

ELECTRONICS

and Beyond

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High Speed Electronics



A look at
Formula 1 Racing
and Thrust 2



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PROJECTS FOR YOU TO MAKE
Short Wave Radio Receiver
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Carousel Project
Universal Battery Charger

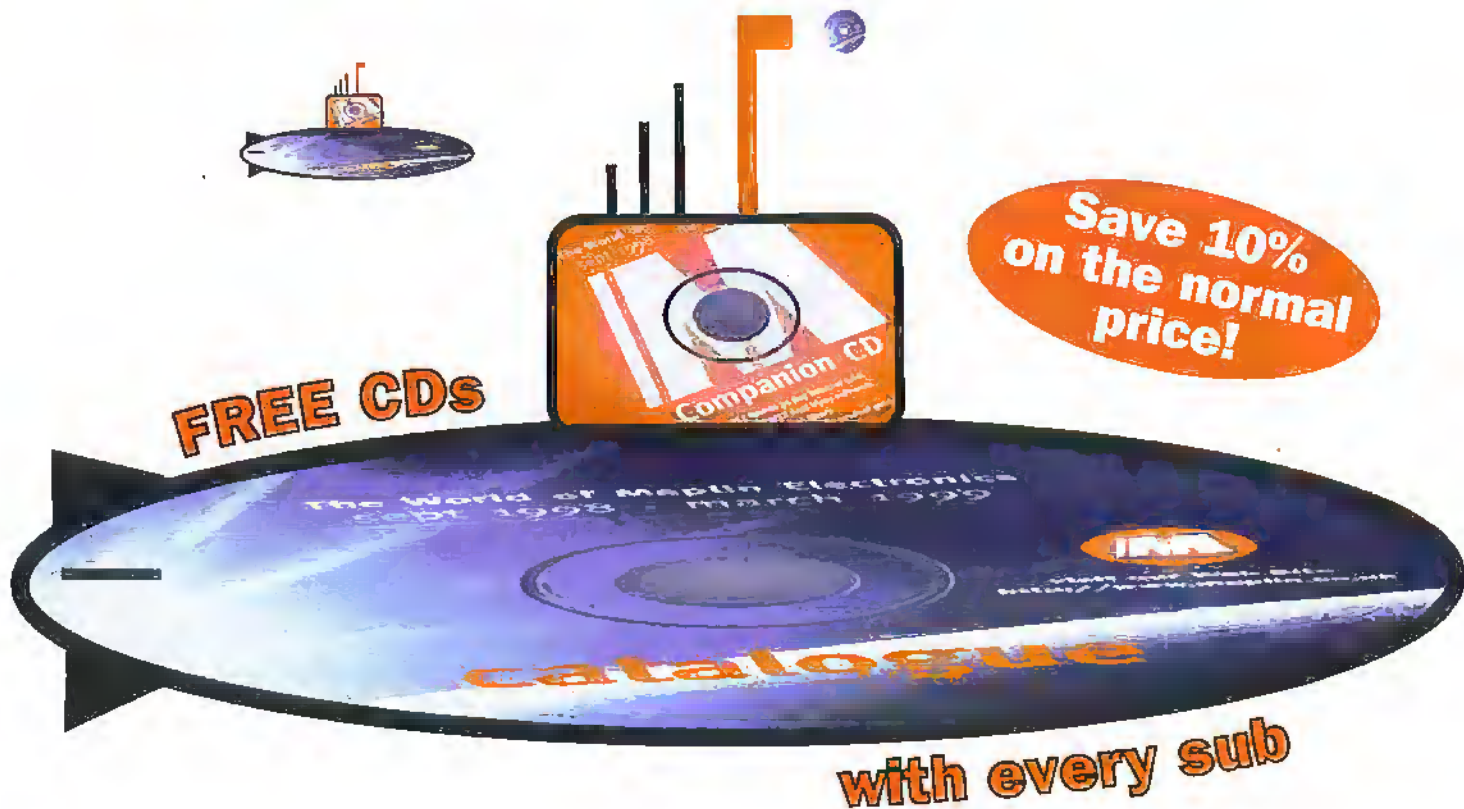


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Treasure
Locator?

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objects deep
underground
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ELECTRONICS

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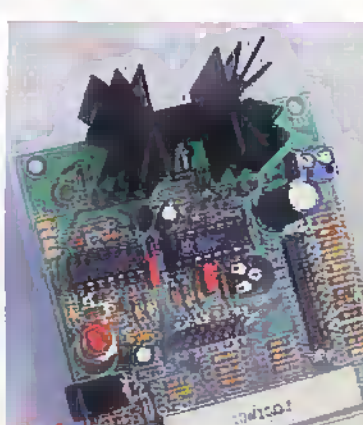
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ELECTRONICS

and Beyond

This month we report on a British company called SearchWell that produces what some would consider to be the ultimate buried treasure locator - actually it was intended for the service industries to find gas pipes etc., but at £22,000 it is a very sophisticated piece of equipment. For those of you who might think this is over the top, then later this year we hope to bring a more realistically priced project for those who are interested in buried treasure.

After our prediction that analogue tape could be on the way out, Martin Pipe reports on a community TV station - TV12 on the isle of Wight - that transmits its programmes from hard drives, directly from the transmitter. Local radio stations have been using this technique for some time now. This novel and economically viable alternative to expensive analogue tape equipment could see the start of a spate of community TV stations.

I'm sure we would all agree that the late entertainer Roy Castle was one of life's gentlemen. Dr. Chris Lavers in Research News reports on a lasting legacy to this popular and much loved entertainer, the Roy Castle Lung Project and Centre which is the only purpose-built centre for lung cancer research in the world.

Next Month

We will include the first part of the March '99 Catalogue on CD absolutely free, on sale 5th March.



Britain's Best Magazine for the Electronics Enthusiast

NEWS

REPORT



HP Jornada Is First Handheld To Run Windows CE Professional

HP has announced that its HP Jornada 820 Handheld PC, the first handheld PC to run Windows CE Professional Edition software hit the streets at the beginning of this month.

This first product in HP's new family of handhelds weighs only 2.5lbs and offers a touch-type keyboard, access to e-mail, the Internet, note taking, and faxing.

For further information check: <www.hp.com/jornada>. Contact: HP, Tel: (0990) 474747.

Own An iMac For £29.95 A Month

Apple resellers in the UK are offering consumers the chances to purchase an iMac for just £29.95 per month. Under the terms of the deal a £50.00 deposit is required at the time of purchase with nothing more to pay for 5 months. After which customers can either repay the balance in full, with no added interest, or repay £29.95 per month for a period of 42 months (APR of 17.9% over 47 months).

For further information check: <www.apple.com/uk>.

Contact: Apple, Tel: (0870) 600 6010.



IT Managers Plan To Celebrate As Millennium Bug Strikes

The last thing on IT managers' minds as the Millennium turns will be the Y2K bug, according to research by The Knowledge Group. A survey of 250 IT managers showed that 95% do not intend to be at work as the clock strikes midnight.

The survey also showed that, although 87% of companies claim to have set firm policies for coping with the Millennium bug, only 7% have so far actually made plans to staff their networks on New Year's Eve.

For further information check: www.ktgroup.co.uk.
Contact: The Knowledge Group, Tel: (0117) 9007500.

BASIC Stamp 2 Windows Interface Available

A Windows version on the BASIC Stamp 2 development environment is now available for download from www.parallaxinc.com. The application runs in Windows 95/98/NT 4.0 and includes a bunch of new features such as: multiple open source code files, and transmit and receive within Debug window.

For further information check: www.parallaxinc.com.
Contact: Milford Instruments, Tel: (01977) 683665.

Spending Spree Ahead For Europe's IT Departments

With the coming of the year 2000 and the switchover to the European single currency, European companies will spend anywhere from \$150 billion to \$400 billion on computer systems, according to estimates by the Gartner Group.

For further information check: www.gartner.com.
Contact: Gartner, Tel: (0800) 716089.

ITS Wins Technical Innovation Award

He's dark, some say he's handsome and he sits in the corner of your TV screen – and is a sign of things to come. Simon the signer is a virtual human being who could eventually make subtitles a thing of the past for deaf viewers by instantaneously deaf signing programmes.

The product of a collaboration between the University of East Anglia, Norwich company Televisual and the Independent Television Commission, Simon has just scooped the Royal Television Society's 1998 Technical Innovation Award for Research and Innovation.

For further details, check: www.itc.org.uk.
Contact: Independent Television Commission, Tel: (0171) 255 3000.



3Com And Siemens Spearhead Voice And Data Convergence

3Com and Siemens are set to form a joint venture to develop a rich set of LAN telephony and multimedia products that will change the way businesses build and operate their data and voice communications networks.

Through the new joint venture, the two companies expect to deliver products in 1999 that will enable businesses to run voice, video and data calls over their local area networks (LANs) – lowering their overall

telecommunications costs and paving the way for new converged multimedia business applications.

For further information check: www.3com.com.
Contact: 3Com, Tel: (01628) 897000.

Amplifier is Best of British

The British designed and manufactured Arcam Alpha 10 hi-fi amplifier has scooped two awards. The amplifier received a Millennium Product award from the Design Council and also received the European amplifier of the Year Award 1998 – 1999 from the European Imaging and Sound

Association (EISA).

The Arcam Alpha 10 is a modular hi-fi amplifier which can handle stereo or with the addition of Arcam 'Smart Modules' Dolby Digital Home Cinema.

For further details, check: www.arcam.co.uk.
Contact: Arcam, Tel: (01223) 203203.



NEWS BYTES

Apple PDA Goes Wireless

Apple Computer is preparing to re-enter the consumer handheld PC market with a palmtop device code-named 'P1'. But unlike the Newton, P1 will run on a slimmed down version of the Mac OS, and will also be capable of communicating via wireless, infrared, cellular connections.

For further information check:
www.apple.com/uk.
Contact: Apple, Tel: (0870) 600 6010.

AT&T Buys IBM Data Network

AT&T is buying IBM's global data network for \$5 billion, in a deal that will give AT&T more than a million individual users in 59 countries as well as access to its network all over the world. As part of the agreement, the companies will provide each other \$9 billion in outsourcing business, and will arrange for 5,000 people to transfer from IBM to AT&T and 2,000 to transfer from AT&T to IBM.

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

Intel, S3 Settle Patent Dispute

Intel and graphics chipmaker S3 have agreed to end their dispute over microprocessor patents, and instead will cross-license the patents for the next 10 years.

