the disparate nature of countries in the region.

About the same time in the US, the first proposals for digital terrestrial HDTV were beginning to be discussed. In Europe, Swedish Television suggested that fellow broadcasters should form a concerted pan-European platform to develop digital terrestrial HDTV.

During 1991, broadcasters and consumer equipment manufacturers discussed how this could be done. Towards the end of that year, Peter Khal, then with the German Federal Ministry of Communications, recognised the strategic importance of digital television in Europe and the need for a collective approach. He invited broadcasters, consumer electronics manufacturers and radio-regulatory bodies to come together to discuss the formation of a pan-European group that would oversee the development of digital television in Europe – the European Launching Group (ELG).

Over the course of about a year, the ELG expanded to include the major European media groups, both public and private, the consumer electronics manufacturers and common carriers. It drafted a Memorandum of Understanding (MOU), establishing the rules by which this new and exciting game of collective action would be played. The concept of the MOU was a departure into unexplored territory, and meant that commercial competitors needed to appreciate their common needs and agendas. Trust and mutual respect needed to be established.

'The analogue market of the past was well defined and relatively stable. The digital market is fuzzy. Means of delivery mechanisms are not yet fixed and are hard to predict. The result is considerable uncertainty. Change is the only constant.'

The MOU was signed by all ELG participants in September 1993, and the Launching Group became DVB and the development work in digital television, already underway in Europe, could now move fully forward under this new umbrella.

At the same time, the 'Working Group on Digital Television' led by Professor Ulrich Reimers, professor at Technische Universitat Braunschweig and director of the Institute for Communications Technology, prepared a study of the prospects and possibilities for digital terrestrial television in Europe. The highly respected report introduced important new concepts, such as proposals to allow several different consumer markets to be served at the same.

In conjunction with all of this activity, there was a wind of change blowing across the European satellite broadcasting industry. It was becoming clear that the once state-of-the-art MAC systems would have to give way to all-digital technology. DVB provided the forum for gathering all the major European television interests into one group. It promised to develop a complete digital television system based on a unified approach.

It was now clear that digital satellite and cable television would provide the first broadcast digital television devices in Europe. Fewer technical problems and a simpler regulatory climate meant that it could develop more rapidly than terrestrial systems. Market priorities meant that digital satellite and cable broadcasting systems would have to be developed rapidly.

Work in Progress

There are a number of local collaborative projects developing digital television broadcasting systems. These include the SPECTRE, STERNE and DIAMOND projects, the European Union's RACE projects dTTB and DIGISMATV, the Scandinavian HD-DIVINE and the German HDTV Module and work to guidelines mutually agreed.

The DVB guidelines will cover 50Hz and 60Hz picture field frequencies and all of the major transmission media: satellite, cable and terrestrial broadcast. At this stage, there is no recommendation for a particular line resolution; rather, the guidelines will likely cover a range of options that will span up to roughly twice the vertical and horizontal resolution of PAL's 625 lines.

Future

The future of HDTV and digital television is uncertain. In the US, it is likely that the DTV alliance led by Microsoft will be a powerful force in driving its standard forward. Sheer power in terms of consumer reach will enable the trio of companies to gain market penetration ahead of the FCC approved ATSC HDTV standard. Microsoft's challenge will be to convince broadcasters and television manufacturers to support its new standard.

Europe lags behind the US. One of two things could happen here. It is possible that the Microsoft-led DTV standard could reach this market, but it would require commitment from European broadcasters. It also depends upon whether the DTV Team plans to target the European target. As yet, they have shown no signs of doing this. The other option is that the various European Union funded HDTV projects will eventually deliver a European HDTV standard. If this is the case, it could be a decade or so before we see HDTV broadcasts in Europe.

As of today, Japan is the only country actually broadcasting HDTV services. The Japanese standard is based on an analogue format with a picture resolution of 540 lines by 1,080 pixels. Approximately 30,000 receivers and 100,000 converters have been sold to customers of this service. It is widely believed that the establishment of this analogue broadcast service essentially eliminates the possibility of starting a digital satellite HDTV service in Japan.

Footnote

We recognise this article is not totally comprehensive. We haven't fully considered how cable and satellite fit into the emerging digital television standards. In many ways, their role is one of the keys of the future. For precisely this reason, next month we'll take a look at the future of digital transmission and storage.

Television Futures: Quote – Unquote

"Once again, a terrible confusion and debilitating paralysis is setting in around the world as broadcasters, manufactures, and consumers contemplate the meaning of this drive by the computer industry to win the HDTV war."

Dale Cripps, publisher, HDTV Industry newsletter.

"We're moving at 100mph but nobody knows where we're going!"

Dick Notebaert, chairman, Ameritech.

"The first prototype digital television systems are expected by the end of this year and we fully anticipate volume implementation of this new technical standard in the second half of 1998. By the year 2000, we expect all PCs shipped to be DTV receivers."

Eckhard Pfeiffer, chief executive officer, Compaq.

"We're talking about incremental change over a number of years, it won't happen just by throwing a light switch".

John Malone, CEO and president, TCI.

Who's Who in Digital Television

ATSC (www.atsc.org)

The Advanced Television Systems Committee (ATSC) – Photo 14 – was formed to establish voluntary technical standards for advanced television systems, including digital high definition television (HDTV). The ATSC is supported by its members, who are subject to certain qualification requirements.

The ATSC, composed of more than 60 member corporations, associations and educational institutions throughout North and South America, is a private sector organisation developing voluntary standards for the entire spectrum of advanced television systems, including high-definition television. The membership includes broadcasters, equipment manufacturers, cable operators, and computer, film, and telephone companies.

DVB (www.teecomm.com/dvb.html)

The DVB Project is a group of organisations committed to a fast-moving and challenging venture, vital for the future of television. Formed in Europe, the DVB Project now includes over 170 organisations from 21 countries, from all regions all over the world.

DVB has set itself the target of establishing, by consensus, the technical framework for the introduction of systems that will be used for digital broadcasting for years to come.

FCC (www.fcc.gov)

The Federal Communications Commission (FCC) – Photo 15 – is an independent federal agency responsible directly to Congress. Established by the Communications Act of 1934, it is charged with regulating interstate and international communications by radio, television, wire, satellite, and cable. Its jurisdiction covers the 50 states and territories and the District of Columbia.

The FCC is directed by five commissioners appointed by the US president and confirmed by the Senate for 5-year terms. The commissioners hold regular open and closed agenda meetings and special meetings. By law, the Commission must hold at least one open meeting per month.

Photo 14. ATSC logo.

The Digital Television (DTV) Team (www.dtv.org)

The Digital Television Team is a three-way alliance consisting of Microsoft, Intel and Compaq, that is working to develop a hybrid digital television standard. The companies have set forth technical recommendations, based initially on a subset of the Advanced Television Systems Committee (ATSC) specifications that would accelerate the transition to digital television in the US. They also announced plans to equip millions of future PCs to receive transmitted digital video and data as soon as the fall of 1998.

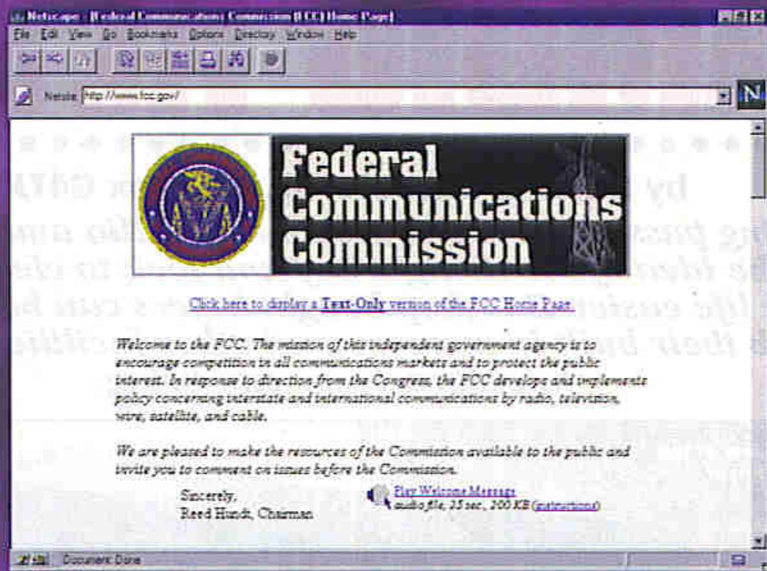


Photo 15. The Federal Communications Commission (FCC) Web site.

MAPLIN modules TOP 20

Position This Month	Position Last Month	Stock Code	Description	Price Inc VAT	Catalogue Page
1	1	YU49	Clock Module	£4.58	620
2	3	FS13	Counter Module	£10.19	563
3	8	FE33	Temperature Module	£10.19	564
4	7	RJ89	W/Less Clock Module	£25.49	620
5	13	YT99	Temp Mod Wide Range	£13.25	565
6	2	YU07	Small Temp Mod Ext	£10.19	564
7	10	AM28	418MHz Rx	£27.99	660
8	11	AM27	418MHz Tx	£16.99	660
9	6	WC20	UHF Modulator 6MHz	£10.99	677
10	4	GW01	DVM Meter Module	£13.25	563
11	18	CK42	Touch Key	£5.59	669
12	14	DK63	16x2 Char Disp Modul	£13.69	551
13	15	LB97	Pre-Amp EQ2S	£12.23	602
14	-	AM11	Expansion Card Assm	£35.69	613
15	-	LP85	RS232-Digtl ConvAssm	£20.39	616
16	20	CK41	Touch Hybrid & Mstr	£24.79	669
17	17	MK68	EM2 MSF Rcvr Module	£16.99	620
18	12	FM85	LED Panel Meter	£35.69	563
19	-	GT39	418MHzAM250uW Enc Tx	£16.99	659
20	5	YU05	Small Clock Module	£9.17	564

Over 100 modules available. Not all modules are supplied with data/instructions, however full technical data is available on request from Technical Sales. The descriptions above are necessarily short; please ensure that you know exactly what the module is and what it comprises before ordering by referring to the current maplin catalogue. Maplin Modules: Top 20: based on May 97 sales figures. All items subject to availability. Prices are subject to change. E&OE.

MAPLIN projects TOP 20 KITS

Position This Month	Position Last Month	Stock Code	Description	Price Inc VAT	Catalogue Page
1	6	LP16	TDA7052 Kit	£6.99	597
2	3	LP28	Beginners AM Radio	£10.99	655
3	4	LP69	L200 Kit	£7.99	652
4	2	LK63	Live Wire Det Kit	£6.99	672
5	5	LP98	SL6270 AGC Mic Amp	£10.99	602
6	1	LP30	1/300 Timer	£8.99	618
7	12	LP77	Lights On Reminder	£7.99	608
8	15	LP66	Courtesy Light Extr	£4.99	608
9	8	LT34	555 Proto Card	£7.99	621
10	10	LU29	PIC 16C84 Programmer	£19.99	623
11	13	LK42	Car Batt Monitor	£12.99	606
12	-	LP14	Light Level Sw Kit	£7.99	643
13	7	LM76	LM386 Kit	£5.99	596
14	-	LT07	Morse Communicator	£5.99	629
15	-	LM57	Watt Watcher Kit	£8.99	601
16	9	LT31	SSM 2017 Pre-Amp	£16.99	602
17	-	LP12	IBM Expansion Kit	£25.49	613
18	17	LP03	TDA2822 Stro Pwr Amp	£10.99	597
19	-	LT23	15Watt Amplifier Kit	£11.99	598
20	18	LT16	PC Relay O/P Card	£29.99	613

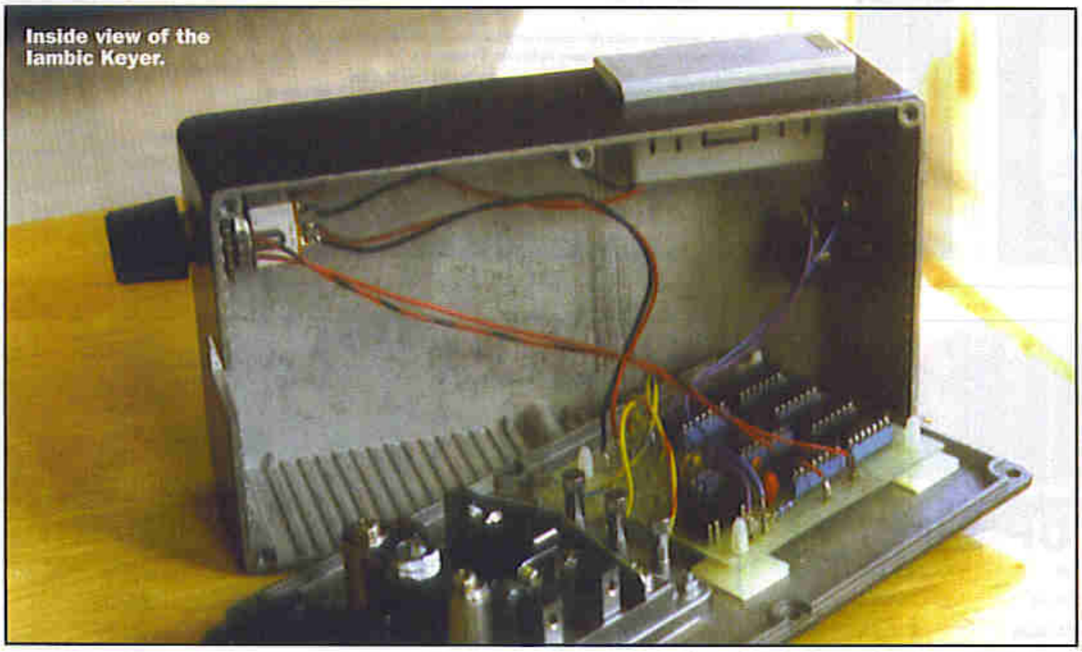
Over 200 kits available. All kits are supplied with full instructions. The descriptions above are necessarily short; please ensure that you know exactly what the kit is and what it comprises before ordering by referring to the current maplin catalogue. Maplin Projects: Top 20 Kits: based on May 97 sales figures. All items subject to availability. Prices are subject to change. E&OE.

PROJECT

A Simple IAMBIC KEYER

by David J. Silvester ZL1DJS (ex G4TJG)

Having passed the Morse test, many radio amateurs give up the idea of the straight key and look to electronics to make life easier. But shop bought keyers can be expensive, with their built in memory and other facilities that the microprocessor can bring.



Inside view of the Iambic Keyer.

With little experience under the belt, you really do not know yet how the CW bug will bite you and the expenditure on such a keyer may not be sensible. I therefore decided to try to build a low cost iambic keyer using a commercially available paddle and some simple electronics to ease the sending but without making it too complicated.

The readability of a Morse signal relies on the sender being able to keep to a constant pace. A multivibrator logic circuit with its constant output pulse time provides the metronome for the Morse rate in this project. Also, the dit-dah time ratio needs to be exactly 1:3 rather than the variable ratio that a hand key can give, substantially aiding the readability of the Morse.

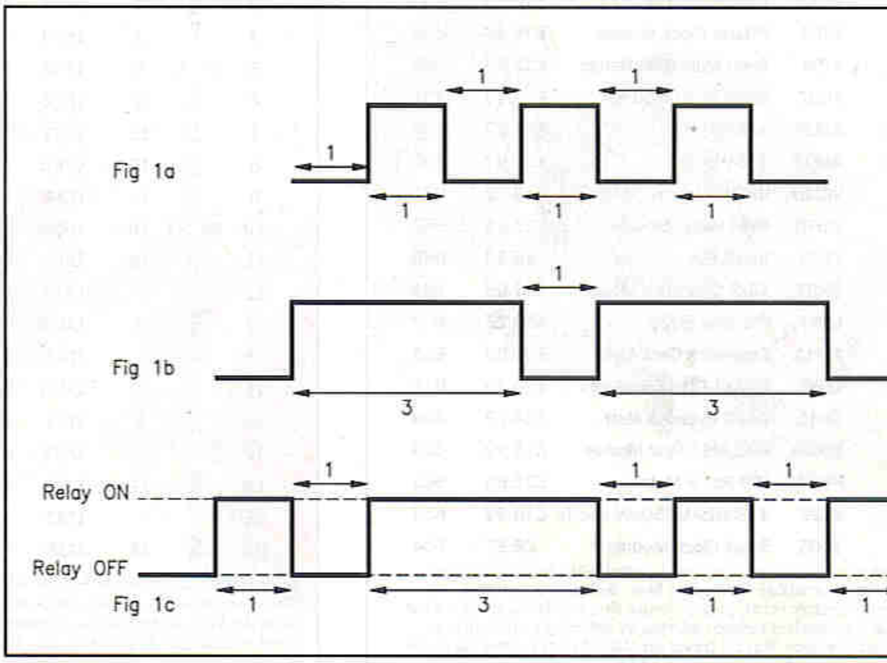


Figure 1a. Timing of 'dits'.

Figure 1b. Timing of 'dahs'.

Figure 1c. Timing of dits and dahs in the letter 'L' (·-··).

Design Considerations

The difficult decision was what to include in the keyer and what to leave out. The keyer must have twin paddles, go dit-dit-dit when one paddle is pressed, dah-dah-dah with the other pressed and dit-dah-dit-dah when squeezed together, that is to say, fully iambic. It also had to look good as well; a dirty box next to the rig ruins the station's appearance and your pleasure in it, even if everything works perfectly. Battery power was used in the prototype as the current drain with CMOS circuitry is very low, although the optional component spaces for an AC power supply are provided on the PCB.

A potentiometer controls the rate of sending, the rest of the timing being set by the requirements of good Morse code. I have seen other keyers have their output switch transistors blow up, disabling the radio, so I decided to use an isolated relay for the output.

However, the relay uses most of the power supplied from the battery, so for constructors who must have the lowest possible current drain, there is a second version of the PCB. This uses two power MOSFETS (VN10KM or similar) as the switching elements. The schematic and the PCB for this version are also provided. There are no descriptions of this version as the operation is identical to the relay version except for the output switching.

Selection of the relay caused something of a problem. The battery powered keyer was designed with CMOS chips and these will work with voltages from below 5 to 15V without problems. The battery is a standard 9V PP3 that is acceptable as far as the CMOS chips are concerned, but the relay is a problem. I have not found a 9V DIL relay that is freely available for amateur constructors. That leaves us with either a 5 or 12V relay. Now, the 5V relay would be over run by a 9V supply and whilst we could use a 78L05 regulator to correct this, the relay's resistance is low so the power drain from the battery would be high; lost partly in the relay and partly in the regulator. The resistance of the 12V relay is higher, giving the same current as the 5V relay running on a 5V supply, and is under-run with a 9V battery. However, the 9V battery will pull in the relay

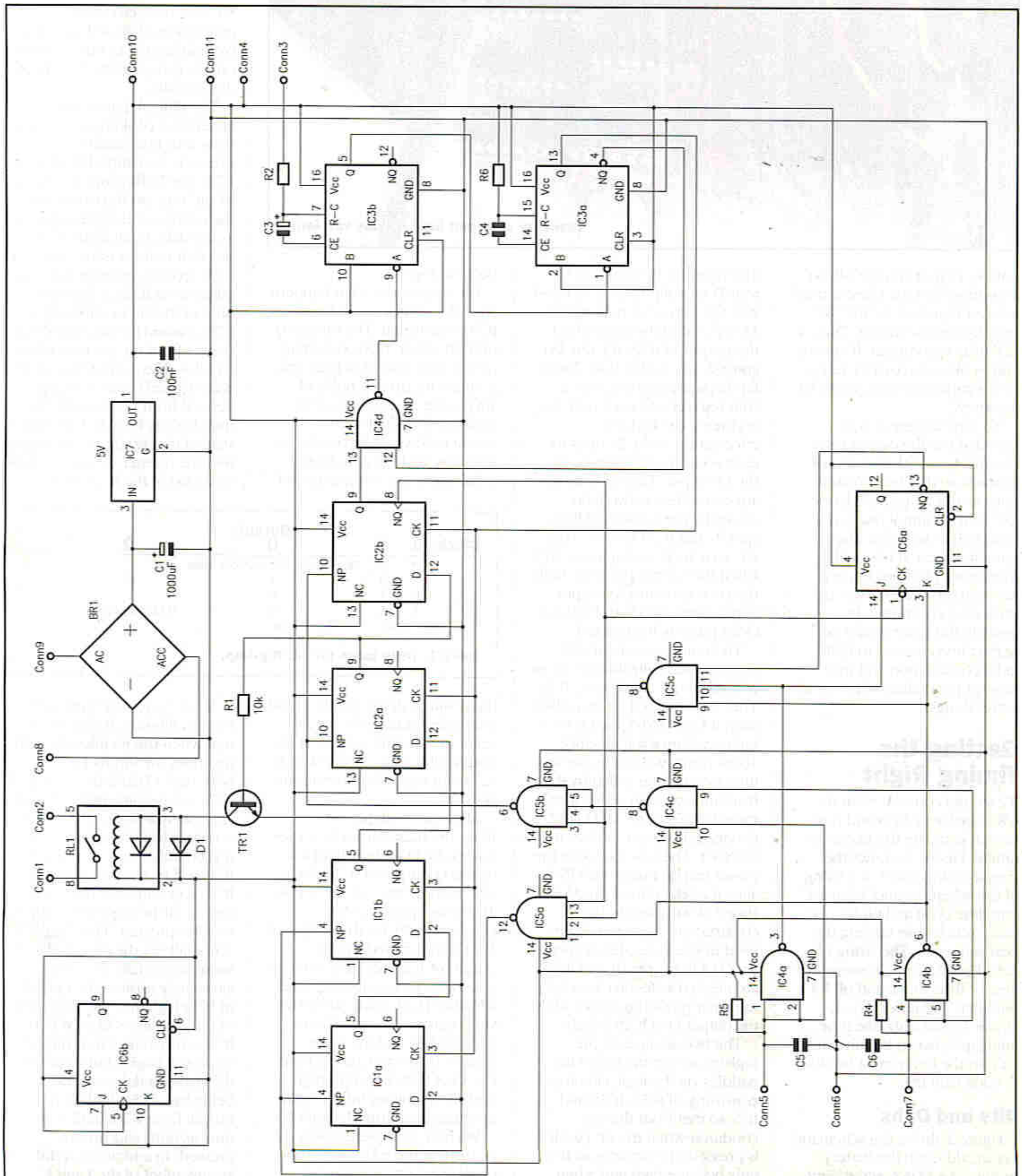
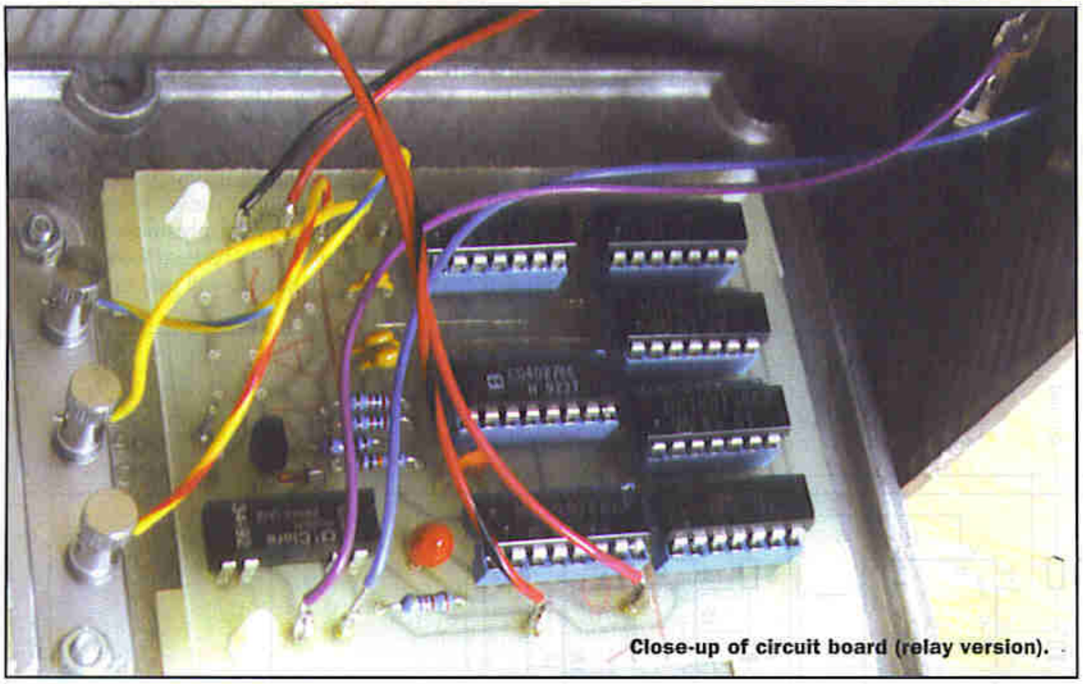


Figure 2. Circuit diagram (relay version).



Close-up of circuit board (relay version).

until its output voltage falls to around 6V and the current used is lower than that for the 5V relay by under-running. Thus, a 12V relay was chosen. If anyone knows of a source of 9V relays of the correct design, please let me know.

No tone generator was included but the output relay was of a type with two sets of contacts so that two isolated outputs can be provided, one for the tone unit if one is not included in the radio. The transistor version has dual transistors. Memory was not necessary, as the idea was to produce a cheap unit. In general, the keyer would be a perfect introduction to QRP radio construction and may prompt the builder to go on to better things.

Getting the Timing Right

We should consider what the CW signal actually is and how we can generate the necessary timing. Figure 1a shows the timing arrangement of a string of dits where 'sound' is on for one time cycle and off for one time cycle before starting the next sequence. The string of dahs Figure 1b has a 'sound on' time of three units and off for one unit. The letter L (·–··), Figure 1c, has only one time unit gap between the dits and dah, so the keyer must be able to cope with this.

Dits and Dahs

Figure 2 shows the schematic circuit, although the battery supply via a switch and the rate potentiometer are not shown here but are discussed later. The heart of the system is the four D-type flip-flops in IC1 and IC2, the output of IC1a (Q, pin 13) operating the relay whilst the output of IC2b (Q, pin 13) controls the timing unit. These flip-flops are connected as a shift register and each time the register is clocked, the information at the D input to each section is transferred to the Q output. The set lines S are connected as two pairs driven by the outputs of IC5a (pin 9) and IC5b (pin 6). They are asynchronous inputs so that when the S input becomes high, the corresponding Q output immediately becomes high, no clock pulse being needed.

The timer consists of two monostable multivibrators, IC4a & IC4b, and a NAND gate, IC3a. They are arranged so that whilst output Q of IC2b (pin 13) is high, the timer will produce 100μs positive-going pulses at a time interval controlled by the resistance of R2 in series with a variable resistor of 22kΩ (RV1) connected across CONN 3 and CONN 4. The time between the pulses can be varied with RV1 allowing selection of the Morse speed most suited to the constructor. These pulses are used to clock the shift register, the $\bar{Q}$ of IC4b (pin 9) and IC3a are needed as feedback to keep the timer producing pulses whilst the output Q of IC2b is high.

The two set lines of the register are connected to the paddles via the logic circuitry consisting of IC5a, IC5b and IC6, so that from the rest condition when the dit paddle is pressed, the set lines to IC2 only become high and when the dah paddle is pressed, the set lines to both IC1 and IC2 become high.

Let us consider what happens after the set line of dit from IC5b is activated. The output Q of IC1b will go high, switching on the relay and Q of IC2b will go high, initiating a pulse of 100μs after a period of say, 0·1 seconds. The $\bar{Q}$ of IC2b becomes low and forces the set lines low via IC5a & IC5b and holds them low, irrespective of the position of the paddles until the system returns to the rest state. In addition, a signal at the output of IC3b is used to clock IC7a, but we shall return to this later.

After the clock pulse from IC4b, the IC2a output becomes low as the D input is held low by the Q output of IC2a, since this flip-flop was not 'set' earlier. The relay opens but the previous 'high' on the output of IC2a is transferred to the output of IC2b and this initiates a second clock sequence. After a further clock pulse, all of the shift register Q outputs have become low and the keyer returns to the rest state where the $\bar{Q}$ of IC2b becomes high and allows the set lines to take up more data from the paddles.

We have now generated a dit by turning the relay on for one clock pulse and off for one clock pulse before returning to the rest state. Similarly, for a dah, where all the Q outputs of IC1 & IC2 become high. Four clock pulses are needed to move the hard wired low at the input D of IC1a to the output of IC2b and of these, three will turn on the relay and one will be with the relay off.

DitDahDitDah = Iambic Working

We now have electronic generation of dit and dah, and by holding one or other paddle on, we can generate a string of dits or dahs.

The difficult part is the generation of alternate dits and dahs with both paddles pressed, the iambic bit. Without IC7b, the JK flip-flop, the keyer would only produce dahs with the paddles squeezed together as the dah circuit loads all of the shift register every time. IC7b receives positive clocking edges from IC3b at the same time as the fall in output $\bar{Q}$ of IC2b, caused by the acquisition of data from the position of the paddles. The output $\bar{Q}$ of IC7b is controlled by information derived from the paddles via their buffers IC6a & IC6b. The state of the paddles at the instant that the register receives data is recorded in the JK flip-flop.

Clock	J	K	Outputs Q	$\bar{Q}$
↑	0	0	No change from previous state	
↑	1	0	1	0
↑	0	1	0	1
↑	1	1	$\bar{Q}$	Q Output toggles
↓	Any input		No change	

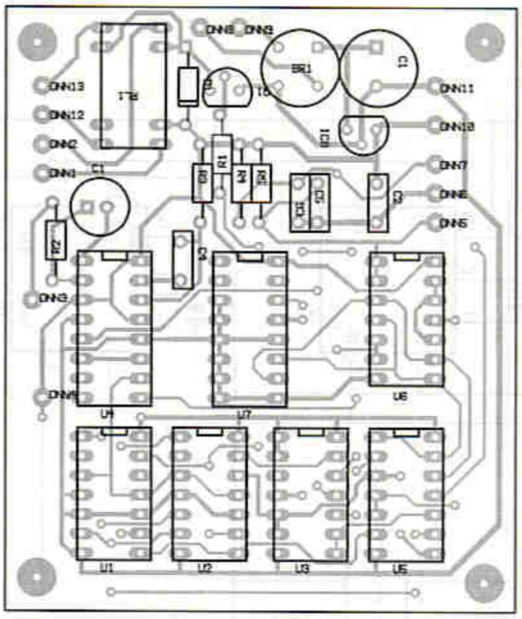
Table 1. Truth table for J-K flip-flop.

Table 1 gives the truth table for a JK flip-flop. It can be seen that when the paddles are held together, the inputs J and K are both high (1) and the output of IC7b will become high and low alternately as each Morse digit is locked into the register. In this condition, the output of IC3c will be the opposite of IC7b's $\bar{Q}$ output as the other inputs will be high with both paddles pressed. This toggle action allows the dit-dah-dit sequence to take place by alternately turning the output of IC5a high and low. The state of the paddles is latched into IC7b every time a new timing sequence begins but to prevent the dah-dah-dah sequence being lost, IC5c disables the output from IC7b until such time as both paddles are pressed. In addition, careful arrangement of the J and K inputs to IC7b allows the dit-dit-dah sequence of letter IC to be achieved by pressing the dit paddle for two cycles and then both paddles together. The low on $\bar{Q}$ of IC7b produced when only the dit paddle is pressed (J input high, K input low) allows the last dah to be incorporated into the shift register with either the dah paddle or both paddles pressed.

IC6a & IC6b act as buffers/inverters for the signals from the paddles and although they are not Schmitt devices, the inherent character of CMOS devices is to provide a Schmitt action for the input. Along with IC6c & IC6d, these gates are arranged so that when only dit is pressed, the input to IC5b becomes high whilst when dah is pressed, the inputs to both IC5a & IC5b will also be high and data will be transferred to the register.

Figure 3. PCB legend and track (relay version).

Note U≡IC Q≡TR



outputs commoned on the PCB through a design requirement. The outputs cannot be isolated from each other.

Lastly, you need to decide how the battery is to be fitted. If you feel happy cutting a large hole in the side of the box for the battery holder, then you can take this approach. Alternatively, the battery can be fitted into a pair of cable ties with sticky hold down pads. This option saves the hole cutting, but means that when changing the battery, you will have to open the keyer's case and cut the cable ties. Alternatively, if you have decided to use an AC supply, then you will need to make the necessary holes in the box for the power plug. It is envisioned that the AC supply will be from a 12V AC source from a 'wall-plug' transformer unit.

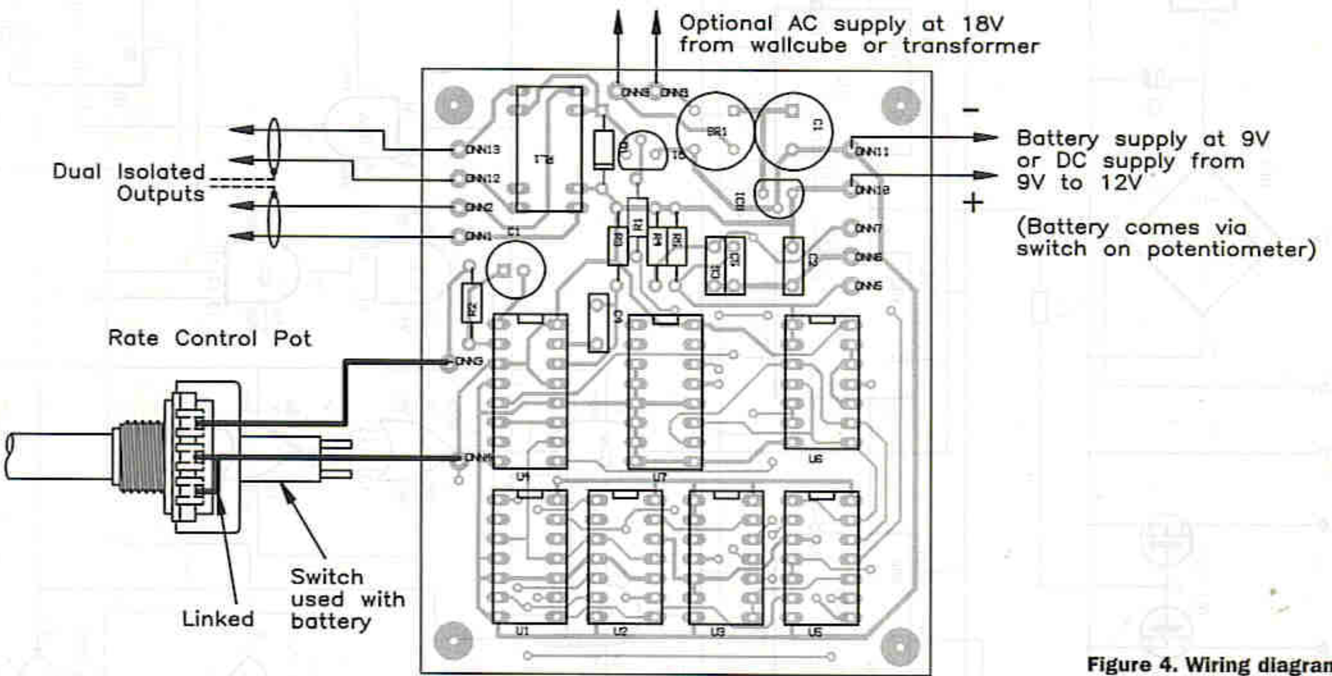


Figure 4. Wiring diagram. Note U≡IC Q≡TR

Power Supply

We should also give a little consideration to the power supply for the keyer. A 12V AC input can be supplied to the PCB from an external wall-cube transformer unit to pins CONN 8 and CONN 9. The bridge rectifier, reservoir capacitor and regulator then supply a stable 12V DC to the electronics. Equally, an 18V DC supply could be used on the same pins, the rectifier ensuring the polarity of supply to the electronics and the regulator stabilising it on 12V. Battery supplies are connected to CONN 10 and CONN 11, with CONN 10 being connected to the positive terminal of the battery. This may be either the 9V PP3 of the prototype or a supply from a car type battery. Polarity is important for these battery connections.

Construction

The first consideration is the metal bashing that needs to be done. We need to use a box of the size and weight given, as anything lighter will tend to move all over the desktop when you try to key up, making the project virtually unusable. The die-cast box is used in the inverted mode with the flat lid forming the bottom and the rest the cover. This is convenient, as the lid slopes slightly inwards at the top, neatening the design. The twin paddle key pad fits at one end of the lid and four holes should be drilled for this first. Fit the paddle on a permanent basis, as there are no further holes for the base.

Now try to fit the lid and mark out the cut that needs to be made so that the paddle is just cleared. This is basically a slot and after cutting the uprights, the waste piece can be snapped out as the diecast will crack if you try to bend it. You can now smooth out the slot with a file. Drill holes in the lid for the potentiometer with its switch and one or two holes in the rear wall opposite the paddle slot for the relay output. You can have either a single output, a dual system like a stereo jack with commoned ground or two isolated outputs, the choice is yours. The transistor switched output version has the

plug' transformer unit.

The last item is the PCB. This has been designed to be used with a number of possible power inputs. Thus, there are 13 off-board connections called CONN 1 to CONN 13 and each of these should be fitted with a solder pin as this eases the connection of the wires at a later stage. You can solder these on first, as they are easier to solder now rather when some of the other components have been fitted. These extra components lift the PCB away from the table and let the pins drop out.

There are also 16 small wire links on the component side of the PCB. These have been left in place rather than use a

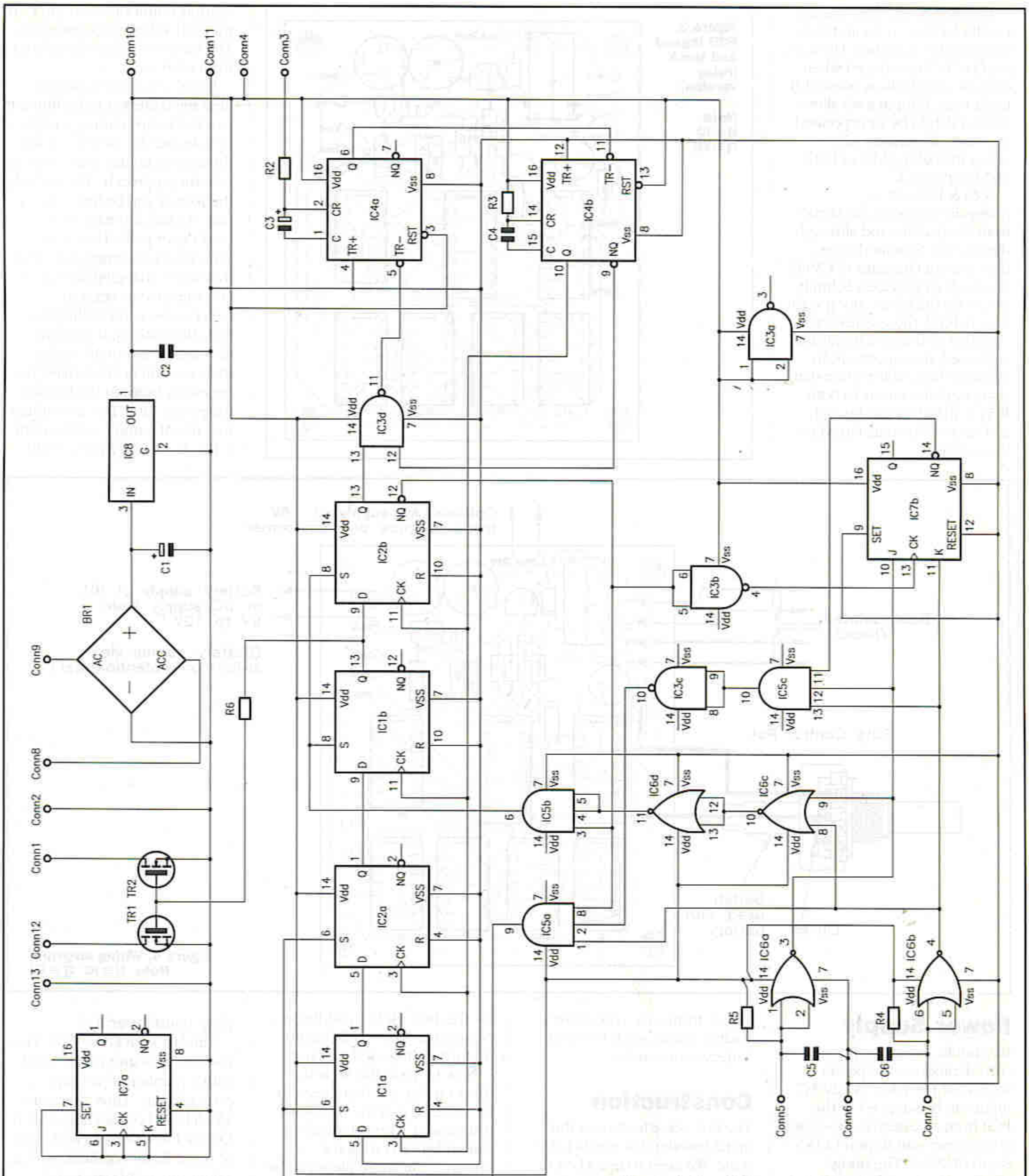


Figure 5. Circuit diagram of transistor output version.

double-sided PCB, as the double-sided PCB with through-board connections costs a small fortune. The single-sided PCB is much cheaper to produce and can be home-etched if necessary. YOU MUST FIT THESE WIRES FIRST: Some go UNDER the integrated circuits. If you have put the integrated circuits or integrated circuit sockets onto the board already, you are in big trouble!

With the links in place, you can fit the integrated circuits, although I prefer to use sockets as it makes the unit easier to service and does help prevent static damage when soldering an integrated circuit into place. Using Figure 3, complete the building of the board but do not insert the chips into the sockets if they have been used. The holes at the corners are for plastic mounting stand-offs and these can be either the self-adhesive or plain types. When built, fit the stand-offs and stick the board into the box lid behind the paddles. Now complete the rest of the connections following Figure 4.

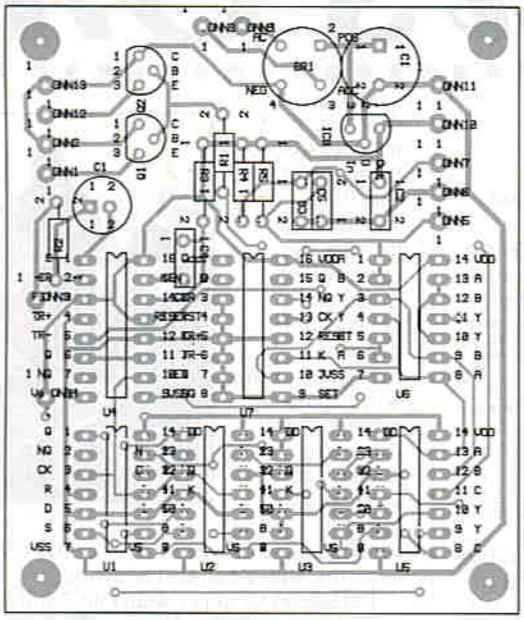
The schematic and the PCB for the transistor output version are shown in Figures 5 & 6. If you are not 100% sure of your soldering, then check the connections with a magnifier.

As a quick test, switch on and measure the power supply across all of the chip sockets from the pin at the bottom left (pin 7 or 8) to the pin at the upper right (pin 14 or 16). This should be the full battery or PSU voltage. If OK, switch off, plug in the chips and a CW test oscillator, then switch on. There should be a small beep as the system starts up, then silence. Pressing one of the paddles should give a series of dits, the other a series of dahs. Altering the position of the potentiometer should alter the rate of sending.

If you have any problems, then you will need to look into two basic types of errors. A number of tracks pass between the chip pins but are not supposed to connect to them. Check with a ten times magnifier that you do not have such a problem and correct any you find. Even the most experienced constructors have these problems on occasions. Make sure you have all of the integrated circuits fitted correctly and that the DIL relay is upside-down compared to the other chips. Other than that, you will need to check over the circuit with a CMOS-compatible logic probe to try to locate the problem. However, if you have taken care over the construction, there should be no problems. A number of copies of the original design have been built and all have worked first time; you may just get into construction and decide to build a receiver or transmitter. Success affects you that way.

Figure 6. PCB legend of transistor version.

Note
U≡IC
Q≡TR



CONNECTIONS LIST

CONN 1	Isolated output from relay A
CONN 2	Isolated output from relay A
CONN 3	To variable resistor
CONN 4	To variable resistor
CONN 5	Twin Paddle Contact dits
CONN 6	Twin Paddle Contact ground
CONN 7	Twin Paddle Contact dahs
CONN 8	AC Power Input
CONN 9	AC Power Input
CONN 10	DC Power Input positive
CONN 11	DC Power Input negative
CONN 12	Isolated output from relay B
CONN 13	Isolated output from relay B

SIMPLE IAMBIC KEYER PARTS LIST

RESISTORS:			
R1,3	10k	2	(M10K)
R2	4k7	1	(M4K7)
R4,5	22k	2	(M22K)
RV1	22k Linear Potentiometer with Switch	1	(FW43W)
CAPACITORS			
C1	1,000μF 25V Radial Electrolytic (Not Needed with Battery Power)	1	(AT52G)
C2,5,6	100nF Ceramic	3	(YR75S)
C3	22μF Tantalum Bead	1	(WW72P)
C4	10nF Polyester	1	(DT95D)
SEMICONDUCTORS			
IC1,2	4013 Dual D-type Flip-flop	2	(QX07H)
IC3	4011 Quad 2-input NAND	1	(QX05F)
IC4	4098 Dual Multivibrator	1	(QX29G)
IC5	4073 Triple 3-input AND	1	(QW44X)
IC6	4001 Quad 2-input NOR	1	(QX01B)
IC7	4027 Dual JK Flip-flop	1	(QX16S)
IC8	12V Positive Regulator in TO92 Package	1	(WQ77J)
TR1	BC108 or Similar	1	(QB32K)
or TR1,2	VN10KM or Similar for Transistor Version	2	(QQ27E)
BR1	W005 50V Bridge Rectifier	1	(AQ94C)
(Not Needed with Battery Supply)			
D1	1N4148 Diode	1	(QL80B)
MISCELLANEOUS			
RL1	DIL Relay with Dual Output Contacts (See Text for Voltage Rating)	1	
	Output Connectors – 2 by PO Jack Mono or 1 by Stereo – See Text		
	PP3 9V Battery	1	(FK67X)
	Battery Box	1	(XX33L)
	Thin Wire for in-PCB Wire Links	As Req.	
	Various Wires for Off-board Connectors	As Req.	
	PCB Pins for Off-board Connections	As Req.	
	Twin Key Hi-Mound MK704 Telegraph Key or Similar	1	
	14-pin IC Socket	5	(BL18U)
	16-pin IC Socket	2	(BL19V)
	Diecast Alumunium Box, Preferably Pre-painted	1	
	Rubber Feet for Box	As Req.	
	Optional Wall-cube 12V AC PSU	1	(GU10L)

The Maplin 'Get-You-Working' Service is not available for this project.
The above items are not available as a kit.

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.

August 1997

3 August. RSGB National Mobil Rally, Woburn, Bedfordshire. Tel: (01707) 659015.

31 August. Radio Rally, Telford, Shropshire. Tel: (01707) 659015.

September 1997

1 to 3 September. Tenth International Conference on Electromagnetic Compatibility, University of Warwick, Tel: (0171) 344 5467.

2 to 4 September. International Conference on Genetic Algorithms in Engineering Systems: Innovations and Applications, University of Strathclyde, Tel: (0171) 344 5467.

7 September. Document 97, NEC, Birmingham. Tel: (0181) 742 2828.

7 September. GIS 97, NEC, Birmingham. Tel: (0181) 742 2828.

7 September. Voice Europe, Olympia 2, London. Tel: (01244) 378888.

8 September to 24 October. Amateur Radio Morse Workshop, Highbury College, Newbury. Tel: (01705) 383131.

17 September. InControl 97, Olympia Exhibition Centre, London. Tel: (01799) 528292.

17 September. OnBoard, Olympia Exhibition Centre, London. Tel: (01799) 528292.

17 September. Time 97, Earls Court Exhibition Centre, London. Tel: (01799) 582292.

22 September. European Exhibition on Optical Communications, Edinburgh International Conference Centre, Edinburgh. Tel: (01322) 660070.

22 to 25 September. 11th International Integrated Optical Fibre Communications Conference, ICC, Edinburgh. Tel: (0171) 344 5478.

22 to 25 September. 23rd European Optical Fibre Communications Conference, ICC, Edinburgh. Tel: (0171) 344 5478.

26 to 28 September. RSGB International HF Convention, Windsor, Berkshire. Tel: (01707) 659015.

27 September. The Internet 97 Show, NEC, Birmingham. Tel: (01923) 261663.

30 September. Microwaves, RF & Technologies 97, Wembley Conference & Exhibition Centre, Tel: (01322) 660070.

October 1997

7 to 9 October. World Power and Energy, NEC, Birmingham. Tel: (01322) 660070.

7 to 9 October. Voice Europe – Computer Telephony and Voice Processing, Olympia, London. Tel: (01244) 378888.

7 to 9 October. GIS '97 – Geographical Information Systems, NEC Birmingham. Tel: (0181) 742 2828.

7 October. Electronic Commerce 97, Wembley Conference and Exhibition Centre, London. Tel: (0181) 332 0044.

28 October. Instrumentation Harrogate, Harrogate International Centre, Harrogate: Tel: (01822) 614671.

21 to 22 October. Property Computer Show, New Connaught Rooms, London. Tel: (01273) 857800.

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

What's On?

Hatches and Matches at Networks 97

Merger talks were top of the agenda at Networks 97, the UK's annual networking industry exhibition. Held at the National Exhibition Centre (NEC) in Birmingham from 24 June to 26 June, Networks 97 saw the close of the deal between 3Com and US Robotics and announcement of yet another hi-tech coupling as well as new product announcements too numerous to count.

Matches

It was the turn of Compaq to announce its intended engagement to Tandem, which could see the formation of the number one server supplier in the world. This, of course, is assuming the announcement is not challenged during the three month cooling off period.

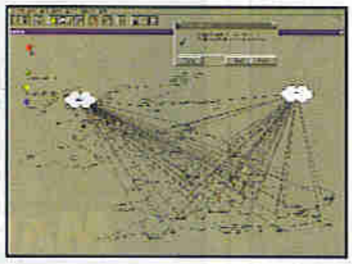
3Com and US Robotics have reached the end of their three month period of due diligence, which is required by US law. Due diligence is a strange term used by US lawyers to describe the period when a company's shareholders can register objections to the proposed union. It's a bit like giving the in-laws time to check out their childs' betrothed.

At Networks 97, the 'new' 3Com hosted the equivalent of a wedding reception with Janice Roberts, senior vice-president of marketing and business development, outlining the company's future plans. Roberts claimed that 3Com has emerged as a new company poised to become the world's largest entity dedicated to bringing customers information via pervasive network infrastructures.

Hatches

But networking industry marriages weren't the only topic of discussion at Networks 97. Many company's used the exhibition as a launch pad for new products and services. Here, *Electronics and Beyond* takes a look at some of the key announcements at the show:

BT introduced an expert software system that enables BT to map out the cost of a company's network in a matter of hours – as opposed to the standard three week delivery period for a detailed proposal and quote.



An industry survey released at the show by network reseller Black Box claimed that one in five company networks suffers a major crash at least once a month. The figure of one in five networks crashing monthly increases to a quarter if the question is asked exclusively of network engineers and network consultants as opposed to general IT staff. This includes 5% who experience a major crash weekly.

Hampshire Police is improving its service by investing over £80,000 in Asynchronous Transfer Mode (ATM) and complementary Ethernet switching technology from Cisco Systems. The deal, which includes Cisco's Catalyst 3000 and 5000 switches, will increase the capacity and speed of the network at its police headquarters in Winchester, making critical data more readily available to the police officers.

Hampshire will be the first police force in the UK to go live with a full ATM network.

120 Silicon Graphics WebFORCE Indy servers have been installed at Planet Online's Network Operations Centre in Leeds. Planet Online, whose clients include Barclays Bank, Channel Four Television and the London Evening Standard, offers a managed and hosted web server which gives the customer direct access to the Internet via a 24-hour backbone network. The Indy web servers allow high-speed access to web sites capable of publishing complete catalogue listings, images and multi-media presentations.

Hayes announced the availability of CENTURY MR200, the latest addition to its new line of Remote Access Servers, and Hayes ULTRA Cable System: a broadcast data-over-cable system, providing Internet access at speeds up to 5M-bps over a standard cable connection.

ON Technology announced a new version of the ON Guard Firewall that allows network administrators to block access to specified Web sites, as well as provide password-protected authentication for remote users such as telecommuters. The URL Blocking application is aimed at organisations concerned about inappropriate or wasteful use of their Internet connection, and includes a regularly updated and downloadable list of thousands of URLs associated with sites that might be considered inappropriate for the workplace.

Perex launched their new networked video system which achieves high quality video communications over an existing LAN without sacrificing bandwidth. SeeNet is an addition to Perex's range of network video solutions which provide Video Conferencing, Remote Video Surveillance, Video on Demand and Business TV.

COMMENT

by Keith Brindley

Multimedia is a funny thing. It means different things to different people. Chuck a CD-ROM drive and a soundcard into a PC, and many people think that's it. Upgrade your microprocessor to MMX and it's even better. Better still, just buy a Mac as they are multimedia-tuned from the outset. Whatever you do with your hardware though, you've only just begun the multimedia adventure.

You see, in the end, multimedia depends largely on the *software* you run. Hardware is certainly one issue, and doubtless a major issue, but unless the software is up to scratch, all the hardware in the world can't hope to make a decent job of multimedia. There are hundreds of examples of software multimedia products that simply shouldn't have been enforced on an unsuspecting multimedia-sampling public. Nothing deters people from sampling more products than the experience of a bad one. Links that lead nowhere, in particular; information that is intended for a different customer (or worse, no particular customer at all); irrelevant interfaces that take an age to fathom and an even longer age to negotiate; the need to watch while multiple screens of information are displayed every time you traverse the same steps (once you've seen and read a screen of information, why do you have to see it again?); clever little multimedia events that are boring the second time you see them and simply mind-numbing thereon. All these factors can make or break a multimedia program and in the process, destroy consumers' faiths in the whole multimedia experience altogether.

With all this in mind, when *Life in the Universe* landed on my desktop, I was naturally sceptical. I've seen too many 'interactive multimedia adventures" over the last few years, albeit endorsed by big names (Professor Stephen Hawking in the case of *Life in the Universe*), to sustain any sense of excitement at the outer wrapper. I always wait until I get a new multimedia CD-ROM into my Mac and run the software for a while before I commit myself to a yeah or nay.

I needn't have been so sceptical. *Life in the Universe* is very well put together. Albeit with a tricky little interface and few possibilities to fast-forward through multimedia events, it doesn't take you long before you're absorbed in the program and its capabilities. Stephen Hawking's part in the proceedings is limited to a lecture about life, how it came about and where we're all heading. It's judiciously hotlinked, though, to other places on the CD-ROM. These areas are wide ranging, covering topics as varied as the origins of life, the speed of light, the Hubble space telescope, life on Mars, volcanoes, thermodynamics, and the list goes on. Also, hotlinking can occur not only to other parts of the CD-ROM, but (via the Web browser of your choice and your own Internet connection) to the Life in the Universe World Wide Web site at: **http://www.lifeintheuniverse.com,** which allows you to glean further information as you require it.

In terms of the quantity of information accessible, this multimedia product, I'm sure, stands without equal. The quality of information is good too, and should interest anyone with a general interest in life and its origins, but will probably best suit students at A-level and beyond. It's a multi-format CD-ROM, which requires a multimedia-capable PC or Macintosh.

Multimedia and Education

While we're broaching the topic of using a multimedia product like Life in the Universe in education (well, I did mention students at A-level and beyond, didn't I?), educators in all areas could do well to take a few days in Edinburgh in August to attend the *Interactive Learning in a Digital World* conference. The conference aims to tackle the use of interactive learning tools (like so-called multimedia CD-ROMs), and their effects on education as a whole. Multimedia being the hot potato it is, it's still not by any means clear how best teachers should be involved with it. This conference hopes to clarify the situation.

Physical topics being covered by the conference include digital video disk, network computers, the Java programming language, and push technologies. Their effects in education with regards to both educators and students should become clear for conference attenders.

Several of the conference speakers are world-renowned. Professor Nicholas Negroponte, for example, kicks off the conference with a keynote address. As a founder and the director of the Massachusetts Institute of Technology's innovative Media Laboratory, there's little doubt he knows his stuff. The MIT Media Lab is an interdisciplinary, multi-million dollar research centre of intellectual and technological resources which focuses exclusively on study and experimentation of future forms of human communication, from entertainment to education. Readers may also recognise Negroponte as senior columnist for *Wired* magazine and the author of the book *Being Digital,* published by Alfred A. Knopf. Dr Michael Barnsley, known as 'the father of fractals' is also speaking, and representatives of the NCET and SCET will be there.

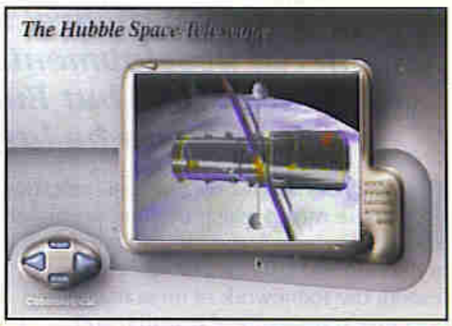
The conference takes place between 21 and 23 August, at the Heriot-Watt University, Edinburgh. Further details from the *Interactive Learning in a Digital World* Website at: **http://www.il97.com,** or contact Mike Fenwick, In Conference Ltd, 10b Broughton Street Edinburgh EH1 3LY. Telephone: (0131) 556 9245.

Web Are We Going To?

While the Internet goes from strength to strength, apparently attracting millions of new users each year, how it will expand to cope with all the new users isn't often considered. Under present constraints, data transfer over the Internet is often slow (particularly in the afternoons in the UK, when US users – some five to eight hours behind us – get online). With more and more users going onstream worldwide, it's not going to be long until a dramatic increase in ability is required just to cope with current rates of traffic.

But current rates are small in comparison to future requirements. The majority of Internet users (around 60%, according to recent survey) regularly browse the World Wide Web, viewing Web sites with their resultant images, sounds, Jave applets, and other multimedia (there's that word again) events. The technology is upon us, however, whereby multimedia events will become larger and require more of the Internet to be able to be downloaded to the browsing computer.

As an example, Acorn (the Cambridge-based computer manufacturer) is setting up a trial over 1,000 homes, to deliver commercial quality television pictures according to the MPEG2 format over the Internet via asynchronous transfer mode (ATM) telephone line links to users' television sets. Acorn hopes that the trial will prove the worth of its set-top boxes which eventually the company hopes to license around the world. This being said, it'll be a while until all Internet users have (and can afford) ATM connections.



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

Twelve Stars FOR INNOVATION

by Douglas Clarkson

There are always scientific topics in the media. Environment issues are well received in an ever more 'green aware' society. Health Care and general developments in medicine also find a ready audience but European scientific research can be largely ignored.

It may not be obvious, but topic selection and the way in which they are presented or angled can come under a great deal of filtering and control. For some obscure reason, the framework of on-going co-operative trans-national research and development within the European Union is very largely ignored.

Within the wider European framework, however, there is indeed a very significant amount of coordinated research which is being undertaken within initiatives from the European Commission. It is only, however, with the services of groups such as Mediascience International, based in Brussels, and operated by the European Commission that the more expansive picture of research and development within the European context can be discerned. This group distributes, free on a monthly basis to interested individuals, sets of technology updates on wide-ranging research initiatives with the European Community.

While in the UK, issues of a more confrontational nature within European politics are allowed to dominate the headlines, a large degree of trans-national co-operation is taking place to improve the quality of life of European citizens – and often in a very practical way. Such activity is funded where there is a Europe-wide remit and where researchers in various countries are pooling resources to overcome common problems. Thus, research of purely 'national' origin will not be credited through this form of information service.

A review of the nature of projects funded within a framework of a series of major initiatives reflects aspects of thought at the heart of Europe. In this regard, there is apparently an intelligent core in the European dimension which is selecting the agenda, ranking the priorities and providing resources to initiate and complete research and development.

Just how much is it relevant for Europe to focus on a distinct identity on matters relating to science and technology? From the very core of the European Commission there is an emerging perspective on making the most of its 'inventive' skills. It is becoming clear that in terms of future economic developments, it is very important to invest in attractive projects and also perhaps more critically, those from which royalties can be secured.

All too often, within the European context, funds may be allocated to work that is not overly original and which, when finally developed, do not yield adequate financial return due to lack of secured patents on the product. The pattern of Research and Development in USA and Japan is that resources are channelled into products which from the outset indicate a good prospect of future licensing revenues. In particular, Green Technologies are set for significant growth. Europe's wind turbine industry is a good example of how foresight within Europe has opened up significant world markets in this renewable energy sector. Photo 1 shows one of the new generation of wind turbines developed successfully within Europe.

This will perhaps tend to set the future directions in the allocating of resources for European Research and Development – it will be more business led.

Navigating the Commission

In describing aspects of the roles and duties of the European Commission, it is very easy to lose a sense of perspective. Even small sections of the Commission are surprisingly complex and diverse.

A good place to start unravelling the mystery of the European Commission is on the web page
`http://europa.eu/int/en/comm.html`.
This indicates how the Internet generally serves browsers exceedingly well in seeking to determine aspects of policy and more importantly, points of contact for the many types of programme currently supported.

Of the 20 European Commissioners led by President Jacques Santer, commissioners Martin Bangemann (in charge of Industrial Affairs with links to Information and Telecommunications Technologies) and Edith Cresson (in charge of Science, Research and Development, Joint Research Centre, Human Resources and Education, Training and Youth) provide key inputs into programmes for innovation in Europe. The wider aspect of European Commissioners is described on the web page
`http:/europa.eu.int/en/comm/20c/pf.html`.
This, in many ways, is like understanding how a national government functions by studying a list of portfolios of cabinet ministers. Details of the main Directorates and Services of the Commission is also given on the web page
`http://europe.eu.int/en/comm/dgserv.html`.

Photo 1. A European success story – Wind Turbines (Courtesy Tacke).

The Secret Green Paper

It is perhaps something akin to Terry Waite receiving a postcard while a hostage in Beirut, to obtain a copy of the European Commission's Green Paper on Innovation which was published in 1995. One factor being that it was apparently difficult to come by and the second that it made encouraging reading. How is it that such a relevant paper on the future technology base of Europe has been such a well kept secret?

The object of the green paper was chiefly to assess how 'Europe' was doing, primarily in relation to the USA, Japan and the Developing Asian Economies (DAE) and what was required within the European framework to put right any deficiencies. The picture, however, is a complex one, reflecting a dynamic world economy.

The European Perspective on Innovation

The European Commission perceives four levels of structure – Community, National, Regional and Local. Within this framework, initiatives have been established to encourage innovation which touch on issues more diverse than simply training more good engineers and scientists. These initiatives can be summarised as:

a) Establishment and development of Economic and Monetary Union.
b) Consolidation of the internal market.
c) Introduction of effective competition policy.
d) Promotion of the information society.
e) Promote policies in research, education and training.
f) Disseminate results for take up by industry.

This perspective takes the view essentially that these moves are necessary for Europe to match rival external trading blocks such as Japan and the USA. Europe is seen as being structurally weak in many aspects and that if this was allowed to continue, the future economic outlook would not be not encouraging. These issues, however, are complex and need to be debated more widely and in light of the core reasons for pursuing such goals.

Figure 1 indicates how, in relative terms, the European Union is faring with reference to manufacturing output. Japan, with a population of 125 million, around 40% of the European Union, is able to produce

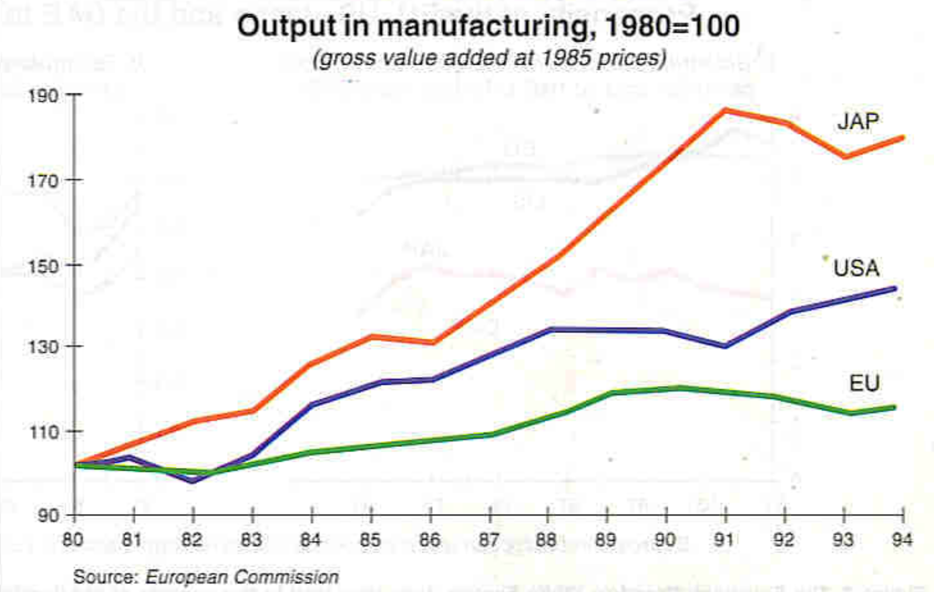


Figure 1. Output in manufacturing for Japan, USA and Europe (Source: EC).

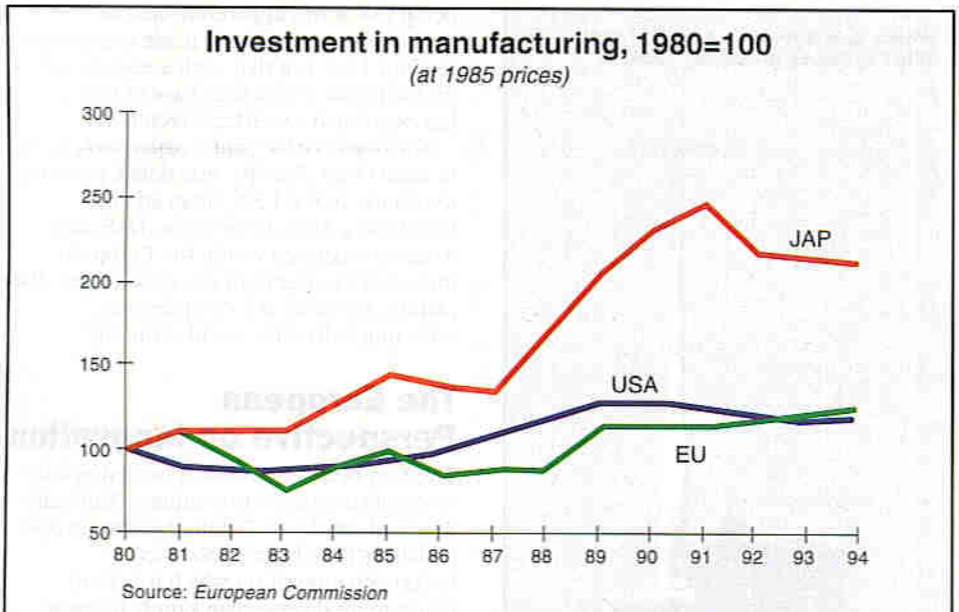


Figure 2. Investment in manufacturing, for Japan, USA and Europe. (Source: EC).

around twice as much.

Investment in manufacturing in Europe is relatively weak, as indicated in Figure 2. This is the European reality.

The Wider Issues

While some of these aspects more directly related to Innovation will be examined in greater depth, it is relevant to consider some of the more general initiatives. The goal of Economic and Monetary union is intended to generally produce a level playing field in terms of economic activity. In the parlance of the European Commission, the phrase is Economic AND Monetary Union, implying that the processes are intrinsically linked. This, in any case, is clearly outlined in the text of the Maastricht Agreement.

Quoting from the green paper on Innovation, 'A policy of monetary stability is essential so that European firms can make better long-term plans for industrial and technological investments, since any monetary disorder prevents an assessment of their long-term viability and encourages enterprises to favour short-term projects.'

This could very well illustrate the result in having a common exchange rate within Europe, so that, for example, fluctuations of Sterling against the Deutchmark did not interfere with international trade within Europe. It is not inconceivable, however, that there could develop relativities between the Euro and the US Dollar, so that trade between these two trading blocks could be subject to exchange rate volatility.

The hope is also expressed that interest rates will fall against the scenario of a more stable exchange rate. This is identified as providing more funds for investment in innovation initiatives and also increasing the efficiency of the various European economies.

It will be seen, however, that there are other factors influencing the success of innovation within Europe, showing that monetary union of itself may not be the key factor to propel the European Community forward with new momentum.

The European Paradox

Figure 3 summarises the so-called European Paradox. While Europe does very well in the number of publications per million Ecus, it fares much less well in terms of numbers of patents per million Ecus expended in research and development. Its research base is the most efficient, but its ability to translate such research to financial success is poor and declining. It is vital that this trend is reversed.

Also, looking at Europe as a whole, the R&D expenditure of Europe was 2% of gross domestic product in 1993, compared with 2·7% in the USA and 2·8% in Japan.

The Information Society

The march of the information Society is seen in the European context as being important in many ways. As more and more activities use a wide range of technologies for their routine activities, this itself creates new jobs and business opportunities. Also, it provides a mechanism for dissemination of information that will in turn be used to initiate subsequent innovations. The geography and national barriers of Europe still contribute towards poorer communications and mobility of citizens, compared, for example, to the USA. Great care is being taken, therefore, in the European context to disseminate details of EU-sponsored research and development. It is hoped that the virtual closeness which, for example, the Internet makes possible, will act to make innovation in Europe more effective.

ESPRIT on Line

As evidence of the European Commission's preoccupation with encouraging the technology sector, the on-going ESPRIT initiative has become a highly important factor for innovation within the EC under the direction of commissioner Martin Bangemann. There are a number of key web pages which provide an information retrieval service for ESPRIT projects. A useful one (`http://www-uk.research.ec.erg/esp-syn/all-ke-index.html`)

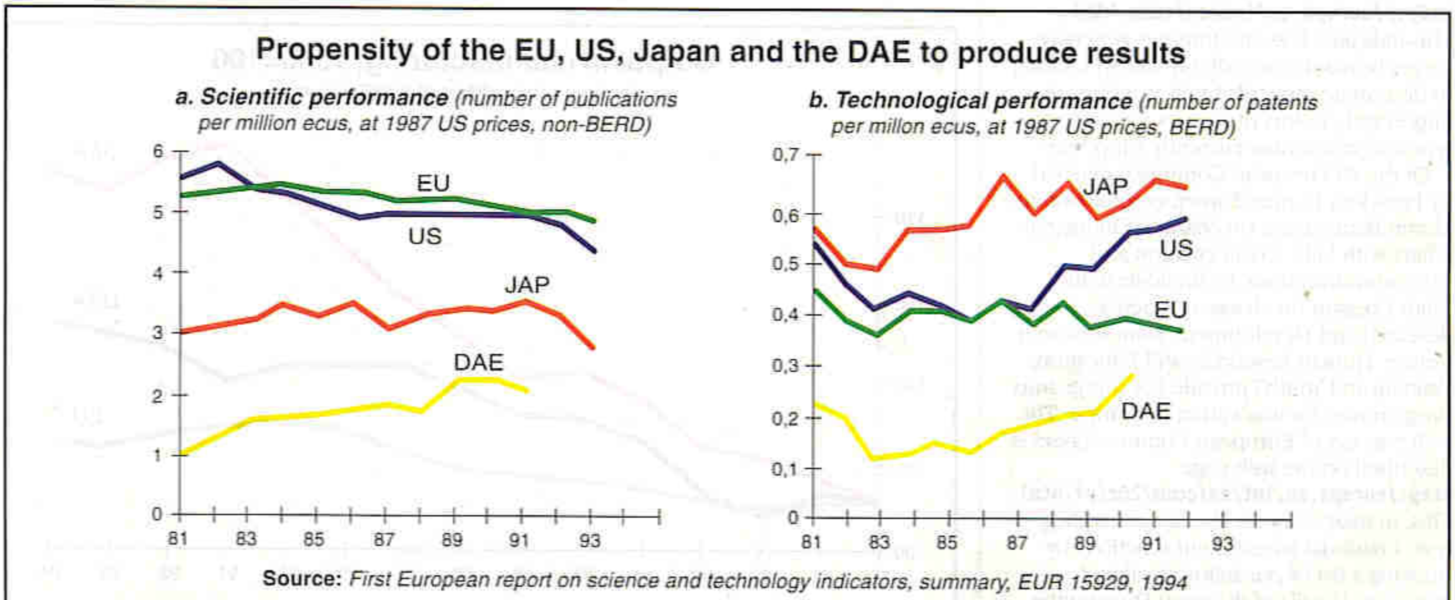


Figure 3. The European Paradox: While Europe does very well in the number of publications per million Ecus, it fares much less well in terms of numbers of patents per million produced. (Source: OECD: Stan database).

Activity	Programme Reference
Technology Simulation	-
Measures for SMEs: Exploratory Awards & CRAFT	CRAFT
Nuclear Fission Safety	NFS 2
Environment and Climate	ENV 2C
Biomedicine and Health	BIOMED 2
Targeted Socio-Economic Research	TSER
Industrial and Materials Technologies	BRITE-EURAM III
Marine Science and Technology	MAST-III
Agriculture and Fisheries	-
Agro-industrial research	FAIR
Controlled Thermonuclear Fusion	-
International Co-operation	COST
Standards, Measurements and Testing	SMT
Biotechnology	BIOTECH 2
Non-Nuclear Energy	JOULE/THERMIE
Training and Mobility of Researchers	TMR

Table 1. Research and Technological development of the DGXII.

provides a complete look-up subject index of many hundreds of indexed topics. This index is itself a useful indication of how diverse the technology sector has become.

Each topic links to at least one ESPRIT project which is typically characterised by a structure referencing work area, keywords, abstract, aims, approach and methods, potential and methods and information dissemination activities. It is typical for such projects to include several European university research sites and several European commercial partners.

On Productivity

Edith Cresson had interesting observations to make on productivity within the green paper on Innovation:

> *'Over the last ten years, Europe has devoted most of its efforts to increases in productivity, which have assumed what amounts to cult status. However, these increases can be negative if they are used in conjunction with a technology which is obsolete or obsolescent.... Innovation must be the driving force behind the entire business policy, both downstream and upstream of the actual production of goods and services.... Innovation can be successful if all the skills in the firm are mobilised. Conversely, it can fail when this cohesion is lacking.'*
>
> Edith Cresson, Compiegne, 6th September, 1995.

This, therefore, clarifies the separate roles of productivity and innovation. A product which can be produced in a highly efficient way cannot guarantee a continued demand for the product if technological change makes it superfluous to requirements.

There is perhaps no better way of comprehending the spirit of such thinking than to access more of Edith Cresson's speeches (see web page of DGXII). For worn-out inventors, rejected, impoverished, undervalued by society and tempted to become accountants, these words will be music in their ears. Yes – it is good to innovate.

Directorate XXII: RTD Programmes

This key Directorate-General, headed by Commissioner Edith Cresson, in terms of innovation within Europe, is DGXXII. This directorate manages a broad range of research and technological developments, summarised in Table 1.

Within the 4th Framework programme (FP4), a budget of ECU 13,100 million has been allocated for the period 1994-1998. The jumping off web page for these programmes is **`http://europa.eu.int.en/comm/dg12/specpr.html`**.

Any one of these research programmes will relate to hundreds of projects involving thousands of researchers and numerous companies across Europe. These will in turn be contributing to the industrial base of member states and future competitiveness.

These web pages must surely be some of the most valuable on the net, in terms of providing highly relevant information about current initiatives.

Towards Innovation Management

Figure 4 summarises how the presence or the absence of the will to innovate and the ability or the lack of ability to innovate at the technical scientific level is likely to affect outcome.

In quadrant one, there is both the will to innovate and the resources to innovate. This is where innovation is most likely to take place. In quadrant two, there is the will to innovate but the lack of resources, such as expertise, training or equipment.

In quadrant three with both aspects lacking, innovation is most unlikely. In quadrant four, this scenario relates, perhaps, to back room boffins who undertake innovation almost 'invisibly' and without direct encouragement from the main organisation.

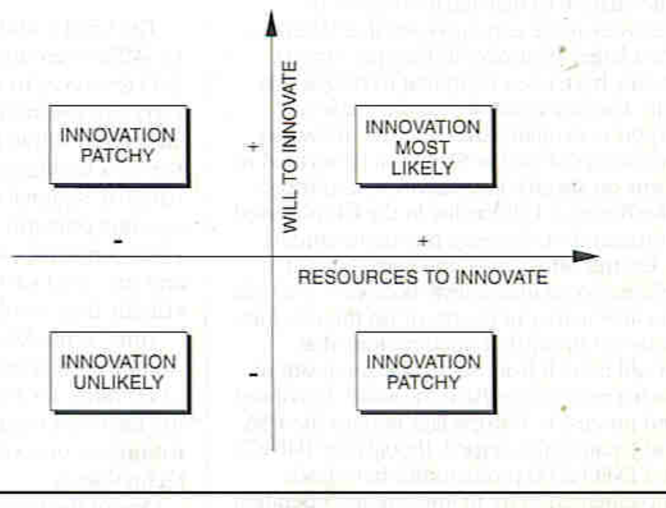
Within this scenario are identified the technology management techniques such as quality systems, participative management, value analysis, design, economic intelligence, just-in-time production, re-engineering and performance ratings, etc.. On this basis, the companies that are most likely to be innovative are the ones which, from the top down in management, are focusing on innovation.

At the same time, while it is recognised that it is the manufacturing sector that ultimately produces the final product on an assembly line, the service sector skills that are pivotal parts in facilitating the process of innovation, have assumed greater importance. These would be identified as training, research, marketing, counselling and financial engineering. Often, these skills are every bit as important as the actual process of developing the innovative product.

Signs of Convergence

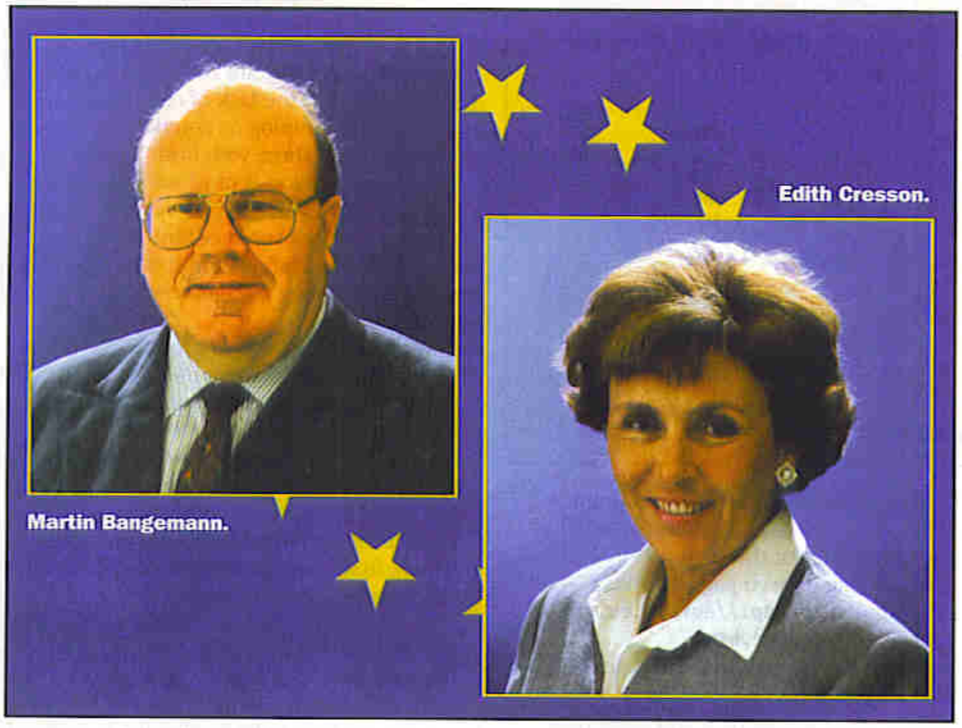
National countries, are, however, responding to demands for a sharper focus on innovation planning. In the UK, the British Technology Foresight Project and the Centre for Exploitation of Science and Technology (CEST), are already finding parallels in the EU countries, in particular, France, Germany and Holland.

Figure 4. How the presence or the absence of the will to innovate and the ability or the lack of ability to innovate at the technical scientific level is likely to affect innovative developments.



	Percentage of Firms EU-12	Percentage of Firms USA	Percentage of Jobs EU-12	Percentage of Jobs USA
Base (millions)	> 5,780	5,074	95,000	93,469
Micro (1-10) staff	93·2	78·3	31·9	12·2
Small (11-99) staff	6·2	20·0	24·9	20·0
Medium (100-499)	0·5	1·4	15·1	14·4
Large (500+)	0·1	0·3	28·1	46·4

Table 2. Size distribution of enterprises and employment share.



Martin Bangemann.

Edith Cresson.

Focus on SMEs

In the parlance of the European Commission, the SME (Small to Medium Sized Enterprise – of less than 100 employees) is seen as the key to employment growth. In the European Union as a whole, firms with less than 100 staff make up 66% of jobs. A key factor is also that employment growth is very largely restricted to SMEs. The employment base within large companies is shrinking. Table 2 summarises the key difference between company structures in the USA and Europe.

The key difference between the USA and Europe lies in the typically smaller size of companies. This tends to result in under-staffing at management level and a lack of technical resources to manage technological change. Also, the cost of know-how and information to manage innovation is relatively more expensive for the SME than for a larger company. In Europe, various means have been identified to bridge this gap. Use, for example, can be made of expert consultants. Also, 'clubs', networks or clusters of similar SMEs can be formed to focus on specific innovation related topics. The Business Link facility in the UK is geared primarily to addressing this requirement.

On the other hand, the very fact that information is increasingly becoming available 'on-line' across networks or on the Internet, does not imply that organisations that would benefit from such data are aware of such a resource or have the ability to contact and process it. Europe lags behind the USA and Japan in this regard, though the IMPACT and INFO 2000 programmes have been implemented to try to improve the operation of the European Information Market.

Also, not all industrial sectors are of equal 'value' for innovation. Some more traditional sectors, such as textiles and ferrous metals, are in relative decline while others such as aerospace, scientific instruments and computers are expanding. Unfortunately, Europe has tended historically to invest in low and medium technology industries which may offer a relatively poor return on investment.

The Task Forces

The European Commission, in addition to broadly based initiatives seeking to improve the climate for innovation, has a separate Task Force initiative which has identified eight technology topics for focused action. These include:

a) New generation aircraft.

b) The car of tomorrow.

c) Multimedia didactive software.

d) Vaccines and viral diseases.

e) Intermodality in transport.

f) Marine systems of the future.

g) Environmentally friendly water technologies.

h) The train of the future.

The CRAFT initiative is specifically tailored to SMEs or groups of SMEs with few or no R & D resources to resort to third parties to carry out research. The system is also structured within Europe for a CRAFT network to inform and assist SMEs at national, regional and local level. This is assisting primarily in the role of encouraging small companies to innovate their products and this would achieve better long-term viability than would otherwise be the case.

Thus, at the level of the European Commission, a lead is being given to the use of EU funds for innovation, as opposed to the historical trend of national governments to support uncompetitive, obsolete technologies.

One of the initiatives of the European Commission in this regard has been to establish the Institute for Prospective Technological Studies (IPTS) in Seville – apparently without trace of a web page.

The first mission of the IPTS is to establish a technology watch to initiate a flow of information relating to movements in technology needs and requirements. This will require also, the establishment of an inventory of relevant resources across the EU.

Education and Training

The SOCRATES (education) and LEONARDO (vocational training) programs place the emphasis in improving the quality of education, the mobility of students and teachers and recognition of the need for on-going training throughout one's life.

SOCRATES

(http://europa.eu.int/en/comm/dg22/socrates.html)

This action program is primarily to develop the European dimension in education, not so much by way of spreading conformity, but by stimulating development, in a wide range of supportive initiatives. For the period 1995-1999, a budget level of ECU 850 million has been established. Initiatives also part of SOCRATES programme include ERASMUS for higher education, LINGUA in the field of language learning, COMENIUS for social education and ODL for open and distance learning.

LEONARDO DA VINCI

(http://europa.eu.int/en/comm/dg22/leonardo.html)

This is an action programme for the implementation of a vocational training policy in the European Community and has evolved out of initiatives under COMETT, PETRA, FORCE and EUROTECNET.

Human Resources

It is recognised Europe-wide that the level and dissemination of technical education is inadequate and that this is primarily because science and technology are inadequately covered in basic education. Typically, there is too little technology content in the teaching of scientific disciplines, with teacher training failing to keep up with advances in the science and too few involved in science and technology courses.

The white paper on education and training entitled 'Teaching and Learning: Towards the Knowledge based society' has been published by the European Commission and seeks to address various key imbalances in the education and training framework. The principal objectives for implementation on a European scale in 1996 are cited as follows:

a) To encourage people to acquire new skills.

b) To bring schools and business sectors closer together.

c) To combat exclusion (e.g., shut out from educational sector).

d) Proficiency in THREE European languages.

Reducing Startup Overheads

While Europe is often presented as being bureaucratic, and obsessed with forms, it is clearly recognised that processes such as the registering of companies can take significant time and resources and with some member states being more of a problem than others but with the lightest European burden being considerably greater than the corresponding burden in the USA.

There is a move within the EC to establish an entity called the 'European Company' as a simplified format which could be implemented – Europe wide – to ease the process of forming new companies. This implementation, however, is blocked by a disagreement within the council. (By who?)

Directorate-General XIII

(http://europa.eu.int/en/comm/dg13/dg13.html)

This Directorate of the commission has specific responsibility for Industry, Telecommunications, Information Market and Exploitation of Research. This web page provides links to two major sources of information of development programmes.

I'M EUROPE (**http://www2.echo.lu/**) provides access to ECHO, an EC host system providing free access to over 20 online databases on the European Information Market.

CORDIS (**http://www.cordis.lu/**) provides access to a wide range of databases relating to initiatives of both DGXII and DGXIII.

As stated previously, these are extremely powerful web pages – providing online access to very large amounts of data related to encouragement of Innovation and economic growth. Also, they continue to grow steadily as the results of programmes and initiatives come on stream.

Summary

The economy of Europe is described as 'marking time'. The low rate of economic growth and the rise of unemployment in member states such as France and Germany point to a reality that all of these factors tending to limit innovation are in fact doing so.

In the UK, however, several of the strands of these central arguments on innovation can be seen as implemented policies, which reflect the central drive of the European Commission's arguments on innovation.

Edith Cresson's paper on innovation makes interesting reading. It advises that society should as a whole be propelled to become innovative and that the scope of innovation should be seen in a more expansive way than the rather limited/eccentric pattern that the media likes to display. It is curious, also, that this debate of great clarity and intensity has not been carried forward to any great extent by the media in the UK.

In this way, companies such as Maplin plc are providing innovators with the wherewithal to develop new products. Never has there been more scope by way, for example, of new semiconductor technologies to develop new products.

At the heart of Europe, however, the clear message is – IT'S GOOD TO INNOVATE.

Points of Contact

Institute for Prospective Technological Studies,
World Trade Centre Building,
Isla de la Carluja,
s/n, E 41092,
Seville, Spain.
Tel: (0034) 54 58 8273.

Mediascience international,
9 rue du Beau Site,
B-1000, Bruxelles.
Tel: (+32) 2 649 99 89.
(link web page
http://www.cordis.lu/vips/src/)

Centre for Exploitation
of Science and Technology (CEST)
(**http://www.cest.org.uk/cest.html**)

Innovation Relay Centres UK
(one of several)
Euro Info Centre (EIC),
21 Bothwell Street,
Glasgow, G2 6NL.
Tel: (0141) 221 0999
Fax: (0141) 221 6539.

European Commission
Offices in the UK
Jean Monnet House,
8 Storey's Gate,
London, SW1 P3AT, UK.
Tel: (0171) 973 1992
Fax: (0171) 973 1900.

AIR YOUR VIEWS

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

MERG to the Rescue!

Regarding the letter 'Trainspotter's Guide' from Peter Smith in *Electronics and Beyond* No. 116, I'm the Secretary of MERG and might be prepared to pass on the query to a site in the US which may well be able to help. BUT, I really can't make much sense of the letter – e.g., "A Velleman Speed Controller connected to the PRIMARY of a 20-0-20V transformer....", etc. Also – breaks up the input AC...and can be a dangerous animal! He continues, "I remember being told that if the centre tap goes open circuit, the whole mains voltage appears at the output." When I started to read the letter, I had decided that he really meant SECONDARY when he wrote primary – until I got to the last bit. It's a miracle the bloke's still able to write a letter! I don't really feel that I could pass on the text verbatim, and I have to say I'm a little surprised that the letter was printed as it stood, but if you are prepared to pass on his address and any information you have on Velleman controllers, I will try to get some help.

Paul King (Hon. SEc. MERG), Hassocks, W. Sussex.

The problem we face when printing such letters is that if we were to try and translate the original letter into what we feel would be a technically correct version, it could end up requesting information that wasn't required after all! Therefore, even if a letter does seem somewhat nonsensical, it's often best left in its unaltered form so that the gist of the letter doesn't get changed, on the offchance that someone is able to understand the problem described. Thanks for offering to help – we'll pass on the details to you. Good luck!

A Drain on Resources

Dear Sir,

Having constructed the U2400 intelligent nicad charger project when it was first published, I was delighted when the MkII version was produced. It was particularly satisfying to be able to upgrade to this much improved version without having to buy the entire kit again. Constant use with the dozens of nicad batteries which I seem to need to keep my house running has highlighted a problem of battery management which suggests another project you might consider. Different batteries of the same type develop varying charge capacities, which means that if one battery of a set fails, the rest of the set then has to be recharged as well, even though there may be plenty of life left in them. What would be useful is a capacity meter which would enable me to match batteries of the same capacity so that they all discharge at the same time. The meter could perhaps take the form of a constant current discharger with LCD counter so that fully charged batteries may have their capacities measured. Any chance?

Gerry Cohen, gerryco@compuserve

Good to hear you have found the project to be useful. There are nicad chargers available which provide a battery test facility (e.g., the Deluxe Nicad Charger, YN27E), while some will reject defective cells (e.g., the Battery Manager Ultra, UG00A, which even gives indication of the expected life of a recharged battery!). Nevertheless, your project suggestion has been noted.

In this issue, Dr. Roger D. Beauchamp, of Uxbridge, Middlesex, wins the Star Letter Award of a Maplin £5 Gift Token for his green-fingered technical enquiry.

£5 MAPLIN GIFT VOUCHER

Star Letter

Dear Sir,

I had a long and helpful discussion with the technical experts on your Technical Helpline this morning, and they suggested I write to you to regarding the particular technical problem I have encountered. The main point of the problem is that I wish to use the LM1830N Fluid Level Detector to operate a mains switching relay controlling a water pump such that when the electrodes are open, the pump is switched off. The purpose of the device is to ensure that when a water butt reaches minimum level, a spray line pump is protected from continuing to operate by running 'dry'. I have connected pins 12 & 14 of the detector to an opto-triac (the opto-triac and triac I have used are those listed in the catalogue under order codes RA56L and QL14Q, respectively), and have found that when the electrodes are 'open', the relay 'chatters'. If connection was made to the pump in these circumstances, then there would be rapid burnout. Your technical experts were unsure as to what advice to give me. The simple circuit shown in the 1997 Maplin Catalogue describes the operation of a loudspeaker or an LED as a warning device for low water level and the article in the September 1996 *Electronics* also describes a similar application. From a practical standpoint, I would have thought that the main emphasis would preferably be on the control of a device which would respond to the warning of a low water level, thereby providing protection of the kind I have described. I hope my enquiry may be of some use to you. I would mention that I am NOT an electronics expert – as no doubt, you will have gathered! – but rather, a horticulturist who is trying to use devices to make life a little easier in orchid growing, where I need a supply of misted (pumped) rainwater from a butt. I would have thought there was some considerable scope for the device I have in mind.

It's a good thing that your letter got passed to us, else you wouldn't have won this month's free gift token – fate works that way sometimes! A possible reason for the relay chattering is that the LM1830N gives out an oscillating (500Hz) output signal, designed to drive a loudspeaker (so that an audible signal is heard when the water level drops). Thus, even if you used an opto-triac to drive the relay from this output, the relay will effectively be switched on and off in rapid succession, causing it to buzz or chatter! You would need to convert the oscillating output into a steady DC one to give the relay a clean switching action, perhaps by using a diode pump (excuse the pun; the 'pump' in this case is a largish value electrolytic capacitor fed by a forward-biased diode) in between the LM1830N output and the opto-triac. Alternatively, try connecting a large value (several thousand microfarad – μF) capacitor between pins 12 & 14 ('+' side to pin 14) of the LM1830N, which should reduce the tendency for the relay to oscillate. It also sounds as though you need to add an inverter stage on the output, so that when the electrodes are dry, the output is switched off; as described, your circuit is performing the opposite switching action to that you require!

Crossing the Tracks

We all know that 'Trainspotter' has now become a term of abuse (whereas the proponents of lorry spotting have recently been spoken of with admiration in some sections of the media!), so it is a pity that Peter Smith's letter concerning model railway controllers in Issue 116 of *Electronics and Beyond* should have been headed 'Trainspotters Guide'.

Gerry Bates, Sheffield.

The heading to Peter Smith's letter was not intended to be in any way derogatory to those who undertake trainspotting as a hobby – it just happened to be in some way appropriate to the letter's content and was snappy and attention-grabbing (it obviously got yours, didn't it!).

Spreading the Word

Dear Sir,

Re: Sound reinforcement systems; radio microphones (*Electronics* Issue 102). It's true to say that there are five unlicenced radio-mic channels available within DTI specifications MPT 1311 and MPT 1345. However, if you attempt to use all five of these channels at once, you will have difficulty with channel 4 (174·8MHz) and possibly, but not always, channel 2 (174·1MHz) due to interaction between the various transmitters. (There is a good summing-up of the situation in the current Canford Audio catalogue). It's always worthwhile to ask around the area too, to discover other users! I work in a church which uses channel 3. Our Anglican friends over the road use channels 1, 2 & 5. There is a disco just over the way from us both; it sometimes enlivens the services of the Anglicans in ways not entirely acceptable to the vicar. . . .