The settlement frees Intel to proceed with development of its next-generation Merced microprocessor without fear of infringing on S3's patents, and means S3 can go forward with plans to integrate graphics technology into a chip set that routes data through a computer.

For further information, check: www.intel.com.
Contact: Intel,
Tel: 01793 403000.

Study Predicts Bandwidth Crunch

Bandwidth will be a major issue facing cable, computer and telephone companies this year, according to a survey released in December by PricewaterhouseCoopers.

With Internet traffic doubling every 100 days, the volume of data traffic will exceed voice within two years, according to a PricewaterhouseCoopers study, 'Technology Forecast: 1999'.

Transmitting digital data will blur the lines between voice, fax, data and video transmissions, and between fixed and mobile services, the survey said.

For further information check:
www.pwcglobal.com.
Contact: PricewaterhouseCoopers,
Tel: (1753) 752000.



Panasonic Drives Disk Storage Upto 120MB

Panasonic was amongst a group of manufacturers throughout 1998 that announced it had developed a new data storage technique that promised a 10-fold increase in the storage capacity of 3.5 in. disks.

The manufacturer is the first company to deliver on its word with the SuperDisk 120MB floppy, now available through PC World and a number of other retail outlets as an upgrade package for

PC users. The SuperDisk 120 Mb features an IDE interface and is priced around £95.00.

SuperDisk120MB is a 3.5 in. floppy disk drive that provides high capacity, portable storage on Imation and Maxwell 120Mbyte media while providing full read and write compatibility with existing 3.5 inch disk formats.

Unlike conventional 3.5 in. media, all SuperDisk 120MB diskettes have a servo pattern

etched into them at the factory. The drive uses a laser to read this pattern and precisely align the read/write head. This positioning accuracy allows SuperDisk 120MB technology to use 2,490 tracks per inch rather than 135 tracks per inch of conventional 3.5 in. disks.

For further information check:
www.panasonic.co.uk.
Contact: Panasonic,
Tel: (0800) 444220.

Sony Launch VAIO Notebooks

Sony UK has announced the UK release of four new VAIO Notebook PC's. The new range upgrades the performance of existing models and adds a new model to offer greater choice and flexibility to the consumer based on the existing VAIO formats and styling.

The new 700 series, which supercedes all other 700 series

models consists of the PCG-745 and the PCG-747. The PCG-74 has been upgraded to an MMX266 processor and a 3.2GB hard disc and is priced at £1,400. The PCG-747 has been upgraded to an MMX266 processor and a 4.1Gb hard disc and is priced at £1,700.

For further information check: www.sony.co.uk.
Contact: Sony, Tel: (0990) 111999.

Growbot Built With Growth In Mind

A new robot called the GrowBot from Milford Instruments is a small robot kit packed with loads of features for anyone wanting to experiment with robotics. Controlled by a powerful microprocessor, the Parallax BASIC Stamp II module (BS2-IC), GrowBot uses two servos for propulsion and a printed circuit board as its chassis.

GrowBot has six reconfigurable I/O locations for bumper switches, phototransistors, photoresistors, LEDs, thermistors

and other sensors and outputs. Each point is connected directly to the BS2-IC's I/O pins.

The GrowBot can be easily programmed to do interesting things - light following, avoidance, and sound broadcasting. With some advanced programming the GrowBot could follow walls, run mazes, and track lines.

For further information check:
www.milinst.demon.co.uk.
Contact: Milford Instruments,
Tel: (01977) 683665.

Psion Breaks Free From Wires With Nokia

Psion Series 5 users can stay in touch with the Internet wire-free thanks to the release of the new Nokia 8810 which has its own built-in infra-red modem, so simply placing it next to the Series 5 gets you connected.

The Nokia 8810 enhances the communication abilities of the Series 5 by connecting it to email, the Internet, faxes and short text messages (SMS) without the need of any additional wires or add-ons.

For further information check: www.pSION.com.
Contact: Psion,
Tel: 0990 143050.

IBM Takes Safeway Shopping With Virtual Basket

Safeway and IBM have unveiled a personalised remote shopping service that lets customers use hand-held devices to build and submit grocery orders from home in advance.

The new service will initially be available to customers via palm sized electronic organisers called 'Easi-Orders'. These portable devices will allow customers to pre-select their weekly groceries from individually tailored, computerised shopping lists compiled from their own past purchases.

Safeway predicts that over the next few years, customers could digitally order groceries using this technology in devices such as TV's and mobile phones. Already fitted with a bar code reader the Easi-Order will allow customers in the future to self-scan products themselves at home or in-store, including those bought at other supermarkets.

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

Contact: IBM, Tel: (0990) 426426.

IBM Chips Help Digital Cameras See the Light

Image sensor chips from IBM are set to slash production costs for camera manufacturers, placing the benefits of digital still camera technology within reach of more consumers.

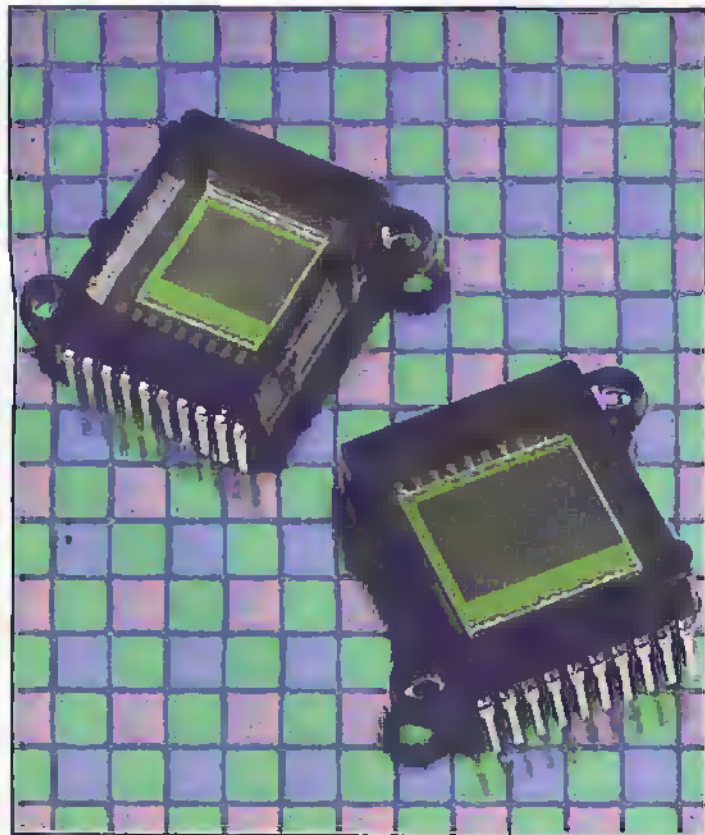
The chips, referred to as charge coupled devices (CCDs), function as the eyes of a digital camera, converting light energy into electronic signals. The camera's internal converter then digitises the signals and the picture information is saved on electronic storage media.

IBM intends to incorporate the 1.3 and 2.0 million pixel array CCD image sensors into two production-ready camera designs developed by leading camera and lens design companies.

These complete solutions include integrated chip designs, lenses, CCDs, operating system, analogue to digital image converters and ASICs to process images and perform camera functions.

For further information check: <www.chips.ibm.com>.

Contact: IBM, Tel: (0990) 426426.



CDT Reaches The Holy Grail Of Plastic Display Development



CDT has developed the final piece of the jig-saw on route to a full colour plastic display - LEPs that emit blue light. Blue has been the most difficult colour to achieve as it sits at the far end of the visible light spectrum, so the polymer synthesis is an extremely complex chemical process.

But CDT now understands the necessary chemistry to produce an LEP screen of any colour in the visible light spectrum. To demonstrate this point, the research and development team has produced a pure white single pixel display, which requires a

delicate balance of red, green and blue polymer components.

CDT and Seiko Epson are working on a parallel project to combine separate red, green and blue LEP displays to produce a full colour display screen. The two companies jointly showed a monochrome LEP display in February 1998. Meanwhile in November, CDT showed a multi-colour LEP displays using red and green, paving the way for a full colour LEP video display.

For further information check: <www.cdtltd.co.uk>.

Contact: CDT,
Tel: (01223) 276351.



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

Evidence for Psycho-Kinetics?

Dear Sir

I have just received my first copy of *Electronics and Beyond* issue 132, so I am writing with barely one copy under my belt, and am disadvantaged in that I have not seen the first of David Aldous' articles on PK. I feel that Mr. Marret had not taken note of the word 'Beyond' in the title.

However, I have witnessed some remarkable occurrences that perhaps the research that Mr. Marret seems to ridicule may one day explain. A dowser of my acquaintance showed me two letters from a farmer in Western Australia. The first was a scribbled note with a roughly sketched map and a plea to indicate where water might be found on his cattle station. The dowser having 'dowsed' on the map sent written instructions as to location, depth at which water would be found and gallons per hour flow rate, and enclosed his fee for £50. About eight weeks later five grubby five pound notes arrived by air mail

with a dry comment that whilst almost all the predictions were correct he had over estimated the drilling depth by three feet, but conceded that it was not a bad effort from 12,000 miles away!

It is answers to such questions as to how the dowser managed the above - and much more that I witnessed - that I would like to learn the answers. To others I would suggest reading *Solar Energy Dowsing* by the late A. P. Tabraham to learn about the scientific tests carried out on the Scilly Isles, and why reflecting the sun's rays, via a mirror, up and down a steel pole struck in the ground will enhance soil heating. Or read Dr. Iyall Watson's book *The Nature of Things* and then one may be glad that people are prepared to investigate 'the pseudoscience' that offends Mr. Marret. More strength to the pen of David Aldous. Please carry on the good work!

Phil Sheaf
 Psheaf4364@aol.com

Thanks for your comments, I am sure we have not heard the last on this topic!

Help Needed!

Dear Sir

I write to you hoping that your readers can help me with two electronic problems. I request that this letter and my address be published.

I am a charity worker for a local branch of a national medical charity and we are always looking for new methods of raising funds to keep our work continuing. I have designed an automated collecting box using Maplin-supplied components. When a coin is dropped into the box it performs an automated sequence of events that relate to my charities activities - well at least one of several activities that the

charity undertakes.

However, what I need is a circuit that will give out a varying voltage or current that relates to the size of the coin and the value that has been donated. To date I have tried magnetic and metal detector circuits that are available from Maplin, but they only detect a coin and give a simple on/off signal.

What I need is to detect the various coins e.g. 1p, 20p, £1 etc., count them and then, based on a formula of some kind, provide a variable timed output based upon the amount of cash donated/dropped into the collecting box. I know that it can be done with a PIC16C71 which has an on-board A/D convertor, but I still need a suitable circuit that can provide a

varying signal.