Arthur Johnson, Gillingham, Kent.

Better not let the DJ know. He may try to charge the Anglicans for *his* services.

Torroidal Earthing #1

I feel compelled to write to you to point out the contradictions in the constructional article on page 20 of the August edition of *Electronics and Beyond*. I quote: "Make sure the earth wiring is secure with connections using 10A cable both to the bolt on the transformer and to the panel on one of the bolts on the iron socket." ... and shortly after ... "Check that the bolt holding the transformer does not touch the top of the case. This would provide a short round the transformer." The earth connection from the top of the transformer mounting bolt to the chassis would itself constitute a shorted turn. A more appropriate place for this earth connection would be a separate earth bolt fitted to the base of the chassis. With the recommended case (XY44Y), removal of the paint around this bolt and the use of a shakeproof washer would also help to ensure a good electrical connection. Another point to be wary of when using torroidal transformers is to not over-tighten the mounting bolt to the point where the windings are damaged.

Ant Goffart, Electronic Design Engineer.

Torroidal Earthing #2

Dear Sir,

Referring to the Soldering Iron Controller Project in your August 1997 issue, page 16 through 21. I am concerned as to the wiring of the earth leads in the photograph on page 16 and the text on page 21. Please correct me if I am wrong, but the case of this project is aluminium (Page 391 of your March-August 97 catalogue). The text on page 20 states "Check that the bolt holding the transformer does not touch the top of the case. This would provide a short round the transformer." I agree, however, attaching the earth leads to the top of the transformer bolt does this just as effectively since, also on page 20, "Make sure the earth wiring is secure with connections using 10A cable both to the bolt on the transformer and to the panel on one of the bolts on the iron socket." The resulting shorted turn will carry a heavy current, possibly as much as 30A, and will get very hot which will have safety implications and will almost certainly result in poor operation of the unit. On a related note, I am not sure of the construction of the Antex TC50 iron, but unless it has an internal ESD resistor, the connection from the centre pin of the socket to earth should be a large value resistor, e.g. 100kΩ or 1MΩ metal film type. It has not been practice to earth soldering irons directly for some years; similarly, a work bench should have a dissipative rather than conductive surface. This is because it was found that discharging the static potential of the device itself to ground via a low resistance can do enough dI/dt damage to destroy the device. The practice in the Aerospace industry is to keep humidity high and avoid conductive surfaces in favour of multi-layer carbon composition materials which provides a uniform dissipative surface. See ESA publication PSS-01-708/738. I have been a regular reader of your magazine since 1983 and always enjoy it, best wishes for the future I look forward to reading it!

John Dunton BEng (Hons), AMIEE
(and ESA Qualified Surface Mount Assembly Operator!)

Torroidal Earthing #3

Dear Sir,

The Digital Soldering Iron Controller project in the August '97 edition of *Electronics and Beyond* clearly shows earth connections being made to the top of the bolt holding down the torroidal mains transformer. DO NOT TRY THIS AT HOME. It is extremely dangerous. The point is already made (on page 20) that shorting the top of the bolt to the case effectively places a shorted single turn around the transformer core. Taking earth connections to the this bolt can have exactly the same effect. In fact, in the article (page 20), we're told to connect an earth lead from the top of the bolt to the output socket fixing bolt, which creates a single shorted turn straight away. Besides this, any contact between the case of this piece of equipment and another earthed device will also create just such a single turn. Earthing connections – or connections of any kind – should never be made to the top of a torroidal transformer mounting bolt, however superficially attractive it may seem. Besides the electrical dangers outlined above, there is the added danger of the bolt working loose (it shouldn't be tightened all that far anyway, and there are rubber washers either side of the transformer, which itself is quite heavy).

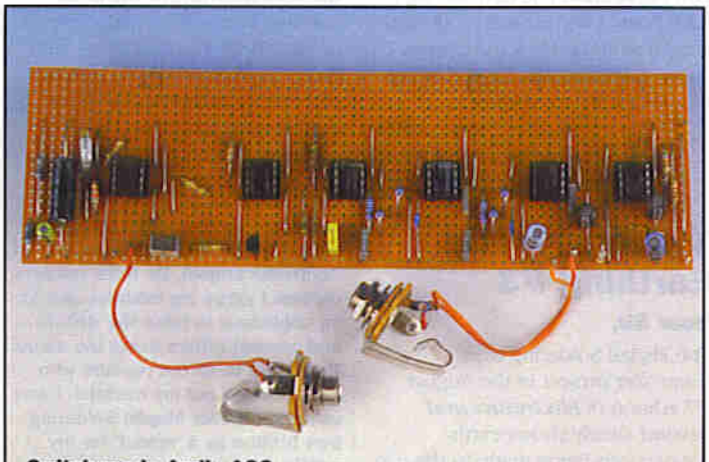
Chris Beeson (cbeeson@cix.co.uk)

Our thanks to those who contacted us about this error. The author of the Digital Soldering Iron Controller project, Dr. Mike Roberts, replies: I agree my mistake should be publicised to raise the debate and prevent others doing the same. Thank you to all the readers who have pointed out my mistake. I was using the earlier Maplin Soldering Iron Station as a 'model' for my article. This uses a similar earthing arrangement BUT uses a plastic case. Much of electronics involves taking published ideas and adding one's own. This demonstrates the care required in doing this. I hope this publicity will help prevent similar mistakes in the future. I have advised all who are building my controller to *make the earth connection direct to the chassis and from there, to the PCB*. I apologise if I have misled any readers. Additional points are that the specified case (XY44X) has a galvanised steel internal chassis (please check), so removal of paint is not required – but this and the use of a shakeproof washer is clearly good practice. Also that the iron can be earthed via a high value resistor, as long as the mains transformer meets the appropriate isolation criteria. I felt it was safer to have the iron earthed (as with the earlier Maplin Soldering Iron Station).

Educational MINI CIRCUITS

PART 2

by Robert Penfold



Switch-mode Audio AGC.

Switch-mode Audio AGC

Audio automatic gain control (AGC) circuits are commonly used in tape recording, but can be used in virtually any situation where the input level to a piece of audio equipment is unpredictable. These circuits are also known as limiters, and their purpose is to prevent the output signal from exceeding a certain level. This prevents subsequent equipment from being overloaded, and avoids the severe distortion which would otherwise be caused by the resultant clipping. The basic action of the circuit is to allow the input signal to pass normally until a certain threshold level is reached. Above that level, the gain of the circuit reduces as the input level increases. This results in the output level rising by only a few dB even if the input signal increases by a factor of 10 or more.

Switching Attenuator

Basing an audio limiter on a voltage controlled attenuator, which in turn uses a J-FET as a voltage controlled resistor, is a common approach to the problem. A major drawback of this method is that it tends to produce quite high levels of distortion. This is simply because a J-FET does not provide pure resistance, especially when it starts to turn on. The lack of linearity produces a form of soft clipping on negative half-cycles, together with what are often quite high levels of distortion. Improved results can be obtained by using feedback over the J-FET, but this common ploy still leaves distortion levels of several percent. Vastly improved results can be obtained by using the J-FET in a switch-mode attenuator, and Figure 1 shows the basic arrangement for a voltage controlled attenuator of

Figure 1. The basic arrangement used in a switch-mode atennuator.

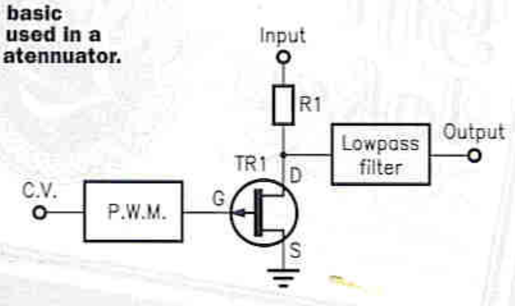
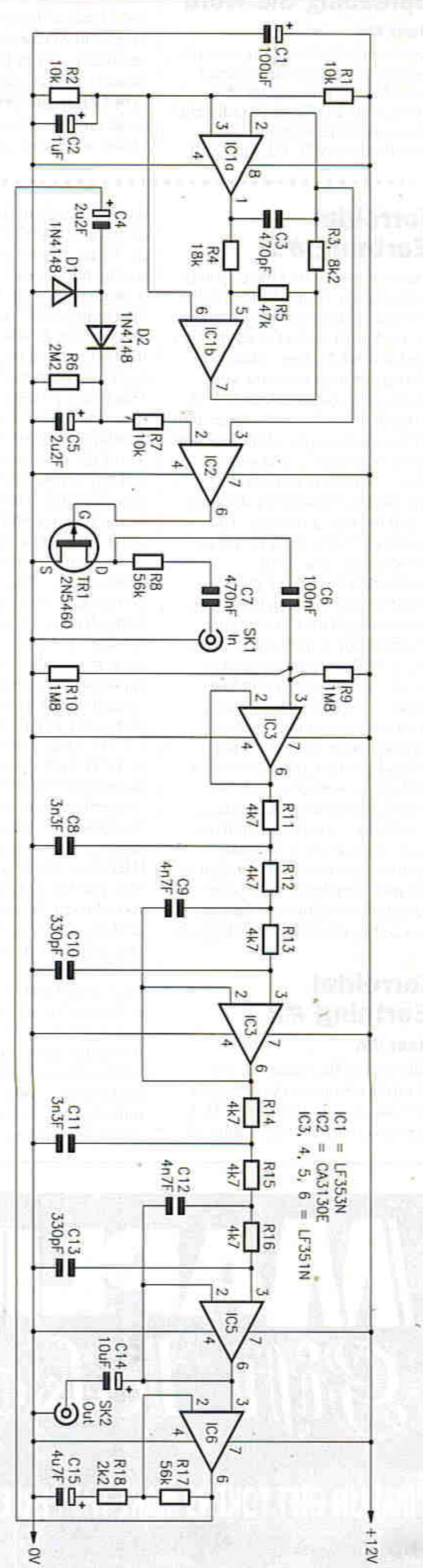


Figure 2. Switch-mode Audio AGC circuit diagram.



this type.

TR1 and R1 form what looks very much like a normal J-FET voltage controlled attenuator, but TR1 is controlled by the pulsed output signal of a pulse width modulator which operates at about 90kHz. TR1 operates as a simple electronic switch and not as a voltage controlled resistor. The output signal is switched on when TR1 is switched off, and turned off when TR1 is switched on.

With a low control voltage fed to the modulator, it provides short output pulses. If the input voltage is taken to the middle of the control range, the output pulses become longer but the output frequency remains the same. This bunches-up the output pulses and produces a roughly squarewave output signal. Taking the control voltage towards the upper limit of the control range results in the output pulses becoming even longer, giving an output signal that has a very high mark-space ratio. The average voltage of the output signal is proportional to the input voltage.

Clearly, the audio input signal is severely chopped-up by the high frequency pulse signal from the modulator, giving an output signal that bears little resemblance to the input signal. However, feeding the chopped signal through a lowpass filter recovers the original input waveform. The crucial factor here is that the output signal is at a lower level than the input signal due to the fact that the output from TR1 is switched off for a certain proportion of the time. The greater the proportion of the time that the output of TR1 is switched off, the lower the average output voltage, and the smaller the recovered audio signal at the output of the lowpass filter. The gain from the input to the output of the circuit is therefore controlled by the input voltage to the modulator, and is proportional to this voltage.

Although this system may appear to offer no improvement over using a J-FET as a simple voltage controlled resistor, it actually provides far lower distortion. When TR1 is switched off, it has a drain-to-source resistance of thousands of megohms, and it therefore has no significant effect on the circuit. When TR1 is switched on, it provides a drain-to-source resistance of a few hundred ohms. Provided R1 has a fairly high value, this results in a large amount of attenuation through the switching circuit, but it does not result in the output signal being totally cut off. Any non-linearity through TR1 will therefore produce distortion on the output signal.

In practice, the amount of distortion introduced by TR1 is quite low because it provides virtually pure resistance when it is biased hard into conduction. Also, it is only when the circuit provides a very high level of attenuation that a significant proportion of the output signal is produced with TR1 switched on. Although a simple switch-mode attenuator might not be in the true super-fi category, the distortion performance is very much better than that of a basic J-FET voltage controlled attenuator. The total harmonic distortion is usually no more than a small fraction of 1% at any attenuation level, as opposed to the 10% or more produced by a basic J-FET circuit at low attenuation settings.

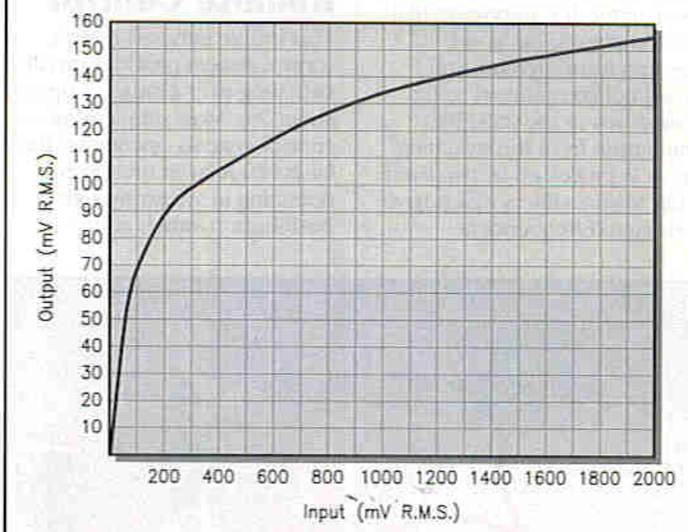


Figure 3. The compression curve for the prototype limiter.

The Circuit

Refer to Figure 2 for the circuit diagram of the switch-mode audio AGC unit. R8 and TR1 are the equivalents of R1 and TR1 in Figure 1. The pulse width modulator is a conventional type, having IC1 as the

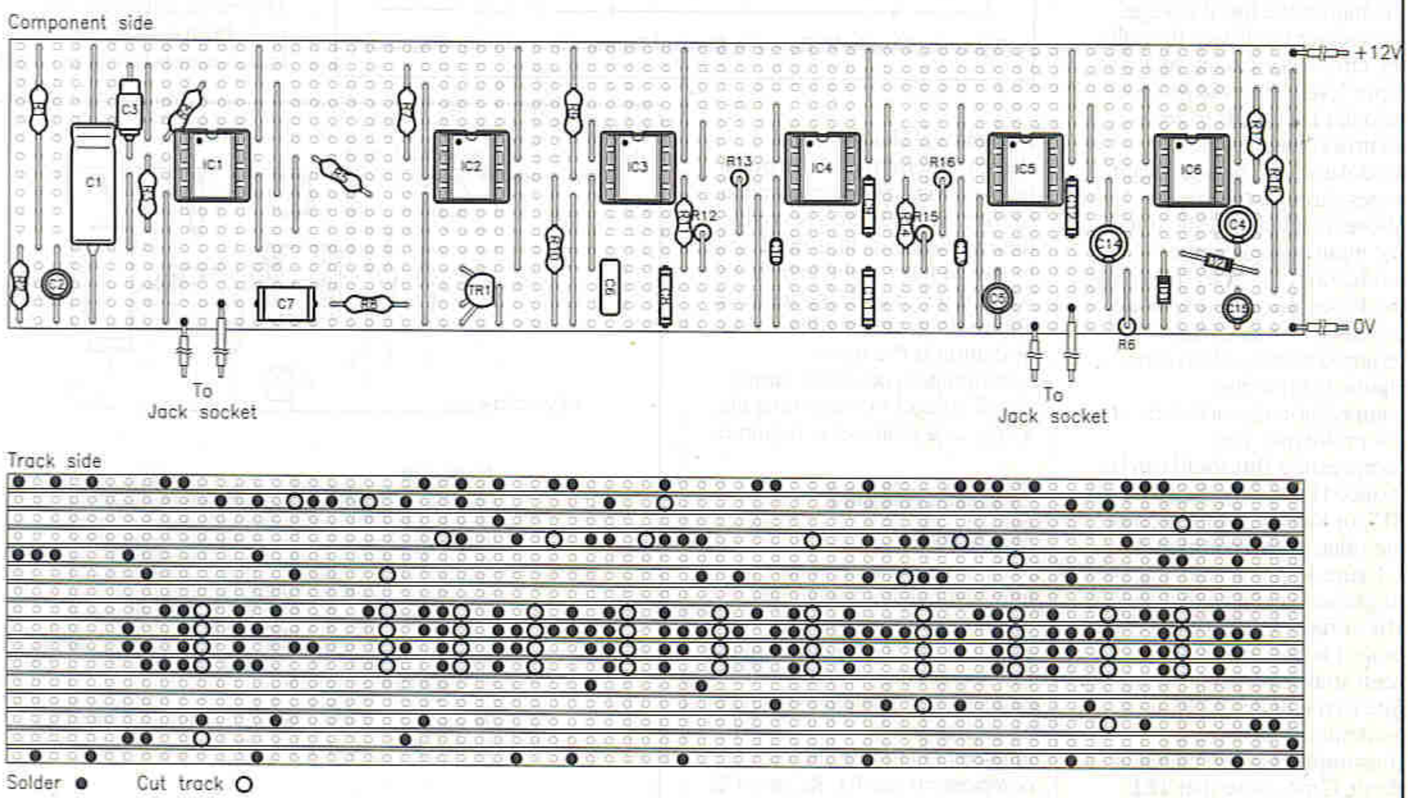


Figure 4. Switch-mode AGC stripboard layout.

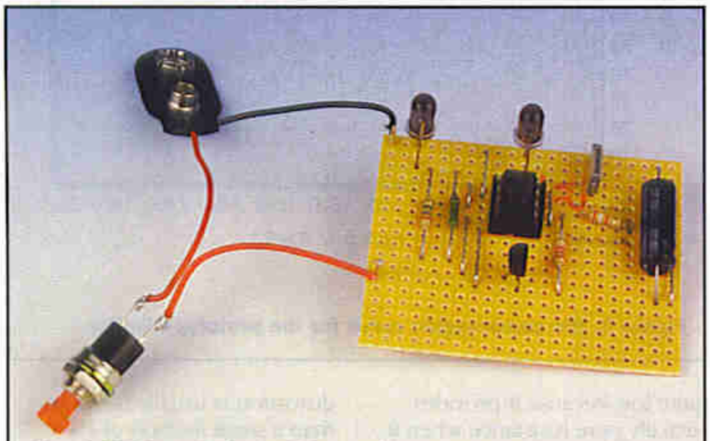
triangular waveform clock generator and IC2 as the comparator. It is important that the comparator has good freedom from latch-up, and I would not recommend using alternatives to the CA3130E. The output from the switching circuit is processed by two third order lowpass filters which have their cut-off frequency at approximately 20kHz. This provides the unit with the full audio bandwidth, but gives plenty of attenuation (nearly 80dB) at the clock frequency of 90kHz.

Some of the output signal is amplified by IC6 and then processed by a simple half-wave rectifier and smoothing circuit. This produces a positive control voltage for the modulator. The modulator is arranged so that the higher the input voltage, the greater the losses through the attenuator circuit. At low input levels, the voltage drop through D2 results in zero control voltage to the modulator, and no significant losses through the circuit. Above a certain threshold level, the input voltage to the modulator does start to rise and the losses through the circuit increase. This gives the required limiting effect, and Figure 3 shows the compression characteristic of the prototype. The compression threshold can be reduced by raising the value of R17, or increased by lowering the value of this component.

Figure 4 provides the suggested stripboard layout of the project. The component layout of this project is not critical, but try to keep stray capacitance from the gate to the drain of TR1 to a minimum. The current consumption of the circuit is about 12mA. Note that TR1 must be a P-channel device, and that the circuit will not function using an N-channel J-FET.

Simple IR Remote Control

This simple infra-red remote control system provides on/off switching over a range of up to about 7m. Most simple remote control systems operate on the basis of a relay in the receiver operating in sympathy with a push-button switch at the transmitter. This system is slightly different, and the push-button switch is operated once to turn on the relay, a second time to switch it off, a third time to switch it on again, and so on. While it is not appropriate to all applications, this method of operation is the more appropriate type where simple on/off control of something like a light or a radio set is required.



Simple IR Remote Control Transmitter.

Transmitter Circuit

Refer to Figures 5 & 6 for the infra-red transmitter circuit diagram and stripboard layout. This is by far the more simple of the two circuits, and it is basically just a 555 timer used as an oscillator which drives two infra-red LEDs. The timing components are R1, R2, and C2. These set the operating frequency at about 15·5kHz, but the precise operating frequency is not too important. It is advisable to use a fairly high frequency as this makes it easy for the receiver circuit to differentiate between the signal from the transmitter and 'hum' from 50Hz mains lighting. A very high operating frequency is not a good idea as the LEDs have reduced efficiency at high frequencies. An operating frequency of around 10 to 20kHz represents a good compromise. On the face of it, the system could use a non-modulated infra-red beam, but it has to be borne in mind that the output signal from the LEDs is quite weak. This makes it difficult to detect using a direct coupled receiver, where high sensitivity gives problems with drift. Also, a weak non-modulated signal would probably be swamped by the background infra-red.

A 555 timer can produce quite high output currents, but in the present application, it is slightly inadequate in this respect. Consequently, the output current capability of the circuit is boosted by an emitter follower buffer stage (TR1). This enables the two LEDs to be driven at a current of about 100mA each, but due to the roughly squarewave output signal, this gives an average drive current of approximately 50mA per LED. This represents the maximum safe drive current for most ordinary infra-red LEDs. S1 is the push-button on/off switch, and power is provided by a 6V battery (B1). Although the supply current is quite high at a little over 100mA, quite good battery life is obtained as the unit will only be operated briefly and very intermittently in normal use.

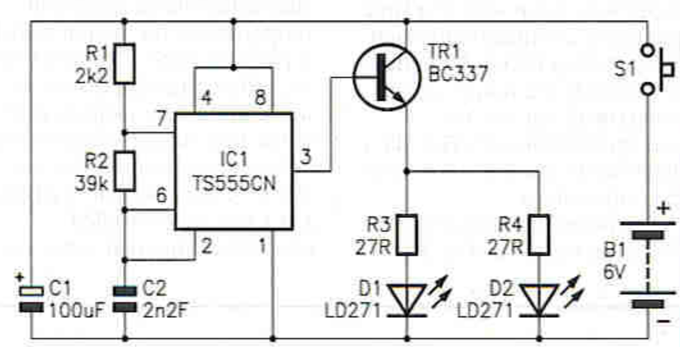


Figure 5. Simple IR Remote Control Transmitter circuit diagram.

Receiver Circuit

The circuit diagram for the receiver is shown in Figure 7. At the input of the circuit, there is an infra-red detector followed by a high gain amplifier. The amplified signal is rectified and smoothed, and the resultant positive DC signal is used to drive an inverting trigger circuit. Under quiescent conditions, the output from the smoothing circuit will be very weak, producing a high output level from the trigger circuit. In the presence of a proper input signal, a strong output is produced by the smoothing circuit and the output of the trigger goes to the low state. Therefore, each time the push-button switch at the transmitter is briefly operated, a

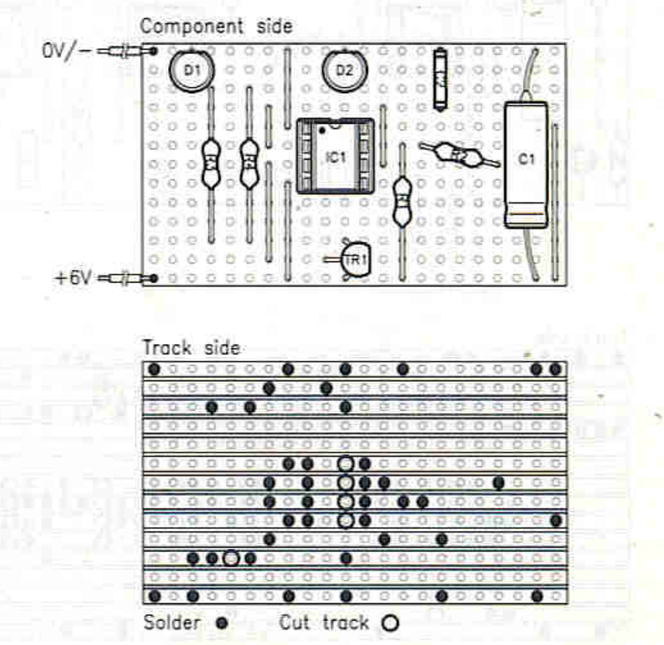
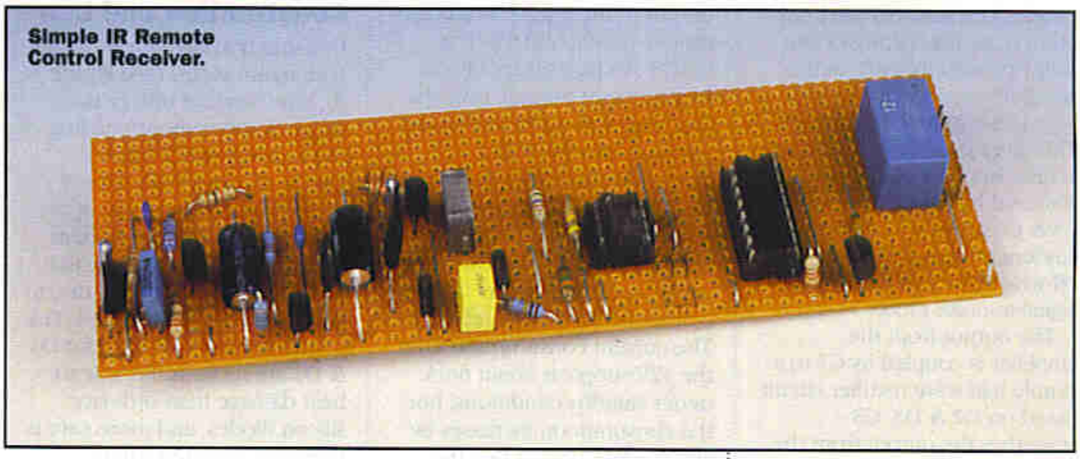


Figure 6. Simple IR Remote Control Transmitter stripboard layout.

negative pulse is produced at the output of the trigger circuit. The pulses from the trigger are fed to a simple divide-by-two stage which controls the relay via a simple driver circuit. Each input pulse toggles the output of the divider circuit and changes the state of the relay. In this way, the required successive operation of the relay is obtained. In the original design, the output signal from the amplifier was fed to a 14-stage binary divider chain, so that operating the transmitter for about half a second would cycle the system from on to off or vice-versa. Unfortunately, noise tended to give erratic operation with the original arrangement, so this more reliable system was developed.

Infra-red pulses from the transmitter are picked up by infra-red diode, D1. This is reverse-biased by R1, and like an ordinary diode, it passes only minute leakage currents. The pulses of infra-red produced increased leakage, and negative pulses are therefore produced at the cathode of D1. These pulses will normally be quite weak, and will in fact be well under 1mV Pk-to-Pk when the system is used near the limit of its range. A large amount of amplification is therefore needed in order to produce a strong enough signal to drive the rectifier and trigger circuits reliably. This amplification is provided by a three-stage transistor amplifier which uses capacitive coupling and has all three stages operating in the common emitter mode. The gain is somewhat excessive with all three stages operating at full gain, so local negative feedback is applied to TR1 by R4. The



Simple IR Remote Control Receiver.

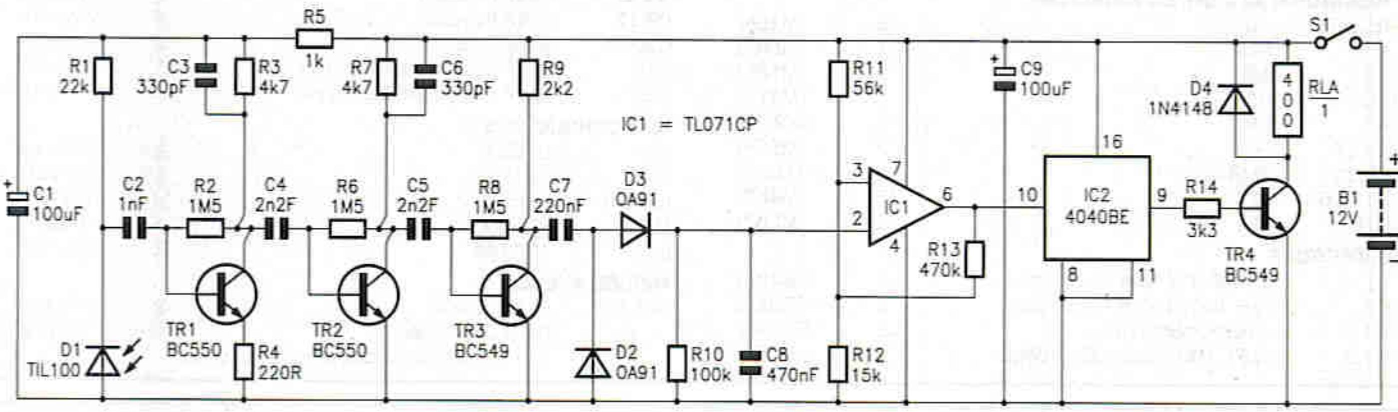
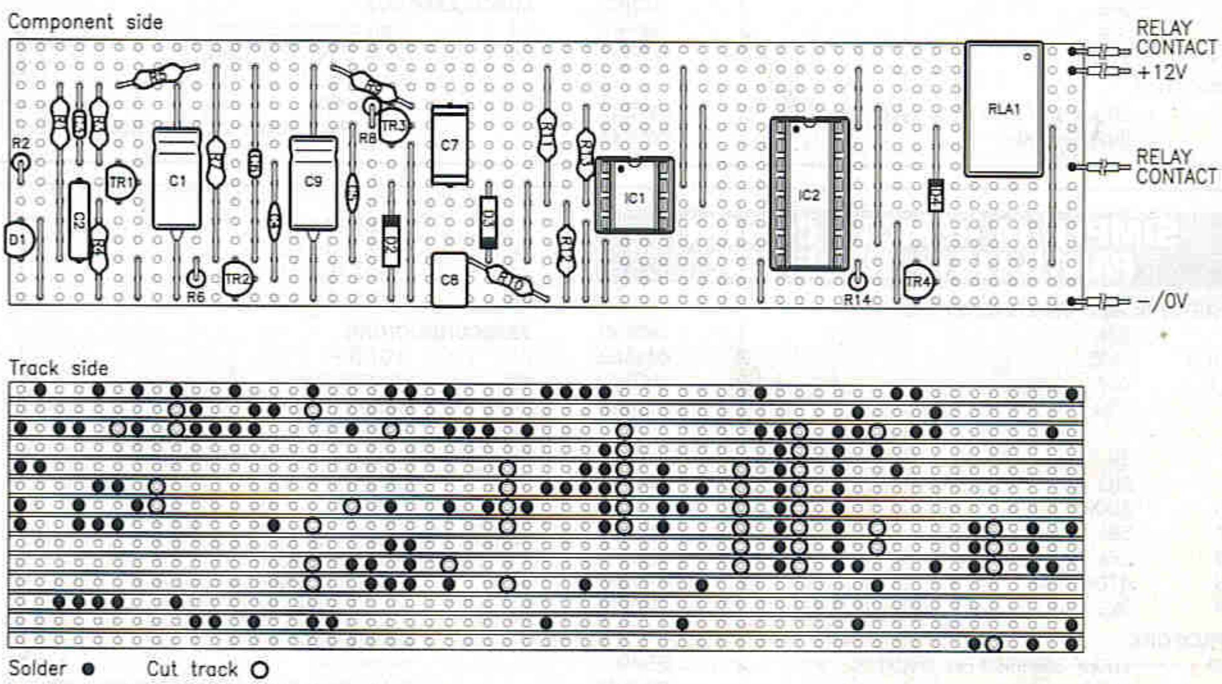


Figure 7. Simple IR Remote Control Receiver circuit diagram.

Figure 8. Simple IR Remote Control Receiver stripboard layout.



coupling capacitors have been given quite low values so that they operate efficiently at the signal frequency but produce high losses at low frequencies. This gives good attenuation of 100Hz 'hum' from mains powered lighting. Capacitors C3 & C6 provide a certain amount of high frequency roll-off which gives an improved signal-to-noise ratio.

The output from the amplifier is coupled by C7 to a simple half-wave rectifier circuit based on D2 & D3. C8 smoothes the output from the rectifier, and the resultant positive DC signal is fed to the input of a conventional inverting trigger circuit based on IC1. A certain amount of hysteresis is introduced by R13 and this helps to avoid problems with 'jitter' at the output of the trigger. IC2 is the divider circuit, and this is a CMOS 12-stage binary divide. In this circuit though, only the first stage is utilized so that the device is effectively just a simple divide-by-two flip/flop. The output of IC2 controls the relay via a simple common emitter switch (TR4). D4 is the usual protection diode connected across the relay coil. The current consumption from the 12V supply is about 6mA under standby conditions, but the consumption increases by about 30mA or so when the relay is switched on. The unit can be powered from a high capacity 12V battery, but a 12V stabilised battery eliminator is a more practical choice if the system is likely to be used for long periods.

Construction and Use

Construction of the transmitter is straightforward (see Figure 6), but there are one or two points to note about building the receiver (see Figure 8). Due to the very high gain of the receiver circuit, it is essential that the component layout is well designed so that problems with instability due to stray feedback are avoided. The germanium diodes used for D1 & D2 are more vulnerable to heat damage than ordinary silicon diodes, and more care is therefore required when soldering them into place. The 4040BE used for IC2 is a CMOS device and therefore requires the standard anti-static handling precautions. The system will only work properly if D1 in the receiver is able to receive the infra-red 'light' from the transmitter. It must therefore be mounted behind a cut-out in the case. The circuit should work properly using a TIL100 or any similar photodiode. With the specified Maplin device, the shorter lead is the cathode and the curved surface is the sensitive side of the device.

The circuit will work using any relay that has a 12V coil having a resistance of 300Ω or more, and contacts of adequate rating for your application. If the receiver is used to control mains powered equipment, it is essential that the normal safety standards are observed when building and installing the receiver. Those of limited experience should only use the unit to control battery powered equipment.

SWITCH MODE AUDIO AGC PARTS LIST

RESISTORS: All 0·6W 1% Metal Film			
R1,2,7	10k	3	(M10K)
R3	8k2	1	(M8K2)
R4	18k	1	(M18K)
R5	47k	1	(M47K)
R6	2M2	1	(M2M2)
R8,17	56k	2	(M56K)
R9,10	1M8	2	(M1M8)
R11-16	4k7	6	(M4K7)
R18	2k2	1	(M2K2)
CAPACITORS			
C1	100μF 35V Axial Electrolytic	1	(FB49D)
C2	1μF 100V Radial Electrolytic	1	(FF01B)
C3	470pF Polystyrene	1	(BX32K)
C4,5	2μ2F 100V Radial Electrolytic	2	(FF02C)
C6	100nF Polyester	1	(WW41U)
C7	470nF Polyester	1	(WW49D)
C8,11	3n3F Polyester	2	(WW25C)
C9,12	4n7F Polyester	2	(WW26D)
C10,13	330pF Ceramic	2	(WX62S)
C14	10μF 50V Radial Electrolytic	1	(FF04E)
C15	4μ7F 63V Radial Electrolytic	1	(FF03D)
SEMICONDUCTORS			
IC1	LF353N	1	(WQ31J)
IC2	CA3130E	1	(QH28F)
IC4,5,6	LF351N	3	(WQ30H)
TR1	2N5460	1	(UL38R)
D1,2	1N4148	2	(QL80B)
MISCELLANEOUS			
SK1,2	Phono Socket	2	(YW06G)
	8-pin DIL Holder	6	(BL17T)
	0·1in. Pitch Stripboard, Wire, Solder, etc.		

SIMPLE IR REMOTE CONTROL PARTS LIST – TRANSMITTER

RESISTORS: All 0·6W 1% Metal Film			
R1	2k2	1	(M2K2)
R2	39k	1	(M39K)
R3,4	27Ω	2	(M27R)
CAPACITORS			
C1	100μF 10V Axial Electrolytic	1	(FB48C)
C2	2n2F Polyester	1	(WW24B)
SEMICONDUCTORS			
IC1	NE555N	1	(QH66W)
TR1	BC337	1	(QB68Y)
D1,2	LD271	2	(CY85G)
MISCELLANEOUS			
S1	Push-to-make Switch	1	(FH59P)
B1	6V (4 3 HP7-size Cells)	1	(JY49D)
	Battery Holder	1	(HF29G)
	Battery Clip	1	(HF28F)
	0·1in. Pitch Stripboard, Wire, Solder, etc.		

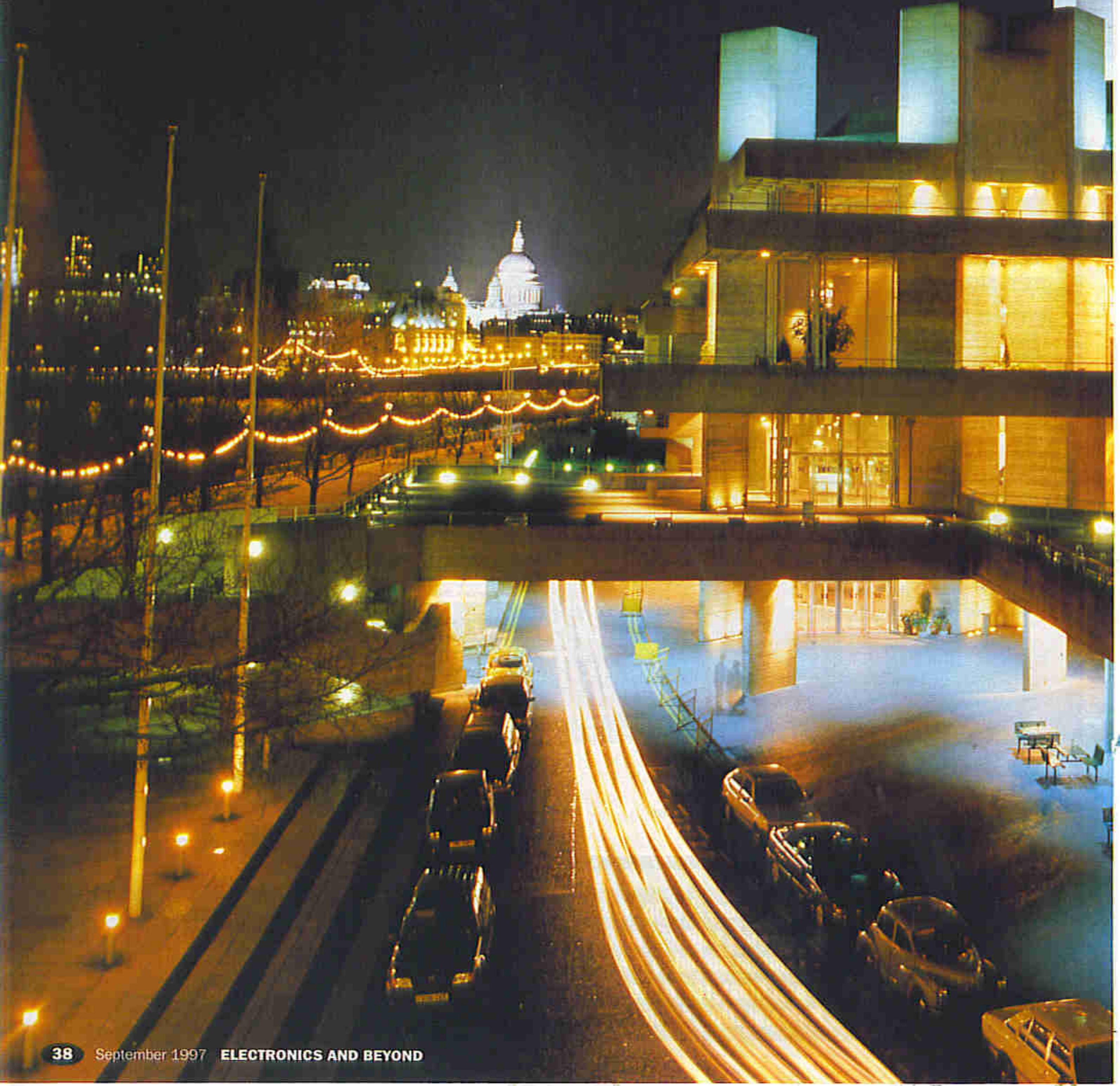
SIMPLE IR REMOTE CONTROL PARTS LIST – RECEIVER

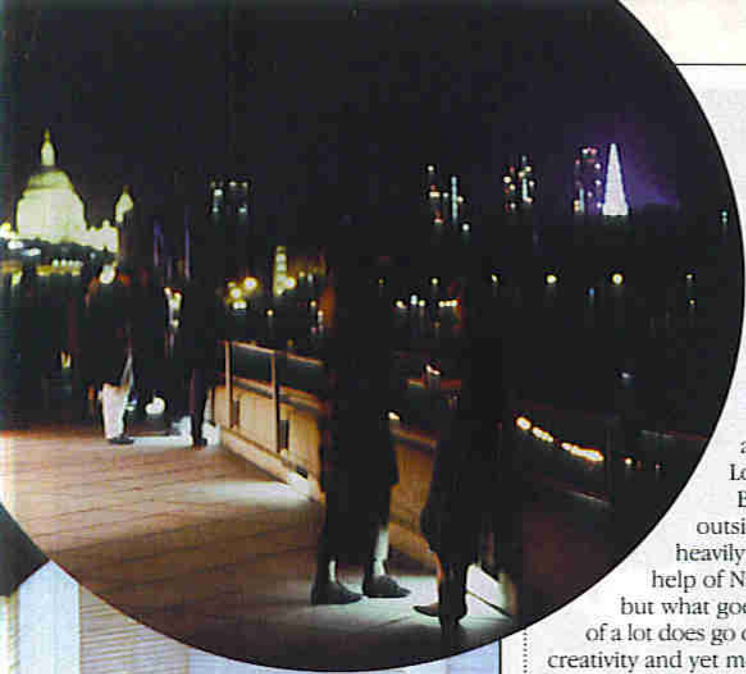
RESISTORS: All 0·6W 1% Metal Film			
R1	22k	1	(M22K)
R2,6,8	1M5	3	(M1M5)
R3,7	4k7	2	(M4K7)
R4	220Ω	1	(M220R)
R5	1k	1	(M1K)
R9	2k2	1	(M2K2)
R10	100k	1	(M100K)
R11	56k	1	(M56K)
R12	15k	1	(M15K)
R13	470k	1	(M470K)
R14	3k3	1	(M3K3)
CAPACITORS			
C1,9	100μF 35V Axial Electrolytic	2	(FB49D)
C2	1nF Polyester	1	(WW22Y)
C3,6	330pF Ceramic	2	(WX62S)
C4,5	2n2F Polyester	2	(WW24B)
C7	220nF Polyester	1	(WW45Y)
C8	470nF Polyester	1	(WW49D)
SEMICONDUCTORS			
IC1	TL071CP	1	(AV59P)
IC2	4040BE	1	(QW27E)
TR1,2	BC550	2	(UL49D)
TR3,4	BC549	2	(QQ15R)
D1	TIL100 or similar	1	(YH71N)
D2,3	OA91	2	(QH72P)
D4	1N4148	1	(QL80B)
MISCELLANEOUS			
S1	SPST Min Toggle	1	(FH97F)
RLA1	12V Relay, 300Ω or More Coil	1	(YX94C)
B1	12V (8 3 HP7-size Cells)	2	(AR43W)
	Battery Holder	1	(RK44X)
	Battery Clip	1	(HF28F)
	0·1in. Pitch Stripboard, Wire, Solder, etc.		

The Show MUST GO ON

by Alan Simpson

Think London theatre and the odds are that you will think The National – or rather, the Royal National Theatre on the South Bank.





Love or loathe the looks of the building – at least the cement-faced construction is now mellowing – the theatre occupies a brilliant location astride the Thames close by Waterloo Bridge. The copious balconies, lounges and restaurants provide a glorious view of London and beyond.

But it is not what goes on outside (currently being heavily refurbished with the help of National Lottery funding) but what goes on within. And a heck of a lot does go on. The levels of creativity, creativity and yet more creativity have thrilled and delighted countless South Bank audiences over the past twenty one years.

Unlike other theatres, something is always going on at the National. The spacious foyers and river terraces are open to everyone all day every day. There are free exhibitions, theatre tours, bars, buffets, a restaurant called Mezzanine, a large car park, and – about six times a month – Platforms (short, early evening performances given in one of the three theatres). The live music in the foyer, played before each evening performance and Saturday matinees, ranges from baroque to jazz, while the bookshops stock everything imaginable connected with the theatre, and a lot more besides.

Heritage and Culture

Britain's National Theatre was founded in 1963 – the culmination of sixty years of campaigning and planning – when Sir Lawrence Olivier established the Company in its temporary home at the Old Vic. In 1969, work began on a new building on the South Bank of the Thames, which was opened by The Queen in 1976. To mark the Company's 25th birthday in 1988, it was granted the title 'Royal'.

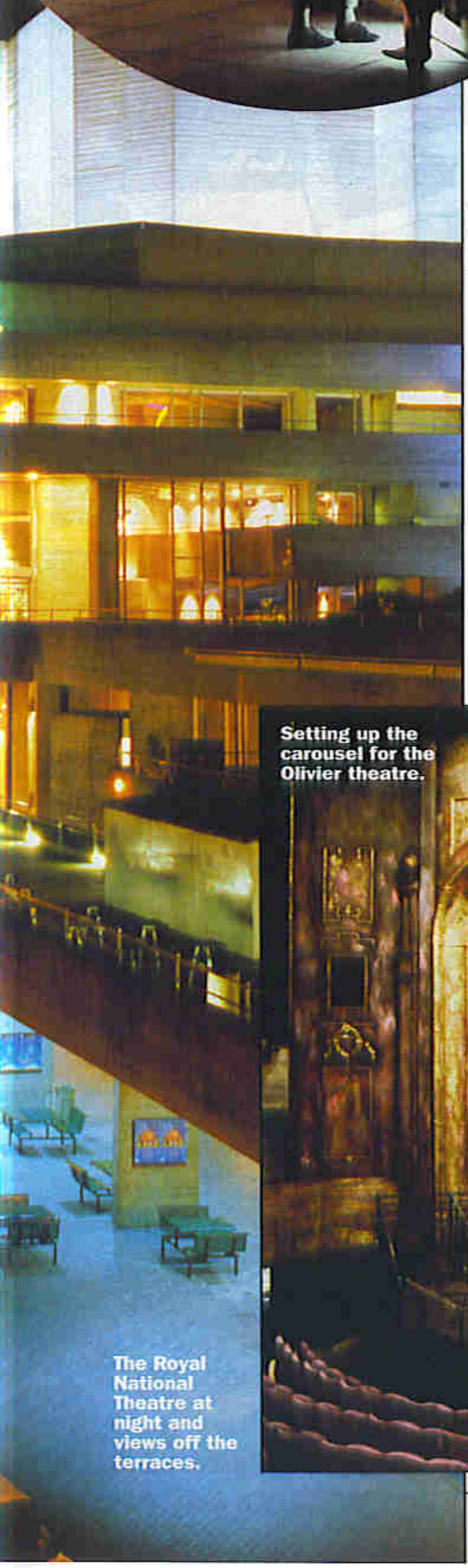
Within the theatre, there are three theatres under the one roof, each with its own style and character: the large open-stage Olivier; the proscenium-stage Lyttelton; and the small, adaptable Cottesloe. These contain, in all, nearly 2,500 seats. The National operates on the repertoire system, offering at any one time, an average of nine different productions. Since its inception, the Company has staged well over 400 plays, covering the work of 250 writers, spanning the 2,500 years from Aeschylus through Shakespeare and other classic dramatists to modern authors. It has provided work for more than 400 actors, 150 directors, almost as many designers and hundreds of technicians. Currently, the National employs about 750 people, including a company of 120 actors. The National's building is open 13 hours a day, 6 days a week, 52 weeks a year, and the public make a million visits a year to its facilities.

Lights, Music, Action

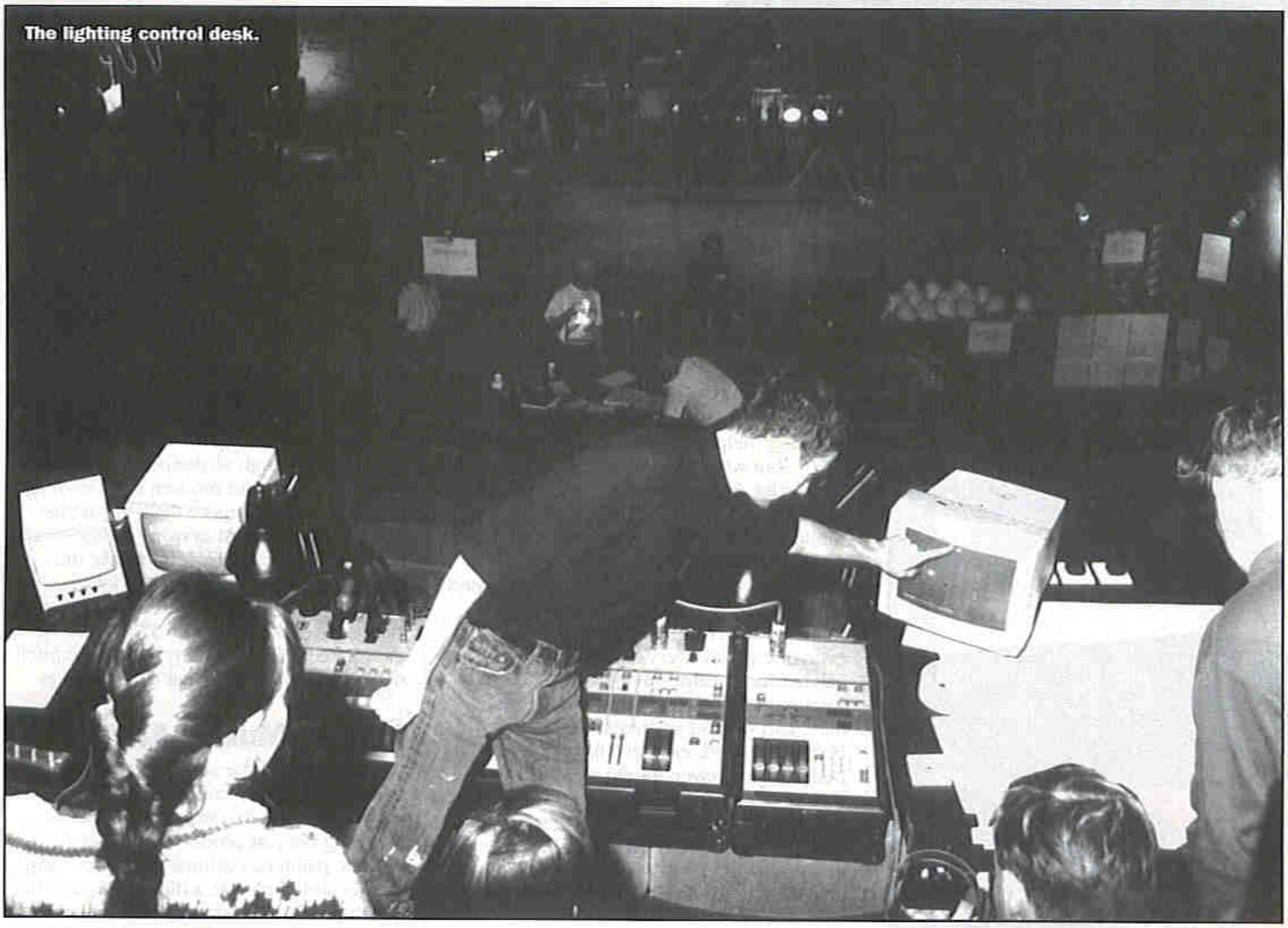
Working behind the scenes at the National is a dedicated, highly creative workforce. Each show is very much a result of teamwork, involving not just producers, but scene makers, painters, costume designers, script editors and of course, a director. Sound has a high profile in all shows, whether in the wide expanse of the Olivier and Lyttelton or the more intimate confines of the Cottesloe.

But equally – some would say more equally – is the role that lighting plays in modern theatre. This is where a bare stage can be turned into a dawn scene or a

Setting up the carousel for the Olivier theatre.



The Royal National Theatre at night and views off the terraces.


The lighting control desk.

carnival at the touch of a (or perhaps many) button(s). Helping to spread light into the National complex is Michael J. Atkinson, Project Manager, Lighting. "If you want a non-challenging job" says Michael, "then stay well clear of the theatre. Each and every event is an artistic and technical challenge. We are the ones who have to turn ideas and concepts into reality – or magic".

"With a possibility of handling 9 different shows in any one week, we have to keep on our toes at all times. Flexibility is the key to our working day, in designing, implementing and operating. Not for us the luxury of a single long running show where sound and lighting can be automated to a high degree. Nor the luxury of permanently erected special lighting gantries. We consider ourselves fortunate if shows run for 2 or 3 subsequent nights. First nights may be special to VIPs, guests and critics, but for us, every night must be seen as a benchmark performance."

A Well-lit Career Path

Michael has worked at the National for seven years, progressing from technician to project management and design. Overall, the National has a 20-strong team of electricians whose role is to maintain not only the stage and theatre lighting.

Now 31 years old, Michael can easily trace his theatre lighting ambitions back to school. Not only was he fired-up by a school visit to the Edinburgh Fringe, but from experience gained at the Abbey Theatre in St. Albans, where he was actively encouraged to take up a technicians role. While at Paddington College where he gained his City & Guilds qualification as a theatre technician, he spent one day a week on attachment to a West End or provincial theatre.

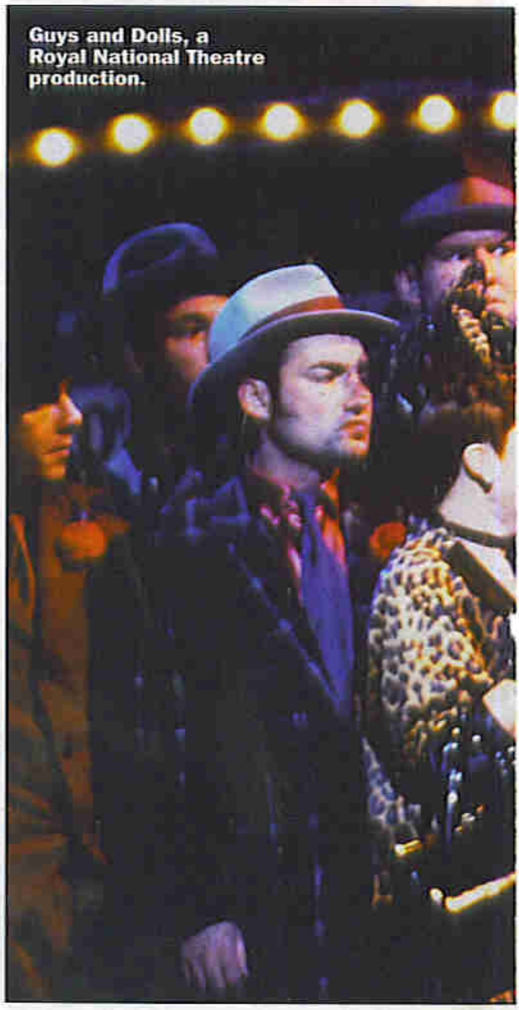
Emerging from college, he had a short stint working freelance as a designer and technician, where a member of the audience offered him his first professional job – at the Apollo Theatre in Oxford. Here, he went on tour with the Muppetts which led to a working relationship with Henson, the creator of the puppets in New York.

Returning to the UK, he joined theatre projects and Lighting Hire Company and worked on West End shows and cooperative events, specialising in lighting control. Then he was contacted by the technical manager of the National. The rest, as they say, is history.

Lights On – Sounds Off

Michael has no doubt about the merits of working in lighting rather than sound. "In a nutshell, lighting is an immediate medium – no pre-recording is possible. No automatic system yet available can anticipate the actors' next move – the beam of light must always remain in focus and behind the action. Only when the performers themselves are automated, can lighting follow suit."

As Michael confirms, you never know what will turn up next. One of his more exotic claims to fame is that of handling the lighting for a series of operas at the Freemasons Hall, Covent Garden.


Guys and Dolls, a Royal National Theatre production.

Getting Technical

There is no doubt about it. As in most other activity areas, the personal computer has revolutionised the lighting control system. Today's lighting desk is, in reality, a piece of software. Basically, the technician sits down in front of the console, switches all the dimmers in to differing colours and positions and presses the record button. The software recognises the mode and takes over. In some ways, the PC hardware board replaces the costly lighting circuit equipment board.

Nowadays, says Michael, technicians are having to change from being a technology in-depth expert to being computer literate with a good knowledge of electronics. Ethernet, for example, now plays a major role in theatre networks, assisting not just lighting, sound and show control, but moving scenery, hydraulics and pneumatics.

But even so, the job offers a very large element of human intervention. Someone with a feel for the show has to execute lighting cues: computerisation is a workhorse, not a substitute for hands-on operations. It is vital to get a prompt sequence of events in a single 30 second timescale. "If we get it wrong," says Michael, "then we could destroy the artistic intent – and perhaps trigger a dangerous situation for the cast on stage".

For the stage electrician, keeping up with technology on the drawing board as well as in the marketplace is a basic necessity of life. New levels of software created by specialist teams is becoming available. The need is to balance the hands-on with that of the automatic approach.

Moving Lights

When it comes to visible developments, that of moving lights takes some beating. Originally developed for pop concerts, the system is now moving into theatre having overcome its earlier operational noise problems. The labour-saving system allows one lamp to replace many focused lamps. Already, a set of vari-lites is being implemented into the Cottesloe Theatre to allow designers to have increased flexibility for creating that artistic magic. And of course, to enhance the 'benchmark' qualifications of the National.

Safety First

Lighting, of course, has more than a display function in the theatre. It lights corridors and audience exit routes, each vital safety factors. The theatre has an emergency back-up system which helps illuminate the evacuation of audiences, casts and behind the scenes staff. Although the back-up system does not power the main stage lighting (the Olivier dimmer room is supplied with a 1,000A 3-phase supply and it is not practical to back-up that amount of power), there is sufficient power to supply the vital system. The emergency lighting, as is required by regulation, is also battery driven.

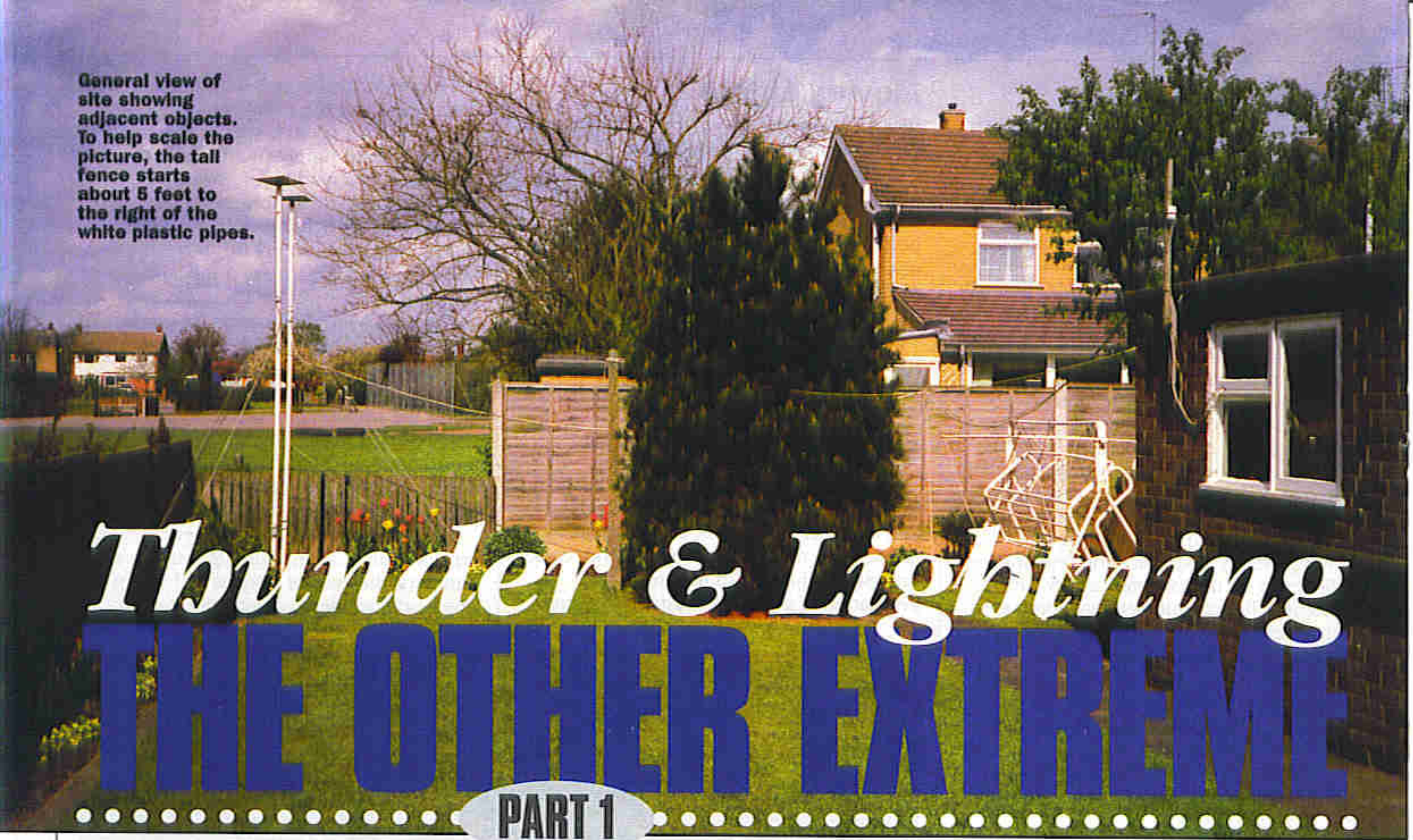
For the electrician crew, compliance testing is no easy matter. Every piece of equipment, some 7,000 items including cables, have to be routinely tested once a year. It is, says Michael, a virtual 'Forth Bridge job'. To add to the routine work loads, the whole National complex is undergoing a major revamp. The lottery award funds are being used to dramatically change the river frontage of the building and that of the Upper Ground frontage.

Within the revamp project, there is a total replacement of all the lighting systems: the dimmers, the control systems and wiring. The work includes replacing the stage floor in the Cottesloe. But, and it is a very big but, the theatre has to stay open – the Show must go on. Whatever the state of the replacement operation, it must not affect the quality of performance. This means in the case of the Olivier, replacing 768 dimmers and rewiring all the electric systems while maintaining show business as usual.

A full house!

All this work involves lots of night activity and arranging the repertoire so that show changeovers do not take place on the Mondays – giving the teams a clear one and half working days. All this takes much planning and very careful scheduling – especially when it comes to the replacement of the stage floor and associated grids. "If only we had a 287 hour day and a 10 day week", says Michael. Reconnect time is scheduled for September 1999, when the wire cutter will be finally disconnecting the old wiring system.

Right now, it is standing room only for the smash hit production 'Guys and Dolls'. Based on a story and characters of Damon Runyon, with music and lyrics by Frank Loesser and book by Jo Swerling and Abe Burrows, the show features a breathtaking lighting impact – even the illuminated cigarette hoarding in Times Square puffs away. A sight to behold.



General view of site showing adjacent objects. To help scale the picture, the tall fence starts about 5 feet to the right of the white plastic pipes.

Thunder & Lightning THE OTHER EXTREME

PART 1

by Keith Garwell

If thunder and lightning are at one end of the scale of atmospheric electricity, then this article is about the other end of the scale. It describes the construction of an atmospheric electricity detector.

The equipment required is simple to build and will detect many of the tiny electrical currents which are often present in the atmosphere. It could well provide supportive data to other fields of research.

The device is intended for the experimenter as a new tool for observations. In my case, for observations of atmospheric phenomena, but it may well be useful in other spheres. Possibly also as an early warning device of storms, as I estimate that the storm signatures begin to appear whilst the storm is about 5 miles distant. (Watch for the flash and time the thunder).

During an astronomical involvement in the past I came across a suggestion that it might be possible to detect meteors by measuring changes in the Earth's electric field.

The upper atmosphere surrounding the Earth contains strongly ionised bands, which, with respect to the Earth, are positive. There is thus an electric field between these bands and the Earth itself.

A meteorite entering the Earth's atmosphere leaves behind it a trail of ionised gas. This can be imagined rather like a conducting rod reaching down from the ionised bands – see Figure 1. Beneath this, the electric field will be intensified because the distance between the Earth and the ionosphere has been reduced. The presence of the 'conducting rod' has been established by radar reflections and by the short-wave listening fraternity, who regularly hear long distance TV as short bursts.

My first experiments used an op-amp operating as a voltage follower connected to a metal plate supported above ground. The input resistor of 100MΩ was bootstrapped so that its effective resistance was 10,000MΩ, giving the arrangement in Figure 2.

This arrangement had several disadvantages, namely the op-amp was not sufficiently stable, the system is susceptible to AC interference. However, the most significant one, it could not be calibrated. Figure 3 illustrates the problem. The arrangement becomes, in fact, two resistors in series – the meter in effect connected across the lower one of the pair. However, the only figure available is the voltage

Figure 1. The Earth surrounded by charged layers.

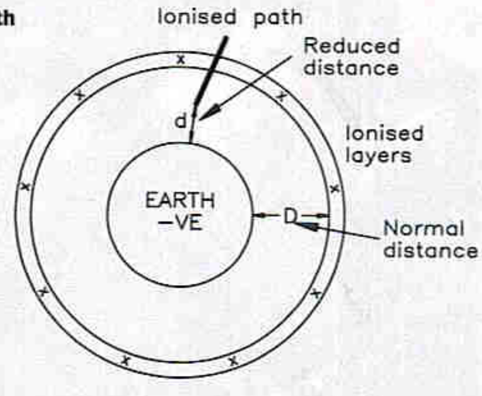
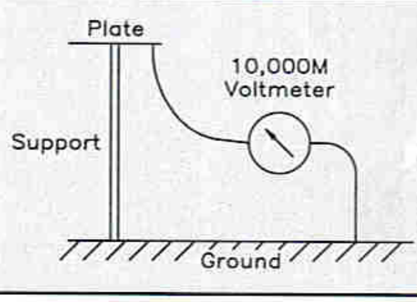


Figure 2. Plate on support with voltmeter.



About the Author

Perhaps I should introduce myself or rather, my background. Currently retired – which gets translated into "I no longer get paid for what I do!" I still get involved in various oddball projects. Starting off in life with an enthusiasm for physics, I gravitated by way of the engineering department of the GPO via industrial data processing as it was then called and as far as I was concerned, translated into "control of steel-making plants". Then into commercial computing, where I spent most of my time writing programs (software) to test the electronics (hardware). Since then, I have been involved with one or two observatories – not, I hasten to add, as an astronomer – but as a designer of electronic systems of various sorts plus writer of software for these systems.

across the 10,000MΩ resistor. The value of the atmospheric resistance is unknown (although it has been estimated) and therefore, the voltage at the ionised layer cannot be calculated. As a consequence, the voltmeter approach was eventually abandoned in favour of an ammeter. The picture is the same as Figure 2, except that the word 'VOLTMETER' is replaced by the word 'AMMETER', and of course, its resistance is low instead of high.

Since we now have an ammeter connected to the plate, it is now possible to calibrate the system in terms of amperes per square metre (well, pico-amps actually), i.e., plate-current/plate-area in amps and square metres.

Several years have passed, and a system is now available which seems bug-free.

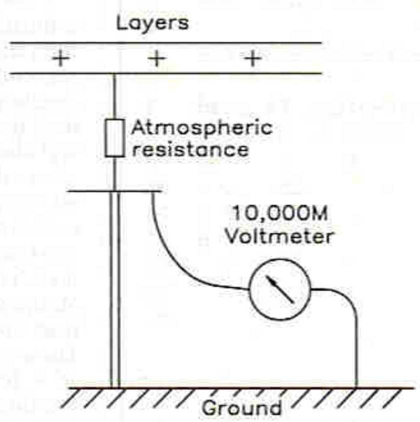


Figure 3. Atmospheric resistance between charged layers and ground.

The Results So Far

The system, known to me, my wife, and a few others as PAM (pico ammeter) is really just the items of Figure 2 – A plate on a support and an electronic ammeter. The output can swing ±10V, representing an input current of ±4nA full-scale. (FSD). The plate is a tenth of a square metre in area.

The output is read by a digitiser (more about this later) reading ±256 parts (8 bits + sign). The system will, therefore, resolve 4/256nA, i.e., 15·6pA. 16pA is near enough!

The output of the digitiser is recorded against time and date on floppy discs by a fairly ancient IBM look-alike (PC). The whole system is powered by a battery so that it is fully independent of a mains failure (often the time when interesting things are happening). The data on the discs is displayed by another PC using programs which I wrote specifically for the job.

This does not mean that handfuls of PCs are required, but they do make life easier. I'm sure there are people out there who can think of other ways of doing the job. However, some form of permanent record is necessary. It is also possible to get older PCs quite cheaply, i.e., less than £100. It is also possible to buy digitisers with accompanying logging software for around that mark (e.g., Pico Electronics ADC 16. More of that later, when we take a real look at the detail).

But first to have a look at some of the results. I should say that the presentation of the results has developed along with the hardware so I would not put my system forward as the best way to do it, especially with the current availability of logging software. However, it does manage to show three variables without resorting to 3D graphics. Plus the fact that it only uses ASCII screen characters so that the charts can be handled by word-processing packages as well as e-mail, etc.

Photo 1. Closer view showing arrangement of the guy ropes, etc.

Photo 2. Close-up of the top, showing the guard ring just above the guys, the stand-offs for the co-ax, the bottle inside which the co-ax is terminated and the pop bottle shield.

Figure 4 shows a day of low activity which makes it easier to show how the chart works. The important bits are really the horizontal time axis through the middle of the chart, spanning 00:00 hours to 23:40 in 20 minute slots. Nothing special about this, apart from the fact that it gives 72 slots per day, which is convenient for 80 character screens and printers.

The vertical axis took a bit more thought. Since the range of values was ±256, some form of compression was needed (alternatively, very long sheets of paper!). If this is not done, then the detail in the low values is lost. This is a snag with simple chart recorders unless some form of logarithmic conversion is included.

I have used a simple

```
b:9703031.PRD  <-- File name incorporating disc, year, month, day, channel
$                                                                         201
$                                                                         118
$   Two incidents of value 8 or more          Minimum value in digits -->  70
$   between 0700 and 0720                                                  41
$               |                                                          24
$               |                  b        b                              14
$               |---> b                     b               Positive        8
$                               bb   db bbcb     c                          5
$                                  b db bbccbc    b                         3
$ Time in 20 minute intervals                                               2
-0--1--2--3--4--5--6--7--8--9--0--1--2--3--4--5--6--7--8--9--0--1--2--3--
$                                                                           2
$b                      b bb  b cbb  c    cbb c b cc                        3
$                    bb  b c  b   b         b   b  b  b                     5
$                           b b     b           b cb        Negative        8
$                                                 b                        14
$                                                                          24
$b  c    b  b     b                                    c  b    bb          41
$                                                                          70
$                                                 b                       118
$                                                                         201
Lines in source 91 days average -7.253

A day of low activity illustrating the charting system.
```

Figure 4. Chart 9703031: A day of low activity.

geometric series, the steps of which appear on the right hand side of the chart. Up for positive and down for negative. In the first instance, asterisks printed on the paper were used to mark the values against time. A mark indicates that the value given has been reached or exceeded but is less than the next value.

Later, the idea came to indicate the number of times a particular value was reached by using different letters. Consequently, an 'a' indicates one occurrence, 'b' = 2, 'c' = 4 and so on, up to 'z'. Amuse yourself to work out the number of hits a z means, but it is definitely more than we are likely to need for this exercise.

To limit the rate at which computer disks are gobbled up, it is possible to set a trigger level below which no record is kept (usually set at 4), and also to set the time between readings (usually 15 seconds). Again, nothing magic about the figures, they have been determined experimentally as giving the best compromise between using up discs and losing information.

Labelling the files with the date in the reverse order has the advantage that any sorting puts them into the correct sequence.

At the bottom of the chart, 'Lines in source' indicates the number of timed readings the system has made during the time span of the chart. The average is given for the same period for all the readings of particular channel shown.

91 lines of source is low and indicates a very quiet day. The number varies over a considerable range, 3 or 4 thousand is not uncommon. Such large numbers are usually associated with windy conditions or sometimes persistent lumpy clouds – a sort of mini storm cloud.

The average value is usually negative. Don't ask me why – I don't know. Yet!

The day of the 23rd August 1996 started like a lot of English days. Cloudy, calm, and dry. At least, that was my observation at 08:19. However, by 12:53, there was heavy cloud and the first flash of lightning, followed 18 seconds later by the thunder. No, I'm not guessing; I had been watching the cloud approaching, so I used my stop watch! The only day so far when I had the luck to be able to watch a quite well isolated storm pass over.

From the 18 seconds delay, I estimated that the storm was then about 6km away. Figure 5 shows the chart for the day. The agitation which preceded the flash first appeared about 10:20 and increased steadily. 13:00 shows the start of a period of 40 minutes where the value was oscillating between -24 (24 × 16pA) and +24, i.e., there were no values less than this. Maximum values were greater than 118 (but less than 201). These give real values of 24 × 16 × 10pA per square metre (3,840) and for 118, 18,880pA/m^2. Rationalised 3·84nA/m^2 and 18·9nA/m^2.

After the excitement was all over, the agitation stopped

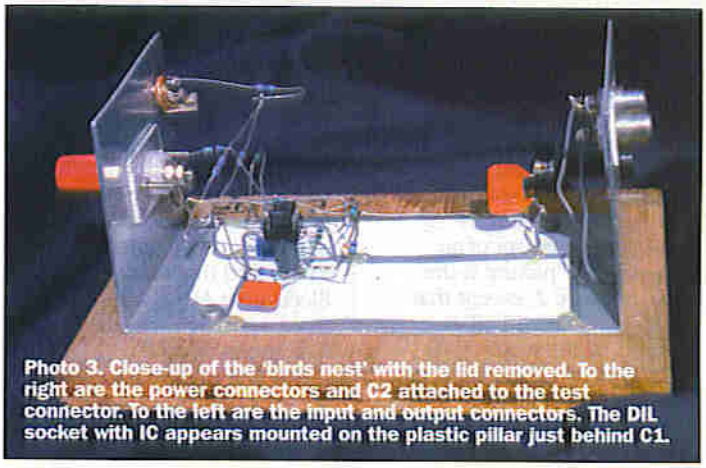


Photo 3. Close-up of the 'birds nest' with the lid removed. To the right are the power connectors and C2 attached to the test connector. To the left are the input and output connectors. The DIL socket with IC appears mounted on the plastic pillar just behind C1.

```
b:9608231.PRD
$                                                                         201
$                                    cdcdedd   bbb d            ef        118
$                                    dcdbbdbb  c  ce            ec         70
$                                  cccddbcd b bcb ee            f          41
$                                  dcdde  dcc cbdcdf            dc         24.
$                                 cdcbcd bdcccdebbddb           bd     d   14
$                               b dcdced  deeecedcdc          b eb     c    8
$               bb           b   ccc cec  bdeeee dc c cc   bb cddccb  ce    5
$               bccb        bcb  cbbbbec  bdedecbcbce  c   bbbccebec  cdc   3
$                                                                           2
-0--1--2--3--4--5--6--7--8--9--0--1--2--3--4--5--6--7--8--9--0--1--2--3--
$                                                                           2
$bcdffggd cdcc  c   bfgfedeeceddcc bedcb  bdcdcdeccbc  ccdeeefdec fe eeed   3
$   bcbf     c   b bbbc    b      cceddb  dddeddfdcdb  d  bdde d  eb efee   5
$      d        bb         b       dcdcd bcddddffdcd         b   ce   ede   8
$      bb                          bb ccc ddbdccdedbc            dd   d f  14
$              b                     dbdc edbb c eedb            ec   d f  24
$                                    c cdddd    bcebb            e    d d  41
$                                    dcccc c    bbe              c    b    70
$                                    b eggebc   b b              d        118
$                                                                         201
Lines in source 2043 days average -6.796

23 Cloudy calm dry 0819
   Heavy cloud first flash 1253. Time delay 18 secs. Approx 6Kms
   Rain started 1259. Heavy at 1322. Brightening.
   Steady heavyer rain 1337. 1611 Heavy cloud - strong convection.
   First thunder 1613.
```

Figure 5. Chart 9608231: Storm. First thunder 16:13.

```
b:9703181.PRD
$                           cb                                            201
$                           cbb                                           118
$                           bcb         c                                  70
$                           c d        cc                                  41
$                           c cc       cc                                  24
$                           dddd       bc              d              d    14
$                           dddc       cd              b           c  d     8
$                           dbcc       ce       b      c    c      c        5
$                        d  ceed  ccb  de bbddddd  b bbbbccbdb    cd  c b   3
$                                                                           2
-0--1--2--3--4--5--6--7--8--9--0--1--2--3--4--5--6--7--8--9--0--1--2--3--
$                                                                           2
$      b b    c   c c b ed c dedbdddd efc cddeeeccd   beddddcc     e  d c   3
$             b         cc  cedc  b  b dc   b    b     e      b    c  d     5
$                        b  bece       dc              c           c  c     8
$                           decc       dc        b     c              c    14
$                           dd c       bb                           b b    24
$     b                     ebc         c                      b    b      41
$                           dbc        bb                                  70
$                           d b                                           118
$                           cb          c                                 201
Lines in source 655 days average -3.489

Overcast, showers, light breeze (weather notes)
```

Figure 6a. Chart 9703181: Overcast, showers, light breeze.

abruptly at 17:00. Why the ending is abrupt whilst the beginning shows a gradual build up, I have no idea.

There was another storm later in the evening, but notice how the current was strongly positive at 21:00 with only a very minor negative occurrence and then at 21:20, was more or less symmetrical. Following this, it became biased to the negative at 21:40. This seems to warrant going back to the original data for closer inspection.

Figure 6A showing the 18th March 97 is interesting. My weather notes (which I don't always remember to make up, I must admit) merely comment – "overcast showers light breeze". However, I did remember that the showers were quite brisk and the overcast was very dark in patches. I suggest, therefore, that the three blocks at 09:00-10:00, 12:40-13:00, and 18:00 were due to rain precipitated from strongly charged clouds, the rain drops carrying a charge and being sufficient in the first block to reach FSD. However, we are not outdone, because a second system stands alongside the first. The only difference being that it has a shunt across its input of 220kΩ which gives a times 100 range – see Figure 6B. Hence, the highest negative value is 3 giving (3 × 16 × 10 × 100) 48,000pA/m² or rationalised 48nA/m². Whilst the highest positive is 2, i.e., 32nA/m².

```
b:9703182.PRD
$                                                                             201
$                                                                             118
$                                                                              70
$                                                                              41
$                                                                              24
$                                                                              14
$                                                                               8
$                                                                               5
$                                                                               3
$                            c b                                                2
-0--1--2--3--4--5--6--7--8--9--0--1--2--3--4--5--6--7--8--9--0--1--2--3--
$                            eddb        b                   b                  2
$                            dbb         c                                      3
$                                                                               5
$                                                                               8
$                                                                              14
$                                                                    bb   b    24
$     b                                                                        41
$                                                                              70
$                                                                             118
$                                                                             201
Lines in source 655 days average -0.730
```

Figure 6b. Chart 9703182.

The Electronics

"The Electronics" seems to be a rather grand title, but nonetheless, Figure 7 shows it all. It's quite simple and quite subtle – don't forget, it's operating as an ammeter and a very low current one at that. Consequently, R1 & R2 are not a potential divider. R1 is a protection resistor to prevent any major splurges from wrecking the IC. R2 is the DC restoring resistor. At FSD, there is only 40mV across each of these resistors.

R4 & R5 together give 3·9kΩ, so if you have a 3·9kΩ, use it instead. It just happened in my case that I had a stock of both 4k7Ω and 24kΩ. This, together with R3, sets the gain of the IC to ×250, so that with 4nA at the input, we have 10V at the output pin 6, i.e., 4nA across 10MΩ ×250 = 10.

C1 is to suppress any high frequencies, where high frequency in this case is anything above about 5Hz.

R6 only serves as a protection resistor, remember, I have tried several ICs in this system and not all of them have output protection. It is also convenient to add more AC suppression.

C2 brings the output pin of the IC out to a test socket on the case to allow the AC component to be measured. If using a digitiser, the peak voltage of the AC must be less than the value of one digit otherwise the digitiser may give errors. I had this problem in the early days, when the plate was too near the garage and was picking up 50Hz from the mains. R7, 8 & 9 (an 18-turn ceramic) are for the zero adjustment.

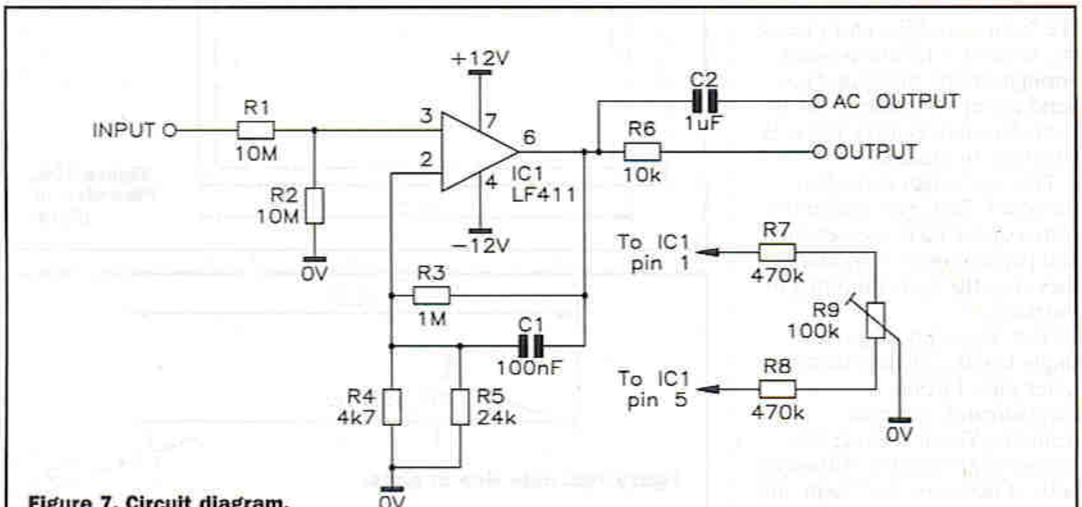


Figure 7. Circuit diagram.

Construction

The main problem is keeping the leakage down sufficiently to prevent spurious readings. With 16pA being within the readable range, 1pA is enough to be noticed and with 12V around, that means $1{\cdot}2 \times 10^{13}\Omega$. Similarly, the op-amp IC1 has got to be stable. In my case, the electronics had to live in the garage. A PCB was no good, there being too much leakage in winter (surface and absorbed moisture).

Plug-boards worked well provided they were plastic and any sticky pads on the underside

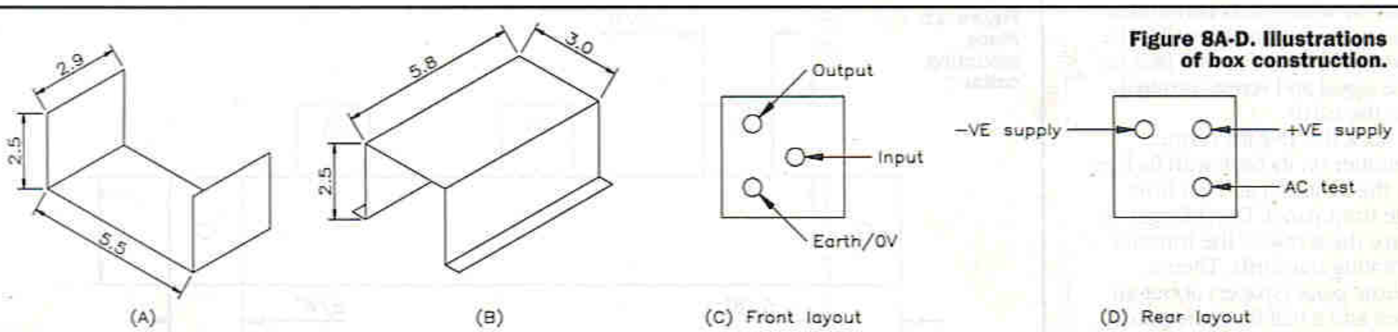


Figure 8A-D. Illustrations of box construction.

were replaced by solid plastic sheet (model shops have it). Clean the sticky off with acetone – don't use nail varnish, it usually contains oil. This all seemed to work well but I was not happy about the long-term reliability of the connections, especially with such small currents being involved.

By far the best arrangement seems to be to 'birds-nest' the components. In other words, make it so that all the components are self-supporting.

Birds-nesting requires a bit more dexterity than usual and can be difficult in an ordinary metal box because the sides get in the way. This can be solved by constructing a box from 18 gauge (1·2mm) sheet aluminium. Figures 8A-D show the general arrangement giving various views with dimensions. Make two U-shaped pieces, one piece as shown in Figure 8A and a lid as in Figure 8B. The lid is made longer than the bottom by about ¼in. (6mm). Similarly, the internal width of the lid is about one tenth of an inch greater than the width of the front and back. Then by squeezing the bottoms of the lid together, spring it inwards slightly so that it is a push fit over the base and grips it firmly. Figures 8C & D show the front and back layout. Dimensions are not madly important, just so long as the components fit properly.

Figure 9 shows a side view. A hot melt glue gun is ideal for sticking various components in place. If this is not available, glues such as clear Bostic work but have the disadvantage that the components have to be held while the glue sets, which the hot glue does quickly.

Fit the connectors to the ends first, then screw the bottom to a wooden base about an inch larger all round. The base is best made from 0·5in. thick sandwich board which doesn't warp. Failing this, a piece of planking will do. This base is really only to add weight, otherwise the box is so light, the cables when attached will move it.

The input connector must use plastic insulation – any washers, etc., needed must also be plastic. All other connectors may be whatever is convenient. I use phono connectors for the two 12V lines. A 3·5mm jack for the signal and screw terminals for the earth.

Stick the 18-turn cermet trimmer on its back with its legs in the air about an inch from the front panel. Don't forget to have the screw of the trimmer pointing outwards. Then a plastic pillar (spacer) about an inch and a half from the panel, as suggested in Figure 9. Glue the 8-pin DIL socket to the top of the pillar, right way up but with its legs bent outwards.

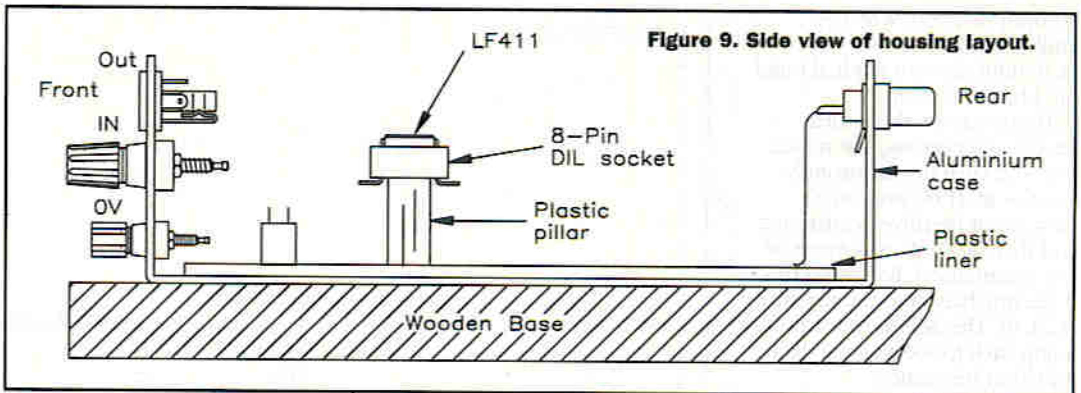


Figure 9. Side view of housing layout.

The resistors and two capacitors can now be soldered in. Some lengths of wire will be needed. Use ordinary plastic coated hook-up wire and anchor them with dabs of glue to hold them still.

The Plate

Just an aluminium plate on top of a length of plastic pipe. Perfectly true, but there are a number of pitfalls, well pitfalls is hardly the word, but there are a number of points to be considered in its construction. I think perhaps the best way is to start at the top and work down, making the particular points as I go along. First, the aluminium plate. 18 gauge is enough – there's no need to go past 16 gauge. Cut out the required size – 31·6cm, i.e., the square root of 1,000. Then cut into each corner about half an inch (12·5mm – apologies for mixing the systems – 12·5in.² is good enough for the plate) and just bend down the outside half an inch all round. Figures 10A & B illustrate the situation.

The bent edges serve two purposes. First, they stiffen the plate considerably and secondly and perhaps more importantly, they stop the plate fluttering in the wind.

Next, the support. Just a single length of white waste water pipe 1·625in. approximately external diameter. This is sold (at DIY stores) in 3m lengths. Although both of mine are 3·5m high, this is only because the original was mounted on the garage roof and just happened to be 3·5m. So I made mine to match, but I can see no real reason for having to buy another length of pipe just for half a metre!

Next, a fitting to enable the plate to be fastened to the pipe. One might suggest a capacitor clip, but I think this would be wrong. These clips are usually steel and it would create electrolytic action with the aluminium in damp weather. It's quite easy to make one from aluminium sheet – Figure 11 shows the shape. The main band is 1in. wide and all five lugs are ⅝ bent at right angles, as shown by the dotted lines. The one important dimension I haven't given, the length, is best obtained by measuring your own pipe. It does vary slightly. Measure the centre of the plate then fix the clip to the plate. This is best done by first fitting the clip to the end of the pipe and tightening the clamp screw, then offering it up to the plate and marking the fixing holes.

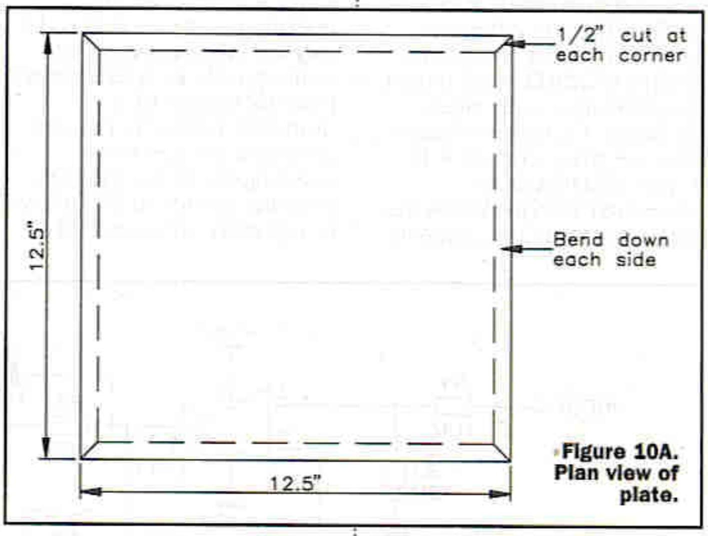


Figure 10A. Plan view of plate.

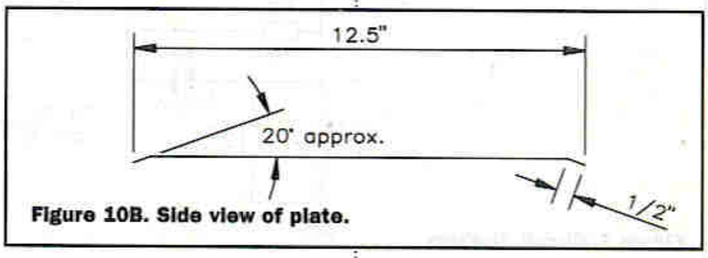
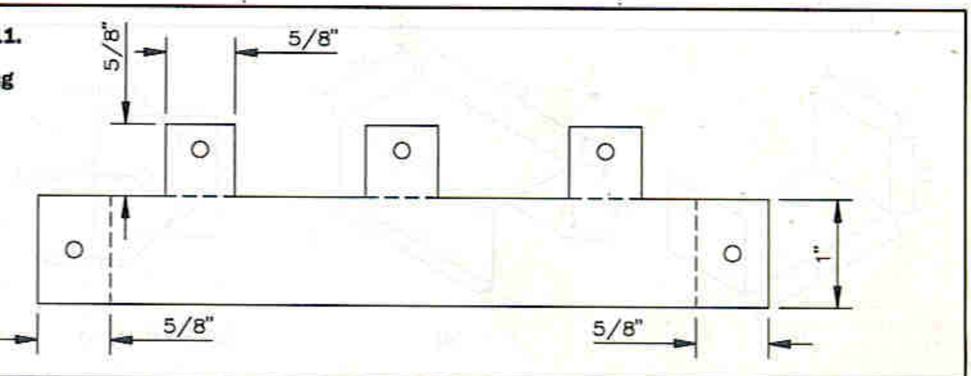


Figure 10B. Side view of plate.

Figure 11. Plate mounting collar.



Next, down at 105cm from the top (see Figure 12) are three self-tapping screws screwed through plastic cabinet feet or grommets and through the pipe. These should be spaced equidistantly round the pipe – see Figure 13. These enable slip knots to be tied at the end of the guy-ropes (which should be terylene), which can then be slipped over the pipe and slid up past the screws. With the knots pulled tight, the ropes cannot slip down. 1·5m out from the base of the pipe is about right for the stakes. All these oddments, terylene, stakes, adjusters for the guys, etc., can be obtained from any camping shop.

At the bottom, the pipe should stand on a block of wood. Three nails round will stop the pipe creeping off the block. If you have a drill for large holes, then just drill a hole equal to the diameter of the pipe about a quarter inch into the block.

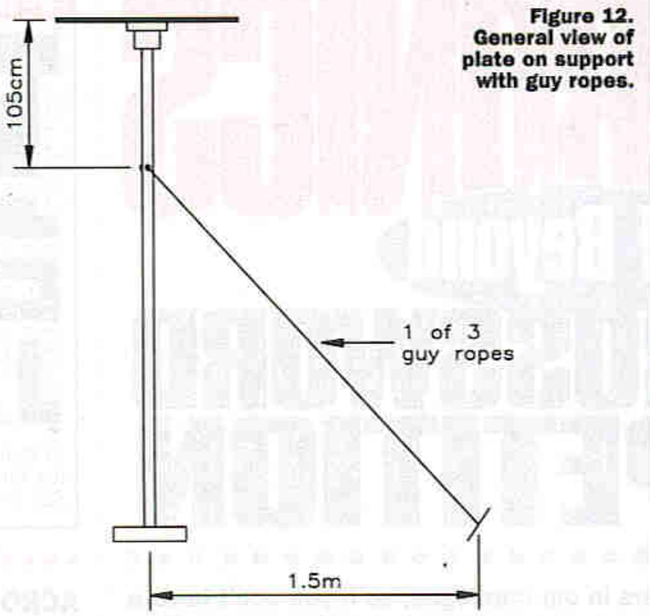


Figure 12. General view of plate on support with guy ropes.