I have read about a theoretical circuit called a magnetic gradient detector, but I do not have any practical working circuits, do any readers have any practical designs for this type of circuit, or any other relevant ideas?

My next problem concerns a proximity detector circuit - totally unrelated to my first problem - relating to security electronics. This particular circuit is designed to be connected to metal objects and has adjustable sensitivity, which is also dependent on the size, type or area of the metal object it is attached. I attached it to a length of heavy duty car electrical cable to see if it would still detect a person. However, you

had to be standing on the cable for it to work. What I need is to have at least several inches separation so that the cable can be buried in the ground.

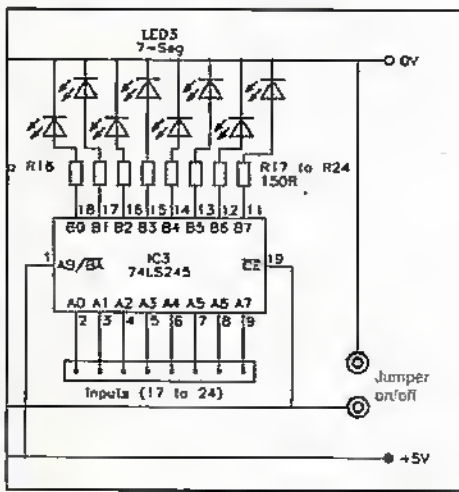
Again on reading several electronic security books they mention a 'buried' cable detection system, but again no practical electronic circuit diagrams and components list. So again I would like to ask readers if they have any of this type of circuit diagram.

R. Moyes
 Flat 2,
 25 Fosse Road Central
 Leicester LE3 5PU

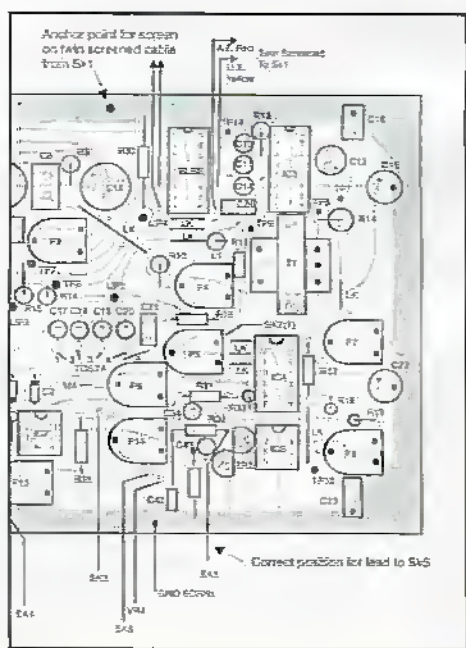
Well I hope readers can be of help here, it may even make an interesting project!

CORRIGENDA

In Volume 18, No. 133, in the Model Railway Point Control System, in Figure 10 the status indicator schematic, the jumper on/off is incorrectly shown. The revised circuit is shown below. The PCB layout is correct.



In the same issue, *Psycho-Kinetic Trainer & Movement Detector*, main board component overlay diagram, there is a connection error on SK5, and no anchor point for the twin screened input cable is shown. This is shown on the revised drawing to the right. Also in Figure 1 the Top Panel drilling, bottom right-hand pot should be marked 'F.M. Volume'.



MEMORY PRICES

DRAM MARKET UPDATE

After the continuously over-supplied DRAM market which resulted in all manufacturers' making major financial losses, we saw at the end of 1998 some dramatic 'moves' in an attempt to prevent further losses and possibly a return to profitability? There were major cut-backs in production, mergers and technology sell-outs. For instance, TI-Micron, LG-Hyundai (ongoing) and there were DRAM fab closures globally. These actions caused prices to rise in the last quarter of 1998.

Alongside production quantity changes there has also been a shift in the mix of production. With the PC-World move towards Synchronous DIMMs, there has inevitably

been a shift in favour of Synchronous DRAM components against Asynchronous components.

So that is what happened at the end of last year - what of more recent events? Generally, prices continue to inch up thanks to continuous demand but more specifically PC100 Synchronous is rising more steeply due to the 'shift' and therefore more bullish demand. With the reduction in production and the move towards favouring production for Synchronous, it was expected that Asynchronous would rise sharper than it has but this is being kept in check by a simultaneous slowing as demand moves over to Synchronous memory. Have they got the balance right?



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A range of DRAM modules for use as memory expansion in computers including PCs, Apple MACs and Amigas, is available. All parts supplied are original and unused. SIMMS supplied by Maplin are branded manufacturers,

chips on selected third party boards.

They are sold with a 'no questions asked' lifetime guarantee and all modules are stored and handled in anti-static environments.

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NM27E	64M	£61.18	£71.88
NM28F	128M	£122.35	£143.76

72-PIN SIMMS

Code	Size	ExVAT	IncVAT
NT00A	16M	£25.33	£29.76
NT01B	32M	£48.01	£56.41

EDO - TYPE

Code	Size	ExVAT	IncVAT
NT03D	4M	£11.55	£13.57
NT04E	8M	£8.83	£10.37
NT05F	16M	£14.45	£16.98
NT06G	32M	£26.37	£30.99

PC100 DIMMS

Code	Size	ExVAT	IncVAT
VG55K	32M	£29.42	£34.56
VG56L	64M	£63.06	£74.09
VG57M	128M	£117.29	£137.81

CONTACT MAPLIN SALES ON 01702 554000 FOR LATEST PRICES

DVD - DIGITAL VERSATILE DISC

Reg Miles explains the history and the development of this latest generation CD format.



Photo 1. Panasonic DVD-L10 portable DVD-video player.

DVD is the first disc format that companies seem to share an enthusiasm for from the word go. Even CD had a mixed reception, and CD-ROM took years to be accepted. While none of the others have developed more than a niche market – usually before disappearing.

DVD began life as two similar, but rival, high density formats – Multimedia CD (MMCD) and Super Density Disc (SD). The former was announced by Philips and Sony in December 1994, the latter by Hitachi, Matsushita (Panasonic), MCA, Pioneer, Thomson, Time Warner and Toshiba in January 1995. Both achieved their high density by utilising a shorter wavelength red laser, enabling the pits to be smaller and the track pitch finer. Both also introduced a feature that had not been used on CD-size discs before: dual-layer from MMCD and double-sided from SD. Both also proposed the format as the next generation Digital Video Disc – with applications for computer use.

For a brief period the rival camps went round drumming-up support for their format. Although they, more than anyone else, knew that rival formats would mean failure in the market. It was no surprise, therefore, when in August 1995 Philips and Sony proposed that a single format should be developed utilising the best aspects of both of them. In September all parties agreed. In December they created the DVD Forum as the body to oversee developments – with JVC and Mitsubishi joining in, and announced the basic specifications for DVD movie and DVD-ROM.

Instead of the piecemeal approach that has characterised the various CD developments, DVD has begun as a unified family of variants with standardised formatting of data. Thus, for example, the video content of a DVD-ROM can be played on a DVD-Video player. Incidentally, the name, Digital Video Disc, was quickly changed when the computer industry became involved to Digital Versatile Disc, but has subsequently been reduced to just the initials – like VHS (Video Home System).

The comparison between the basic DVD and CD standards are interesting, and show just how much can be achieved by reducing the laser from infrared to only as far as red. Aided by reducing the amount of data



Photo 2. Toshiba SD-3107 DVD-video player.

used in the data storage algorithms and for error correction, leaving more space for programme data.

For DVD the wavelength of the laser diode is specified as 635-650nm compared to 780-790nm. This, and a higher numerical aperture (NA) of 0.6 against 0.456 that produces sharper focus, has enabled the spot size to be reduced from 1.6µm to 1.0µm. As a result the track pitch has been reduced from 1.6µm to 0.74µm; and the minimum pit length from 0.834µm to 0.4µm (Figure 1a and 1b). At the same time the nominal scanning velocity has been increased from 1.2m/s to 3.49m/s. Together, these changes increase the nominal data rate from 1.536Mb/s to 11.08Mb/s,

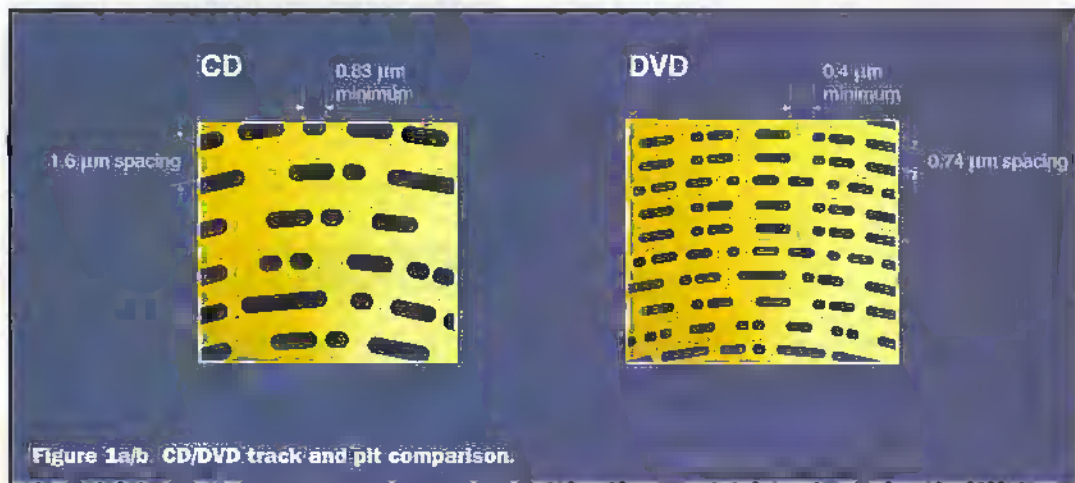


Figure 1a/b. CD/DVD track and pit comparison.

only need to make use of the one side). If not, they may well use DVD's dual layer facility instead (developed by 3M),

which increases the capacity to 8.54GB per side, and provides a seamless changeover.

Figure 2a shows a single sided disc, and Figure 2c a double sided one. These are created in the same way as a CD with the data pits and lands (the surface between the pits) moulded into the clear, normally polycarbonate, substrate and coated with a reflective material. Creating a dual layer begins the same way with the moulding process. But the pits and lands produced are coated with a semi-reflective material. The back of this Layer 0 is then covered by a clear polymer which has the second lot of pits and lands pressed into it, and these are coated with the fully

reflective material to give Layer 1 (Figure 2b shows dual layer single sided, Figure 2d dual layer double sided). Separate lasers are not required for reading the layers, the light is refocused to pass through Layer 0 and a 40µm intermediate layer to the fully reflective Layer 1.