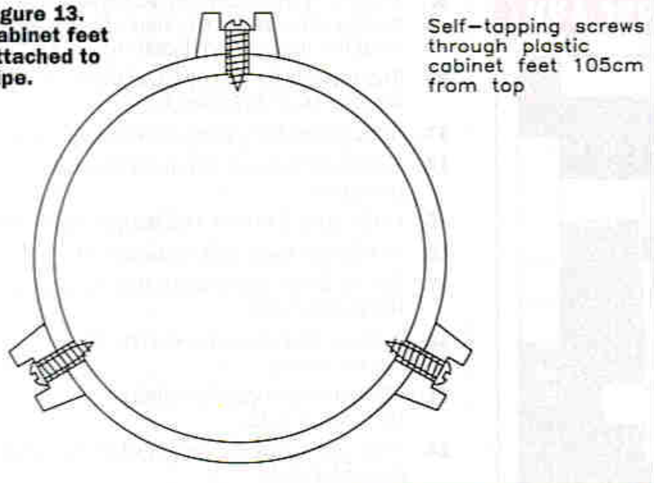


Figure 13. Cabinet feet attached to pipe.

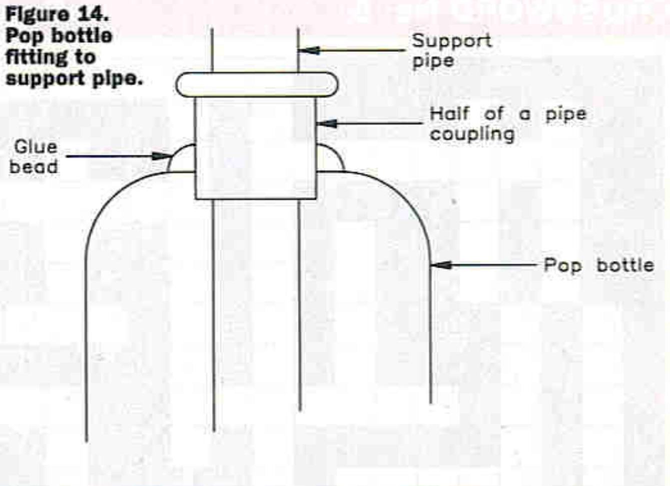


Figure 14. Pop bottle fitting to support pipe.

Now for a bit of adornment! A large clear plastic pop bottle is required. Cut off the bottom as close as practical to the bottom. Next, at the top, a means of fastening it to the support pipe close to the plate is required. I'm not sure if I made a bigger job of this than necessary, but I got a straight pipe coupling, and cut it in half. Then cut round the neck of the bottle until it will just fit over the coupling. And then – guess what – yes, some hot glue right the way round; see Figure 14. The rubber sealing ring inside the coupling will hold it in position on the pipe; a little drop of soap makes it easier to get on in the first place. You may well think of an easier way. The requirement is that it must stop any moisture running in at the top (hence my elaborate seal) and be open at the bottom.

The reason for it is simple (though it took a long time to cotton on). There are certain weather conditions which will produce a layer along the pipe; this was found when the layer happened to be frost – as it melted, so the problem disappeared. Figure 15 is a chart where the problem is present – the positive 'bridge' from 00:00 to 12:40. I admit that this picture is not fully understood. The recorded messages below the chart show that there was a potential of 0·239 on the guard wire (more about the guard shortly) and in fact lowering the guard to -0·239 more or less restored the output to zero. However, it continued to remain positive for the rest of the day. This is the reason for the very high number of source lines (recording was being triggered continuously) and the high average.

```
b:9701021.PRD
$                                                                         201
$  eghhhhhhhhhhhhhg                                                       118
$hhhhg             ghhhhhhhhhgb d                                          70
$                            fghhheb                                       41
$ Note. Started to           c    hhhf                                     24
$ rise 1700 970101.                   ggde bbcc b bd  dcccc cecdcceeeegghg 14
$                            b          egggggghhhhhhhhhhhhhhhhhhhhhhhhgeef  8
$                                        edgfgff  db   dbcbb                5
$                                        c  dbd                             3
$                                                                           2
-0--1--2--3--4--5--6--7--8--9--0--1--2--3--4--5--6--7--8--9--0--1--2--3--
$                                                                           2
$                             d                                             3
$                             c                                             5
$                                                                           8
$                                                                          14
$                                                                          24
$                                                                          41
$                                                                          70
$                                                                         118
$                                                                         201
Lines in source 5614 days average 57.204

b:970102.msg
09:16:52 making test on hi input c1
09:44:11 0.239 on guard wire now
09:49:11 yes ice on pole again
b:970103.msg
11:47:02 fitting anti icing collar
12:17:41 collar fitted
```

Figure 15. Chart 9701021.

CONTINUED NEXT MONTH...

ELECTRONICS and Beyond

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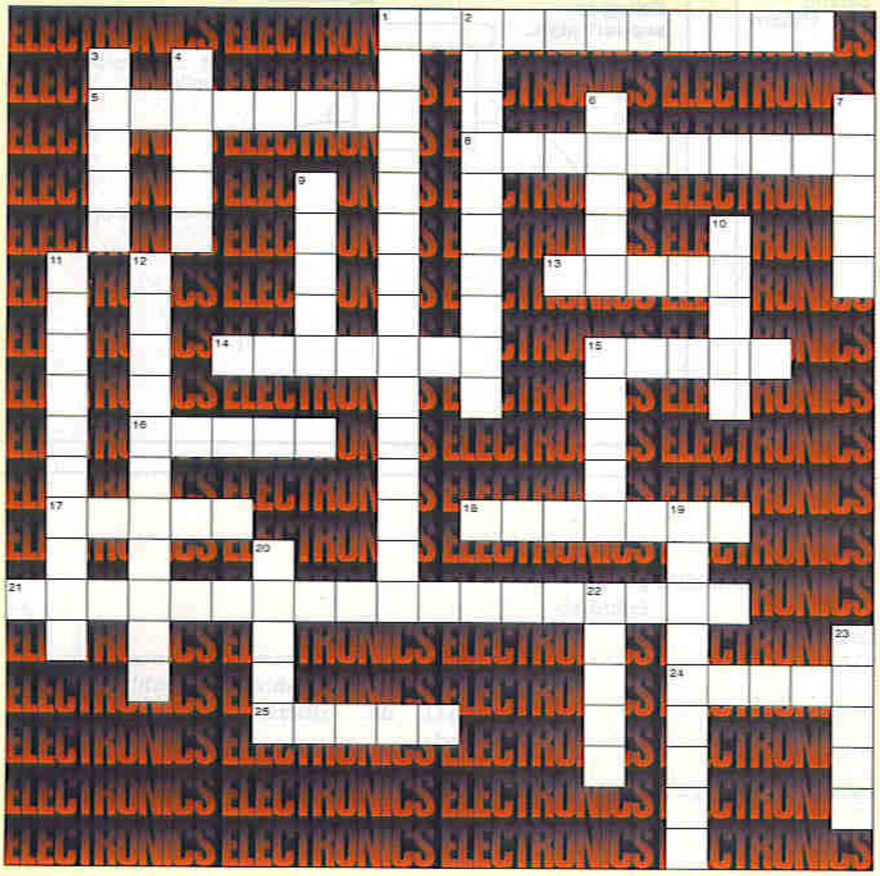
You will find some of the answers in our catalogue, so if you don't have a copy go out and search for one today and complete this crossword.

CROSSWORD No. 6 September 1997



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Postcode

Daytime telephone number

No purchase necessary. Entries on a postcard, back of a sealed-down envelope or photocopies will be accepted.

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All employees of Maplin Electronics are excluded from entering.

CROSSWORD No. 4 *Solution* July 1997

Congratulations to Mick Clark of Skegness for winning crossword No. 4, he receives £25 for his efforts

ACROSS

1. Maplin store in area 8
5. Process of measuring an analogue signal at regular times to find its value. Commonly used for analogue to digital conversion
8. The highest frequency a transistor can operate as an amplifier(Ft)
13. Screened in-line phono socket order code
14. Unwanted current that flows through a transistor
15. Order code for the 4 wire burglar alarm cable
16. Goodmans in-car radio cassette order code
17. Colour band on a resistor that represents the number five
18. A meter that measures current in an electric circuit
21. AT75S component description (two words 6,12)
24. This screw driver is very flexible, but what's the order code ?
25. Order code for the TDA2822 amplifier kit pcb

DOWN

1. BX05F Capacitor description (three words 4, 7, 4)
2. Purpose of the third band on a four coloured band resistor
3. Eric's Cellular Telephone replacement Battery order code
4. Order code for the Camcorder Battery charger / discharger
6. Experience the real life sound from your TV and VCR with this Dolby Pro Logic add on system, what's the order code ?
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15. Order code for the PCB miniature DIL switch
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Bury St. Edmunds Amateur Radio Society. Meetings held at Culford School, 7.30pm for 8.00pm on the third Tuesday of each month, unless otherwise stated. Further details from Kevin Waterson, (G1GVI), 20 Cadogan Road, Bury St. Edmunds, Suffolk IP33 3QJ. Tel: (01284) 764804.

Crystal Palace and District Radio Society meets on the third Saturday of each month at All Saints Church Parish Rooms, Beulah Hill, London SE19. Details from Wilf Taylor, (G3DSC), Tel: (0181) 699 5732.

Derby and District Amateur Radio Society meets every Wednesday at 7.30pm, at 119 Green Lane, Derby. Further details from: Richard Buckby, (G3VGW), 20 Eden Bank, Ambergate DE56 2GG. Tel: (01773) 852475.

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SEEMUG (South East Essex Mac User Group), meet in Southend, every second Monday of each month. For details Tel: Michael Foy (01702) 468062, or e-mail to mac@mikefoy.demon.co.uk.

Southend and District Radio Society meets at the Druid Venture Scout Centre, Southend, Essex every Thursday at 8pm. For further details, contact: P.O. Box 88, Rayleigh, Essex SS6 8NZ.

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Wakefield and District Radio Society meet at 8.00pm on Tuesdays at the Community Centre, Prospect Road, Ossett, West Yorkshire. Contact Bob Firth, (G3WWF), (QTHR), Tel: (0113) 282 5519.

The (Wigan) Douglas Valley Amateur Radio Society meets on the first and third Thursdays of the month from 8.00pm at the Wigan Sea Cadet HQ, Training Ship Sceptre, Brookhouse Terrace, off Warrington Lane, Wigan. Contact: D. Snape, (G4GWG), Tel: (01942) 211397 (Wigan).

Winchester Amateur Radio Club meets on the third Friday of each month. For full programme contact: G4AXO, Tel: (01962) 860807.

Wirral Amateur Radio Society meets at the Ivy Farm, Arrowe Park Road, Birkenhead every Tuesday evening, and formally on the the first and third Wednesday of every month. Details: A. Seed, (G3FOO), 31 Withert Avenue, Bebington, Wirral L63 5NE.

Wirral and District Amateur Radio Society meets at the Irby Cricket Club, Irby, Wirral. Organises visits, DF hunts, demonstrations and junk sales. For further details, please contact: Paul Robinson, (G0JZP) on (0151) 648 5892.

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Video CAMERAS

by Reg Miles

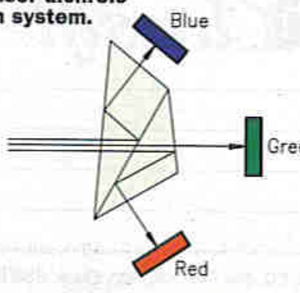
The change from pickup tubes to solid-state image sensors has expedited video camera development in all fields, from consumer to broadcast, while the use of digital processing has added further impetus. Now cameras are poised to expand into multimedia by exploiting digital compression and rapid growth in computer memory and disk capacity.

The video camera is simply a device for converting photons into electrons. The more photons that hit the pixels in an image sensor, the more electrons each produces – degrees of brightness are converted into degrees of charge. Colour cannot be so directly converted, however. An image sensor cannot detect and assign colours to the frequencies as the eye and brain do, so manufacturers have to resort to filtering. This can be achieved by filtering the pixels of a single image sensor with vertical stripes of primary colours – red, green and blue, or complementary colours – cyan, magenta and yellow, or a mosaic of cyan, magenta, yellow and green. Alternatively, greater quality can be achieved by having three image sensors, with the light split into its RGB components and directed to the correct sensors by a dichroic prism system (see Figure 1).

Dichroic filters do not absorb light, they selectively transmit and reflect frequencies; normal filters, conversely, do absorb, so light is lost to a single sensor. Additionally, the colour resolution of the single sensor is reduced because it takes three or four filtered pixels to form one luminance block. Prisms have only an optical affect on resolution, and this is minimal. Image contrast does suffer, but the glass is chosen to maximise light transmission and glass-to-air surfaces are coated to reduce reflections. Because sensitivity extends into the infrared region, this must be filtered out to prevent it affecting the video signal and giving an image that differs from that seen by the eye. Also, because the pixel array is so fine, an optical low pass filter is used to remove fine image details that would react with it and cause interference patterning – a 1/3in. sensor has an image area of 4·8 × 3·6mm and will contain around 400,000 pixels (the size is a hangover from the days of pickup tubes when it was the overall diameter that was quoted, not the dimensions of the image area).

Cameras can also have two or four image sensors. Those with two have one for brightness (or luminance) information, the other filtered for colour, with the luminance sensor providing the detail missing from a single filtered sensor. When four are used, they may be one for luminance and three for RGB, or two green plus red and blue (green constitutes the greater proportion of the luminance signal

Figure 1. 3-sensor dichroic prism system.



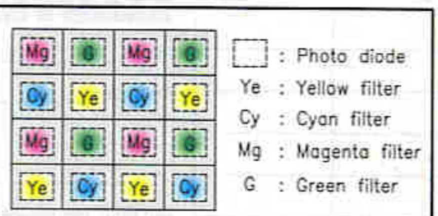
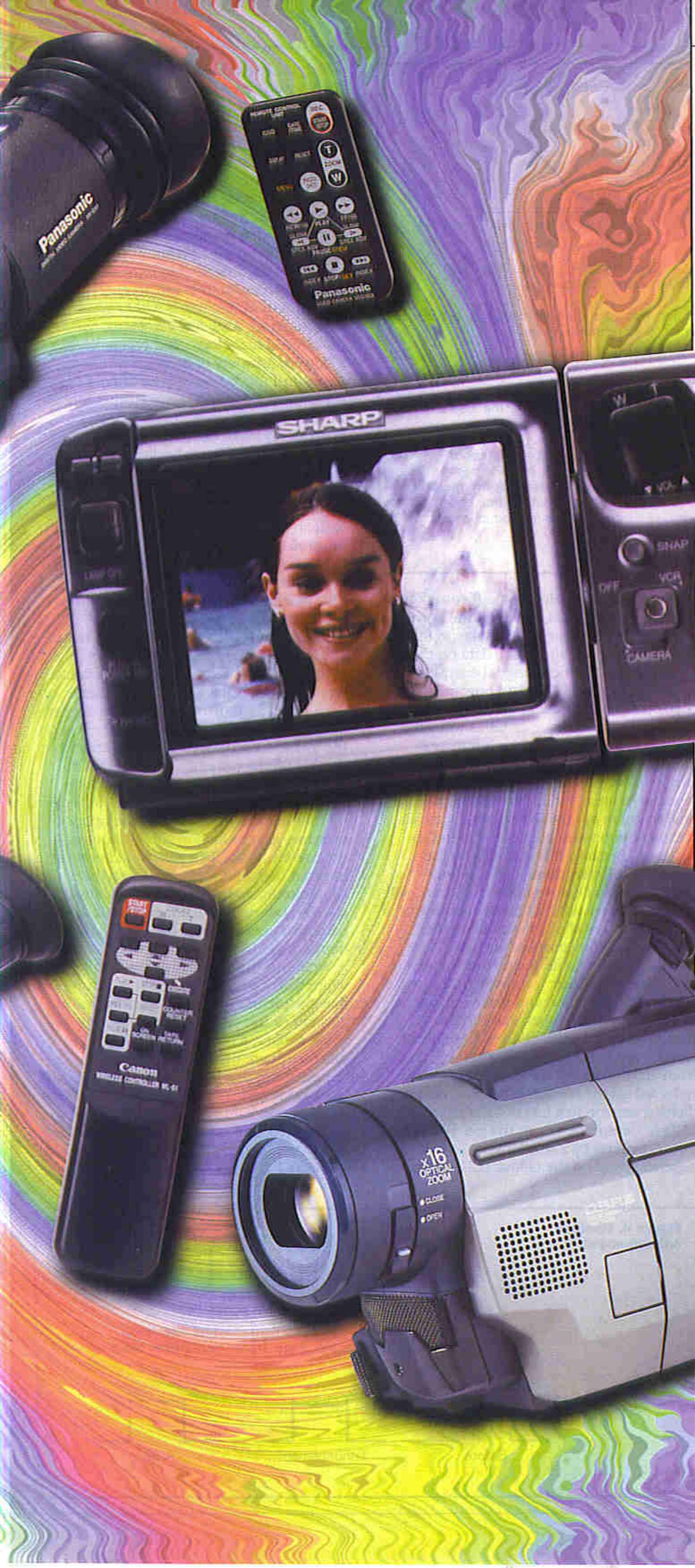


Figure 2. Sensor with mosaic filters.



because the eye is more sensitive to middle frequencies, the proportions being: 30% R, 59% G, 11% B). Again, these configurations increase both horizontal and vertical resolutions (these are ultimately limited by, in the case of horizontal resolution, the number of available pixels making up each scanning line and, in the case of vertical resolution, the number of lines that compose the frame – 575 picture carrying lines for PAL).

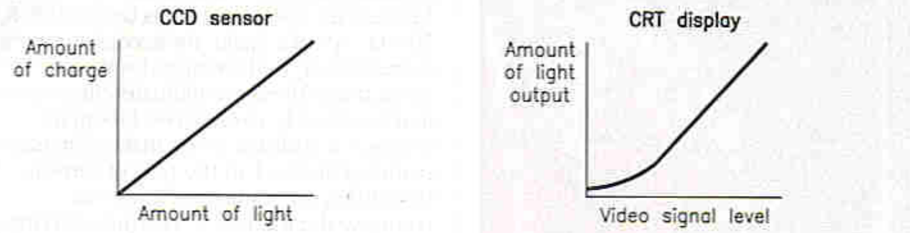
The vast majority of consumer camcorders have one image sensor, usually with a mosaic of cyan, magenta, yellow and green filters (see Figure 2). The charge in the image sensor is transferred to a shift register and is read out line by line to produce odd and even 20ms fields alternately. This is achieved by a pulse drive generator. As the charges are clocked out, the luminance (Y) is separated from the signal by a low pass filter and the modulated colour by a band pass filter; the colour signal then passes through a detector, from which colour difference signals, R-Y and B-Y, emerge.

The luminance signal then undergoes processing. Its black level is clamped at 0·3V to hold the black constant, regardless of variations in luminance amplitude. Gamma correction is then applied to compensate for the discrepancy between the linear sensor and the non-linear CRT (see Figure 3). The charge stored in a sensor is directly proportional to the amount of light received but the amount of light output by a CRT is not directly proportional to the video input – at least at the low end, so to avoid loss of detail in dark areas, the low end is raised. Because the signal goes through these processing stages, the changes in amplitude representing horizontal and vertical edge transitions tend to be softened so contour enhancement is used to exaggerate them and return them to normal sharpness (see Figure 4). This can be done by analysing one horizontal line as it is scanned (1H contour), or by the use of a delay line to analyse two lines, current and previous, for more consistent results (2H contour).

Professional cameras normally allow the user to adjust black level, gamma correction and contour enhancement to suit the camera response to the subject matter, but on consumer models, the controls are internal to avoid inappropriate settings.

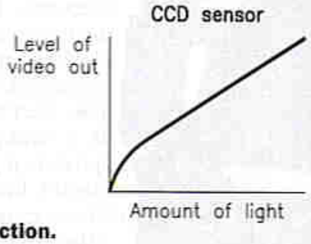
Finally, the line and field synchronising pulses are added below black level by the sync pulse generator to provide the scanning timebase.

The luminance signal may remain in analogue form or be converted to digital for this processing. Because digital signal processing (DSP) minimises degradation and enables processing to be performed more cheaply with fewer chips, more can be done. Contour enhancement, for example, can include diagonal edges and be done



The curve for the CRT, in mathematical terms, is close to a X^Y curve. The term Y is referred to as gamma and has the symbol γ (Greek letter for gamma).

The value of gamma is around 2.2. To correct for this, the camera signal is processed by an amplifier with the inverse curve, typically of 0.45 gamma value.



The gradient of the curve shows compression at bright levels. This is good for highlight compression e.g. of car head lamps or of specular energy from metal or jewellery, but is not good for true image reproduction.

Figure 3. Gamma correction.

without the time delay, with the degree of enhancement being automatically suited to the scene being shot. DSP cameras usually work at either 8-bit resolution, giving 256 grey levels with an equivalent S/N ratio of 48dB (250:1), or 10-bit, giving 1,024 grey levels and an equivalent S/N ratio of 60dB (1,000:1). DSP also allows three line simultaneous processing of the RGB luminance signal for greater quality. Cameras having three image sensors with RGB outputs will process separately, anyway.

One of JVC Professional's new cameras uses Virtual Focal Imaging (VFI) DSP to provide artefact-free and 'super-clean' images for compressed digital transmission standards. A complete virtual focal image is created of each frame, representing both fields complete with motion information, before encoding to a recordable video signal. VFI uses both intra- and then inter-frame analysis and modification of the whole image characteristic, as opposed to discrete correction for individual signal defects; all the while analysing the preceeding and succeeding frames as a dynamic 3D object, which also allows 3D Digital Noise Reduction (DNR), that is claimed to remove only noise elements and not wanted information, and a lost pixel compensation feature for blemish-free images over the lifetime of the camera. Internal processing works at 10-bit resolution, but variable bit-rate pre-processing can range up to 14-bit for head room when the signal demands it. VFI also allows variable vertical resolution – 430, 500 or 580 TV lines.

Returning to consumer camcorders, virtually all models now have digital autofocus, exposure and white balance.

The manual focusing ring has disappeared from many camcorders because their lenses now employ internal focusing, but some offer powered manual override. Autofocus relies on contrast to determine whether the image is in or out of focus – the greater the high frequency component in the luminance signal, the sharper the image. To achieve this, a microprocessor commands the focus motor to move the focusing component of the lens and, by analysing the feedback from the luminance signal, arrives at the correct position. Some cameras also take brightness into account, and all require data on the iris opening and the focal length because both affect the depth of field and how much the focus tails off before and behind the subject.

To improve accuracy, cameras will either analyse only that part of the luminance signal that represents the centre of the image or will subdivide the signal into a number of areas for the microprocessor to analyse them in turn to find what it thinks is the most important area of the scene to focus on. Because this is usually in the centre, it will start there, and if it finds nothing in the close-to-middle distance, will spread the area until it finds something or, if it is a landscape shot, will settle on the hyperfocal distance where virtually everything is in focus. Sanyo was the first to introduce fuzzy logic to provide rules to govern the operation and make it more flexible, and some others have followed. None, however, have followed Canon with its eye controlled focus (see Figure 5). Light from an IRED in the viewfinder eyepiece is reflected off the cornea of the eye, via a dichroic mirror, to a line-of-sight detecting CCD to determine where the eye is looking. This is marked by a small frame superimposed on the colour LCD screen which moves to follow the eye and acts as the focusing area. If the subject is static, the frame can be locked; if moving, it is used to track it. It is also used to select functions from a menu, and the frame is where exposure readings are taken.

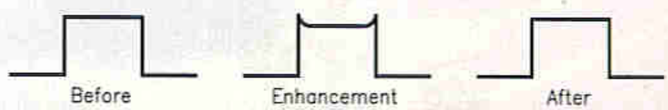
All exposure systems base their readings on the amplitude of the luminance signal – too high and the iris in the lens is closed down to give a small aperture, too low, and it is opened up. As with autofocus, the signal is usually divided to represent different areas; in this case, to enable the distribution of brightness within scenes to be compared. Also, like autofocus, Sanyo introduced fuzzy logic, and others have followed. A variety of Program AE (Auto Exposure) modes enable the camera to be set for specific functions: in Portrait Mode, for example, the camera sets a large aperture to make the subject stand out against an out of focus background. Some cameras allow the iris setting to be locked and possibly offer manual control – although normally with a knob rather than with an aperture ring on the lens, as found on professional cameras.

The amplitude of the signal is also controlled by the auto gain control (AGC). This maintains a normal looking picture as the light fades at dusk, for example, although upmarket cameras allow it to be switched off. They will probably have a manual gain-up control as well, to increase amplification, usually in 3dB increments, up to as much as 18dB. Obviously, this degree of amplification has a considerable effect on the image – every decibel of gain knocks a decibel off the camera's S/N ratio, but it does allow it to operate in very low light (the JVC VFI camera allows up to 39dB gain-up thanks to its 3D DNR!). At the opposite extreme, gain reduction allows shooting in excessively bright light that would otherwise burnout highlight areas even with the iris at its minimum aperture. The gain controls can also be used to maintain the iris at a particular aperture to achieve the desired depth of field.

Whatever the intensity of the lighting, the white balance has to be set. This ensures that the picture does not look too blue in daylight or too yellow in tungsten light – if white is right, all colours should be. The differences are measured in colour temperature: this is based on a theoretical black body (one that would absorb 100% of the heat and light radiation falling upon it) and the colour it assumes as the temperature rises – red, orange, and so on, measured in Kelvin (K). A video light will normally be

Figure 4. Contour enhancement.

To combat this unwanted effect, contour circuits are used. These artificially exaggerate the edge transitions (from black to white or vice versa).



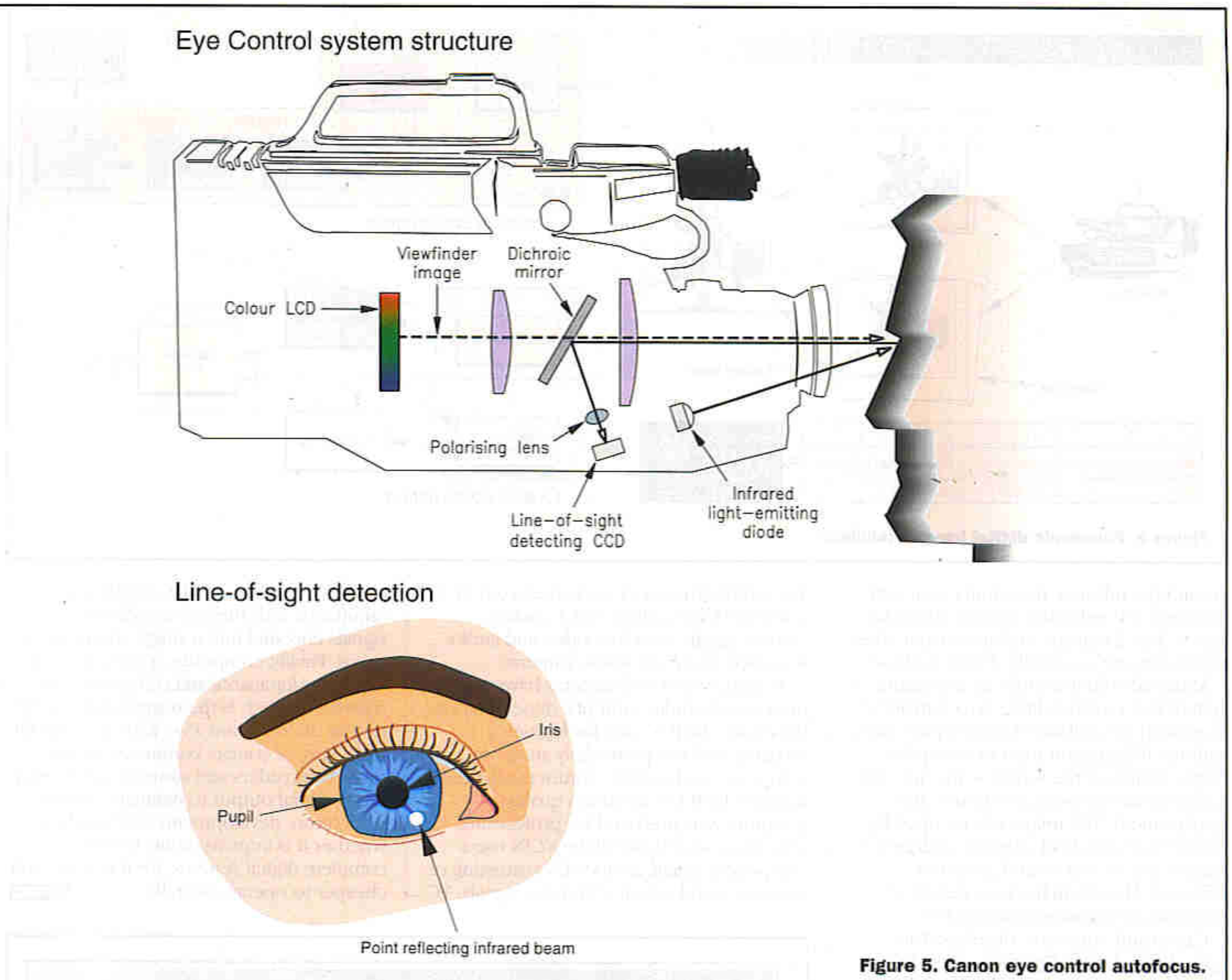


Figure 5. Canon eye control autofocus.

3,200K, while 'average' daylight is 5,600K (in reality, daylight can vary between half and twice that figure – but it's convenient).

All consumer camcorders and many professional cameras employ auto white balance (AWB), first introduced by Hitachi. If it is a through-the-lens (TTL) type, then the colour difference signals are compared with a number of optimum settings stored in memory and if there is a discrepancy, red or blue is adjusted to compensate. If it is an external type, then red and blue filtered photodiodes provide the colour temperature information. Because the TTL type can be unduly influenced by large red or blue objects and external types can be equally influenced by colours outside the lens' field of view because of their greater acceptance angle, some cameras employ both types. Most have TTL types and divide measurements into small areas for comparison, possibly with fuzzy logic rules. Some may also take green into account to compensate for the green cast caused by the discontinuous spectrum of fluorescent lamps (it can tell the difference between a fluorescent lamp and a field of grass by whether red or blue is also high – although it is still not infallible).

Other white balance options are semi-auto, pre-set, and red and blue gain. With semi-auto, the camera is pointed at a white card or a translucent white lens cap is put on and this white is compared to a reference white. Pre-set uses a number of fixed settings – 3,200K, 5,600K, etc. – for when the colour temperature is known or lighting is mixed. Red and blue gain allows direct control of the colour difference signals: this is the most accurate means, but it does require a colour monitor for setting (a small LCD screen is probably not accurate enough).

Many camcorders do have a colour LCD screen: either a small one of about 0·5-0·75in. combined with a magnifying eyepiece in an electronic viewfinder (EVF), or a panel of about 3in., as first introduced by Sharp. Others, including professional cameras, have an EVF with a B&W CRT of about 0·75-1·5in. and a magnifying eyepiece. This is fed by the luminance signal, while the LCD screen obviously uses the full signal. Whatever the type, it also acts as an information display, such as indicating the shutter speed, which can range from the standard 1/50 second (20ms) field rate up to 1/10,000 second. This is a function of the image sensor, which instead of accumulating the charge for 1/50 second, dumps it and then saves the last 1/1,000 second – or whatever duration has been selected – before reading out normally. Those cameras that also have slow shutter speeds accumulate charge in the sensor for, say, 1/2 second then transfer it to a digital memory, from where the video signals are read out at normal field rate, thus allowing shooting in very low light – a fraction of 1 lux.

Digital zoom also relies on a memory store. As each field enters the store, so the central section is enlarged and fed out, increasing the focal length by two or three times at the expense of image degradation. All camcorders have a power zoom lens, while professional cameras have interchangeable lenses to allow a choice of zoom or fixed focal length lenses. The power zoom drive may be of constant speed or proportional to the pressure put on the rocker switch – harder=faster.

As the focal length increases, so hand shake is magnified – hence, the increasing popularity of image stabilisers. Panasonic was the first to introduce one on a consumer camcorder (see Figure 6). Each field is digitised and divided into five detection areas, each containing thirty reference points; it is then stored and compared with the next field, and if the reference points differ, the field is cropped by about 13% to allow realignment, and is then enlarged and fed out. Having five detection areas largely overcomes the problem of movement within a scene, because all need to show similar displacement, and random noise is filtered out. Panasonic has also introduced a modified version in which an image sensor with more pixels is used, but only the same number of pixels provide the image, leaving an unused border. The whole lot goes into the field store, and the image can be 'floated'

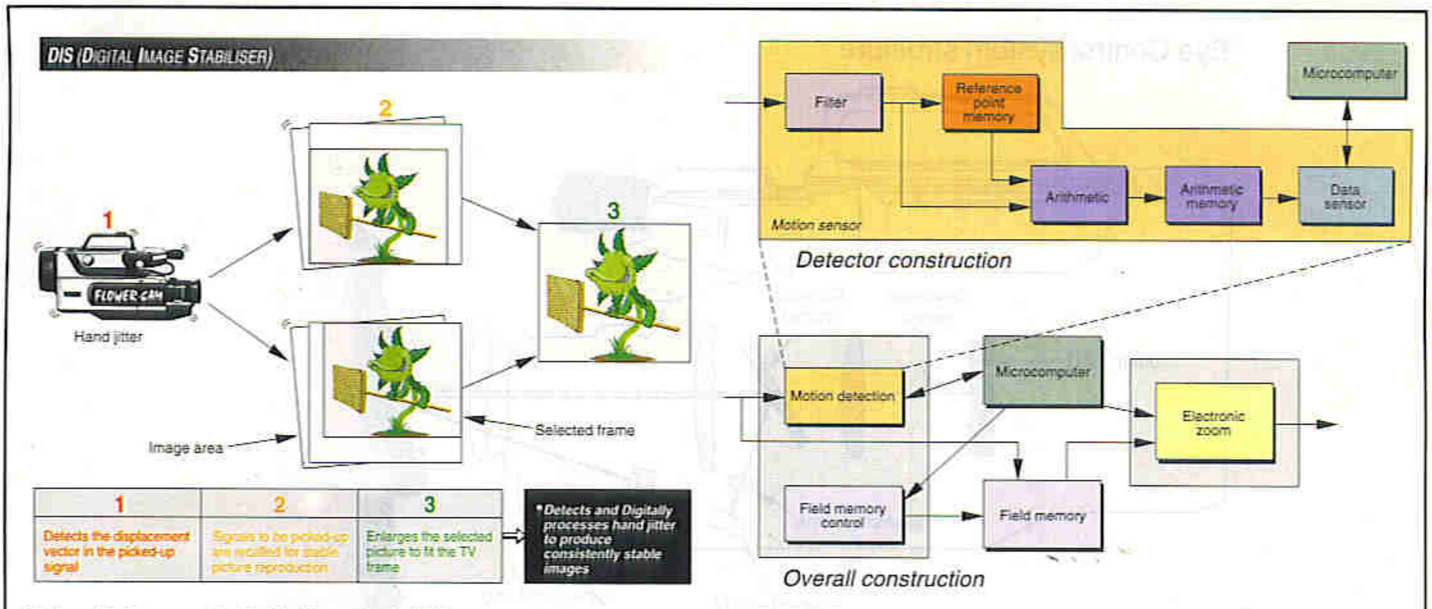


Figure 6. Panasonic digital image stabiliser.

around the full area, thus doing away with cropping and enlarging and the attendant quality loss. Electronic stabilisers from other companies are essentially similar to those.

Mitsubishi did introduce an alternative system that employed two gyro sensors to ascertain horizontal and vertical displacement, with the information used to adjust the output timing of the sensor – 'moving' the image in the opposite direction to the displacement. The image was cropped by about 7%, but instead of being enlarged, a narrow border was placed around it. However, Mitsubishi has now ceased to manufacture consumer camcorders.

Canon and Sony have developed an optical system (see Figure 7). This also employs sensors to detect horizontal and vertical displacement, but in this case, the microcomputer controls an active prism in front of the image sensor to refract the image forming light so that it remains steady. The prism consists of two glass plates joined by a bellows and filled with a liquid. The glasses are moved individually by actuators: one compensating for horizontal displacement, the other for vertical. This gives the best quality on consumer models.

Turning from images to sound, camcorders normally have an electret condenser microphone, either mono or stereo, depending on the recording capability of the VCR. The audio level is controlled by an AGC – only upmarket and professional models provide manual control of the level. A headphone output is usually provided for monitoring, and, possibly, a small loudspeaker. Upmarket and professional models will accept one or two external microphones.

The audio, in analogue or digital form, is then passed to the VCR for recording. Video needs to be formatted for recording on VHS, S-VHS, 8mm, Hi8, or the new ¼in. Digital Video (DV). In the professional arena, the choice is even greater: upgraded versions of DV – DVCam, DVCPro and DVCPro50, Digital-S, MII, Betacam, Digital Betacam, D3 or D5. Professional models may be camcorders or dockable types – a camera to which a small VCR can be attached, providing a choice of formats.

The alternative is a camera connected to a portable VCR by a lead which carries control signals as well as video and audio. And then, there are studio cameras.

All camcorders and cameras have video (and usually audio) outputs, depending on their roles. RGB is used for high-end imaging, which is particularly suited to computer use because capture cards need separate RGB for maximum quality. Component is preferred for professional uses because virtually all the VCRs use a component signal, as does DV, consisting of luminance and colour difference signals. YC is used for Hi8 and S-VHS, consisting of luminance with the colour difference signals encoded into a single chrominance signal. Finally, composite, a general signal in which the luminance and chrominance are combined, which is the normal video input/output on VCRs and TVs. With more digital VCRs and, of course, computers in use, more camcorders and cameras now have a direct digital output to maintain quality.

All future developments will be digital, whether it is improvements to DSP or complete digital systems, for it is easier and cheaper to operate digitally. ELECTRONICS

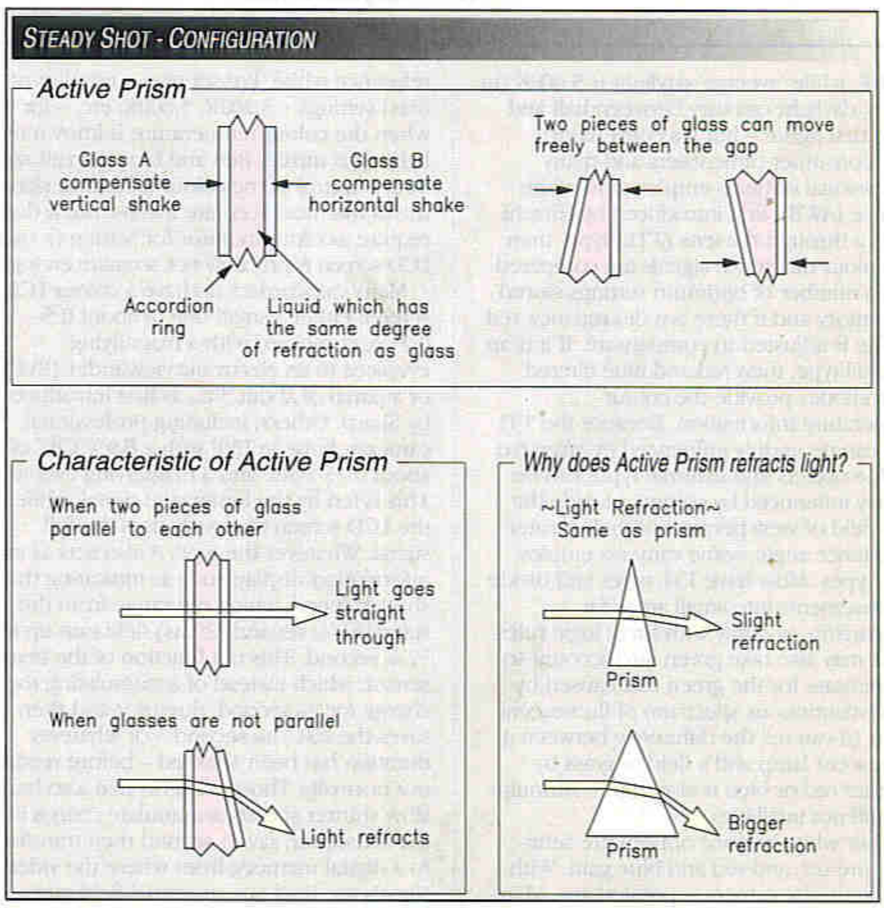
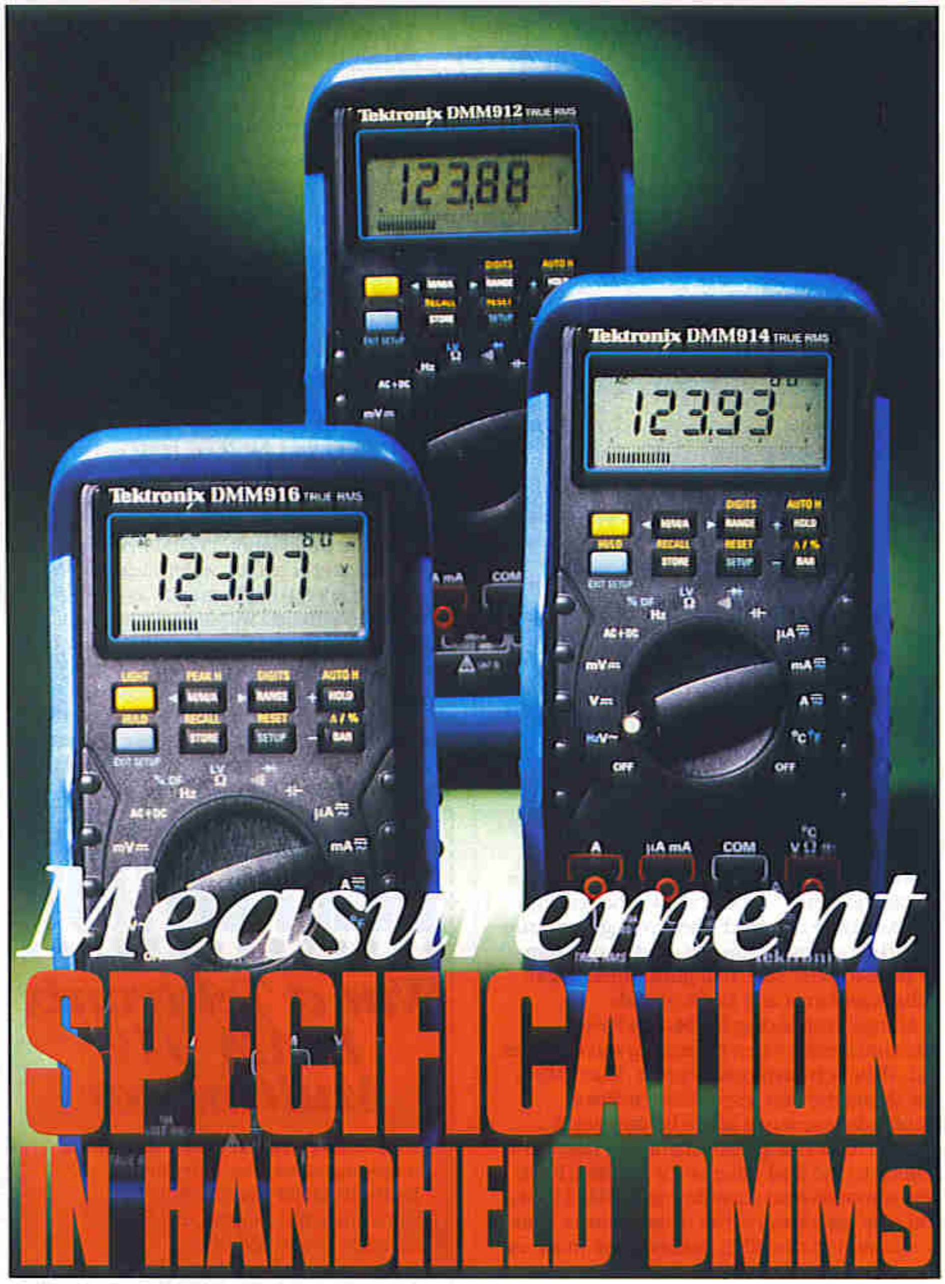


Figure 7. Canon/Sony optical image stabiliser.



Measurement SPECIFICATION IN HANDHELD DMMs

by Trevor Smith, Tektronix

The handheld digital multimeter (DMM) is the most common of all electrical and electronic test instruments. Despite the pervasiveness of the DMM, its specifications and features are often not fully understood.

This may lead to potential users overlooking its more advanced measurement solution capabilities or, worse still, not understanding its limitations. This article will help DMM users to better understand the significance of the important performance specifications.

Display Digits

Traditionally, DMM displays have been specified in the form '3½-digit', for example. This means there are three complete digits, each capable of displaying the numbers zero to nine, and one additional preceding digit which may display only a zero (which may be blanked) or a one for a full-scale reading of 1999. This is not exactly an intuitive scheme, but it has been around long enough for most users to understand it.

Newer DMMs have clouded the picture somewhat by increasing the full-scale range to 3999 or 39999 or more. These have been dubbed 3 and 4 digits, respectively. This description is even less intuitive than it was for 3½ digits.

A better approach, which is now displacing the fractional digits, is to specify the number of counts that may be displayed. For example, the 3½-digit display is described as 2000 count (1999 plus the reading of 0). From that description, it becomes readily obvious what the display is capable of showing. The 3-digit display becomes 4000 counts and 4 digits becomes 40,000 counts. Some confusion arises in cases where 3 digits has been used to denote 3000 or 5000 counts. Table 1 shows the relationship between digits and counts for the more common DMM displays.

The number of counts usually applies to the DC volts function. Fewer counts may be displayed on the same instrument for certain functions. For instance, a 40,000-count DMM may be limited to 4,000 counts when it is used for measuring capacitance.

Digits	Counts
3½	2,000
3	4,000
4½	20,000
4	40,000

Table 1. Digits versus counts.

Resolution

Resolution is a measure of the smallest increment that may be discerned. At first glance, it would seem that 10·000V measured with a 40,000-count DMM would be read to a resolution of 0·001V. This is usually the case where the DMM's A-to-D converter resolution exceeds that of the display, but some multimeters have less resolution than the display. In this case, the last digit could read 0, 1, 2, 3, 5, 6, 7, 9, etc. with a linearly increasing voltage. Note that only eight out of the ten possible values were displayed. This is an artefact which results from the digital nature of the conversion. In a more extreme case, only odd or even digits are displayed, hence the need for a resolution specification which is separate from the display count.

The increased resolution of 20,000 and 40,000-count DMMs does not come without penalties. Longer settling times are required for the far right digits to reach their final value. To offset this problem, at least partially, analogue-like bargraphs are included. Because of their lower resolution, they provide near-instantaneous response to changing input signals. They permit peaking and nulling adjustment where rapid indication of the adjustment effects is needed.