The single layer single sided disc with its 4.7GB capacity is known also as DVD 5, and for DVD-Video has a playing time of 100-140 minutes depending on the degree of compression and the amount of space required for implementing multiple subtitles, multiple languages, multiple viewpoints (camera angles), etc. The dual layer single sided with 8.54GB is known as DVD 9, and has a



and the maximum capacity from 650MB to 4.7GB. The thickness of the discs are the same at 1.2mm, but DVD is composed of two 0.6mm halves bonded together with a UV hardening polymer: the optical result of this thinner plastic is to reduce distortion and birefringence, the physical result is a more rigid disc that is less likely to warp.

But the practical result is that two sides are possible – being effectively two separate discs (although with a capacity of 4.7GB many applications will



Photo 3. Philips DVD930 DVD-video player.



Photo 4. JVC XV-D2000 DVD-video player.

playing time of 180-250 minutes. A single layer (double sided disc has a capacity of 9.4GB (DVD 10), and will play for 200-280 minutes. While the dual layer double sided disc has a capacity of 17.08 GB (DVD 18), and a playing time of 360-500 minutes. An 80mm disc is also provided for in the specifications, and this will have capacities of 1.46GB, 2.66GB, 2.92GB and 5.32GB – in the same order as above. The rather excessive reduction in capacity is explained by the fact that the unrecorded centre of the disc is the same diameter for both sizes (Figure 3).

Dual layer discs come in two forms – parallel track and opposite track. Figure 4a shows the basic single layer disc with the laser tracking across from the lead-in area at the hub of the disc to the lead-out area at the outer edge. In Figure 4b both layers are tracked in the same outward direction. This would normally be used for randomly accessing data on a DVD-ROM. However, it could also be used for DVD Video where the movie on Layer 0 is accompanied by parallel plot lines and additional material recorded adjacently on Layer 1. Opposite track is for longer movies (Figure 4c). Here, the movie starts at the inner lead-in area on Layer 0, goes out to a middle area where the laser runs out, refocuses to Layer 1, and runs back into the data area again and tracks back to the lead-out area.

- All data information is placed on the disc in sectors, which run continuously along the data spiral, and are numbered sequentially. Each sector contains 2048 Bytes of data. To avoid read errors the data is placed in error correction blocks of 16 sectors (= 32kB) using Reed Solomon Product Code (which is said to be ten-times more effective than the Cross Interleaved Reed

Solomon Code – CIRC – used for CD). The lead-in area consists of a two block reference code, and 192 blocks containing information about the disc that the player requires to read it correctly. In the middle area all the sectors carry zeros. The lead-out area ensures that all the programme content can be read to the last sector, and signs off with all the main data in the sectors set to zeros.

The use of run length limited (RLL) 8/16 channel modulation, instead of RLL 8/14, allows the data to be written more efficiently to disc. But once on

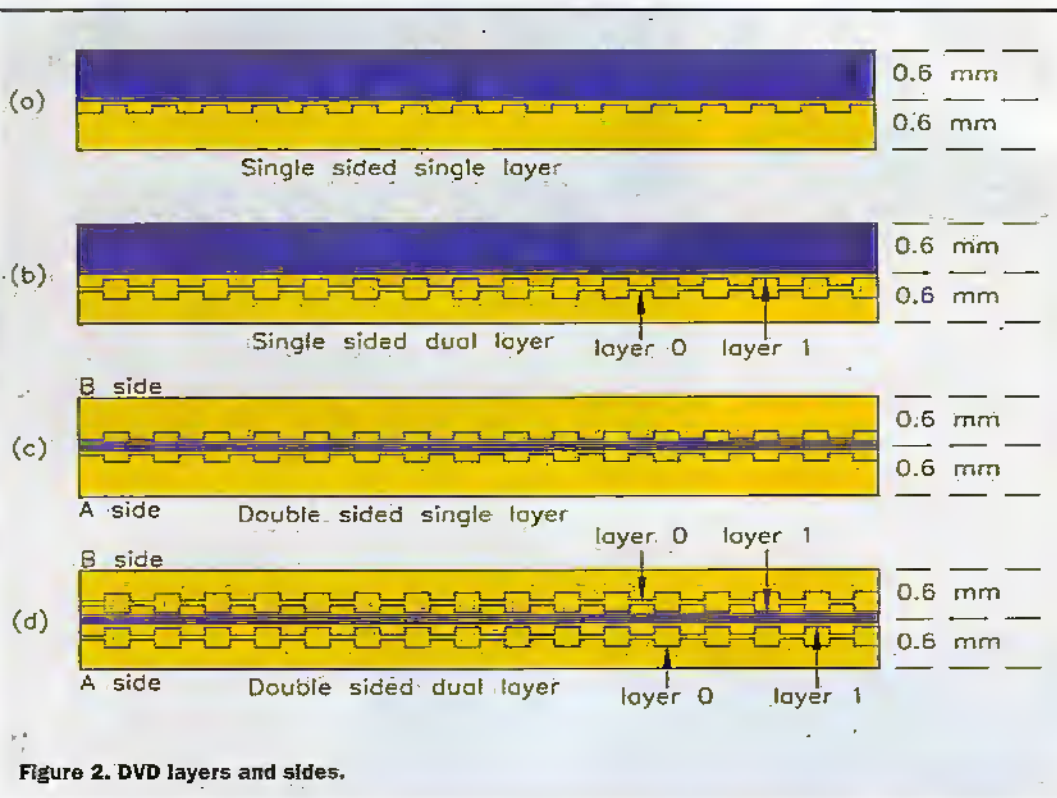


Figure 2. DVD layers and sides.

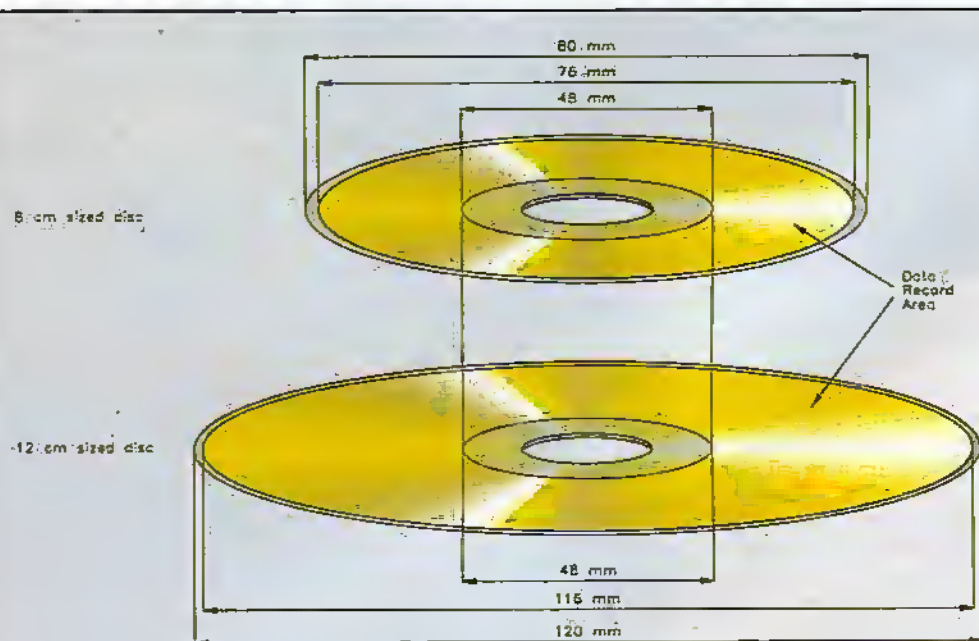


Figure 3. 80mm and 120mm discs.

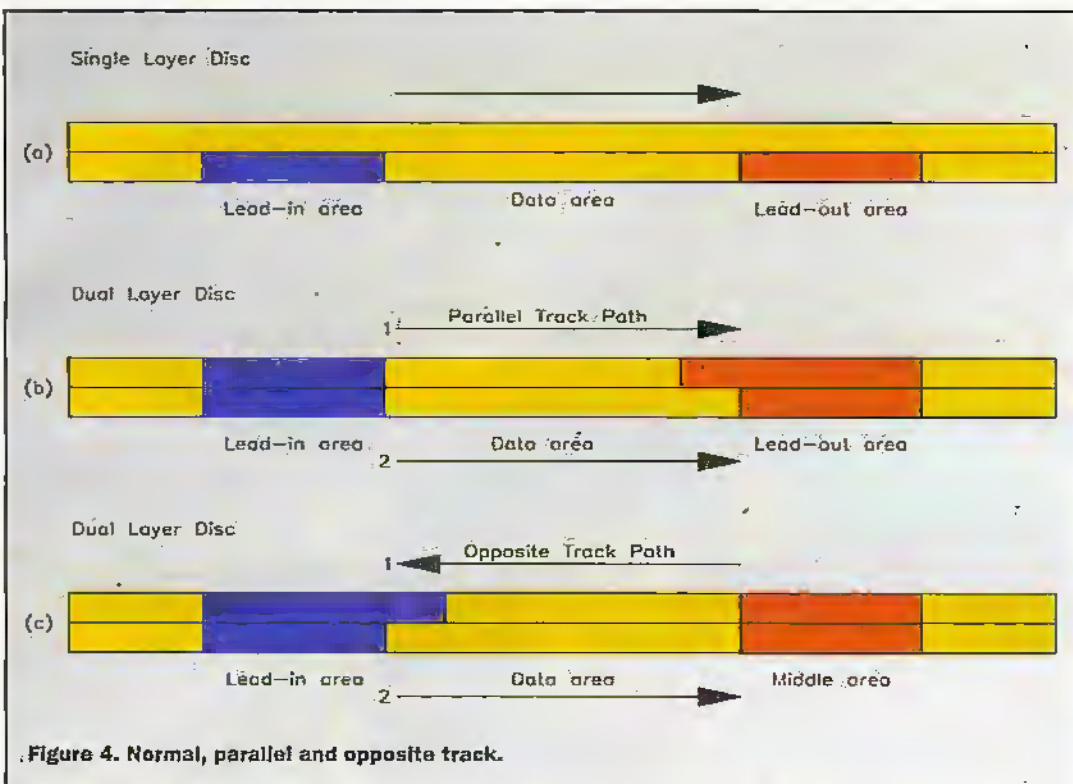


Figure 4. Normal, parallel and opposite track.

the disc '1' are still represented by both the leading and trailing edges of pits (where the reflected intensity of the laser light changes abruptly), and '0' by the relative length of each pit and land between them – the longer the pit or land the greater the number of zeros (Figure 5).