The resolution specification for certain functions may be limited intentionally because of noise or accuracy limitations related to that particular function. The meaningless trailing display digits are usually blanked in such a situation. Capacitance is a good example of a function included in many high-end DMMs where accuracy limitations make it desirable to limit the display to only those digits which are meaningful.

Displaying more digits leads to two fundamental problems. The first is that the meaningless digits are usually rapidly changing, and would serve only to distract the user from those digits that are significant. Secondly, the display of random numbers leads the user to think that the instrument is inaccurate. Even if the reading appears stable, it may not be as accurate as a 40,000-count DMM having 0·5% accuracy on AC voltage. Additional resolution without a corresponding accuracy improvement is not meaningful to anyone except the advertising department!

Accuracy, Uncertainty and Repeatability

Accuracy is often the key differentiating specification between models which otherwise appear similar. DC accuracy is usually used for the banner specification since it is usually better than the accuracy for other functions. DC accuracies of better than ±0·1% are just now becoming available. Added to the percentage figure will be a specified number of counts (sometimes referred to as digits) resulting from rounding error and noise limitations. For DMMs, accuracy is specified as a percentage of the reading as opposed to the percentage of full scale normally specified for analogue multimeters.

If possible, users should avoid the bottom 10% or so of any range, since accuracy is badly degraded there. It is not the percentage error that is the problem: it is the effect of the number of counts, so that deviation becomes substantially larger in proportion to the measured value.

AC accuracy is usually less than that for DC. It is also optimised for 50-60Hz. Other frequencies may have poorer accuracy. As with DC accuracy specifications, a number of counts (often greater than for DC) will be added to the accuracy percentage. In addition, for waveforms other than a pure sine wave, additional inaccuracy will be encountered when using an average responding DMM. Even a true RMS responding DMM will have some accuracy limitations for waveforms with high peak amplitude components if measured near full scale.

From a metrologist's standpoint, what appears in the manufacturer's specification sheet under accuracy is more properly deemed uncertainty, with accuracy being reserved to indicate the probability of the reading being accurate. A specification of 1% uncertainty would have an accuracy of 99%. It is now common practice for instrument manufacturers to use the term accuracy and for calibration laboratories to use uncertainty, with both representing the same thing in real life.

Repeatability is often more important than absolute accuracy when making a series of measurements. The user wants the DMM to read the same value each time a measurement is made of exactly the same value. Repeatability is not usually specified directly, but a limit is implied by the accuracy specification, since it must always be within the specified accuracy. It may or may not be considerably better than the specified accuracy, and can vary considerably from one DMM to another, even of the same manufacturer and model. Component ageing, battery condition, temperature, and warm-up time may all effect repeatability to some degree.

The only way to get a feel for a particular DMM's repeatability is to make a large number of measurements of a precision source under a variety of conditions. The source should have better than four times the rated accuracy of the DMM to be able to sort out repeatability and accuracy limitations.

Calibration

In the past, the calibration of DMMs has usually been accomplished by adjusting several internal tweaks. Initial calibration by the manufacturer included these tweaks, as well as filing or applying solder to the high current range shunt resistor (actually a piece of buswire) to adjust its value. This was the stone age version of the laser trimming process used for film resistors. These manual adjustments are gradually being displaced by software calibrations stored in the microprocessor. These software tweaks are accessible through a particular keystroke sequence while a specified input signal is applied to the DMM input. This technique reduces time and cost for calibration. It also allows better accuracy than is obtainable with a potentiometer or resistor adjustment, since both solder and cermet potentiometers have undesirable temperature coefficients.

True RMS and Average Readings

True RMS reading DMMs populate the high end of available handheld instruments. They are assuming greater importance today in light of the heightened concern over power-line harmonic distortion caused by widespread use of switching power supplies in office computers and todays proliferation of electronic devices. True RMS is an advantage when measurements of AC waveforms other than sinusoidal are required.

RMS measurements are a measure of the equivalent heating effect produced by a voltage and, to be accurate, must include any DC component present along with the AC component that most users associate with RMS readings. Many true RMS DMMs are not capable of measuring the true RMS value of the combined AC and DC components, and errors may result if there is any DC superimposed on the AC voltage.

Waveform	Actual Pk-Pk	Actual RMS	TRMS AC+DC	TRMS AC Only	Average Reading	Error For Avg.
Sine	2·000	0·707	0·707	0·707	0·707	0%
Triangle	2·000	0·577	0·577	0·577	0·555	-3·8%
Square	2·000	1·000	1·000	1·000	1·111	+11·1%
Pulse (25%)	2·000	0·433	0·433	0·433	0·416	-3·8%
Pulse (12·5%)	2·000	0·331	0·331	0·331	0·243	-26·5%
Pulse (6·25%)	2·000	0·242	0·242	0·242	0·130	-46·2%
Sine+ 1·000 VDC	2·000	1·224	1·224	0·707	0·707	-42·2%
DC	n/a	1·000	1·000	0	0	∞

Table 2. Average versus true RMS comparison of typical waveforms.

DC	1·000
Square Wave	1·000
Sine Wave	1·414
Triangle Wave	1·732
Pulse – 25% Duty Cycle	1·732
Pulse – 12·5% Duty Cycle	2·646
Pulse – 6·25% Duty Cycle	3·873

Table 3. Crest factors of typical waveforms.

Conventional (non-true-RMS) DMMs measure the average AC voltage, and are calibrated so that the readings are corrected to that of the RMS value for a sine wave. This procedure works well, but errors occur if harmonics are present, with the effect becoming progressively worse as the harmonic content increases. Table 2 shows the readings that would be obtained when average and true RMS responding DMMs are used to measure 2V peak-to-peak sine, triangular, square, and pulse waveforms and 1V DC signals.

Average responding DMMs can have a substantial error when measuring square waves with their rich harmonic content. True RMS is not always the best, especially if millivolt amplitude sine waves are to be measured. Average responding instruments are faster in settling to the final value or for adjusting levels near zero volts than equivalent true RMS DMMs, and may have lower offset or zero errors. This is common to true RMS meters, since most use the same type of true RMS convertor integrated circuit.

A true RMS DMM that does not read AC and DC components will exhibit a -42·2% error under the AC-with-DC offset condition shown in the table. In this case, if true RMS readings are required, it will be necessary to compute the value from separate DC and true RMS AC measurements using the equation:

$VT_{RMS} = (VDC2 + VAC2) - 2$

In both the previously described instances, understanding what the DMM is actually responding to will help to prevent misinterpretation of measurements. A few DMMs offer the ability to select average, AC true RMS, or AC+DC true RMS, thus allowing the user to choose the optimum mode for the desired measurement.

Crest Factor

Crest factor should also be considered when making AC voltage measurements of non-sinusoidal waveforms. Crest factor is defined as the ratio of the peak or crest voltage compared to the RMS voltage. The crest factor relates to ideal waveforms as shown in Table 3.

True RMS reading DMMs will usually specify the maximum crest factor that they can handle accurately. This will usually be at its lowest near the full-scale reading, owing to the saturation characteristics of the true RMS converter chip. Better accuracy may be obtained near mid-scale.

Conclusion

The versatility of the DMM and the design compromises required to allow additional features or optimisation of certain specifications for advertising purposes require a thorough understanding by the user in order to achieve maximum accuracy and to apply it to problem solving in new applications. The competitive trend among DMM manufacturers toward greater accuracy, wider measurement range, and special features such as waveform viewing – combined with compactness and reasonable cost – are certain to continue. The user will be the ultimate winner as new problem solving capabilities emerge. It is important, however, for the user to take a little time to understand the instrument's limitations as well as its features, in order to realise the maximum return on investment.

COMPETITION

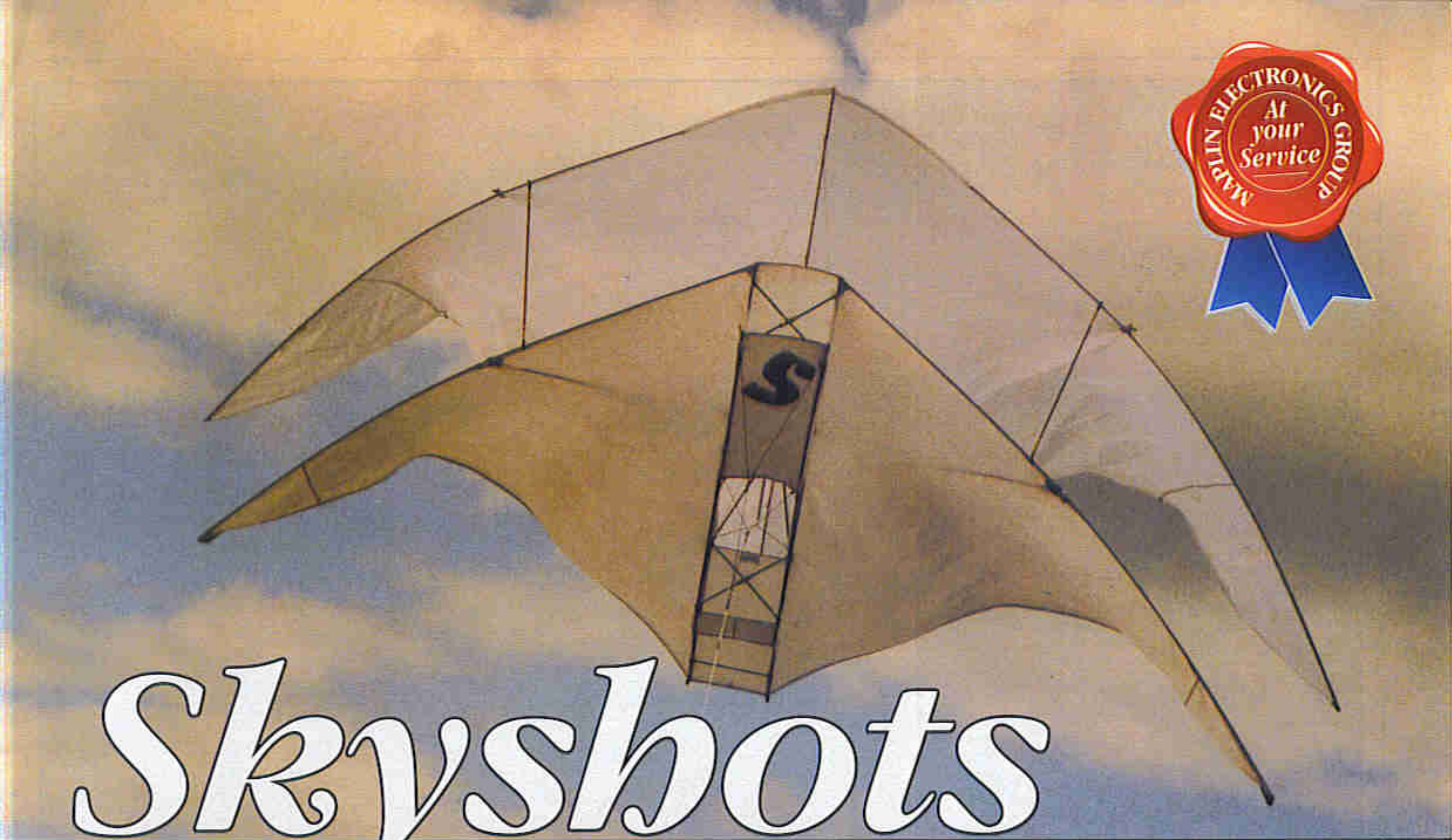
Win a Tektronix DMM 916 Multimeter

All you have to do is to tick the correct boxes and send your entry into:
Tektronix DMM Competition
Electronics and Beyond, PO Box 777
Rayleigh, Essex. SS6 8LU.

Entries must be received by 5th September 1997. The first correct entry to be pulled out of the hat will be the winner.

All employees of Maplin Electronics and Tektronix are not eligible to enter. Multiple entries will be disqualified. Editors decision is final. Prize is not exchangeable for cash.

1. What is the display resolution of Tektronix 900 series DMM's?
   - a) 60,000 count ☐
   - b) 20,000 count ☐
   - c) 40,000 count ☐
2. What is the basic DC volts measurement accuracy on a DMM916?
   - a) 0.02% ☐
   - b) 0.06% ☐
   - c) 1% ☐
3. Which of the 900 series DMM's provide true-RMS AC measurement capability?
   - a) All of them ☐
   - b) DMM912 ☐
   - c) DMM916 ☐
4. In which US state is Tektronix headquartered?
   - a) New Jersey ☐
   - b) California ☐
   - c) Oregon ☐
5. What is the new address of Tektronix Internet web site?
   - a) http://www.tok.com ☐
   - b) http://www.tek.com ☐
   - c) http://www.tik.com ☐



Skyshots THE MOVIE

by Alan W. Mackie

The original concept was simple. Find a way to take aerial photographs that's cheaper than hiring a plane or helicopter and is both legal and insurable. Did I say simple?

A kite seems obvious, and in fact, was chosen early on as the best way to get the camera aloft, but the problem was how to control it and to be sure that it photographed what was wanted. A browse through a few kite books taught me that the best available was a guess and hope method, so I grabbed Maplin's catalogue and set out to do better.

The control of the camera, in terms of pan, tilt and shutter, is easy enough. A standard radio control set-up, as used by aero modellers, would fit the bill nicely. So, enter 4-channel Futaba radio gear and a set of servos. A few days of filing, sanding, drilling and metal bending later, and I had a working rig. But how could it be aimed correctly? Having discarded exotic ideas using laser beams or RDF, the obvious way was by video, using a miniature camera.

Radio transmission of the video signal to the ground was no use, due mainly to the weight involved, both of the transmitter and the power supplies. So, a cable was attached to the kite line (not a lot of fun over a 350 feet length) and the device was sent up to 200 feet on the first decent windy day. No signal. It worked OK on the ground, but as soon as the cable was

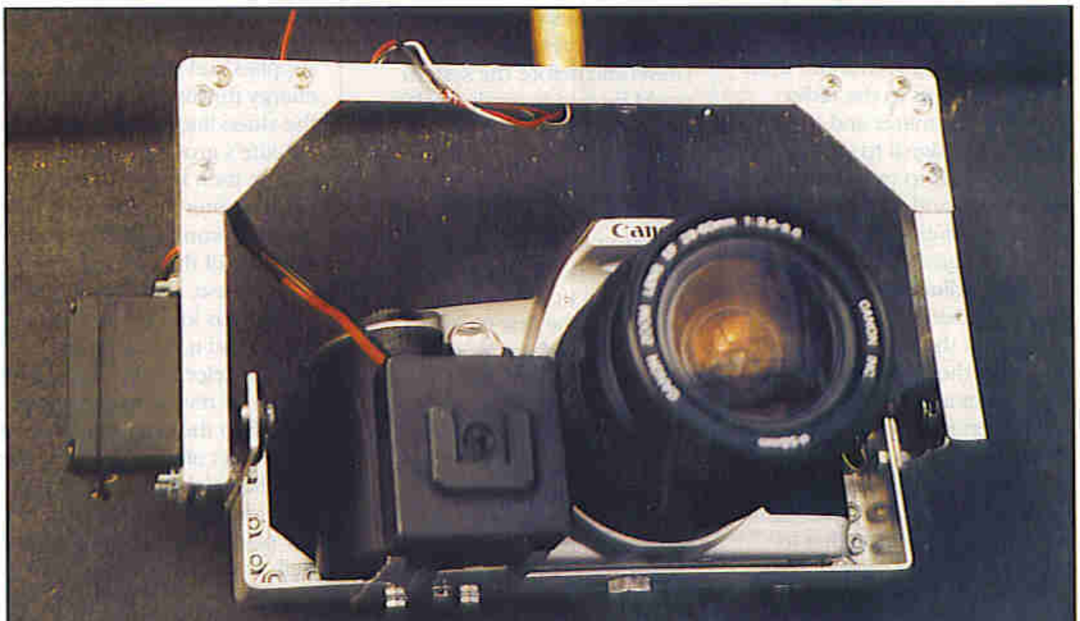


Photo 1. Skyshots' camera unit – the Canon 35mm SLR and pinhole video cameras are both tilted by means of a servo (the black box to the left of the mounting frame) and can be panned also.

Photo 2.

stretched out and strung vertically, the picture was useless. Not the fault of the camera at all, it just wasn't designed to be used in that way. Especially not when powered by one humble (but lightweight) PP3 battery.

Add to this the difficulty of seeing the picture on the monitor perched in the back of the car, and it was back to the drawing board. The solution was to first fit a viewfinder from a video camera to the radio control transmitter and then to digitise the signal to the ground from the kite to overcome the dissipation and signal loss. This, of course, meant carrying more batteries and electronic gear on the kite (solution – bigger kite) as well as beefing up the power source for the transmitter, now handling the radio signals, the viewfinder and the electronics to convert the signal back to analogue mode.

That was OK as far as it went. It all worked fine but was limited to windy days due to the weight being carried. So, a gradual improvement was carried out over a year or so, each step improving the quality of the system. The main improvement came with the kite line. Rather than strap the video line to it, a special line was made up in which the video line was wrapped in 350 pound breaking strain Dyneema. This helped solve a lot of line tangling problems as well as reducing the drag.

Flashover

But there was one other important problem to overcome before the system could be said to work reliably and properly. As we might expect, moving charged air molecules and that includes dust flowing over a nylon wing (the kites are made from spinnaker rip-stop) causes a huge build up in static electricity. The first indication of this was a loud crack one day while taking some aerial shots and the entire system shut down.

All the usual checks and tests revealed no fault in the wiring or power sources, but opening up the video system revealed a mess of melted plastic and silicon. The best guess is that a spike of a few thousand volts came down the video line and earthed itself in the picture tube. Ouch.

Once again, back to the drawing board. A simple fuse is no use; static electricity at these levels can jump gaps like that without pausing for breath. The eventual solution was a fairly complex sensor system that compares the charge in the line and on the kite frame (carbon fibre) and when it reaches danger level, shuts down the video system, disconnects the camera totally from its power supplies and then dissipates the energy through the shield of the video line, directly through the kite's ground spike. The system then restarts a few seconds later and all the operator knows about is a brief blackout of the picture.

Of course, all this meant that the various kite struts and beams had to be all linked together electrically. So the kite had to be re-made with wiring sewn into the seams and edges to connect all the parts together and the nylon connectors had to be replaced with steel in a few places. And a lot bigger as well, as you've guessed.

So does it work reliably? Well, on one occasion, I forgot to connect the earth strap to the kite frame and the system exploded again, so it seems safe to say that it works perfectly. Operator error excluded.

The kites now have a wingspan of over 17 feet and can be flown in a number of different configurations to suit the weather. The still camera has been upgraded to a Canon FOS 500M fully automatic 35mm and the video camera reduced to a pinhole version. The kites can also be easily rigged to fly up to 30° 'off' the wind, to improve coverage of hard-to-get-at subjects and as a result, the radio control system now uses 6 channels powering 8 servos.

Pan and tilt controls are obvious. Not so apparent is the need for pivot controls. As the wind changes, the kite flies at different angles, steeper in strong winds and levelling off into a glide at lower speeds. It's too limiting to pre-set the angles on the ground so a control is needed to bring the main axis to vertical to prevent squint pictures. Equally, the kite flies tilted to one side when flying off the wind so that also has to be allowed for.

Think of a pan and tilt control to bring the main axis to vertical and you then control the pan

Photo 3.

and tilt of the camera through 360° and from above the horizon to vertically downwards, and you'll get the idea. Add to this the video, shutter and lens zooming controls, and you can see that the kite has to be able to fly on its own, untended, to leave the operator time to take the picture. It does, with excellent stability.

Other snags? Well, the camera unit's weight has to be kept in the same place, directly in line with the kite's aerodynamic centre of lift, regardless of the angle of turn or tilt, to avoid throwing the wing off balance. Also, there being no way of knowing how many shots are left in the camera. Add to this the fact that the whole thing has to operate in winds of up to 30mph, and you can see that it needs pretty powerful servos and strong gearing to operate it all. The whole assembly now weighs around four and a half pounds.

Photo 4.

On calm days, a hot air balloon (18 feet high, 14 feet wide) does the same job of lifting the camera module to the required height. Both systems fully comply with all the CAA regulations and the needs of the insurance companies. A few changes were asked for, adding extra weight with safety devices and so forth, but as I said at the start, it has to be legal. Imagine the damage it could do if the system failed and you can see why full insurance is essential and a legal requirement.

Skyshots is now fully operational, and our customers are reporting that they're very happy with the results, so all the time, effort and money seems to have been well spent. The help of the **Maplin Electronics** staff in their Glasgow branch over the development period was much appreciated. As I am total novice to the world of video and electronics in general, Gavin Briggs and his team at the Glasgow store were able to offer me a great deal of practical help and encouragement. To protect all this hard work, Design Rights, Patents and Copyrights have been established and there are a few more pending as the system is further developed and improved.

The photos on these pages make it clear what can be achieved, showing the video camera installed and the complete assembly flying. The aerial photos give a pretty good idea of the quality obtained. And yes, I do occasionally use a camcorder instead of a still camera. Same controls, just a bit bigger.

Oh yes, the next step is a digital camera, linked by cable to a PC and printer and able to turn out good quality pictures direct from the kite or balloon to paper in hopefully a few seconds. Watch this space!

SKYSHOTS PROJECT PARTS LIST

FLYING PARTS	
Pinhole Camera (MB20W)	£99.99
3× High Power Servos (CDX08J)	£168.27
2× Micro Servos (DXI0L)	£92.78
PP3 and AAA Ni-Cd batteries	
Voltage regulators, digitiser, connectors, flexible wire, etc.	
GROUND CABLE	
100m Ethernet Cable (API6S)	£45.89
Wrapped (braid) in 150K breaking strain Dyneema	P.O.A.
CONTROL UNIT	
Futaba 6-channel Radio set (DX02C)	£254.99
Video camera viewfinder (various)	
Sealed 12V battery (XG74R)	£18.17
Charger for above (GU07H)	£29.99
Voltage regulators, D/A converters, switches, etc.	

Photo 5.

Photos 2, 3,4 & 5. Pictures taken using the Skyshots kite equipment, respectively showing: Truun marina from the South-East; Ross & Co factory in Irvine, Ayrshire; Petrol station on the A71 at Galston, Ayrshire; Anchorage Hotel, Truun, Ayrshire.

projects

New Project

150W BIPOLAR POWER AMPLIFIER

PROJECT RATING 2

FEATURES:

- 175W RMS into 4Ω*
- 100W RMS into 8Ω*
- Classic Bipolar design throughout
- Wide frequency response 15Hz to 37kHz (-3dB)*
- Low distortion less than 0.1% at 1kHz*
- Full output at 1V RMS input*
- Operating voltage ±25V to ±50V DC

APPLICATIONS:

- PA Systems
- Disco equipment
- In Car Entertainment using PSU LP39N

*Quoted values measured using recommended PSU

Kit includes all components, PCB, heatsink, greaseless insulators, fixing hardware and full instructions. Pre-amp components and PSU not supplied.

150W BIPOLAR AMPLIFIER KIT LP33L £34.99
Construction details: 150W Bipolar Amplifier Kit leaflet XZ37S 50p
Issue 107 / November 1996 Electronics & beyond XD07H £2.25

AUDIO VIDEO MODULATOR

FEATURES:

- Simple construction. No alignment required
- Multiple inputs – SCART or BNC/Phono
- Silk-screened , pre-punched case
- Built in test signal for TV tuning
- Allows video equipment such as camcorders to be connected directly to the RF input of any TV
- Provides a SCART input to your TV (Composite video and audio only)
- Allows two videos to be linked without disconnecting the TV

APPLICATIONS:

- Low cost security monitoring using our range of CCD cameras

Kit includes all components, connectors, wire, PCB, box, and full instructions.

Requires +8V to +15V DC regulated mains adaptor 300mA minimum (not supplied).

PROJECT RATING 2

AUDIO VIDEO MODULATOR KIT LU35Q £34.99
Construction details: Audio Video Modulator leaflet XZ10L 80p
Issue 108 / December 1996 Electronics & beyond XD08J £2.25

ACTIVE TRANSFORMER DI BOX

FEATURES:

- Active design
- Battery or PSU operation
- Low battery and power on indicators
- 6.35mm (1/4in) jack inputs and XLR output
- Pre-punched silk-screened front and rear panels
- Sturdy and compact

IDEAL FOR:

- Matching unbalanced lines into balanced inputs
- Breaking earth loops
- Impedance matching

PROJECT RATING 1 Simple

Kit includes all components, connectors, wire, PCB, box, panel labels and full instructions. Requires PP3 battery or 9V mains adaptor (not supplied)

ACTIVE TRANSFORMER DI BOX KIT LU32K £32.99
Construction details: Active Transformer DI Box leaflet XV98G 50p
Issue 106 / October 1996 Electronics & beyond XD06G £2.25

ACTIVE SCART SPLITTER/SELECTOR

PROJECT RATING 2

FEATURES:

- SCART, Composite and S-Video compatible
- Separate phono audio outputs
- Split or source 2 ways
- Can be daisy chained for more outputs
- Easy to build and use
- Mains powered 230V AC 1.84W

IDEAL FOR:

- Connecting a single TV, VCR or cable/satellite unit to two other units
- Buffering of signals to reduce degradation
- Simple input selection of audio and video source

Kit includes all components, connectors, PSU, mains lead and plug, PCB, labelled box and full instructions. Connecting leads are dependant on use and not supplied.

ACTIVE SCART SPLITTER/SELECTOR KIT LU21X £39.99
Construction details: Active SCART Splitter/Selector leaflet XZ36P 80p
Issue 107 / November 1996 Electronics & beyond XD07H £2.25

These kits are:

- Supplied with high-quality fibre-glass PCBs – pre-tinned, with printed legend and solder resist
- Supplied with comprehensive instructions and a constructors' guide
- Covered by the Maplin Get-You-Working Service and 12-month warranty

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

Kits from Maplin

AUDIO LEAD CHECKER KIT

– No home or professional studio should be without one!

FEATURES:
- Easily and clearly identifies interconnections on most types of audio cable
- Battery powered and portable
- Easy to build
- No setting up required
- EMC / CE Compliant

IDEAL FOR:
- PA/sound engineers
- Gigging Bands
- Home & professional studios
- Audio/Hi-Fi

PROJECT RATING 3 Average

Kit includes all components, PCB, box, box label, sockets, wire, etc., and full instructions. Requires Alkaline PP3 battery (not included in kit).

AUDIO LEAD CHECKER KIT LU26D £19.99
Construction details: Audio Lead Checker Leaflet XZ20W 80p
Issue 114 / June 1997 Electronics & Beyond XD14Q £2.25

1.5A VARIABLE VOLTAGE POSITIVE AND NEGATIVE REGULATED PSU KITS

PROJECT RATING 3 Average

FEATURES:
- Output reverse polarity and back-voltage protection
- Output voltage range: 1.25V to 37V (depending on input)
- LED power-on indication
- Variable output voltage
- Low noise
- Compact dimensions
- Easy to build
- Can be used with single, split and twin secondary transformers
- EMC / CE compliant

Kit includes all components, PCB, heatsink and full instructions. Mains transformer, other mains-side components and enclosure are dependant on users intended application and therefore not included in the kit.

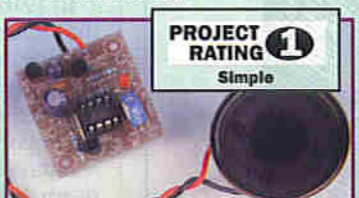
VARIABLE POSITIVE PSU KIT LU86T £10.99
VARIABLE NEGATIVE PSU KIT LU87U £10.99
Construction details: Positive and Negative Variable PSU Leaflet XZ40T 50p
Issue 113 / May 1997 Electronics & Beyond XD13P £2.25

SIREN SOUND GENERATOR KITS

FEATURES:
- Easy to build – ideal beginners' project
- Three versions available
- Auto power-off for long battery life
- Low quiescent current (typically 1μA @ 3V)
- Wide supply voltage range: 2.4V to 24V
- Speaker or buzzer output drive
- Touch, switch contact or digital input to trigger siren
- Pulsed LED output
- Compact PCB
- EMC / CE Compliant

IDEAL FOR:
- Audible warning devices
- Sirens and alarms
- Children's toys

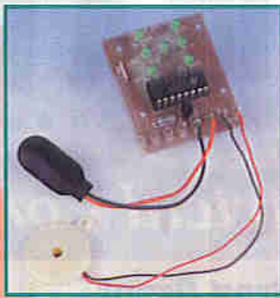
PROJECT RATING 1 Simple



Kit includes all components, PCB, LED, piezo sounder and full instructions. Enclosure, loudspeaker, switch/touch pads, battery, etc., are dependant on user's intended application and therefore not included in the kit.

CAR ALARM SIREN KIT LU85G £7.99 USA POLICE SIREN KIT LU88V £7.99
WAILING POLICE SIREN KIT LU89W £7.99
Construction details: Siren Sound Generator Leaflet XZ42V 50p
Issue 112 / April 1997 Electronics & Beyond XD12N £2.25

ELECTRONIC DICE KIT



FEATURES:
- Easy to build – ideal beginners' project
- Auto power-off for long battery life
- Low quiescent current (typically 1μA)
- 3V supply voltage (2 x 1.5V cells ideal)
- Touch, switch contact or digital input to 'roll' dice
- 'Rolling dice' sound effect
- Dice can be interlinked for games requiring more than one dice
- EMC / CE Compliant

Kit includes all components, PCB, LEDs, piezo sounder and full instructions. Enclosure, fixing hardware, switch/touch pads, battery, etc., are dependant on user's intended application and therefore not included in the kit.

ELECTRONIC DICE KIT LU78K £7.99
Construction details: Electronic Dice Leaflet XZ43W 50p
Issue 112 / April 1997 Electronics & Beyond XD12N £2.25

VIDEO DISTRIBUTION AMPLIFIER KIT

FEATURES:
- Composite video input/output
- Four outputs as standard
- Units can be cascaded for multiple outputs
- Easy to build and use
- Compact dimensions
- Video gain (0dB to 8dB) control
- HF boost (0dB to 8dB) controls
- Wide bandwidth: 20Hz to 50MHz
- 75Ω or high impedance input
- 75Ω outputs
- Single +12V DC @ 50mA Supply
- EMC / CE Compliant

PROJECT RATING 1 Simple

IDEAL FOR:
- Video signal distribution
- Video dubbing/duplication
- CCTV/Security

Kit includes all components, PCB, potentiometers and full instructions. Enclosure, knobs, coaxial cable, connectors, etc., are dependant on user's intended application and therefore not included in the kit.

VIDEO DISTRIBUTION AMPLIFIER KIT LU79L £14.99
Construction details: Video Distribution Amplifier Leaflet XZ38R 50p
Issue 111 / March 1997 Electronics & Beyond XD11M £2.25

CONTINUITY TESTER KIT

FEATURES:
- Easy to build – ideal beginners' project
- Audible continuity indication
- Can discriminate between semiconductor junctions and 'true short-circuits'
- Compact, lightweight and portable
- Battery powered
- No setting up required
- EMC / CE Compliant

PROJECT RATING 1 Simple

IDEAL FOR:
- Tracing faults on PCBs
- Checking components
- Tracing wiring

Kit includes all components, PCB, box, box label, sockets, wire, speaker, test leads, etc., and full instructions. Requires Alkaline PP3 battery (not included in kit).

CONTINUITY TESTER KIT JA13P £19.99
Construction details: Continuity Tester Leaflet XZ39N 50p
Issue 111 / March 1997 Electronics & Beyond XD11M £2.25

ORDER NOW!

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Or Tel: 01702 554002 for details of your nearest Maplin or Mondo store.
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For orders over £30.00 inc VAT goods are dispatched free of handling charges. A small order charge of £2.95 inc VAT is applied to orders less than £30.00 inc VAT. All items subject to availability. All prices are inclusive of VAT and are subject to change. E&OE.

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Internet Web Site: **http://www.maplin.co.uk**

WHAT'S IN A NAME

PART 7

The First Electrical Component

by Greg Grant

The first electrical component is usually taken to be the capacitor, but was it? Well no, actually, it wasn't. From where I'm looking, it's in Bronze Medal position, with the leading role undoubtedly going to the Compass Needle.

Right, let's begin at the very beginning. The word Electricity stems from the Greek word for Amber, Elektron. This came about because, as long ago as 580 BC or thereabouts, Thales of Miletus discovered that rubbing a chunk of amber with a piece of cloth resulted in the amber attracting bits of wool, small feathers and the like. When, 2,000-odd years later, William Gilbert decided to investigate this phenomenon further, he opted for a compass needle as part of his inquisitorial kit.

A native of Britain's oldest recorded town, Colchester – the town, it seems is almost completely unaware of his contribution to electrical science – Gilbert was a physician and mathematician and the scion of a wealthy family.

He began his career as a physician in London and since he was a first class practitioner, he shortly attracted some of the richest citizens as his patients, thus acquiring considerable wealth of his own. In fact, such was his professional reputation, that he was appointed Physician to Elizabeth the First, who, in turn, also paid handsomely for his services.

If this pre-occupation with dosh appears distasteful, not to say vulgar, it's merely to illustrate a point. Gilbert, you see, put his wealth to good use, underwriting some 18 years work investigating magnetism, which bit deeply into even his considerable wealth. The results, however, were well worth the expense.

Although magnetism had been studied – actually 'looked at' would be a better expression – during the Middle Ages, Gilbert would take the phenomenon out of the realms of the fabulous and into mainstream, early 17th century science.

Among his many experiments was that illustrated in Figure 1. The structure is a model of the Earth, fashioned from lodestone, with which Gilbert demonstrated that a compass needle, located on the surface, would point to the opposite pole. It was this experiment that led him to conclude that the Earth itself was one massive magnet.

He published his findings in 1600, in his work 'De Magnete,' in which he also used the word Electric for the first time, in his description of magnetic phenomena. This book much impressed other scientists of the time, such as Johann Kepler, for example. It also established the compass needle as something more than simply a useful aid for steering ships by. More than two hundred years later, when electricity was beginning to reveal some of its secrets, it was still a useful investigative tool. Among the scientists who found it essential in their experiments were men of the stature of Oersted, Ampere and the great Faraday.

Some 60 years after 'De Magnete' saw the light of day, the next electrical component appeared. In fact, it wasn't so much a component, more an early machine.

Otto von Guericke, another son of a wealthy and distinguished family, was a trained engineer and sometime Mayor of Magdeburg. Already renowned for his experiments with the nature of the vacuum, he was no less deeply interested in phenomena that would act at a distance.

Among the latter, von Guericke counted gravity and inertia as well as light, sound and heat. He was also of the view that the heavenly bodies acted and reacted on each other magnetically.

A firm believer in a demonstration being far more impressive than any verbal or written explanation, he decided to display some of these phenomena, especially the last one. Consequently, he built a sphere of sulphur and minerals which could be rotated on a crank-driven shaft, as shown in Figure 2.

When touched by hand as it rotated, a considerable amount of static electricity built up. The globe could be alternatively charged and discharged virtually indefinitely. It was, in fact, the first electrostatic generator, producing the earliest man-made sparks. Von Guericke also attempted to mimic what he thought was the composition of the Earth and, in so doing, modify Gilbert's results.

This was the forerunner of the Wimshurst Machine, an electrostatic generator with a pair of parallel insulating discs revolving in different directions. Each disc was in contact with a slim metal wiper which produced a charge on the disc. The invention of the English engineer, James Wimshurst, it was mainly used for demonstration purposes. Von Guericke would surely have approved!

In 1916, Charles P. Steinmetz developed the Lightning Arrester at the General Electric Company in New York. To simulate lightning discharges, he built what was generally regarded as the largest electrostatic generator constructed up to that time.

Almost thirty years after Wimshurst's death, his machine inspired a successor. The Alabama University-trained engineer, Robert van de Graaf, arrived at Oxford University as a Rhodes Scholar, to carry out research in physics under Sir John Townsend.

In the course of this research, van de Graaf realised that the Wimshurst Machine could be improved greatly by storing the charge on a hollow metal sphere. He

Figure 1. Gilbert's terrella, taken from his 'De Magnete,' showing the dip of the needle at different latitudes.

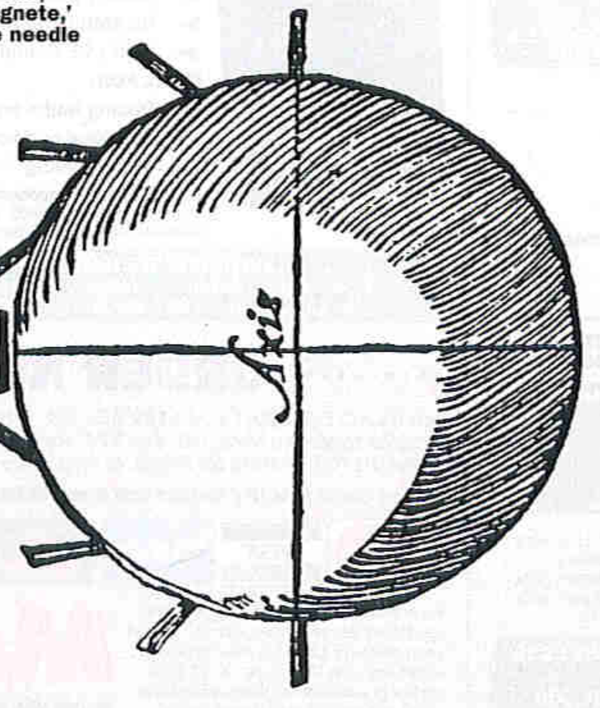
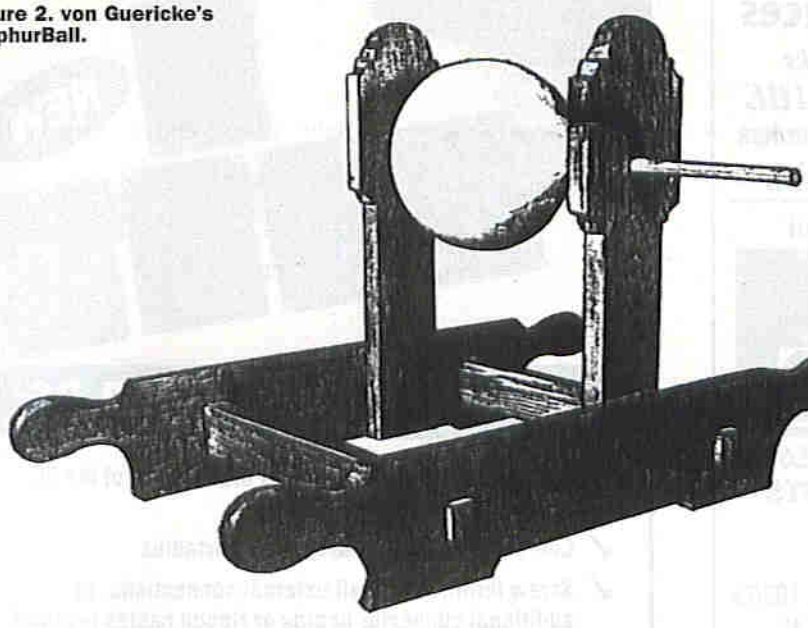


Figure 2. von Guericke's SulphurBall.



produced his first model in 1929, it generating some 80kVA! His later models improved considerably on this figure, one for example, reaching an astonishing 15Megavolts!

These machines were used in atomic physics as well as in medical and industrial X-ray equipment. By 1946, van de Graaf had set up the High Voltage Engineering Corporation to develop and market his generator.

The first thing that ought to be made clear about the Leiden Jar is that it was not discovered, developed or invented by anyone of that name. Leiden, or Leyden, is a city in the West Netherlands, in South Holland Province, whose university dates from 1575. It was the home of some of the Pilgrim Fathers for around 11 years before they opted for the 'Mayflower', the New World and a place in history in 1620.

It was at the university, around 1745, that the physicist, Pieter van Musschenbroek, was experimenting with electric charge. His apparatus consisted of a bucket suspended by insulating silk cords, with a brass connector, insulated by a length of cork, placed in the water (see Figure 3). Gradually, he built up an electric charge in the water, in fact, a fairly substantial one.

Just how substantial became clear when his assistant picked up the brass connector below the cork insulation. The bucket promptly discharged through the assistant, giving him the first decent artificial electric shock in history!

The German physicist, Edwald von Kleist, also developed a component similar to the Leyden Jar, at about the same time. However, where van Musschenbroek shrewdly got someone else to do his testing for him, von Kleist accidentally discharged his capacitor himself. Feeling every bit as aggrieved as van Musschenbroek's assistant had been, von Kleist flatly refused to have anything further to do with capacitors, his own or anyone else's!

Two years after van Musschenbroek and von Kleist, the English physicist, John Bevis, decided that the bucket simply had to go. He replaced it with a glass jar and metal foil inside and outside the glass.

He attached a conducting wire to the inside foil, which projected from the mouth of the jar. The original Leyden Jar was now two conductors separated by an insulating substance, which was made as thin as the technology of the time would allow. This device shortly became standard equipment in the 'Natural Philosophy' laboratories of the day and, for a brief period, it was thought that the glass was essential to the component's operation.

In 1762, however, a year after van Musschenbroek's death, this was proved a fallacy when the first parallel-plate capacitor was produced by simply covering two large boards with metal foil. The glass was obviously no more important than the water had earlier been.

The capacitor has had some important achievements to its credit. To begin with, it was the earliest method of storing electricity until the invention of the Voltaic Pile in 1800.

It also became the ancestor of the Dipole Antenna* and so played a major part in the development of communications engineering. However, the device – or rather, the Capacitive Effect – proved something of a problem on the first Trans-Atlantic telegraph cable after it had been laid.

This difficulty was investigated by Lord Kelvin – he of the temperature scale – no less, who looked on the problem as similar to charging up an immensely long, very thin, Leyden Jar. In fact, it was from Kelvin's work on the Atlantic cable problem that the communications engineering profession got its basic understanding of the workings of the capacitor. Moreover, the device leant itself to further, not to say extensive, development.

By 1874, the German physicist, Manfred Baur, had come up with the Mica capacitor which was followed, four years later, by the Rolled paper capacitor, developed by the British physicist, D. G. Fitzgerald.

In 1900, the Italian inventor, L. Lombardi, announced his development of the Ceramic capacitor, which was followed in 1904 by the Glass Tubular capacitor, patented by the Polish electrical engineer, Ignacy Moscicki. In fact, they came to be known as Moscicki Tubes.

Moscicki himself had a most colourful career, being at once statesman, scholar, trained electro-chemist, would-be assassin and, eventually, President of the Polish Republic! He had fled to Britain after a bungled attempt to assassinate the Governor-General of Warsaw. Hence, the British patent for his capacitor. Having returned to Europe, he taught at the University of Freibourg in Switzerland before taking up the Chair of Electro-Chemistry at Lemberg.

In a modified version, with flat glass plates separated by zinc sheets and oil-filled, Moscicki Tubes became the mainstay of Spark-Gap transmitters up to the middle of the First World War.

The first radical departure from the standard construction of two conducting plates separated by a slice of insulating material came in 1921, when H. O. Siegmund developed the Electrolytic capacitor. He did so to minimise the space taken up by the paper in the existing capacitors of that type. By the end of the decade, the electrolytic capacitor was in widespread use.

Finally, in 1956, two Radio Corporation of America (RCA) researchers, L. J. Giacoletto and J. O'Connell, invented the Semiconductor Diode Junction capacitor, thus bringing the ancestors of the Leyden Jar into the semiconductor age.

There seems little doubt, therefore, that should superconductivity become possible at civilised temperatures, the capacitor will, once again, give a Gold Medal performance from the Bronze Medal position.

* See 'Birth of the Antenna', Electronics, Issue No. 105, September 1996.

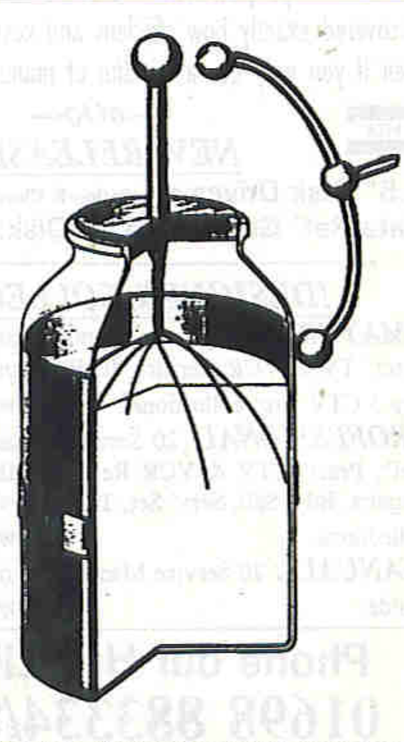


Figure 3. Musschenbroek's Leyden Jar.

Users guide to SPECIAL AUDIO PROCESSING IC'S

PART 3

Ray Marston looks at two 'remote-controlled' audio tone/volume ICs and at the MF10C filter IC in the final episode of this series.

The first episode of this series looked at the basic theory and practical working details of the MC3340P electronic attenuator IC, the NE570/571 dual 'compander' ICs and the LM1894 dynamic noise reduction IC, and the second episode looked at a variety of analogue switching ICs that are suitable for use in multi-way Hi-Fi channel selection applications. This month's concluding episode of the series continues the 'special audio processing ICs' theme by taking detailed looks at two special 'remote-controlled' tone/volume ICs, and at the ever-popular MF10C dual switched-capacitor filter IC.

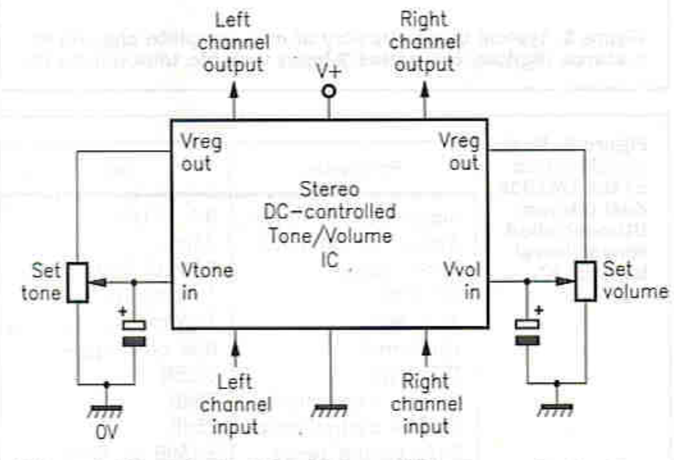


Figure 1. DC-controlled Tone/Volume IC basic usage circuit, using potentiometer-derived control voltages.

Variable Tone/ Volume IC Basics

Voltage-controlled ICs

Prior to the advent of modern signal-processing IC technology, all audio tone and volume control circuits were designed around simple but inherently noisy electromechanical 'pots' (potentiometers), which were usually mounted on the audio unit's front panel and were thus prone to pick up unwanted signals via their signal-carrying interconnecting leads. During the late 1970s, however, the ever-increasing demands for improved audio quality and remote controllability of tone and volume in Hi-Fi and TV sets resulted in the development of new types of IC that housed all-electronic tone and volume control circuits that were variable via interference-immune input signals applied to the appropriate 'control' pins of the IC.

Throughout the 1980s and the early 1990s, most of these 'variable tone/volume' ICs were designed around OTA (Operational Transconductance Amplifier) types of analogue circuit elements and used remotely variable DC input voltages as their primary control medium. One of the best known of these ICs is National Semiconductor's LM1036 dual (stereo) DC-controlled tone/volume/balance IC, which is very easy to use and typically generates a THD figure of only 0·05%. This IC is described in greater detail later in this article.

Figure 1 shows a typical basic usage circuit for a DC controlled stereo variable tone/volume IC, using pot-generated DC tone and volume control voltages, and Figure 2 shows a 'remote controlled' version of the circuit, in which the DC control voltages are derived from digital voltage generator circuitry that can be activated via panel-mounted push buttons or via a conventional remote control system. In the digital circuit, each DC control voltage is derived from the output of an 8-bit digital-to-analogue converter that is driven via a locally or remotely controlled 8-bit end-stopped up/down counter, thus enabling the DC control voltage to be varied from zero to maximum in 256 discrete steps.

Digitally-controlled ICs

During the early 1990s, the continuing demand for ever-better audio quality and ever-greater circuit sophistication resulted in the development of a new generation of variable tone/volume ICs that relied heavily on a mixture of analogue and digital – rather than purely analogue – circuit techniques, and which were specifically designed to be digitally controlled via simple microprocessor or microcontroller systems. Currently, the best known of these ICs is National Semiconductor's LMC1983, a 28-pin device that can select any one of three stereo inputs, can control the selected channel's bass and treble response and its volume, and typically generates a THD figure of only 0·008%. This IC – which requires the use of a specially designed microprocessor interface – is

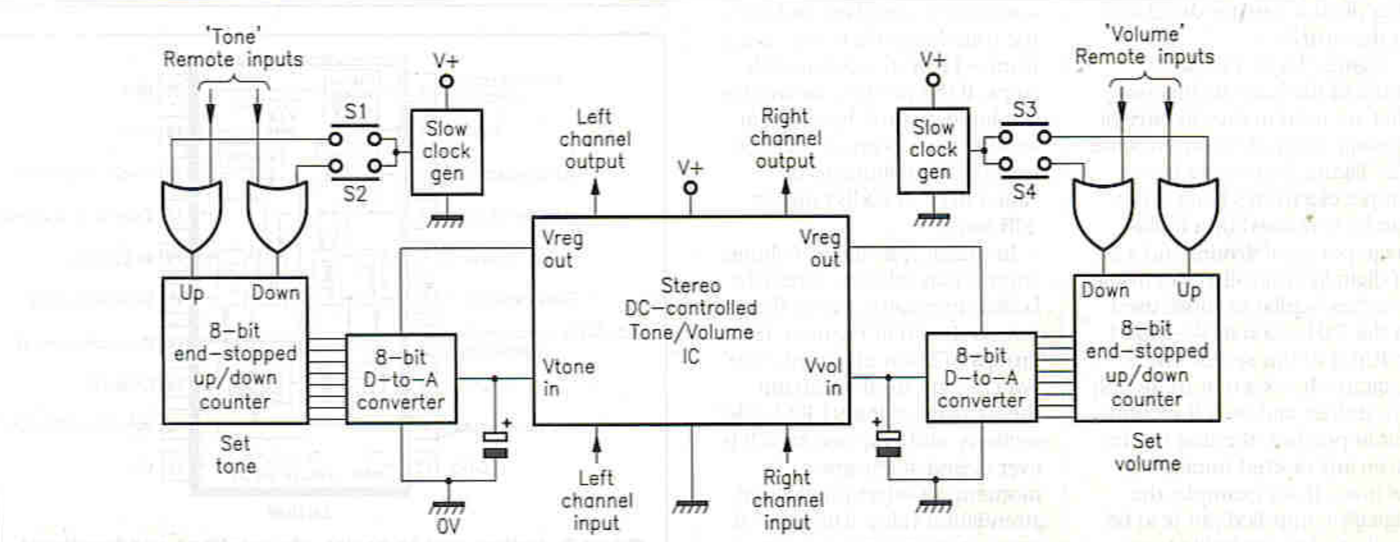


Figure 2. DC-controlled Tone/Volume IC basic usage circuit, using digitally-generated control voltages.

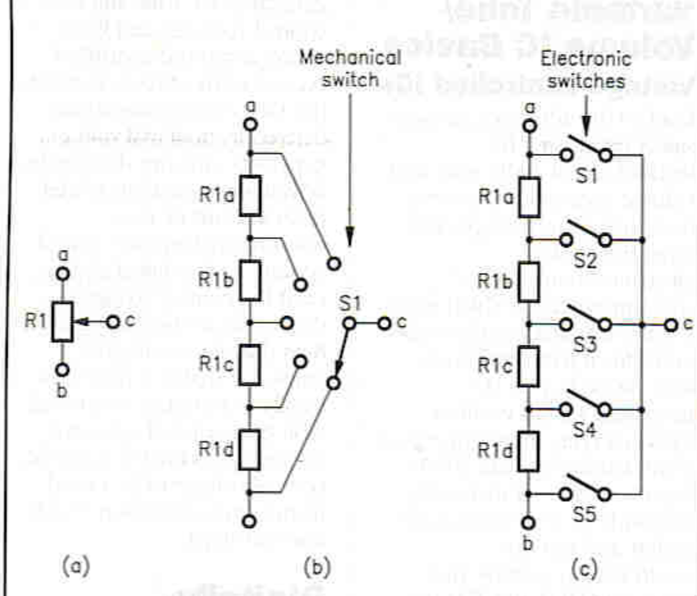


Figure 3. A simple electromechanical potentiometer (a) can be simulated by a multi-stage potential divider and an electromechanical switch, as in (b), or by a multi-stage potential divider and a set of electronic switches, as in (c).

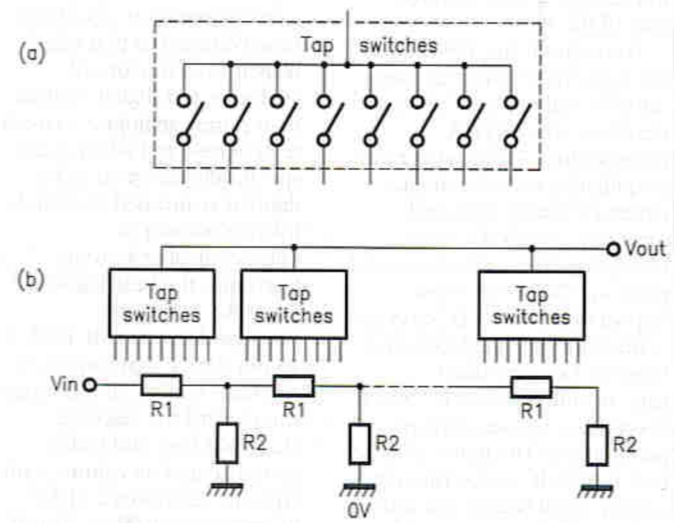


Figure 4. Groups of multi-section electronic 'tap' switches (a) used to make a variable ladder attenuator (b).

described in greater detail later in this article.

Figures 3 and 4 illustrate some of the basic techniques that are used in the circuitry of digitally-controlled tone/volume ICs. Figure 3(c) shows how a simple electromechanical pot can be simulated by a multi-stage potential divider and a set of digitally controlled electronic switches similar to those used in the 74HC4066 IC described in Part 2 of this series. The diagram shows a unit using only five divider and switch sections, but in practice, the unit can be given any desired number of sections. If, for example, the digitally-controlled pot is to be used as a bass or treble tone control element, a total of only twelve sections are normally considered adequate, and allow the tone response to be varied from +12dB to -12dB in 2dB steps. If the pot is to be used as a volume control, however, at least forty sections are needed, to allow the volume to be varied over an 80dB range in 2dB steps.

In practice, a 'digital' volume control may take the form of a ladder attenuator, rather than a pot, as shown in Figure 4. Here, groups of 8-way electronic 'tap' switches are used to tap into the R1 parts of the R1/R2 ladder sections, and only one switch is ever closed at any given moment, to select the desired attenuation value. This type of attenuator presents a constant input impedance at all attenuation settings.

Figure 5 shows – in slightly simplified form – the typical basic circuitry of one complete channel of a stereo digitally controlled 3-input variable tone/volume IC. Here, the desired input can be selected digitally and passed on to the main tone control circuitry via C1, and the treble, bass and volume levels can be varied digitally via the RV1 to RV3 digital pots. Note that C1, C2 and C3 are the only components that are external to the IC, and that all other components are high-precision very-low-distortion elements.

Practical Variable Tone/Volume ICs

The LM1036 DC-controlled IC

National Semiconductor's LM1036 is an easy-to-use 20-pin dual (stereo) DC-controlled

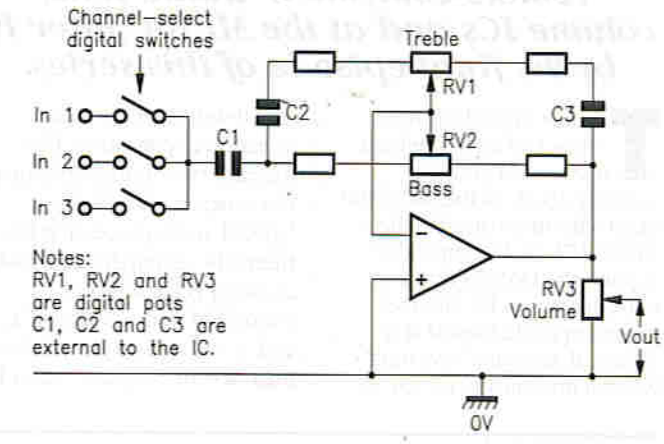


Figure 5. Typical basic circuitry of one complete channel of a stereo digitally controlled 3-input variable tone/volume IC.

Figure 6. Basic specification of the LM1036 dual (stereo) DC-controlled tone/volume/balance IC.

Parameter	Value
Supply voltage range	9V – 16V
Supply current (typ)	35mA
Zener output	5.4V at 5mA max
Vin max	1.6Vrms at 12V
Vout max	1.0Vrms at 12V
Vgain max	0dB at 1kHz
THD (typ)	0.05%
Channel separation	75dB
Volume control range	75dB
Bass control range	±15dB at 40Hz
Treble control range	±15dB at 16kHz
Balance control range	+1dB to –26dB

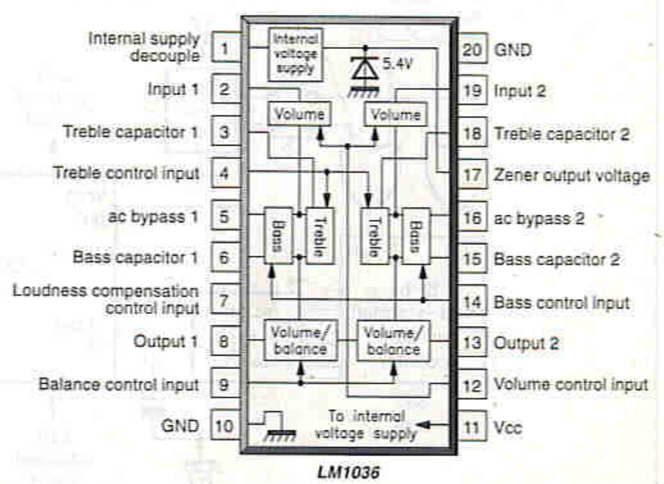


Figure 7. Outline (not to scale), pin notations and functional diagram of the LM1036.

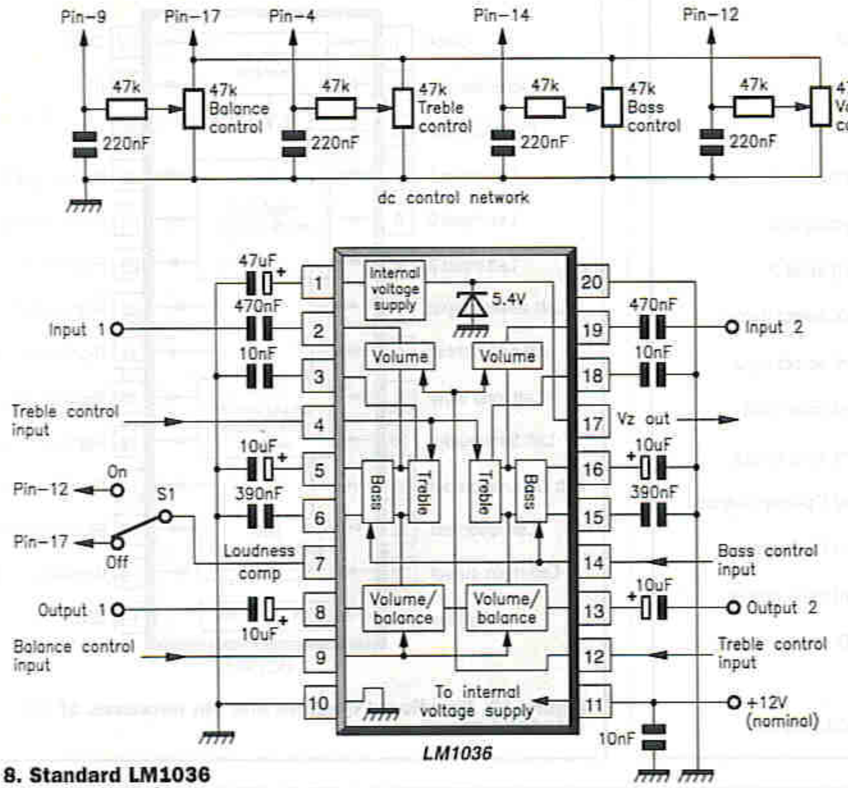


Figure 8. Standard LM1036 application circuit, using pot-derived DC control voltages.

tone/volume/balance IC that can use any supply in the 9 to 16V range and that typically generates a THD of only 0·05%. Figure 6 lists the IC's basic specification, and Figure 7 shows the IC's outline (not to scale), pin notations and basic functional diagram. Note in each channel, that the input signal is applied to pin 2 or 19 and then flows through the volume control network before being processed by the bass/treble tone control network; the signal is then passed to the pin 8 or 13 output terminal via the IC's volume balance network.

Figure 8 shows the LM1036 IC's standard application circuit, using DC control voltages that are derived from simple pots powered from the IC's pin-17 5·4V Zener output voltage. Figure 9 shows the circuit's tone gain characteristics, at three different values of DC control voltage, VCONT. Thus, the circuit gives maximum cut at zero volts, maximum boost at 5·4V, and gives a flat frequency response at 2·7V.

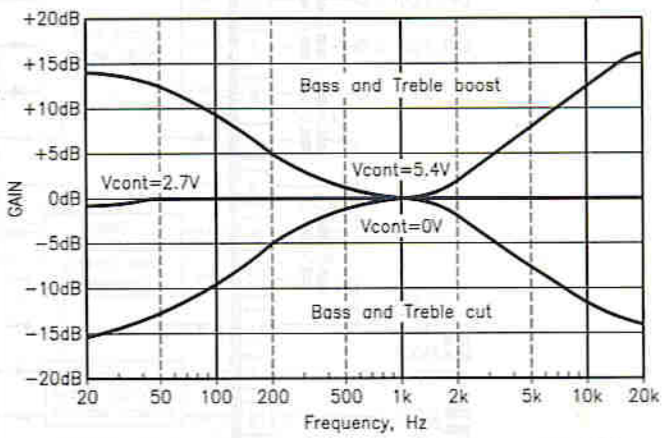


Figure 9. Tone gain characteristics of the standard LM1036 application circuit.

Normal human hearing has a sensitivity curve that peaks at 3·5kHz and falls off significantly below 300Hz and above 5kHz. The rate of fall off varies, however, with the relative mean amplitude of the signal. At 100Hz, for example, sensitivity is typically down by 10dB (relative to 1kHz sensitivity) at moderate to loud sound levels, but is down by almost 20dB at very low sound levels. Consequently, conventional volume control circuits (which have a perfectly flat frequency response at all signal levels) produce low-level outputs that sound distinctly bass and treble cut to the sensitive human ear. To overcome this particular problem, most good-quality Hi-Fi units are fitted with an optional loudness control that modifies the response curve of the normal volume control so that the unit produces an acoustic output that is tailored to match the characteristics of the human ear. The LM1036 is fitted with just such a facility.

The LM1036's volume control circuitry can be made to give normal volume control action by simply tying pin-7 to pin-17, or can be made to give loudness compensation action by tying pin-7 to pin-12. In Figure 8, these two options are shown made available via switch S1. Figure 10 shows the actual loudness compensated volume control frequency response curve of the standard LM1036 application circuit, with the normal bass and treble controls set to the 'flat' position. Note that, at low output levels, effective bass and treble boost is attained by simply increasing the midband attenuation.

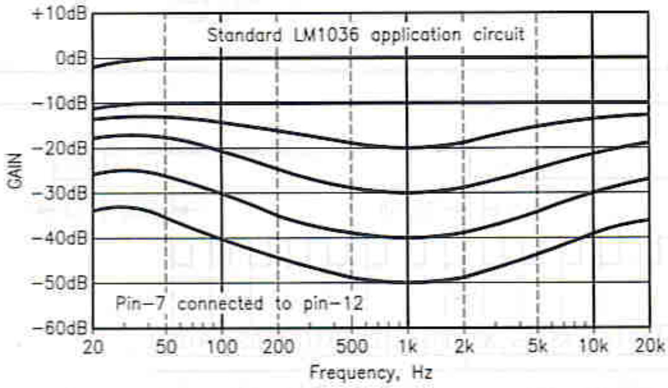


Figure 10. Loudness compensated volume characteristics of the standard LM1036 application circuit.

Parameter	Value
Supply voltage range	6V – 12V
Supply current (typ)	15mA
Vin max	2.0Vrms at 12V
THD (typ)	0.008% at Vin = 0.3Vrms
Cannel separation	80dB
Mute attenuation	105dB
Volume control range	80dB, in 2dB steps
Bass control range	±12dB, in 2dB steps, at 100Hz
Treble control range	±12dB, in 2dB steps, at 10kHz
Channel balance (typ)	0.2dB
Signal-to-noise ratio	95dB (0dB = 1Vrms)
Maximum clock frequency	5MHz

Figure 11. Basic specification of the LMC1983 digitally-controlled 3-channel stereo selector and tone/volume control IC.

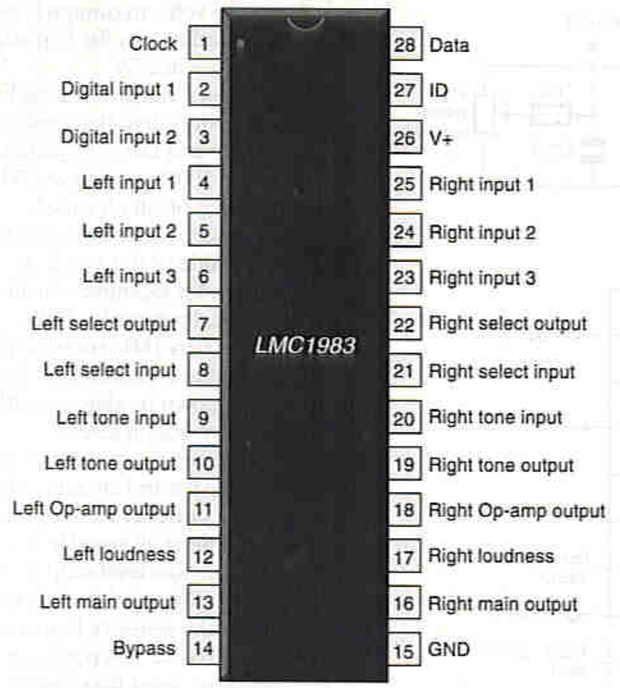


Figure 12. Outline and pin notations of the LMC1983 IC.

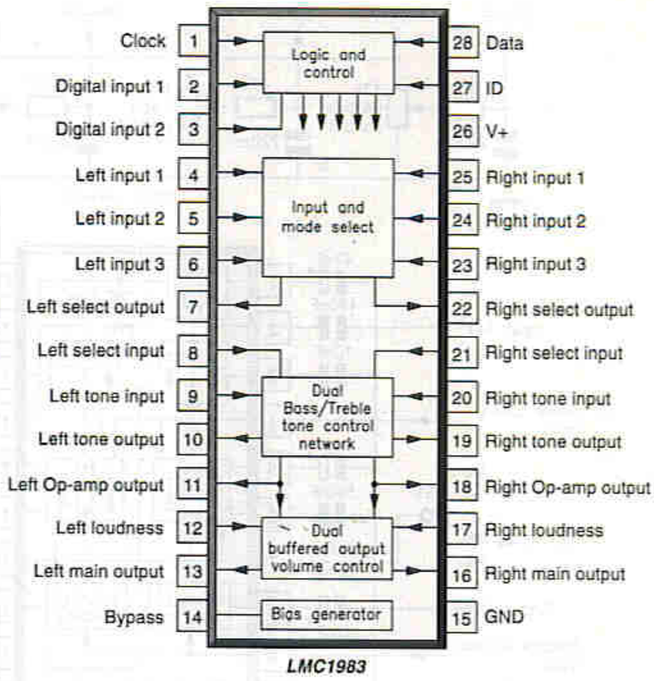


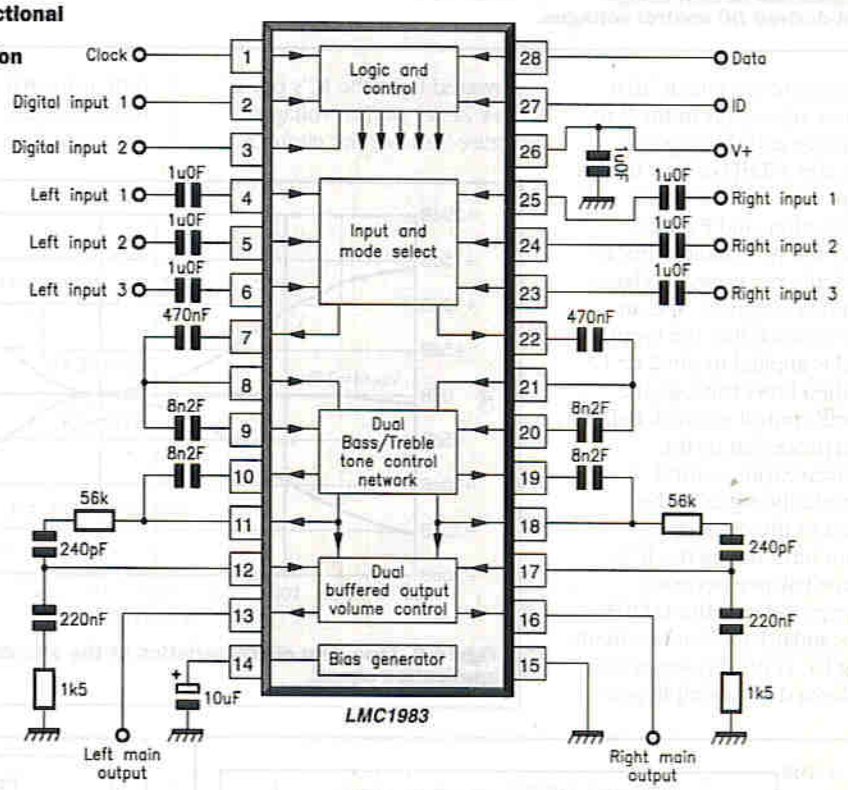
Figure 13. Functional diagram and pin notations of the LMC1983 IC.

The LMC1983 Digitally-controlled IC

National Semiconductor's LMC1983 is a 28-pin digitally-controlled 3-channel stereo selector and tone/volume control IC that can use any supply in the 6 to 12V range and that typically generates a THD of only 0·008%. Figure 11 lists the IC's basic specification, Figure 12 shows the IC's outline and pin notations, and Figure 13 shows the IC's basic functional diagram together with (for clarity) its pin notations. Referring to the functional diagram, the IC operates as follows:

The LMC1983's internal Input and Mode Select section acts like a 2-pole 4-way selector switch that can select any one of three stereo inputs or a 'mute' (zero signal) input, and makes the selected input available (in buffered form) at pins 7 and 22 via a selector that enables the signals to be presented in Left Mono, Stereo, or Right Mono form. From pins 7 and 22, the signals may be externally processed (via a separate dynamic noise reduction system, etc.) or can be simply capacitively coupled directly back into pins 8 and 21 of the IC. Signals fed into pins 8 and 21 are passed through the IC's tandem controlled tone and individually controlled left and right volume control networks, which are similar to

Figure 14. Functional diagram and basic application circuit of the LMC1983 IC.



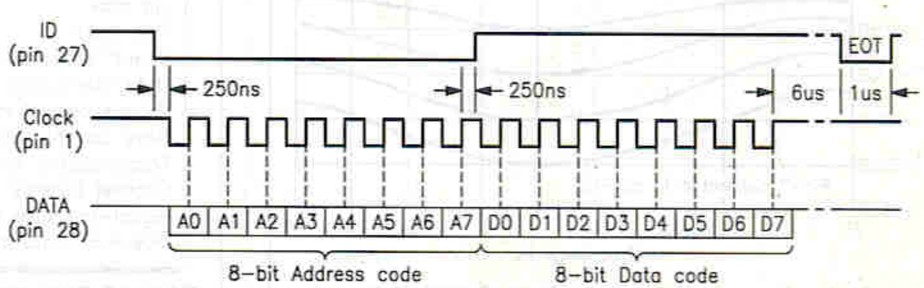


Figure 15. Basic timing details of the LM1983 INTERMETAL (IM) bus system.

Address (A7–A0)	Function	Data (D7–D0)	Function Selected
01000000	Input Select + Mute	XXXXXX00 XXXXXX01 XXXXXX10 XXXXXX11	INPUT 1 INPUT 2 INPUT 3 MUTE
01000001	Loudness	XXXXXXX0 XXXXXXX1	Loudness OFF Loudness ON
01000010	Bass	XXXX0000 XXXX0011 XXXX0110 XXXX1001 XXXX11XX	−12dB −6dB FLAT +6dB +12dB
01000011	Treble	XXXX0000 XXXX0011 XXXX0110 XXXX1001 XXXX11XX	−12dB −6dB FLAT +6dB +12dB
01000100	Left Volume	XX000000 XX010100 XX101XXX XX11XXXX	0dB −40dB −80dB −80dB
01000101	Right Volume	XX000000 XX010100 XX101XXX XX11XXXX	0dB −40dB −80dB −80dB
01000110	Mode Select	XXXXX100 XXXXX101 XXXXX11X	Left Mono Stereo Right Mono
01000111	Read Digital Input 1 or 2 IM Bus	XXXXXXD1D0	D0 = Digital Input 1 D1 = Digital Input 2

Note: X = don't care

Figure 16. List of the main 16-bit IM Bus programming codes that are used by the LM1983, together with their functions.

the basic circuit shown in Figure 5, except that the volume control network can be subjected to loudness compensation and the outputs are buffered, and then passed out of the IC via pins 13 and 16.

Figure 14 shows the LMC1983's basic application circuit, together with (for clarity) the IC's functional diagram. The 8n2F capacitors wired between pins 8-9 (or 20-21) and between pins 10-11 (or 18-19) control the IC's tone response, and the four components (56kΩ, 240pF, 220nF, and 1k5Ω) wired between pins 11-12 (or 17-18) and ground, control the loudness response of the volume control. The settings of the selector and mute switches and the tone and volume units are all controlled via digital input signals applied to pins 1, 27 and 28 via a three-wire INTERMETAL (IM) bus interface. When the supply voltage is initially applied to the IC, however, the volume is automatically set to minimum and the tone controls are set to flat. Digital input pins 2 and 3 do not form a direct part of the control system, but allow peripheral devices to send single-bit data to the unit's external microprocessor control system via the DATA pin (pin 28).

Note at this point that – since it uses a microprocessor-based digital control system – the LMC1983 is not really suitable for use in one-off or short production-run audio systems, but is highly suitable for use in long production-run audio systems, where (since it uses no external pots or switches and uses very few other external components) it offers great economies in system manufacturing costs. Design engineers considering serious use of the LMC1983 should note the following data regarding the IC's digital control system.

Control instructions are sent to the LMC1983 via digital signals applied to pins 1, 27 and 28 via a three-wire INTERMETAL (IM) bus interface. Pin 28 is the serial DATA input. Signals arriving here take the form of a 16-bit word, in which the first eight bits represent an Address, which specifically selects the LM1983 IC and one of its eight basic functions, and the remaining eight bits represent a Data word that sets the selected function to the desired value. Each one of the 16 bits is clocked into the IC on the rising edge of a clock signal applied to pin 1, and various signals on the pin-27 ID (IDENTITY) terminal allows the IC to identify the 'Address' and 'Data' part of the 16-bit pin-28 word and to identify an EOT (End Of Transmission) condition. Figure 15 shows the basic timing details of the LM1983 INTERMETAL bus system, and Figure 16 lists the 16-bit programming codes that are used by the LM1983.

Note in Figure 16 that, in the tone and volume control sections, the table lists only various 'spot' data codes and their corresponding function values, and that intermediate values can be worked out by interpolation. The tone and volume settings are variable in 2dB steps, and the volume can – for example – thus be set at -20dB by a Data code of XX001010 (i.e., ten binary steps greater than the XX000000 '0dB' value), or at -60dB by a Data code of XX011110 (thirty steps up on the 0dB code), and so on.

Figure 17. Diagram illustrating the basic operating principles of the MF10 switched capacitor filter IC.

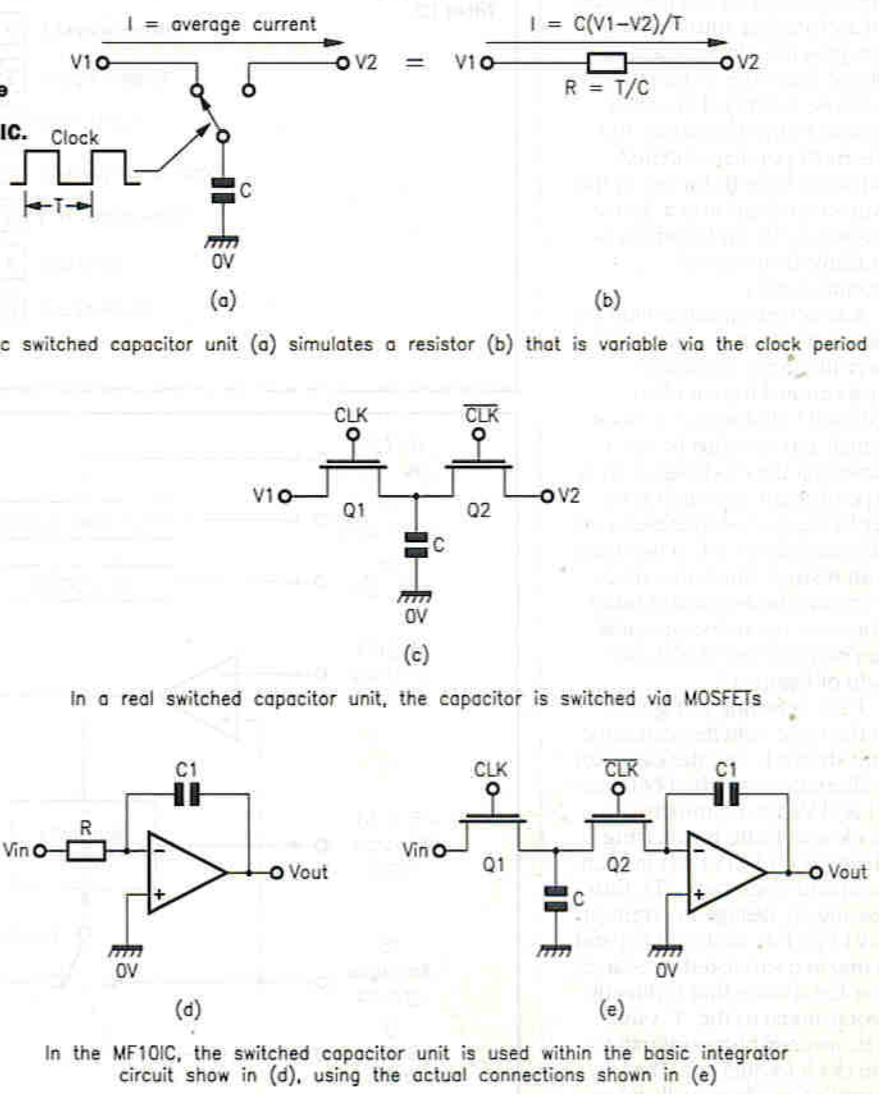
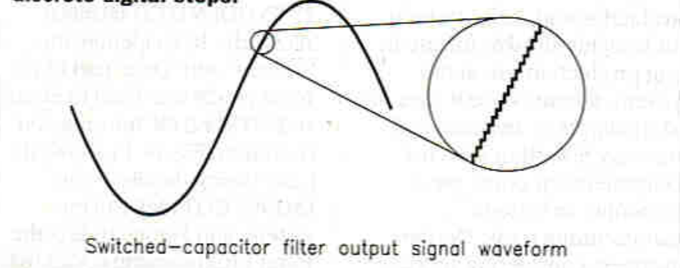


Figure 18. The signal output waveform of a switched-capacitor filter is quantized, and takes the form of a large number of discrete digital steps.



Switched-capacitor Filter IC Basics

In the great majority of practical audio systems, filter circuits take the form of fairly simple 'active' (usually op-amp based) 1st- or 2nd-order low-pass, band-pass or notch types such as speech-band selectors, tone controls, graphic equalizers, and hum or tone rejectors, etc. There are, however, a few rare occasions when special high-precision frequency-tracking or 4th-order or greater filters are required, and in such cases, the filters may be best designed around a special type of IC known as a switched-capacitor filter. The most obvious application of such a filter is as an anti-aliasing auto-tracking low-pass filter in analogue or digital delay line systems, such as those described in earlier articles in this magazine, and the most popular switched-capacitor filter IC for use in this type of application is a device known as the MF10, which is available from several manufacturers.

A switched-capacitor filter is a device in which the filter's turn-over frequency is directly proportional to that of an external high-frequency clock signal, and can thus be set or varied via the clock signal. This type of action is achieved by replacing the resistive elements of conventional R-C active filters with resistor simulators made from switched-capacitor units. The basic operating principle can be understood with the help of Figure 17.

Thus, referring to Figure 17, in the basic switched-capacitor unit shown in (a), the capacitor is alternately switched between V1 and V2 via a symmetrical clock waveform, transferring a charge (Q) of C(V1-V2) in each complete clock cycle (T), thus passing an averaged current of C(V1-V2)/T as shown in (b) and acting as a simulated resistance that has a value that is directly proportional to the 'T' value (i.e., inversely proportional to the clock frequency). The circuit's 'switch' actually takes the form of two MOSFET switches that are clocked in antiphase, as shown in (c). In the MF10 IC, the switched capacitor units are used in the basic integrator circuit shown in (d), using the connection shown in (e). The integrator functions as a 1st-order low-pass filter that has a fall-off slope of 6dB per octave (20dB per decade).

Switched-capacitor active filter circuits produce outputs that are almost identical to those obtained from similar types of conventional active filters, except that their outputs appear in quantized – rather than purely analogue – form. In other words, the filter output waveforms appear as a number of small digital steps, rather than as a smoothly varying waveform. The number of steps (S) equals the clock frequency (fc) divided by the signal frequency (fs). In ICs such as the MF10, these steps are – as illustrated in Figure 18 – usually too small to be seen on an oscilloscope, and their basic frequency is too high to create problems in most audio applications. If, for example, the MF10 is used as a 12kHz low pass filter, it will use a clock frequency of 600kHz, thus producing 600 steps on a 1kHz filter signal or 100 steps on a 6kHz filter signal.

The MF10C Switched-capacitor Filter IC

The MF10C is the most popular commercial version of the MF10 IC, and is supplied in a standard 20-pin dual-in-line plastic package. Like all MF10 ICs, it is a dual switched-capacitor filter IC that is configured as two identical general-purpose 2nd-order active filter blocks that can each be used in a variety of modes (high-pass, low-pass, band-pass, notch, or all-pass) at frequencies up to 20kHz. The two blocks can be used independently or can be cascaded to give 3rd-order or 4th-order filter action from a single IC, or can give an even greater number of orders from two or more cascaded MF10 ICs. Figure 19 shows the outline (not to scale), pin notations, and simplified block diagram of

Figure 19. Outline (not to scale), pin descriptions, and simplified block diagram of the MF10C dual switched capacitor filter IC.

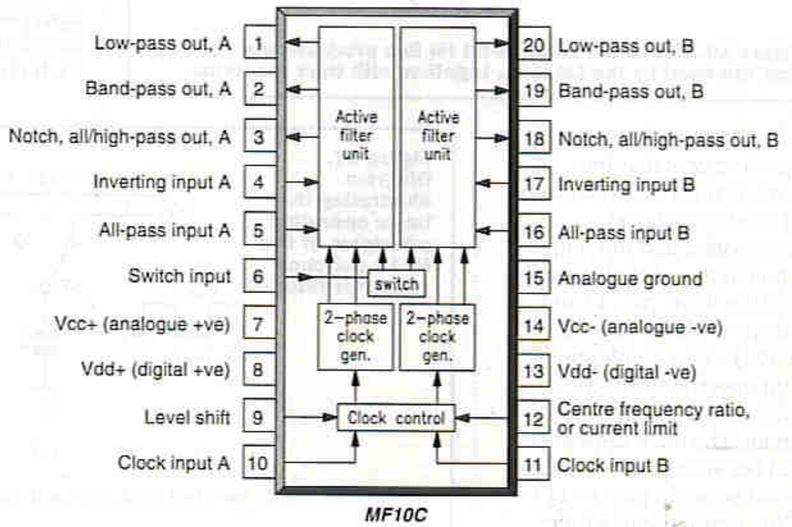
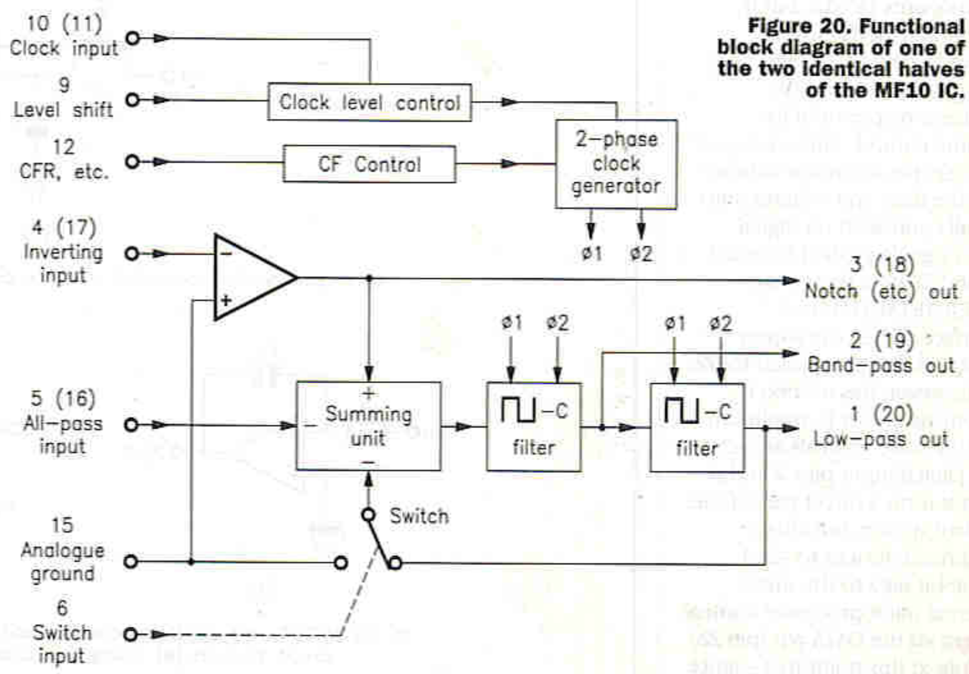


Figure 20. Functional block diagram of one of the two identical halves of the MF10 IC.



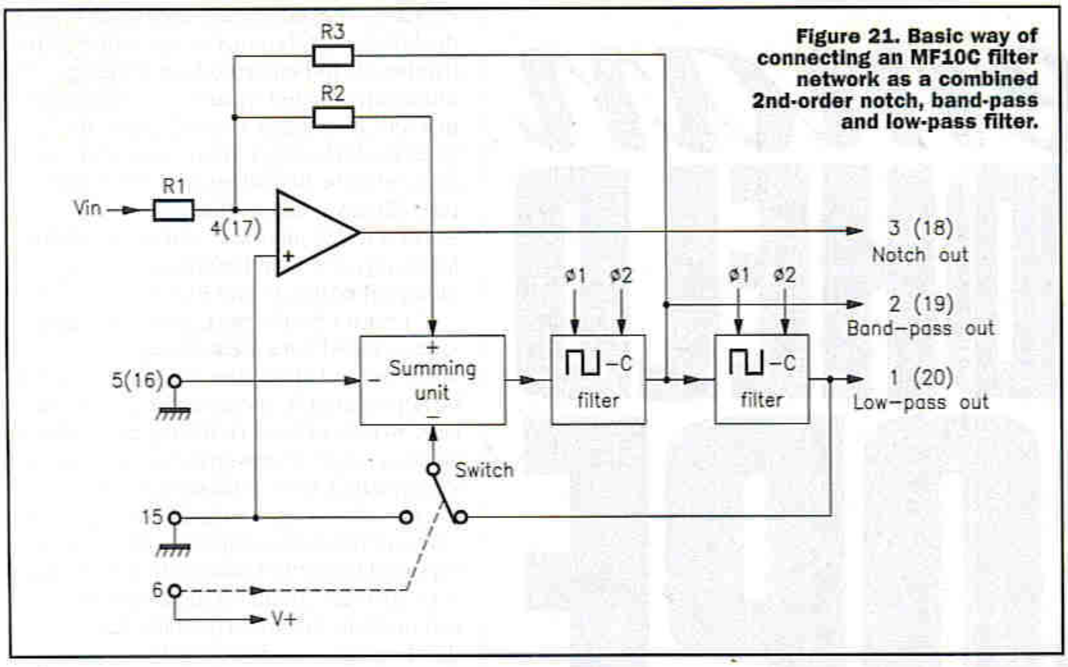


Figure 21. Basic way of connecting an MF10C filter network as a combined 2nd-order notch, band-pass and low-pass filter.

the MF10C IC, and Figure 20 shows the full functional block diagram of one of the two identical halves of the IC, which operates as follows:

Referring to Figure 20, each active filter unit consists of an op-amp, a special 3-input 'summing' unit that subtracts two of the inputs from the third, two cascaded non-inverting switched-capacitor filter units (which are similar to those shown in Figure 17(e) but have a modified switching arrangement), and a feedback control switch. These components can be configured, via the switch and/or by using various feedback connections, to make the unit function as any one of the five basic types of active filter, and – by using suitable feedback resistors – to give any one of several types of response, including Butterworth, Chebyshev, and Bessel.

The IC can use single-ended or split (±5V) 10V supplies, and the clock network thus includes 'level shift' circuitry for use with 5V clock inputs. The pin-12 'CFR' terminal gives the filter a clock frequency (fc) to filter turn-over frequency (fto) ratio of 50:1 when tied to Vdd+, or 100:1 when tied to ground with dual supplies or to mid-supply level with single-ended supplies. The IC can accept a maximum fc input of 1MHz, and can thus give a maximum fto value of 10kHz with a 100:1 fc/fto value, or 20kHz with a 50:1 value. The IC is thus very versatile.

Note in Figure 20 that functions that are associated with pin numbers that are shown singly (such as 9 and 12) are common to both halves of the IC, and that where pin numbers are shown as a pair (such as 10 and (11)) the plain number applies to the IC's L/H filter, and the number in brackets applies to the R/H filter.

Figure 21 shows the basic way of connecting an MF10C filter network in its most popular mode, as a combined 2nd-order notch, band-pass and low-pass filter. In this mode, the notch centre frequency, fo, equals the clock input frequency divided by the 100:1 or 50:1 CFR value set by pin-12, and the notch Q equals R3/R2. In the low-pass mode, the filter's gain equals R2/R1 and the fall-off slope equals 12dB/octave (40dB/decade).

In Hi-Fi audio systems, the most important application of the MF10C is as a 4th-order Butterworth low-pass filter, which gives a fall-off slope of 24dB/octave (80dB/decade), and to conclude this series, Figures 22 and 23 show practical examples of the MF10C connected in this mode, as a 1kHz (nominal) filter using a 100kHz clock frequency, using alternative supply connections. In both circuits, the clock input signals are derived from normal +5V TTL or CMOS sources. In Figure 22, the circuit is shown for use with a split (±5V) power supply, with the analogue ground (pin 15) terminal, etc., tied to zero volts. In Figure 23, the circuit is shown for use with a single-ended 10V supply, and in this case, a simple potential divider is used to generate a +5V 'half supply' voltage, which serves as the IC's analogue ground reference. Note in both filter circuits, that the turn-over frequency (1kHz nominal with a 100kHz clock signal) can be varied from less than 100Hz up to at least 10kHz by simply changing the clock signal frequency.

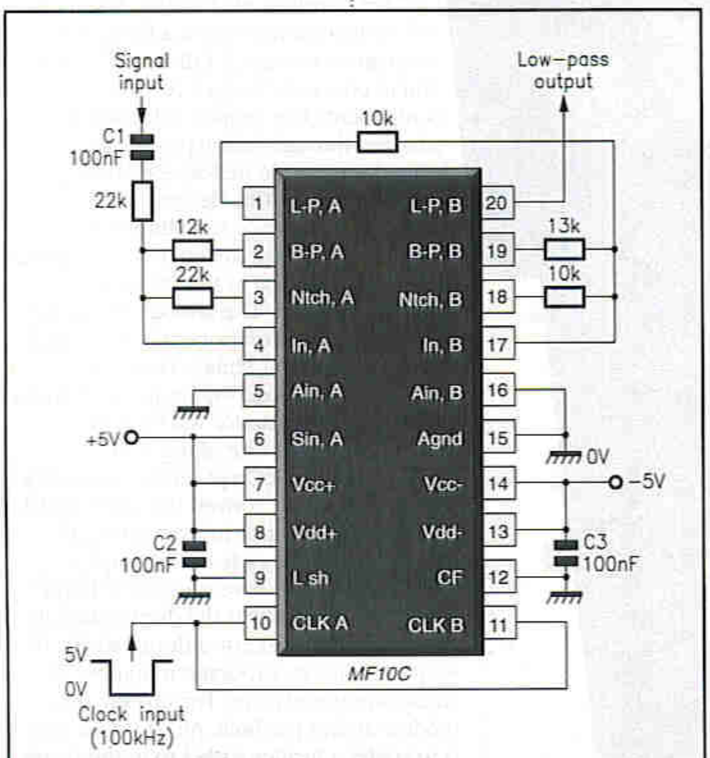


Figure 22. Connections for using the MF10C as a Butterworth 1kHz 4th-order low-pass filter, using split (±5V) power supplies.