However, before video is put onto a disc it must first be compressed. This is done using MPEG-2 (Motion Pictures Expert Group), at a ratio of between 20:1 and 80:1. Virtually all compression systems rely on Discrete Cosine Transforms (DCT) to prepare the images, and MPEG-2 is no exception to that. Each image is divided into discrete blocks of pixels which are then transformed into a numerical series of coefficients describing the amplitude of the various frequency components. Statistically, most of the picture information will be concentrated in the lower frequencies, allowing the highest frequencies to be largely ignored. Run length coding is then performed to reduce repetitive values to codes that merely specify the number of times they are repeated; and then variable length coding that assigns short codes to the most commonly occurring sequences and longer codes to the least common.

With MPEG-2 interlaced fields can be coded individually or as a single frame. The choice will depend on the degree of motion in the picture, if there is a lot then the fields are coded separately. The result becomes

the intro (or I) frame, which is used as a reference for creating other frames: predicted (or P) frames to estimate motion and predict changes that will occur in the picture – with only the actual changes being stored; and bi-directional interpolation (or B) frames which average the changes based on information from previous and forward I and P frames (Figure 6). The frequency with which the I, P and B frames occur is determined during the encoding process, based on the application and the desired quality and bit rate; however, groups of pictures

(GOP) must always have one I frame, with up to 14P and B pictures for 50Hz PAL/SECAM and 17 for 60Hz NTSC. Generally used GOP sizes are 12 and 16 respectively. The bit allocation for the picture types is: 100-600kb for I, 50-300kb for P, and 30-200kb for B.

MPEG-2 is a component based system. It requires a component video input, which will probably be a 27MB/s stream from a Digital Betacam or D5 DVTR, and stores it as a 4:2:0 signal. Which is actually the beginning of the compression process – at least for the colour

difference signals: a full signal is 4:4:4; the 4:2:2 commonly used by broadcast equipment halves the colour resolution horizontally; while 4:2:0 also halves it vertically (the 1/4in DV camcorder format is also 4:2:0). However, the overall picture resolution is 720x576 for PAL/SECAM and 720x480 for NTSC. Thus, it can cater for anamorphic 16:9 as well as 4:3 aspect ratios. MPEG-2 can also cater for lower quality MPEG-1, so DVD-Video players and computer based DVD Video hardware and software will play Video CD and other CD and any DVD carrying MPEG-1.

In order to play both DVD and CD the laser beam has to be focused at just under 0.6mm for the former and 1.2mm for the latter. Figure 7 shows Panasonic's dual-focus hologram lens pickup, which simultaneously focuses on both levels. An alternative solution is to use two lenses.

It would also have been possible to play MPEG-1 audio on all PAL/SECAM DVD equipment. However, the original specification for compressed audio, of MPEG-2 5.1 as the standard and Dolby Digital (AC-3) 5.1 as the option, has now been reversed, bringing discs and players into line with NTSC ones. Both share a sampling frequency of 48kHz but, whereas MPEG has a maximum transfer rate of 640kb/s, Dolby Digital can only manage 448kb/s. The real quality stuff is uncompressed linear PCM: this has two sampling frequencies of 48 or 96kHz, with 16, 20 or 24bits, and a maximum transfer rate of

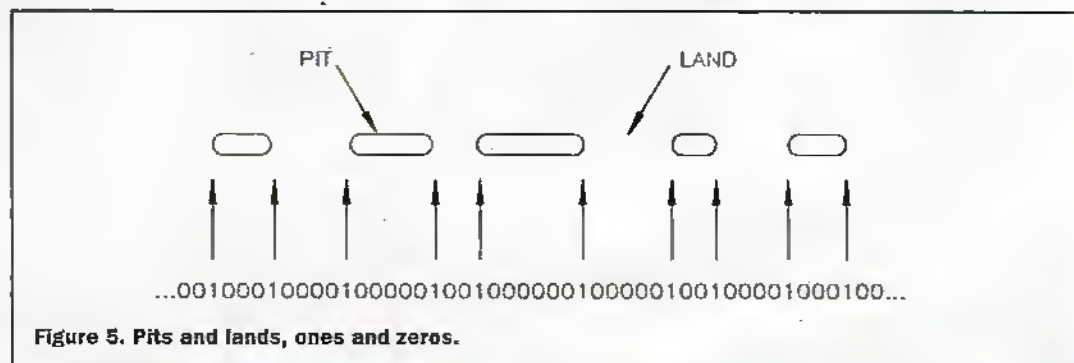


Figure 5. Pits and lands, ones and zeros.

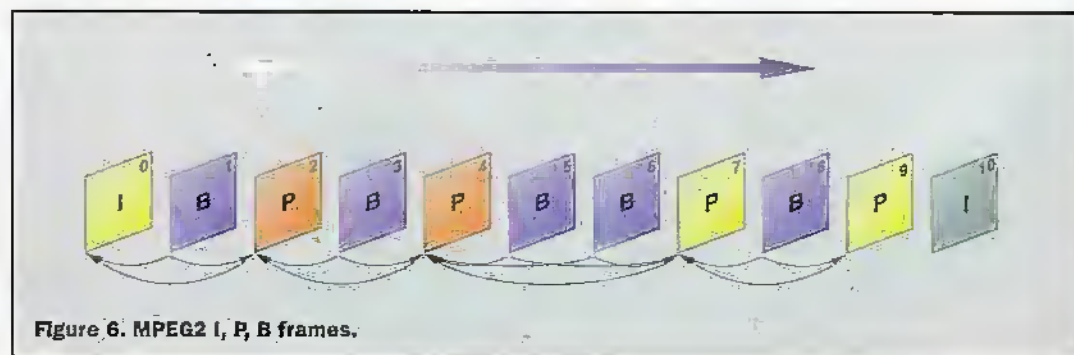


Figure 6. MPEG2 I, P, B frames.

6.144Mb/s. Although the only mandatory LPCM function on players is 48kHz/16bit, and LPCM is an option on discs.

In addition to DVD Video and DVD-ROM, two other discs have recently been launched: a recordable, write-once, disc – DVD-R, and a rewritable disc – DVD-RW or DVD-RAM. Both types operate on the same principles as their CD-R and CD-RW antecedents.

DVD-R uses an organic dye coating (Figure 8) with recording by laser power modulation. The laser's power is turned up, causing changes in the coating that permanently alter its refractive index, producing dark marks that are the equivalent of pits. The recording wavelength is 635nm, while playback is 635-650nm. The shortest data bit that can be recorded is $0.293\mu\text{m}$ (DVD-ROM is $0.285\mu\text{m}$) with a track pitch of $0.8\mu\text{m}$. A wobbled spiral groove is pre-formed in the disc during manufacture to stabilise the rotational speed and provide guidance for the laser during recording and reading – with pre-pits providing position data (address signal). Marks are recorded on both the groove and land between. The 120mm version has a capacity

of 3.95GB single sided and 7.9GB double sided, while the 80mm version provides 1.23GB and 2.46GB respectively. A 4.7GB/side 120mm version is planned for the future.

For DVD-RAM the initial version is 2.6GB/side. Figure 9 shows the difference in the sizes of the recorded marks which is due to a phase change in the recording layer, otherwise the disc is similar to DVD-R. The laser selectively heats areas of

the recording track above the polycrystalline layer's melting point – 500°C to 700°C . As the areas melt they become amorphous (non-crystalline), and this phase is set by rapid cooling of the layer (leaving less reflective marks). To rewrite the disc an annealing process is used, with the laser set to heat the amorphous marks to just below melting point at which the crystals reform. Reading is done by a low power laser as

with CD-R – although, in this case, the wavelength is 650nm for both. The minimum data bit length is $0.41\text{-}0.43\mu\text{m}$; and the track pitch is $0.74\mu\text{m}$. Two types of disc cartridge are specified, one for single-sided the other for double-sided discs. The latter discs must be kept in the cartridge, but for compatibility with DVD-ROM and DVD-Video hardware single-sided discs can be extracted.

The use of phase-change technology has only become possible because of improvements to the sensitivity of photodiodes. The original CD specifications required reflectances of 70% minimum for lands and 28% maximum for pits. Whereas DVD-RAM operates with reflectances of less than a third of those.

Both DVD-R and DVD-RAM can be played in the latest DVD-ROM drives and, theoretically, in DVD-Video players – if, of course, the discs have a video content. DVD-ROM drives will also play all the CD variants that have accumulated over the years. Although for early CD-Rs a second, 780nm, laser is required because the dye polymers used are incompatible with red.

DVD-R and DVD-RAM use a

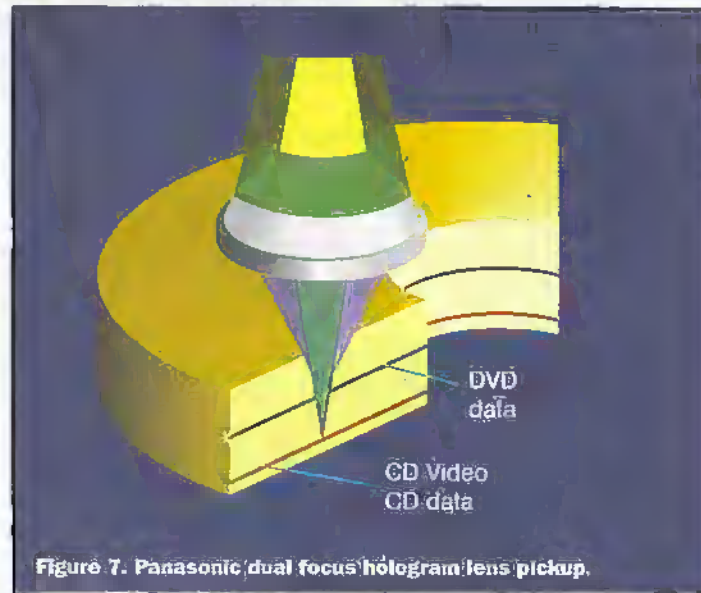


Figure 7. Panasonic dual focus hologram lens pickup.



Photo 5. Panasonic LF-0101 DVD-RAM and PD drive.

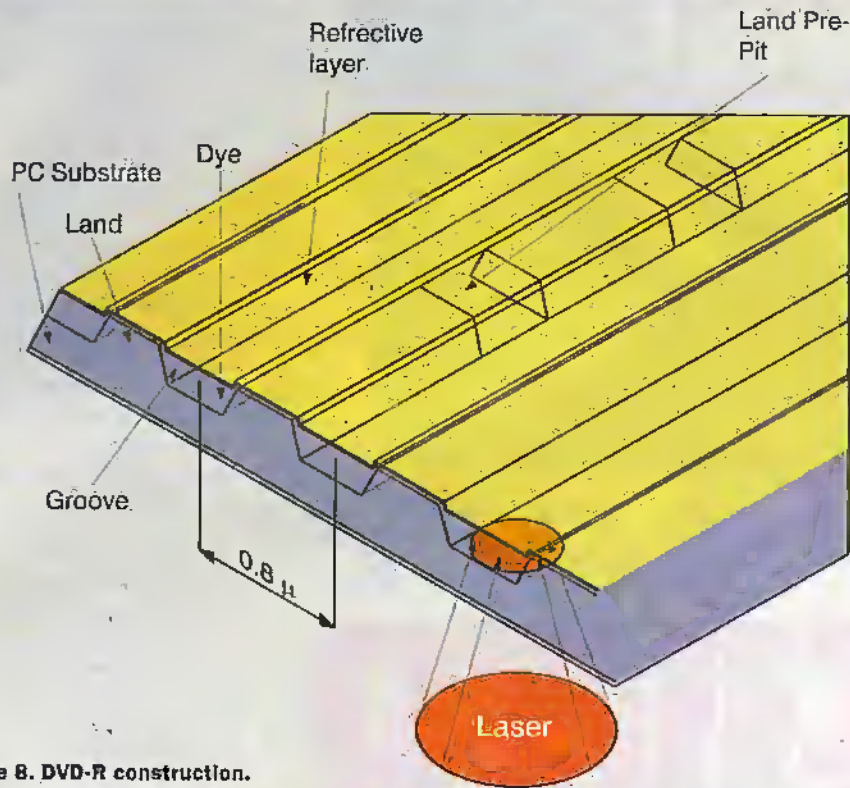


Figure 8. DVD-R construction.

While DVD-Audio is likely to eventually take over from CD audio, and DVD-ROM, DVD-R and DVD-RAM are highly likely to take over from their CD antecedents, consumers have never shown much interest in video discs – from laser disc to Video CD. Also having the discs 'marked' with a Region Code that will only operate in a player with a matching code, preventing access to the far greater number of US titles, seems the wrong way to tempt them. There is a zero code that will play in all six region codes, but it is intended for corporate business users not the mass market.

Columbia Tristar, Polygram and Warner have already released a number of titles for European Region Code 2, including some recent films; but as long as DVD-Video remains both restricted and read-only the majority of consumers are unlikely to look beyond VHS.

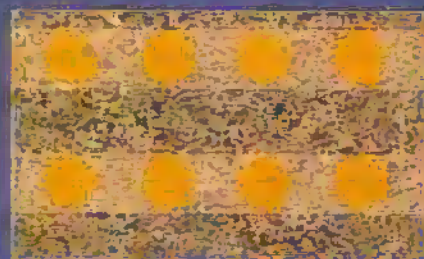
REUTERS

new open file management system called Universal Disc Format (UDF). This is an upgrading of the ISO9660 file format developed for CD-ROM, and it allows programs with more features and more performance to be designed for all computer platforms. DVD-ROM and DVD-Video use a version known as UDF Bridge; a subset of UDF, incorporating features of ISO9660 for compatibility with CD media.

This also applies to the latest disc – DVD-Audio (also known as Super Audio CD), which can also be played on DVD-ROM and DVD-Video hardware. It has a playing time exceeding 74 minutes with contents from two channel stereo mode to up to six channels.

With additional functions, such as video clips and 'slide' shows (still images).

Recorded marks for 2.6 GB and 4.7 GB conditions



1 μm

4.7 GB condition
High SNR Media.
New Write Strategy



1 μm

2.6 GB condition
Conventional Media
& Write Strategy

Figure 9. DVD-RAM 2.6GB and 4.7GB recorded marks.

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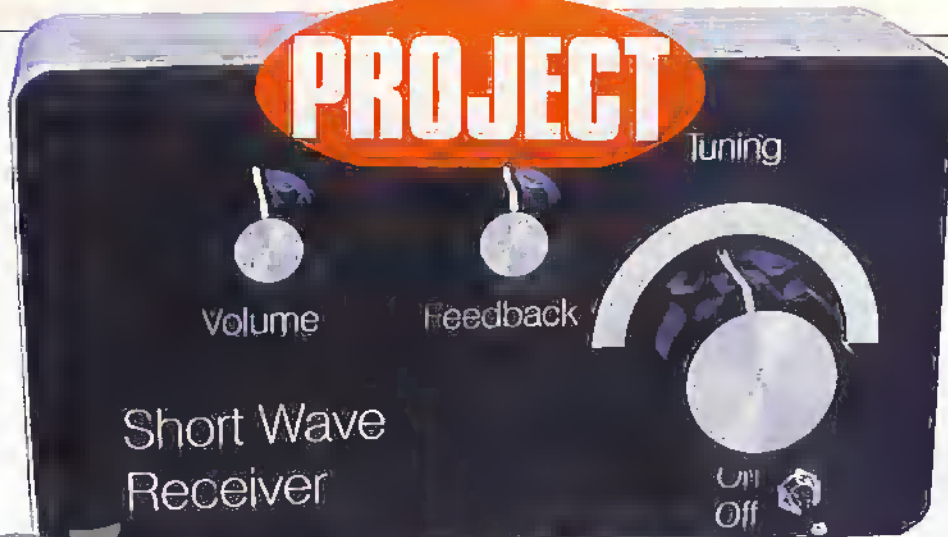
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PROJECT



Short Wave RECEIVER

Gavin Cheeseman constructs a simple short wave receiver with excellent sensitivity.

Introduction

In the past, long before digital ICs were even thought of, much of the interest in electronics revolved around radio in one form or another. Indeed many beginners to electronics started by building simple radio circuits, such as the crystal set, moving on to more complex designs as skill and knowledge developed. In a world where the majority of electronic circuits were based on analogue principles, a basic knowledge of radio circuits and techniques provided a good foundation for engineers in almost all areas of electronics. However, in recent years digital technology has moved on in leaps and bounds replacing traditional analogue circuitry in many applications as well as spawning a host of totally new innovations. Personal computers, digital broadcasting, mobile telephones, ... the list is almost endless.

With the vast array of products now available, you may well wonder whether there is still a place for simple analogue AM radio circuits. If you are purely interested in staying at the forefront of technology, then the answer is probably no.

However, for those interested in experimenting with low cost circuits that are capable of international reception, AM radio has a great deal to offer, even now. In this article we look at a simple receiver design that can be constructed from a

handful of components. The receiver cannot be expected to give the same performance as a modern superheterodyne receiver but is nevertheless capable of providing usable results when aligned correctly and can be fun to build.

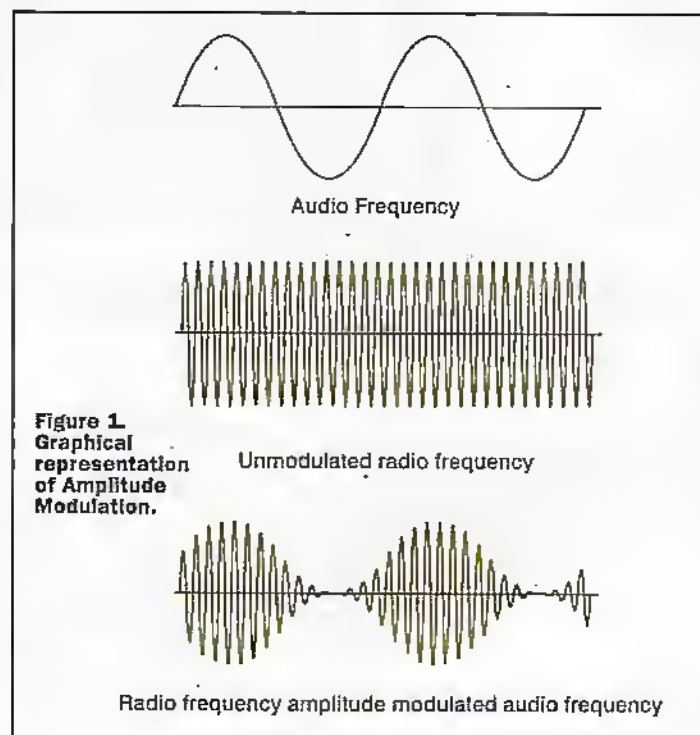


Figure 1
Graphical representation of Amplitude Modulation.

Some background information

The short wave or HF (High Frequency) band is of particular interest for those wishing to receive international stations. This part of the radio spectrum is still widely used for both amateur and broadcast transmissions. Signals are readily propagated by the ionosphere, an electrically charged region of the atmosphere high above the earth, allowing reception over considerable distances. Because the state of the ionosphere is continuously changing, stations from different locations may be heard at different times of day. Conditions also vary with the time of year and the sunspot cycle. Ionospheric propagation tends to follow a general pattern but is never entirely predictable. In fact this unpredictability can make short wave listening a fascinating pastime.

Basic Theory

AM or Amplitude Modulation is a system whereby audio information, such as speech, is superimposed on a radio frequency (RF) signal known as a carrier. The amplitude of the RF varies with that of the audio signal. This concept is illustrated in Figure 1. The task of the receiver is to recover the original audio waveform from the RF transmission, a process known as demodulation.

A wide range of reception techniques for AM signals have been developed over the years, each with advantages and disadvantages. One of the simplest is the crystal set, which demodulates the incoming signal using the diode junction formed between a point contact (known as a cat's whisker) and the surface of a crystal (usually an impure form of lead sulphide). A more modernised form of this circuit uses a germanium diode as shown in Figure 2. A graphical illustration of the demodulation process is shown in Figure 3. Signals of many different frequencies are present at the receiver aerial. Before demodulation can take place, it is necessary to tune the input of the receiver to the frequency of the station that you wish to receive. A receiver's ability to discriminate between signals of different frequency is known as selectivity. In Figure 2, tuning is a function of capacitor

C1 and inductor L1 which form a parallel tuned circuit providing a peak in response around one frequency. Incoming signals are effectively rectified by D1. The selectivity of the circuit is determined largely by the 'Q' or quality factor of the tuned circuit. In simple terms, a higher Q gives a sharper response. The basic crystal set has some advantages over more complex circuits; it is easily constructed and does not require a power supply (it is effectively powered by the received radio signals). However, in practice it is only really suitable for receiving the strongest signals.