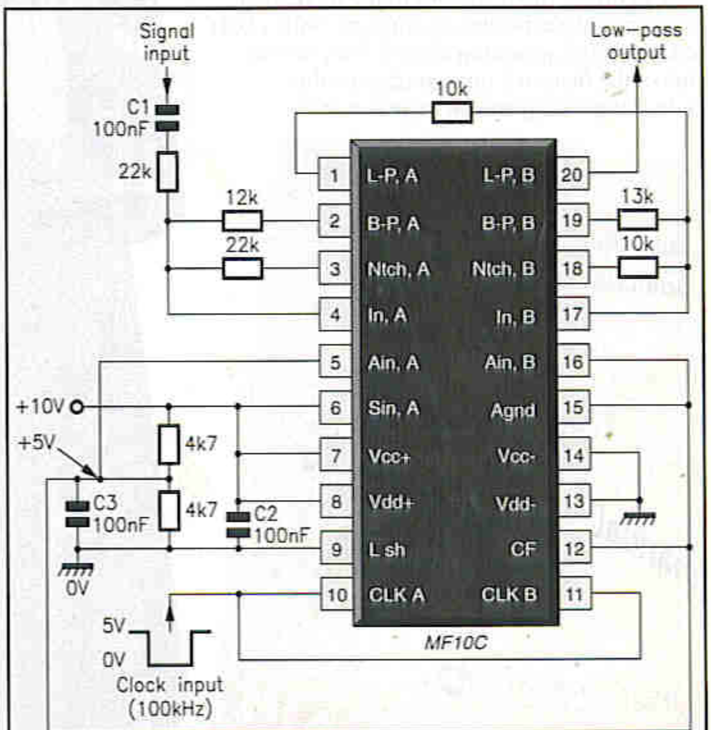


Figure 23. Connections for using the MF10C as a Butterworth 1kHz 4th-order low-pass filter, using a single-ended 10V power supply.

Velleman HANDHELD SCOPE

Reviewed by Martin Pipe BSc (Hons) AMISTC

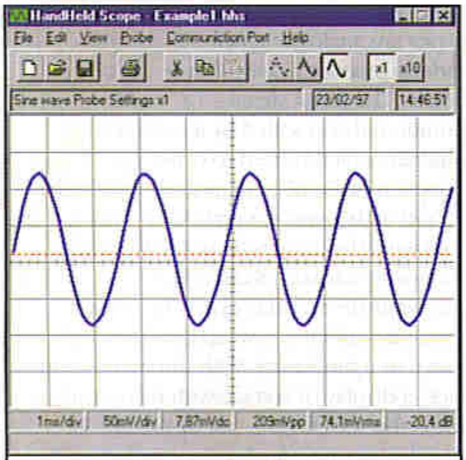
Portable oscilloscopes have been with us for some time, their introduction fuelled primarily by the field service industry. If a mobile engineer can diagnose and repair a fault at a customer's location, money is saved and the customer is impressed by the speed of service.

The first such scopes, launched 15 years ago, were based on a tiny CRT display, and needed a large (and heavy) Ni-Cd battery pack to power them. Thanks to the increasing use of digital electronics, instruments with a LCD screen started appearing around five years ago. One of the first such units available – the Fluke/Philips Scopemeter, reviewed in the February 1993 edition of *Electronics* – was a dual-trace digital storage scope with 50MHz bandwidth and integrated autoranging multimeter. Aimed squarely at professional markets, it included a whole range of facilities (including a 'zoom' mode to overcome the limitations of a 240 × 240 pixel display, a display 'freeze' and an isolated RS232 interface) and set standards for this type of unit. Unfortunately, it's rather expensive at over £1,000.

If it wasn't for the price, portable digital scopes would have great appeal to hobbyists and education. The small size will be appreciated by those without access to a large workbench, while the digital approach allows a range of convenient functions to be incorporated. One of these, the computer interface, has come to the fore in these days of cheap personal computers. Data can be exported for further analysis by a PC or Mac – it's also very useful for those with reports and manuals to write! Portability has disadvantages – instruments have more chance of disappearing – but many advantages. If you install in-car audio equipment, for example, a portable 'scope would be an excellent aid for adjusting the levels and cut-off points of the various electronic crossovers so that an even frequency response results. A 'scope could also aid diagnosis and repair of some other car-related electronic systems.

The main disadvantage – price – has been addressed by a new Velleman product, which is available from Maplin here in the UK. This product, the 'Handheld (LCD) Scope', doesn't have the professional-level features of the Scopemeter and its ilk, but sells for a fraction of the price. In ready-made form (HHS5, Maplin order code VM79L), the Handheld Scope sells for £199.99. As an alternative, you can buy a complete kit of the required parts (K7105, Maplin code VF82D). If you have soldering experience and a multimeter, you can save yourself £40 – significant if you're on a tight budget. All of the components that require soldering are standard through-hole types, which are located on a single well-labelled double-sided glass-fibre PCB; electronic construction is hence straightforward.

The 'brains' of the system is an ubiquitous PIC microcontroller, in this instance, running at 20MHz. The analogue-to-digital converter, a core component of any digital scope, is a fast 8-bit Philips TDA8703. Evidence of its speed will be apparent when I tell you that the device will be better known to some as one of the chips employed by VideoCrypt satellite decoders, where it is used to convert the video signal into digital form prior to 'cut-and-rotate' descrambling. The only really complex assembly that may have caused the home constructor difficulty is the display module – the single most expensive device within the scope – which incorporates a number of surface-mounted chips. Fortunately, this module arrives pre-built. All you need to do is to solder a header socket to it; this mates via a multi-way pin assembly soldered to the main board.



Optional Windows 95 software allows data to be downloaded onto your PC and displayed on screen.

What other bits and pieces are inside the case? To avoid unwanted noise, such as mains hum, from affecting measurements, the signals section is screened by an earthed conductive 'envelope'. There is also space for a couple of Ni-Cd battery holders, which are included (the batteries are, however, an optional extra). Together, these will accommodate six 1·2V cells (a total of 7·2V) for portable operation. Charging the Ni-Cds – a process that takes 14 hours if the batteries are dead – is simply a case of applying a DC voltage (9V unregulated, or 12V regulated) to the unit's power supply input. Velleman doesn't recommend the use of dry cells; as they run down, the voltage drops off quickly when loaded, and this can affect the accuracy of the unit. Note that a power supply isn't included – nor, for that matter, is a 'scope probe. Maplin does sell such items, however. Access to the innards of the unit, for calibration or battery replacement, is possible once six screws are removed. When this is done, the front (control) panel can be lifted off – note, however, that this is attached to the main PCB via a ribbon cable.

When assembled, the Velleman Handheld Scope is very professional-looking indeed in its attractive 'T'-shaped dark grey case. The control panel keypad is a splash-proof tactile membrane type of the company's own 'Clicktouch' invention. There are a variety of keys, some of which have multiple applications. The basics include adjustment for timebase (time per division, from 2µs/div to 20s/div), amplitude (volts per division, from 5mV/div to 20V/div), Y-position, and trigger mode (single-shot or repetitive) and level adjustment. There is also a toggle-action 'hold' key that will display a 'snapshot' of the input signal for closer analysis – ideal for fault-finding or demonstration. This snapshot is effectively the contents of the current sequence of samples, which are stored within some RAM located on the PIC chip. At the top of the unit are a power supply connector, a LED to indicate charging and a 3·5mm stereo jack that offers two outputs. The first is RS232 data – the Handheld Scope can instantaneously export the most recent data, as a tab-spaced 'table', to a PC – while the second is a 400Hz sine wave, usefully provided for the testing of audio equipment.

On the side are a level adjuster for the sine wave output, a display contrast control, a power indicator, and a button that grounds the input to provide a reference point. A recessed pad, accessible from the tip of a scope probe, provides a low-frequency (400Hz) square wave. This is intended primarily for the calibration of the input amplifier's transient response; the procedure, which is outlined in the manual, involves adjusting a trimming capacitor inside the scope so that the square wave appears flat – in other words, there is no peaking or troughing. There is also a BNC connector for the input signal – up to 100V peak-to-peak (AC) or DC, input impedance 1MΩ – and a switch for selecting AC or DC coupling. Unfortunately, the Handheld Scope is only a single-trace instrument, which makes the comparison of signals difficult (but not impossible). Giving its dual-trace capability would have put the price outside the means of the average hobbyist, and made it more difficult to construct as a kit.

Inside the unit.

- Single-trace
- In-built 400Hz sine-wave oscillator
- True RMS or peak-to-peak readout
- Markers for voltage and time
- Auto range function for input measurement
- DC readout, with zero reference function
- Frequency readout through markers
- dB measurement (new software)
- Dot-join function
- Grid or ruler function
- Adjustable trigger level
- Trigger mode: normal, auto or single
- Trigger edge: rising or falling
- Waveform memory
- RS232 data output to computer
- Auto power off (after 8 minutes)
- Demonstration mode (old software)
- Optional accessories: Ni-Cd batteries (6 off), probe, power supply, carrying case

Table 1. Hand-Held Scope Features.

The display, which has a resolution of 64 × 128 pixels, is high in contrast and has a wide viewing angle. This doesn't sound much – although the device's vertical resolution is 8-bit, the display is only accurate to 6-bit, with a linearity of ±1bit – it allows the overall shape of a waveform to be accurately portrayed – nasties such as crossover distortion on Class B power amps can be picked out without problem. Fine detail, such as noise 'riding' on a signal, cannot be seen. There is no 'zoom' function of the type incorporated into the rather more expensive Scopemeter – again, presumably, due to cost constraints. The display shows the input waveform, either in 'dot' form (which represents the actual samples taken from the signal), or as a more familiar line (in which the dots are 'joined up'). To aid measurement, a 'dot' graticule or crosshair-type X/Y grid can be selected for background display. Also shown are the current timebase and X amplifier settings – it is interesting to note that while these can be manually adjusted, the Handheld Scope includes an auto-setting function. The markers, another display feature, are very useful. Horizontal markers are moved up and down using the Y-position and trigger level keys. The voltage between these markers is displayed on-screen, together with its frequency.

Other information provided by the Handheld Scope includes the RMS or peak-to-peak voltages of an AC signal, or a DC voltage. A new version of the unit's software – not on the early review sample, but likely to be standard by the time you read this review – will also allow measurement in dB. This will undoubtedly prove to be a real

HAND-HELD SCOPE SPECIFICATION

Maximum sample rate for repetitive signals:	5MHz
Maximum sample rate for single shot events:	500kHz
Input impedance:	1MΩ, 20pF
Maximum input voltage:	100V (AC & DC)
Input coupling:	DC, AC and GND
Vertical resolution:	8-bit (6-bit on screen)
Linearity:	1-bit
LCD:	64 × 128 pixels
Timebase :	2μs to 20s/div
Input sensitivity:	5mV to 20V/div
Sine wave generator:	400Hz, 1Vrms (adjustable), output impedance 10kΩ
Square wave output:	400Hz, 3·5V peak-to-peak
Power supply:	9V DC/min. 200mA
Rechargeable battery:	AA (6×) 900mAh (not included)
Charge current:	90mA
Charging time:	14 hours
Operating time (full charge, 900mAh cells):	5 hours
Operating temperature:	0 to 50°C (32 to 122°F)
Dimensions:	130 × 230 × 43mm (5·1 × 9 × 1·7in.)

boon for all those who work with audio signals. But what of the bandwidth? In digital scopes, bandwidth is dictated by the maximum sampling frequency. In the normal (repetitive, or continuous) mode, the sampling frequency is 5MHz. In its single-shot mode – a useful feature in which the display is only updated when the signal's voltage reaches the (adjustable) trigger level – it is 500kHz. It doesn't sound much when compared with other models of ten times the price, but this specification will be fine for most hobbyist projects.

The RS232 interface will be of great interest to computer users. The data can be read by any personal running a terminal emulation program (such as Windows 95 Hyperterminal), set to 8 bits, no parity, 1 stop bit, handshaking off. A tab-spaced table is displayed. The table includes all of the 96 samples taken per display. Each sample has 256 possible steps, corresponding to the A-D converter's 8-bit resolution. The zero reference is given a value of 126, which allows negative voltages to be expressed. A free program, which runs under Windows 95 or NT, is available from a page on Velleman's web site (**http://www.velleman.be/Downloads.htm**).

This will plot the waveforms, and provides other information on the oscilloscope's settings. The software is also available from Maplin (VF86T) in a package that includes an opto-isolated RS232 interface cable for £11.99 – well worth considering if you're working with high voltages and don't want to risk zapping your PC!

All in, the Velleman HandHeld scope is a useful tool. It is easy to use, and construction is well within the capabilities of the average enthusiast. It will bring the benefits of portability and digital storage to many people who could not previously afford one. There are some limitations, but then again, one cannot expect miracles from a sub-£200 instrument.

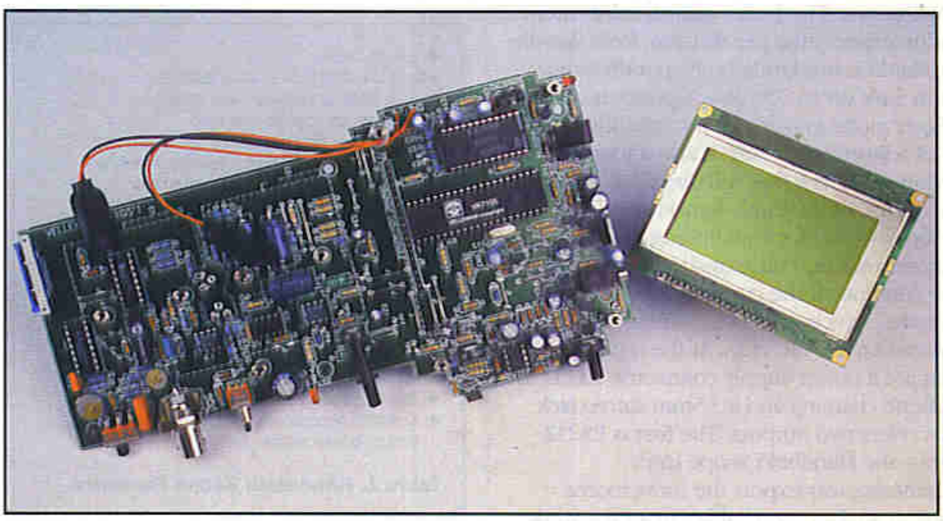
What is an Oscilloscope?

The oscilloscope is one of the most essential items of any enthusiast's toolkit, and indeed, most people have a mains-powered CRT-based scope. A 'scope gives a visual representation of an electronic signal, allowing alignment and fault-finding of equipment and projects. You can look at the output of a faulty amplifier, for example, which will give clues as to the origins of the fault. Problems such as crossover distortion, the effects of a missing supply rail and unwanted DC offsets can all be diagnosed and pinpointed. The scope is also a great educational tool. The concepts of signal types can be better understood if you can 'see' them. The outputs of oscillators, the effects of filters and the pulse trains of digital circuits can all be observed in an easily understood format. You can also use scopes for measuring DC and AC voltages, and for frequency measurement.

The vast majority of enthusiast-level scopes are analogue types, capable of working practically with signals up to 50MHz. The input signal – DC or AC – is conditioned and scaled by a precision amplifier, which is used to drive the Y deflection (axis) plate of a cathode ray tube marked with a grid (or graticule). This represents the amplitude of the frequency. The horizontal axis (X deflection) represents time, and is driven by an accurately calibrated sweep generator (also known as a timebase). With the two axes in place, a display of voltage with respect to time – the waveform – can be plotted, or 'traced'. A scope's final main component is a trigger circuit, which ensures that the displayed trace always starts at the same point in the waveform. Most 'scope have the ability to display two traces – there are two Y amplifiers, each with their own input – which allows, for example, the input and output of an amplifier project to be compared.

Analogue scopes have been around for over 60 years, and are gradually being replaced by digital storage types. In these, 'samples' of the input signal are digitised at various points and then stored as numbers in RAM. The samples stored can then be plotted. Unlike analogue scopes, it is possible to 'freeze' the display by simply displaying only the current series of samples. Some scopes hold several groups (or 'screens') of samples, which can be stepped though. Digital storage scopes are ideal for systems such as computers, since fast phenomena – such as power supply glitches – can be isolated. Digital scopes lend themselves to miniaturisation though the use of ASICs, and – thanks to low-voltage electronic display technologies such as LCDs – can be built into lightweight portable units, such as the Scopemeter and the Velleman Handheld Scope examined here.

The Velleman Handheld Scope is available from Maplin Electronics.
Order code VM792 Complete - £199.99.
Order code VF82D Kit version - £159.99.
Order code VF86T Opto-isolated RS232 Cable and Windows 95 Software - £11.99.



RESEARCH NEWS

by Dr. Chris Lavers

New Anti-Cancer Lamp

Work started 8 years ago by Dr. Colin Whitehurst of the Paterson Institute in Manchester and funded by the Cancer Research Campaign (CRC) has led to the manufacture of a compact new lamp which heralds an effective new treatment for skin cancer. Dr. Whitehurst wanted to design a relatively cheap way of producing a pseudo-monochromatic (almost single wavelength) illumination source, for use in Photodynamic Therapy (PDT), to replace more expensive laser-based systems costing in the region of £100K plus servicing costs.

Conventional PDT uses light-sensitive drug, which are given to a patient either intravenously, orally, or in ointment form to treat skin cancer. After a set time interval, the drug accumulates in the tumour tissue, which is then illuminated by light (see Figure 1). Energy absorbed by the drug stimulates the production of toxic chemical species, which react with and destroy the surrounding diseased tissue. Neither drug nor light alone is sufficient to cause damage, and this method offers a way of killing cancer cells with minimal damage to the surrounding healthy tissue. High costs of conventional lasers have prohibited the widespread use of this technique. Dr. Whitehurst and Dr. Morton, who has trailed this new lamp in Glasgow Western Infirmary, are set to change things rapidly.

The key to the new device is a source of radiation having laser-like brightness, but without laser instabilities and having reduced cost overheads. The optics contain a small intense light source produced under high pressure by an arc discharge. Electrodes are separated by less than a millimetre and a focused beam having a divergence of 2° is delivered to the skin surface through flexible multi-mode optical fibre having a diameter between 200-400μm. Filters cut out ultra-violet radiation and infra-red that could otherwise prove hazardous. Up to 100mW of power may be delivered, but skin temperature rises of less than 1°C have been observed, which means scar tissue and damaging lesions do not form.

Whitehurst and Morton have investigated the treatment of superficial skin cancers, requiring the application of a light-sensitive drug. The compound used, 5-aminolaevulinic acid (5-ALA), known commercially as Photofrin II, has several peaks in absorbance (see Figure 2), one absorption peak sited at around 630nm has led to its being used in conventional laser PDT with red (632·8nm) Helium-Neon lasers. After the cream is applied, Dr. Morton waits for 4 hours before treatment; this permits the drug to penetrate the cancerous skin, which is fortuitously more permeable than healthy skin. Therefore, in PDT, healthy skin suffers less damage than surrounding diseased skin. The new lamp permits the doctor to activate the photosensitiser at different depths, depending on the power used.

The skin is bathed with radiation for 30 minutes across a 1in. diameter region, and is envisaged to take place in hospital as a single out-patient treatment. After irradiation, the 5-ALA generates the active photosensitiser photoporphyrin IX (PpIX), liberating toxic-free radicals.

Dr. Morton, Senior Registrar at Glasgow Royal Infirmary, has treated some 80 patients with a variety of cancers. The overall success rate so far is very good, 82% for the treatment of basal cell carcinomas, which based upon a single illumination treatment, is approximately 70% successful.

According to Dr. Colin Morton, non-melanoma skin cancer accounts for 90% of cases, and therefore, combined with the concerns of increased levels of skin cancer due to depletion of the ozone layer, there exists a huge potential for new treatments. At present, this treatment is performed in only a couple of UK centres – Glasgow and Leeds. Dr. Morton hopes the treatment could be adopted more widely in the NHS in the next year or so.

Dr. Whitehurst is pleased with the clinical results so far and hopes future work will use diode lasers and optical fibre endoscopy to treat other parts of the body such as the prostate and brain in early diagnosed localised cancers. In addition, this sort of treatment could be applied to gastroenterology and gynaecology. Clearly, the insertion of a needle containing a photosensitive agent into an organ such as the brain is less drastic than taking a knife to both diseased and healthy tissue alike.

The Cancer Research Campaign is about to enter into marketing agreements with a manufacturer for the lamp to produce the light machine. The cost of the so-called Paterson lamp is expected to lie in the region of £10,000-£15,000, and has received some £700,000 funding already from the CRC.

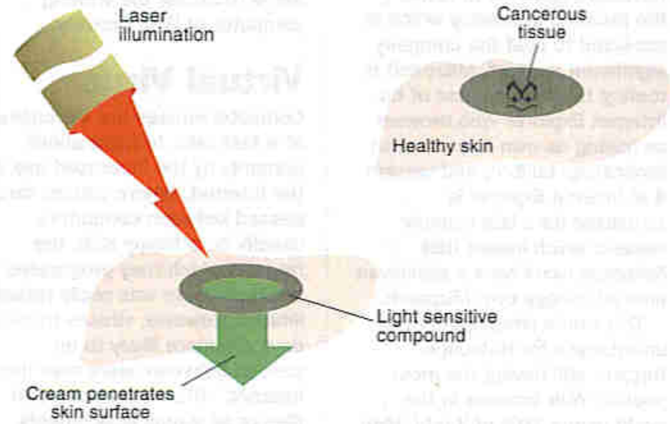


Figure 1. The photosensitive cream, Photofrin II is absorbed into the cancerous tissue cells preferentially as cancer damages the skin barrier. Continuous wave (CW) pseudo-monochromatic radiation is delivered by optical fibres to the skin where the photosensitiser liberates singlet oxygen, causing a deadly reaction in the diseased cell, leading to its destruction. Photofrin products will be washed from the body usually within 24 hours.

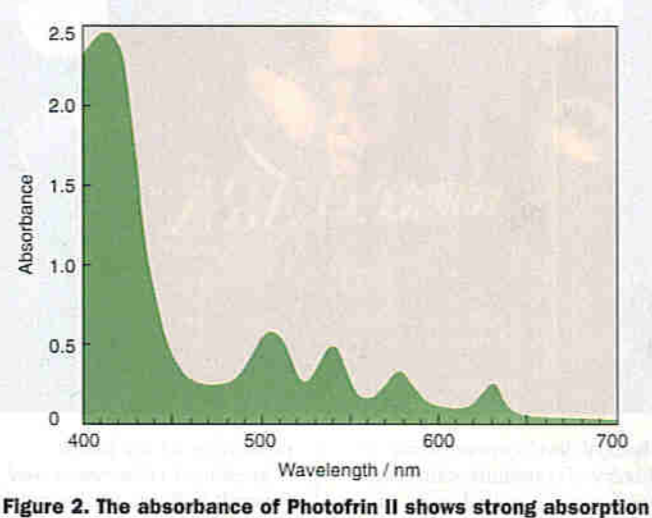


Figure 2. The absorbance of Photofrin II shows strong absorption bands with an absorption band sited close to 630nm.

Slow European Businesses

According to the EU's representative on a G7 project, The Global MarketPlace for SME's, European small to medium-sized enterprises (the SME in the project) are woefully lacking in their commitment to and use of the Internet. Rosalie Zobel, who is head of an EU section responsible for studying IT in businesses, said that while "many SMEs have heard of new technologies, they are not well understood". Zobel's opinion is that SMEs who utilise the Internet fully should be able to increase turnover significantly. Citing the fact that only 4% of European SMEs have Internet access, Zobel confirmed that the 16 million SMEs in Europe represent 99·8% of all companies, provide 65% of business turnover, 40% of exports and 66% of employment throughout the continent. Not at all bad, I'd have thought. Indeed, when you look at it this way, maybe European SMEs don't need the Internet at all!

Netcaster Delay

Push is a new term we should all become familiar with. It encapsulates the idea that World Wide Web users merely need to specify the sorts of things they are interested in, and Web content providers can then have the information delivered automatically to them. In contrast, the more common method of users accessing information is to browse Web sites to find the information – pulling the information they want back to their computers.

It's in its infancy now and several variations on a theme are already around. But the market is expected to expand at a huge rate over the coming years. One such push application is Netcaster, in late development stages from Netscape (the producers of the world-beating Web browser Navigator).

Originally, Netcaster was to have launched in the latest release of Netscape's Communicator this June. However, at the last minute, Netscape declined to release the product, in a delay which is expected to cost the company significant support. Microsoft is touting the next release of its Internet Explorer Web browser as having its own form of push technology built-in, and version 4 of Internet Explorer is scheduled for a late summer release, which means that Netscape won't have a significant time advantage over Microsoft.

This whole situation is rather unfortunate for Netscape. Despite still having the most popular Web browser in the world (some 70% of World Wide Web users browse the Web with Navigator), Microsoft's Internet Explorer is gaining ground rapidly. Microsoft Internet Explorer has a distinct (some might say unfair) marketing advantage in that it is the in-built browser within Windows 95, so everyone who buys a new PC, or upgrades an old one, already has Microsoft's browser on their desktop. Future versions of Windows are also to be driven by the Microsoft Internet Explorer interface, rather than the traditional Windows desktop.

The advent of the World Wide Web and, in turn, Web browsers, has shown computer software producers (or at least, those without an axe to grind) that software can be made to cater for all computer users (and by which, I refer to whichever computer platform users own). Web browsers can run on all the main platforms (PC, Mac, Unix) with an identical (well, apart from a few minor interfacial differences) interface. After all, it doesn't matter where on the World Wide Web you are, a Website looks more-or-less the same whatever the viewing computer or Web browser.

Virtual Virus

Computer viruses are increasing at a fast rate, brought about primarily by the increased use of the Internet. Where viruses once passed between computers usually on a floppy disk, the rates at which they progressed between users was really rather limited. However, viruses these days are more likely to be passed between users over the Internet, either as downloaded files or as e-mail attachments (the leading virus transfer method these days).

In a recent survey conducted by the US National Computer Security Association (NCSA), it was found that the rate of infection by computer virus has nearly tripled over the preceding year. This, despite efforts by many users to ward off viruses with commercial anti-virus products. The rate is so high as to be alarming – for a company with 100 PCs, around 46 infections can be expected over the course of a year. And the rate is increasing.

Most common today are macro viruses, accounting for some 80% of all known viruses. Macro viruses are specially written entities, produced using a program's in-built macro language, which in fact use the program itself to infect the next computer. So, if a computer which receives a macro virus doesn't have the program installed, the virus can't infect the computer.

The most worrying aspect about macro viruses, perhaps, is that the macro programming languages in modern programs is usually quite complex, and allows a macro to access the computer's file resources on disk. It's not hard to see that viruses can do all sorts of damage – maybe deleting files, at best, changing them.

The single most common macro virus at present is known as Concept, accounting for almost half of all virus infections. It's a Microsoft Word macro virus, which prevents Word users from saving work as anything other than template files. While not destroying work, it certainly creates a situation for users which is frustrating and time-consuming to repair.

Interestingly – though probably not so interesting if you've been infected with one of the little beggars – the first macro virus ever recorded was found only in July 1995. There are now over 1,000 macro viruses in circulation.

Web Site Gives Insight to Technology History and Future

The Arthur C. Clarke Foundation Web site launched this month at **www.acclarke.co.uk**, is based on the work of the accomplished scientist and author, Arthur C. Clarke, and is a definitive History of Modern Communications, Computing and Media on the Internet.

Designed to place the technological developments of today into a historical perspective, the site is the result of extensive research over a one year period into the history of communications from 1793 to the present day.

The size of a large reference manual, the site contains over 40,000 words and 200 images, as well as links to well over one hundred other Web sites of interest.

Adopting a linear timeline structure, the site shows the key

dates of developments in the history of communications over the last two hundred years – as well as showing some of Clarke's predictions for the future.

Speaking to *Electronics and Beyond*, Arthur C. Clarke said, "The Web site, dedicated to the History of Communications, is both a metaphor and symbol of the unfolding digital revolution. For the first time, we can begin to see the tangled web of influences, technologies and ideas that have now converged to create a global communications network in time for the new millennium".

"Our awareness of ourselves as a species will be enhanced by this technological evolution from stone, ink and paper to satellites, television, telephones and computers. People in virtually all societies will, by the first decade of the 21st century, be able to communicate through these new broadband digital networks and information highways. I hope that this Internet site will give people deeper understanding of the forces at work that are changing all our lives", added Clarke.

Final Version of RealVideo Ships

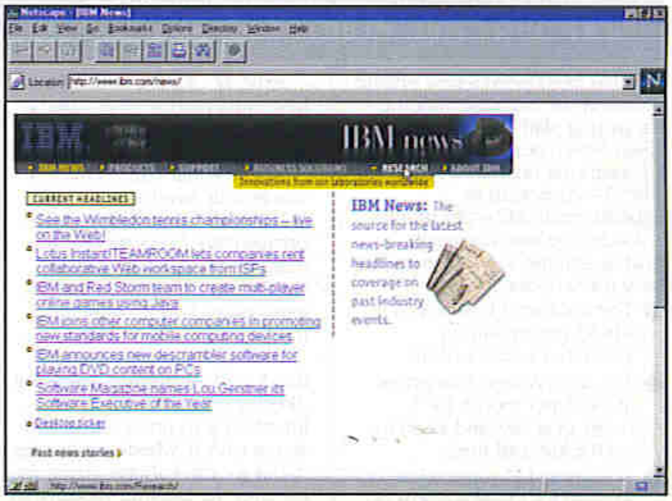
The final release of RealVideo is available for free download at www.real.com. New features added to the final version of RealVideo include six programmable destination buttons which enable single-click access to popular audio and video programs; stream thinning that dynamically adjusts video frame rates for best user experience during Internet congestion; and smart networking that automatically delivers audio and video streams via the most efficient network protocol and gives users behind corporate firewalls access to RealAudio and RealVideo.

Additionally, 38 content partners, such as ABCNews.com, CBS/Sportsline, FOX News, ESPNSportsbeat, MSNBC and HGTV, have announced that they will provide RealAudio and RealVideo programming via destination buttons.

Speaking to Electronics and Beyond, Rob Glaser, chairman and CEO of Progressive Networks said, "Today is a real milestone for Internet video. The final release of RealVideo demonstrates the same commitment to quality, reliability, and ease-of-use that made RealAudio the industry leader. RealPlayer 4.0's destination buttons and great programming from major broadcasters are giving users easy, one-button access to some of the most popular audio and video content on the Web."

RealVideo's streaming thinning detects poor or congested Internet connections and will dynamically adjust the video frame rate for both live and on-demand content in real-time. For RealVideo users, this results in superior audio and video continuity, delivering an 'always-on, all-the-time' video signal and minimises the need to pause and rebuffer while listening to clips on the Internet.

UK Companies Setting Pace for European Web Adoption



Manufacturers in the UK are ahead of French and German counterparts in terms of Internet and intranet technology adoption, according to research from Cadis.

The survey of 100 large manufacturers found that UK firms are ahead in using intranets for internal communications, and using the Internet to research competitive market information.

The intranet's role as an internal communications tool was endorsed by 70% of the UK firms surveyed, but by only 45% and 60% of their respective French and German counterparts.

Meanwhile, a Gallup survey of European businesses released this month indicates that two out of three major European companies are currently using the Internet for business, and one in five reported higher sales as a result.

The Gallup survey, commissioned by the Wall Street Journal Europe and IBM, also found that corporate investments into the Internet have paid off with handsome returns in enhancing corporate image, improving the quality of products or service offerings, and adding efficiency to business operations.

While the survey indicates that web usage is still immature, 37% of wired companies are actually conducting electronic commerce over the Internet. A complete listing of survey results can be obtained at **www.ibm.com/news/wsjsurvey.**

Jupiter Sees Internet Causing Music Industry Chaos

Over the next decade, the Internet will dramatically change the music industry, according to a new report from research house, Jupiter Communications. Anticipating a shift similar to that heralded by the CD in the eighties, Jupiter believes a wide range of models in the music industry business will be reinvented.

Gene DeRose, CEO of Jupiter Communications, told Electronics and Beyond, "For the music industry, the Internet is a blender that will shatter and enmesh the compartmentalised mini-industries that are dominated by traditional, typecast players".

"Today, the business logistics of concert tours, TV and Radio stations, and record sales are entirely separate. Over time, the Internet will render as artificial the distinctions between performance, broadcast and distribution", added DeRose.

For further details, check: **www.jup.com.**

Contact: Jupiter Communications, Tel: +1 212 780 6060.

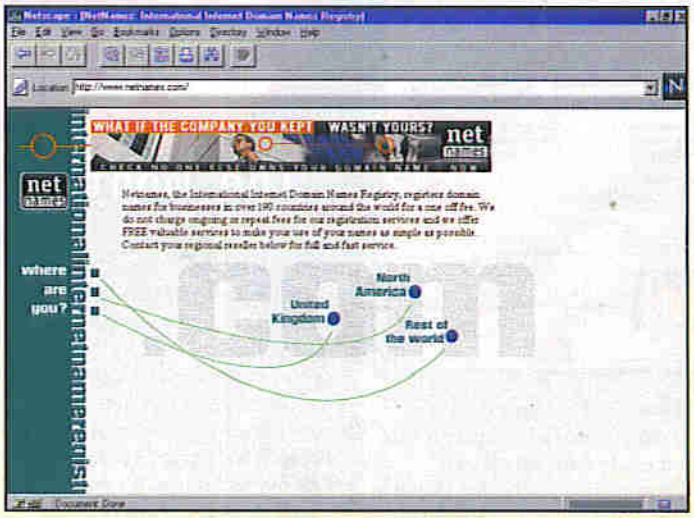
NetNames Covers All Bases

NetNames has launched a Domain Name Search and Alert service. The service offers the ability to register any name with NetNames and to be informed the moment it is registered anywhere in the world. Speaking to Electronics and Beyond, Ivan Pope, CEO, NetNames said, "This is a service that the Internet and Intellectual Property community have been crying out for. We see it as providing the missing link between Domain Name registration and protection of lawful interests".

"The service works from a huge database that is assembled on a 24x basis by an automated Namecrawler, developed by NetNames. The Namecrawler brings us immediate information on everything that is registered around the world and allows us to alert clients automatically and immediately", added Pope.

Companies may have already moved to register their names in multiple countries and they are registering multiple names: for example, their trading and product names. However, it is almost impossible to cover all bases. The legal profession are expected to be big users of the new service.

NetNames' Search and Alert service is competitively priced at £150 per name per year. Discounts are available for volume users and for multiple name notifications.



For further details, check: **www.netnames.com.** Contact: NetNames, Tel: (0171) 317 1306.

@Internet

Flat Pricing Plan from AOL

AOL has introduced a new pricing model in the UK, reflecting the flat pricing plan launched in the US in November last year. In the US, users get unlimited access for $19.95 – equivalent to approximately £12 – per month.

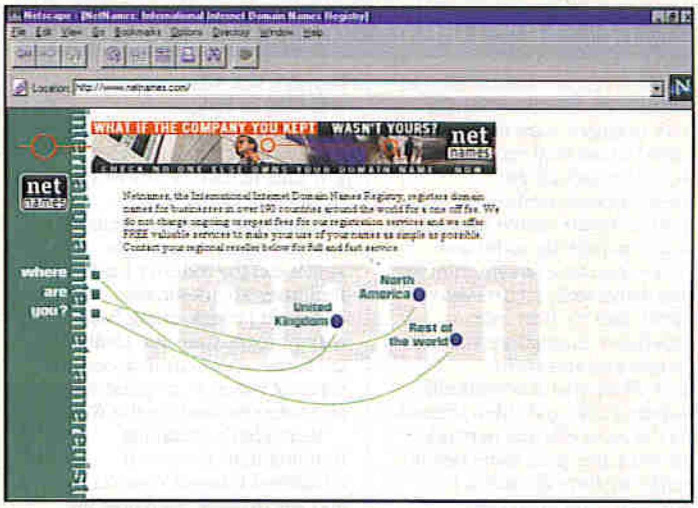
Under the new European pricing scheme, subscribers will have three options:

- The Unlimited Plan priced at £16.95 per month for Unlimited access to AOL.
- The Light Access Plan priced at £4.95 per month for 3 hours of access and £2.35 for each additional hour.
- The Annual Plan priced at £179.40 for a year's worth of prepaid access to AOL, equivalent to £14.95 per month.

Existing UK AOL subscribers have until August 19 to make a pricing selection at Keyword: New Pricing.

The AOL network in the US was quickly overloaded when AOL initially introduced its flat pricing plan. Users more often than not received an engaged tone when they dialled up the network and once online, Internet access was sluggish.

Perhaps its for this reason that Jonathan Bulkely, managing director of AOL UK, said "Our intention is to provide you with access to AOL whenever you want it, but we can't always guarantee it – over the last four months, we have built out our network to handle increased capacity".



"Our planning was based on our current members usage plus forecasted member growth plus the assumed increased usage from the introduction of new prices. I am confident that we have added enough to handle your needs, but if we are short at any time, I will keep you informed, and we will fix it as quickly as we reasonably can", added Bulkely.

Netscape Upgrades Navigator

Netscape is offering users of Netscape Navigator the opportunity to upgrade from their existing browser environment to the new Netscape Communicator client software available for download from Netscape's Web site at **www.netscape.com.**

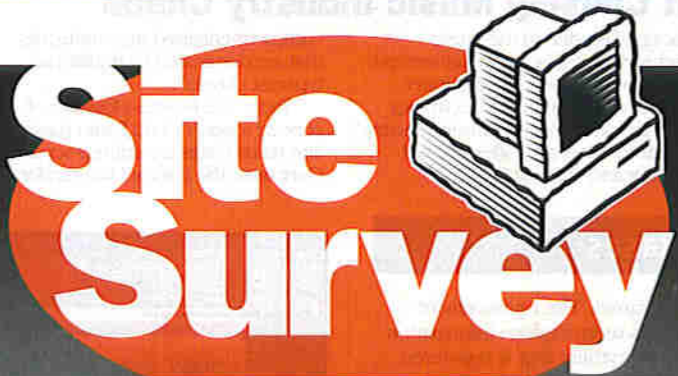
Communicator is an open e-mail, groupware, and browser suite that provides the complete set of tools users need every day to easily communicate, share, and access information on Intranets or the Internet.

Network Briefing Revamped

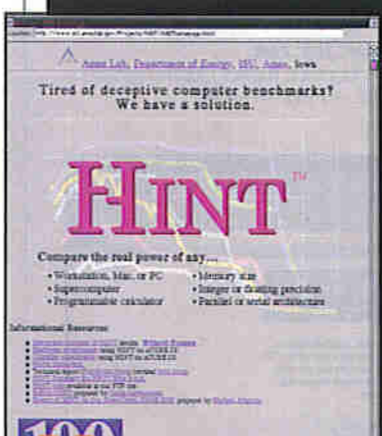
Network Briefing, the weekly newsletter which originally covered the data and telecommunications industry, has been relaunched on the Internet by ComputerWire at **www.computerwire.com/nwb/.**

The new look Network Briefing has been launched to reflect the assimilation of the internet, datacoms and telecoms industries and the pace at which news now develops around the globe.

The newsletter is now updated daily on the net, supplying about twenty new stories every day, along with a rolling five day story listing and a complete archive search facility. The publication is divided into four main sections; telecoms; datacoms; finance; and the Internet.



The month's destinations



If you want to check out your computer and to compare it with others, but are fed up with benchmark tests that are biased in their capabilities, you should take a look at the Iowa Ames Laboratory's HINT site, at: **http://www.scl.ameslab.gov/Projects/HINT/HINThomepage.html,** where you'll find out how to do it.

Movie-goers will be interested in the Batman & Robin Web site, coinciding with the new Batman & Robin film starring George Clooney as Batman. It's well worth a look at: **http://www.batman-robin.com,** even if you're not a movie-goer.

Check out for yourself, the NCSA survey of computer viruses. Trend Micro's Web site at: **http://www.antivirus.com** holds the press release and a link to download a Microsoft Word document (if you dare!) of the survey results.

ELECTRONICS and Beyond

in the pipeline

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

Strike a light! *– it's the second part of Keith Garwell's Thunder and Lightning project.*

PLUS Security Electronics Systems and Circuits is a new series from Ray Marston.

Martin Edwards reviews the ins and outs of Peter Brunning's Experimenting with PC Computers book on mastering programming techniques.

Douglas Clarkson examines the aftermath of the Chernobyl nuclear disaster.

Part 8 of Greg Grant's series What's in a Name? discusses the invention and development of the antenna.

Part 2 of Stephen Waddington's series about the Information Economy explores the revolution currently taking place the media.

Digital Television by Reg Miles gives us the full picture about the new TV format.

Catching data through the games port has never been easier with Dr Pei An's project!

Don't miss another selection of Bob's Mini Circuits from Robert Penfold.

Issue 118 on sale Friday 5th September

ELECTRONICS and Beyond

BRITAIN'S BEST MAGAZINE FOR ELECTRONICS

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 setting-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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You can contact Maplin Electronics via e-mail at `<recipient>@maplin.co.uk` or visit the Maplin web site at `http://www.maplin.co.uk`.

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Prices of products and services available from Maplin shown in this issue, include VAT at 17·5% (except items marked NV which are rated at 0%). Prices are valid until 5th September 1997 (errors and omissions excluded). Prices shown do not include mail order postage and handling charges. Please add £2.95 to all UK orders under £30.00. Orders over £30.00 and MPS Account Holding customers are exempt from carriage charges.

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TECHNOLOGY WATCH

with Martin Pipe

Although the capacities of hard disk supplied with the average PC have increased immeasurably over the last ten years – from 40M-bytes to 2G-bytes – the humble 3·5in. floppy drive hasn't changed much. Sony's industry-standard high-density' floppy, originally introduced in 1987 on IBM's then-popular range of PS/2 machines, is a fixture on PCs to this day. It is clear that the 1·44M-bytes available on a high-density floppy after formatting is becoming of less and less practical value, whether for back-ups of the hard disk, transfer of information (notably multimedia files) between PCs, or as an installation medium.

'High density' is increasingly becoming a laughable term. Indeed, most software manufacturers now supply their wares on the much more convenient CD-ROM format. And just as well – the floppy version of Microsoft's Office 97 suite ships on an unprecedented 38 (count 'em) disks. The problem with CD-ROM is that it is a read-only medium, and so a floppy disk drive has to be included, as a medium by which data can be gotten out of the machine. The fact that it is an industry standard, unlike the plethora of high-capacity tape formats, is a clear benefit.

Word for Word

Several attempts have been made to get around this problem of limited floppy capacities. In the mid-1980s, the Verbatim magnetic-media offshoot of Kodak tried to get the world to standardise on a high-density 3·3M-byte version of the old 5·25in. floppy diskette – but failed. At that time, everybody was waiting with bated breath for the more robust (enclosed) high-density 3·5in. 'microfloppy', as Sony then called it. I still have one of the Verbatim monsters, which relied on packing more sectors and tracks onto specialised pre-formatted diskettes. Gathering dust in some long-forgotten cupboard, my Verbatim drive is now a museum piece.

In the late 1980s, IBM tried to standardise on a 2·88M-byte version of the 3·5in. disk. The drives, which were backwards-compatible with 1·44Mb disks, never really caught on. Indeed, I don't even know if you can buy the 2·88M-byte disks any more. Other high-capacity rewritable/removable media have met with rather more success. Interestingly enough, these formats are not backwards-compatible with the standard floppies. The first to become popular was Syquest's 5·25in. removable hard disk, which became an industry standard among Apple Mac users. The first disk cartridges', available in 1989, had a 44M-byte capacity – backwards-compatible 88 and 200M-byte versions followed in time.

The SCSI-based Syquest system was particularly favoured by those in the creative industries, and even to this day, is used to transport images and page layouts from publisher to printer. The text you are reading now was, at some point, stored on a Syquest. Unfortunately, the cartridges are very expensive by today's standards (£50 for an 88M-byte) and consequently, the standard never really took off among the general public. Nor did a 270M-byte 'mini' version launched some time later. It's much faster than a floppy, although somewhat slower than today's hard disks.

Zip it Up

More recently, we have seen Iomega's Zip drive, which will store 100M-byte on a 3·5in. floppy disk contained within a beautifully-robust shell. The £100-odd Zip drives are, sadly, not compatible with standard floppies. They are, however, available in a variety of Mac and PC configurations, and is even offered as an option by some personal computer manufacturers. One version attaches to a PC's parallel port, making it a quick and easy back-up medium – even for notebook computers. The Zip is much faster than a floppy, but the main reason behind its success is the low price of the media – typically £10 for each 100M-byte disk.

A 1G-byte removable-media drive from Iomega, the SCSI-based 350 Jaz, has been selling well amongst Mac users and some say that it could eventually replace the 5·25in. Syquest cartridge in the publishing and associated industries. Sadly, the disks are, at £70, not cheap – although the capacity is great. Alternatives to the Jaz include a 540M-byte system from Nomai, and Syquest's latest SyJet 1·5G-byte format – the highest-capacity removable-disk system currently available. Both of these alternatives are aimed primarily at Mac users.

As far as PC users go, it's the Zip that has proved to be the most popular high-capacity alternative to 1·44M-byte floppies. This situation could change if 3M's Imation subsidiary has its own way. Imation has just launched Superdisk – a single 3·5in. diskette that holds a slightly-bigger 120M-byte of data, which is the equivalent of 83 high-density disks. The main advantage of the required Superdisk drive, known as the LS-120, is that it is backwards-compatible with high-density 1·44M-byte floppies, as well as the older 720k-byte types.

Imation sees PC manufactures specifying LS120s instead of conventional floppy drives – generally at a £100 premium. Some manufacturers are already beginning to offer it as an extra – notably Compaq, Fujitsu and Siemens-Nixdorf. The hardware, like the Iomega Zip, has the same dimensions as a regular floppy drive. Mitsubishi is working on a slim-line version for notebook computers. Like other systems, and Apple Mac floppy drives, the LS-120 features an electronically-controlled eject mechanism.

The LS-120 interfaces via a standard PC-type IDE interface – no Mac version is yet planned. Maxell will, in addition to 3M/Imation, be producing blank Superdisk media.

While it will read and write to conventional floppies the LS-120 will not, alas, format them – something that has not been made abundantly clear in Imation's literature. This may not be too much of a problem, though – most high-density disks are sold pre-formatted, and so the LS-120 should still be able to produce backwards-compatible disks for other machines. Although the LS-120 is currently only available as an OEM product for manufacturers, a retrofit kit for the upgrading of regular PCs should be available soon. Unfortunately, the BIOS in the PC may need to be updated – particularly if you want the option of booting from it – although a dedicated interface card may get around this. A parallel port version of the drive is also planned. The UK prices of media and upgrade kits are not yet known, but expect Superdisk to be pitched heavily against Zip.

Modus Operandi

So how does the Superdisk medium work? Each disk has a servo pattern, in the form of 900 special tracks, etched into it at the factory. LS-120 drives employ a laser to read this servo pattern and align the read/write head – the 'LS' part of the drive's name, if you haven't already guessed, stands for 'Laser Servo'. The use of a laser servo system allows precise head positioning, and hence, narrower tracks can be written and read.

The magnetic media itself is composed of two layers of high-density metal particle (MP) material. When combined, these technologies make possible a recording density of 2,490 tracks per inch (tpi) – compare this with the 135 tpi offered by conventional high-density floppies. To achieve backwards-compatibility with older floppy formats, a dual-gap read/write head is employed for each side of the disk. Imation claims that the Superdisk system, which rotates the disk at 720rpm, is five times faster than conventional floppies; the LS-120 is capable of sustained transfer rates of up to 400-680k-bps, or 4·0M-byte/s in burst mode. The company also says that the drive will also accelerate the process of reading and writing to older floppy formats.

Martin Pipe welcomes comments and ideas.
E-mail him as: whatnet@cix.compulink.co.uk.

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