Better performance can be obtained by connecting an audio amplifier to the A.F. output of the crystal set. This enables the circuit to drive a loudspeaker and also amplifies some of the weaker stations up to a level where they are intelligible. However, signals that are too weak to drive the diode detector still cannot be received.

To obtain further enhancement to reception it is necessary to provide some amplification at radio frequencies, ahead of the detector. This type of arrangement is known as the Tuned Radio Frequency or T.R.F. receiver. Improved sensitivity can be obtained using this method but the addition of RF amplification also introduces new problems. As well as enhancing reception of weak stations, stronger

signals are also amplified and this often overloads the RF amplifier. An effect known as swamping often occurs whereby stronger signals to which the receiver is not intentionally tuned create unwanted interference. Also if only a single tuned circuit is used selectivity is poor.

Swamping can be reduced and selectivity improved by the use of additional tuned circuits and filtering at the aerial input and between stages of RF amplification. However, to provide a degree of selectivity suitable for use in crowded short wave bands using the T.R.F. principle, complicated tuning arrangements are often required.

Another, perhaps less obvious method that can be used to improve selectivity and provide improved sensitivity involves feeding some of the output from the RF amplifier back to the input in phase. Too much feedback results in oscillation, but at a point just before oscillation occurs selectivity becomes very sharp and the circuit provides a high degree of amplification at the frequency to which it is tuned. Using this arrangement, often known as the regenerative detector, it is possible to design relatively simple receivers that are capable of providing acceptable performance at low cost. The short wave receiver circuit described in this article uses the regenerative principle for exactly this reason.

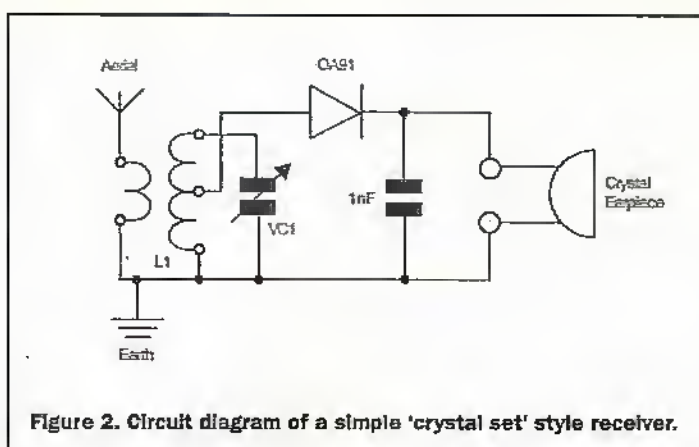


Figure 2. Circuit diagram of a simple 'crystal set' style receiver.

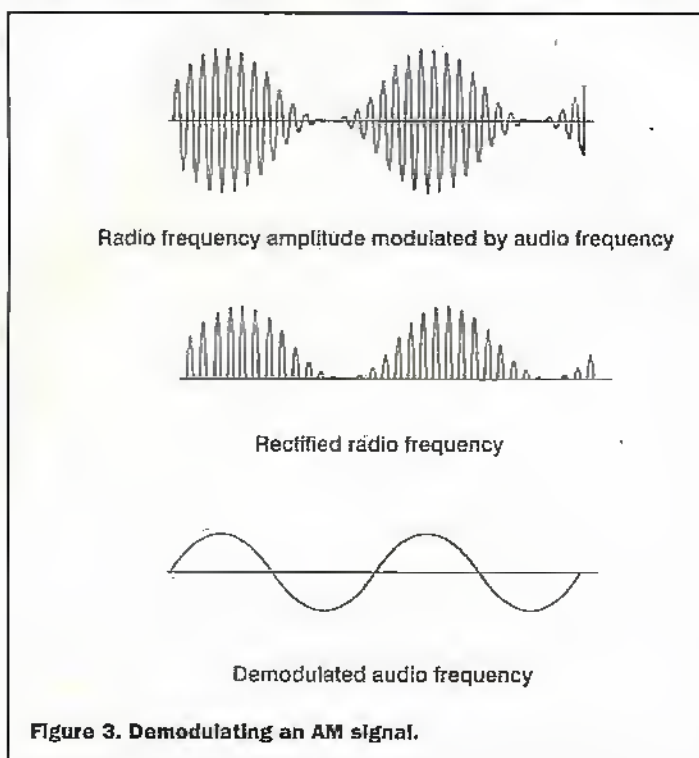


Figure 3. Demodulating an AM signal.

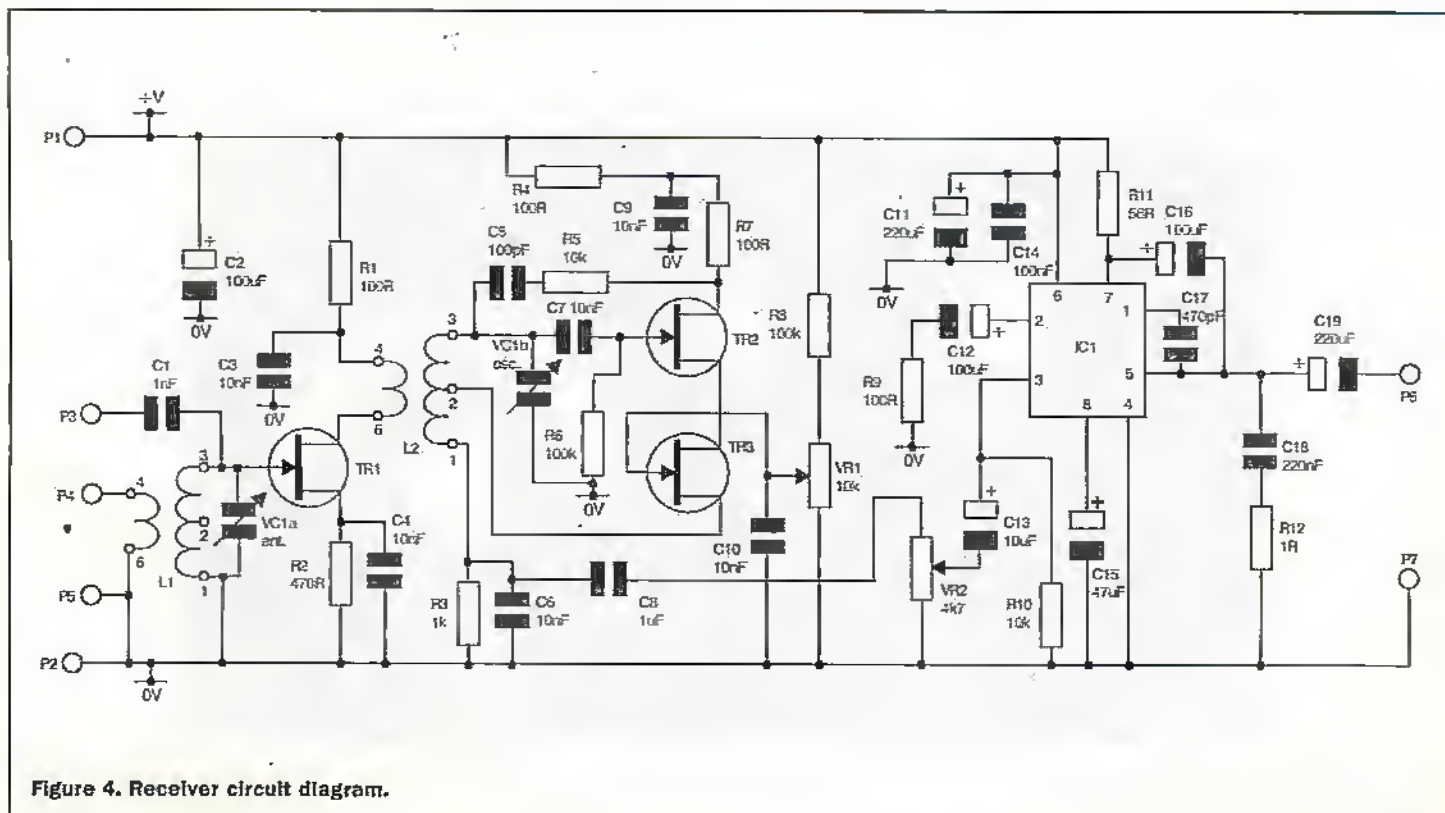
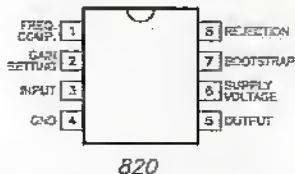
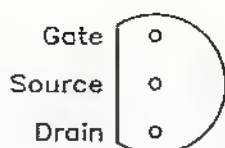


Figure 4. Receiver circuit diagram.

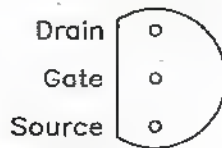


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Figure 5. Semiconductor pinouts.



TO92c



TO92d

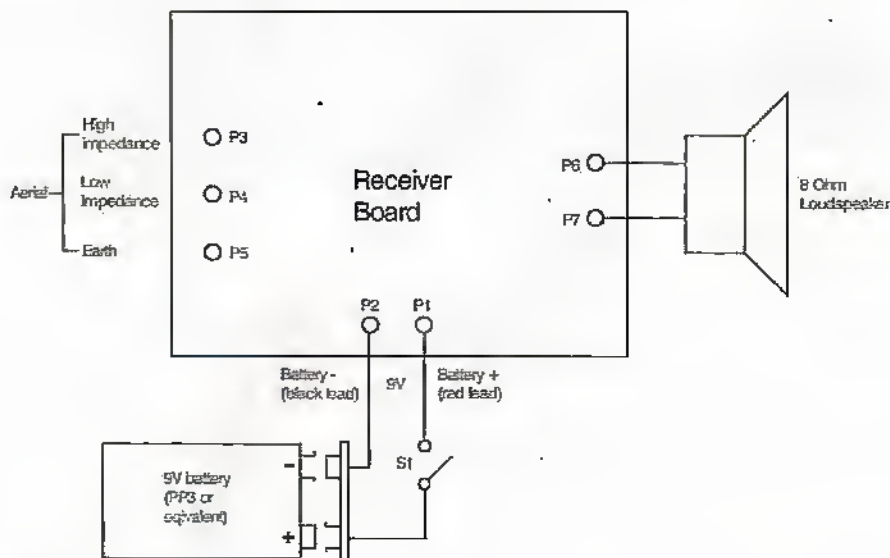


Figure 6. Wiring Diagram.

The Circuit

The circuit diagram of the receiver is shown in Figure 4. The RF section of the circuit is based around Field Effect Transistors, TR1 – TR3. Tuning can L1 together with VC1a provide tuning at the aerial input. VC1a and VC1b are actually different gangs of the

same capacitor but are shown separately for convenience. In reality, the earth connection is common to both gangs of the capacitor. Terminals P3 and P4 allow for different aerial impedances. TR1 acts an RF amplifier providing an additional boost to the incoming signal and helps to isolate the aerial from the

detector circuit. The output of the RF amplifier is coupled to the next stage via L2. The stage comprising TR2, TR3 and associated components provides further amplification and selectivity and also acts as the detector. This section of the circuit is fundamentally a high gain tuned amplifier or an oscillator depending on the

degree of positive feedback. Tuning is provided by L2 and VC1b. Capacitor C5 and resistor R5 provide negative feedback to the gate of TR2 to improve stability of operation over the tuning range. The degree of positive feedback is controlled by TR3 which is in turn controlled by feedback control VR1. R8 sets the maximum level of feedback. C6 has a low impedance at radio frequencies effectively providing a 0V return for L2; however, at DC and audio frequencies the impedance is high allowing a voltage to be developed across R3. Demodulated audio available at this point is fed to volume control VR2 via coupling capacitor C8. The wiper of VR2 is connected to the input of the AF amplifier stage comprising IC1 and associated components. The amplifier is based around the TBA820M IC which is capable of providing a good level of amplification without any further AF stages and will drive an 8Ω loudspeaker without difficulty. The output from the amplifier is coupled via C19.

Building the Circuit

The circuit can be built using matrix board preferably without strips. This may appear an unusual approach for a radio frequency circuit but for a simple design of this type does not generally present any problem as long as wiring runs are kept as short and direct as possible. Take some time to plan the board layout before commencing construction. It is best to run a separate set of



Figure 7. Example front panel label.

supply rails for IC1 joining at the power supply input. All capacitors should be kept as close to the relevant parts of the circuit as possible. Using short interconnections helps to avoid stray coupling which can lead to unwanted instability. Try to keep each stage separate where possible. VR1 and VR2 can be mounted through the circuit board. In order to fit tuning cans L1 and L2 it is necessary to drill additional holes in the board to cater for the centre tap pin. This is best carried out before mounting the other components. To simplify matters, place the tuning can in position on top of the board and mark the position for the required hole using a PCB marker.

As always, it is important to ensure that all polarised components are connected observing the correct polarity. This point cannot be overstressed and is particularly important with the electrolytic capacitors; these can explode violently if connected incorrectly. The polarity of the capacitors is indicated by a negative (-) symbol on the side of the component close to the negative lead. The negative lead is also usually the shortest. Semiconductors should be connected referring to the pinout diagram (Figure 5).

When construction of the board is complete, double check your work to make sure everything is connected correctly. Also check the soldering to ensure that there are no unwanted short circuits or dry joints.

Testing and Alignment

The circuit is designed to operate from a 9V (PP3) battery. If necessary a bench power supply can be used for testing purposes. If you are using a power supply, limit the current to around 300mA as this may help to minimise damage if there is a fault. Even when everything has been visually checked and appears to be OK it is always best to apply caution when first applying power to a circuit.

Figure 6 shows the wiring diagram. The terminal positions shown are arbitrary and do not necessarily reflect the actual board layout. The loudspeaker is connected between terminals P6 and P7. Almost any general purpose 8 ohm loudspeaker with a power rating in excess of 1 watt can be used. Lower power loudspeakers can be used by fitting a low value limiting resistor in series with the amplifier output. Apply

power to the circuit. The power supply or battery is connected between P1 (+V) and P2 (0V). In order to test and align the circuit a short length of hook-up wire may be connected to terminal P3 to form an aerial (a couple of metres should suffice). Reception will also be improved by use of an earth connection (more of this later). *Do not use the mains supply earth for this purpose.*

Set VR1 to minimum position and VR2 to maximum. Carefully adjust the core of L2 until it is level with the top of the metal can. At this point turn VC1 through its tuning range, listening for a signal. If nothing is heard, adjust the core of L1 and try again. Because the capacitance of each gang of VC1 is different, the position of the core of L1 will normally vary from that of L2. Keep trying until a signal is detected. This can take some time, especially during daylight hours when signals are often weaker. Once a signal is detected, adjust the core of L1 until the volume from the speaker is loudest. L1 is best adjusted with VC1 set to central position but final adjustments can be made at a later stage once you are sure everything is working. Whilst tuned to a signal, slowly increase the setting of VR1. The tuning should become more critical as the bandwidth narrows and the output from the loudspeaker should increase. Further adjustment of VR1 should result in distortion and a whistle from the speaker. At this point the detector is on the verge of oscillation. Slightly back off the setting of VR1 to provide optimum performance. Once set up, it should normally be possible to tune into a number of different stations by adjusting VC1.

Housing the Receiver

The receiver can be housed in a wide variety of different cases to suit individual needs. Either plastic or metal types are suitable. Care must be taken to insulate the circuit components and wiring from the case if a metal enclosure is used.

The case used for the prototype is stock code CC82D. A typical front panel label for use with this case is shown in Figure 7. The tuning dial calibration has been left blank as the actual tuning range will depend on the setting of L1 and L2. The dial can be calibrated by tuning into signals of known frequency: These may either be broadcast stations, standard frequency transmissions or if available the output from an RF signal generator connected to the aerial input. The aerial input socket is normally mounted on the back of the case. More than one socket may be used to allow for different types of connector or different input impedances. There are no hard and fast rules in this respect.

The circuit board may be fixed into the case by mounting VR1 and VR2 through the board and through the front panel of the case. If properly arranged, the potentiometer fixings are enough to hold the whole assembly in position. Alternatively the board may be mounted in the case using spacers providing a more secure fixing. The mounting bolts should be M2.5 countersink head types. It is best to mount as much into the front half of the case as possible as this simplifies removal of the rear cover when it is necessary to change the battery.

Variable capacitor VC1 can be mounted directly onto the front panel using countersink head bolts. Take care not to insert the mounting bolts too far into the capacitor housing as this may result in damage. Depending on the type of tuning knob used, it will probably be necessary to extend the shaft of VC1. Metal spacers of the appropriate size may be used for this purpose.

Using the Receiver

The receiver is a fairly open ended design and can be adapted to suit a variety of different situations. Using a length of wire as short as two or three metres and a good earth connection, it should be possible to receive a wide variety of stations. Even without an earth, some strong signals should be audible.

The advantage of a good earth system can be considerable. In the past, water pipes could be relied on to provide an earth connection but this is no longer the case with the advent of plastic pipes. Probably the best way to make an earth connection is to knock a length of copper pipe into the ground. Of course, the need to avoid areas where there are already pipes or cables in the ground goes without saying. The earth connection should be made with the heaviest gauge wire available. If it is not possible to make an earth connection, try using a longer or different type of aerial. Dipoles can be used, particularly at higher frequencies.

If you wish to experiment with a more effective aerial system, a random length of wire 20 or 30 metres long will normally improve incoming

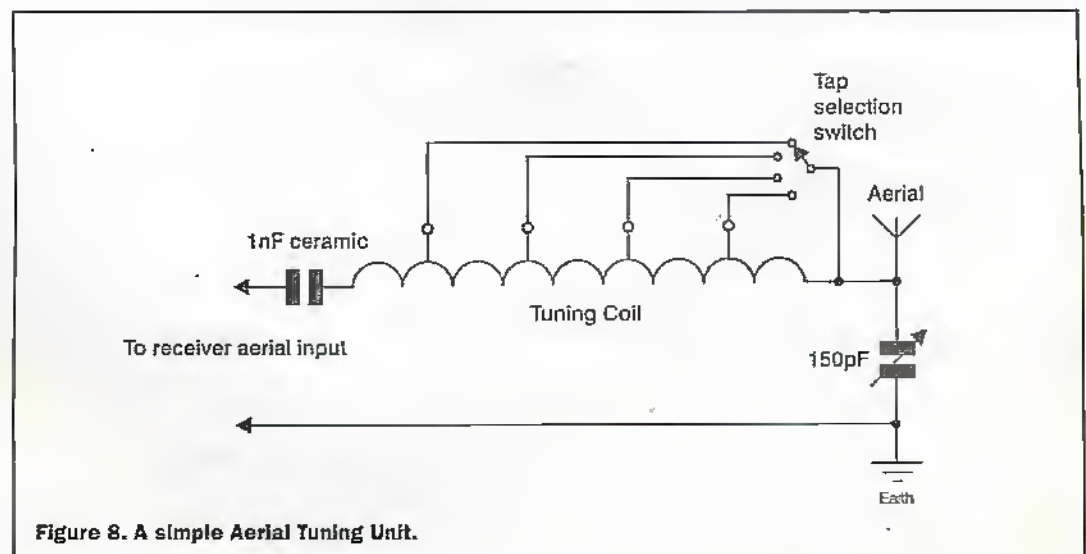


Figure 8. A simple Aerial Tuning Unit.

signal strength enormously. A simple tuning unit can be used to match the impedance of the aerial to that of the receiver. An example is shown in Figure 8. The tuning coil may be produced by winding 40 turns of bare copper wire onto a suitable plastic former. A piece of plastic drainpipe is generally suitable. Take care to leave enough space between consecutive windings to avoid short circuits. The coil is tapped at various points for use at different frequencies. The most effective position for the taps is best determined by trial and error. If required a crocodile clip lead may be used in place of the switch allowing connection to be made to any part of the coil. When set up correctly, it should be possible to obtain a peak in signal strength as the tuning unit variable capacitor is

adjusted across its range. The circuit shown is about as simple as they come and is therefore not ideal in all situations. There are a whole host of designs for tuning units to suit different situations. Readers interested in experimenting further are referred to the Books section of the Maplin catalogue, Maplin also stock ready made tuning units.

One drawback with connecting a large aerial system to the receiver is that overload may occur resulting in the strongest signals being continuously audible independent of tuning position. As mentioned earlier, this is a drawback of simple receivers (and some more expensive ones). Therefore, paradoxically it is often necessary to provide attenuation at the aerial input simply because your aerial system is too good!

Alternative Power Supplies


The circuit will operate from a 9V battery and this has been chosen as the simplest option. However, if the receiver is in use for extended periods or at high volume levels, the battery may become discharged quite quickly. It is therefore advantageous to run the unit from a power supply. The supply should be regulated and must have an output voltage of 9V – 12V DC (300mA). It is recommended that a suitable fuse is fitted in series with the positive power supply line if the power supply is not current limited.

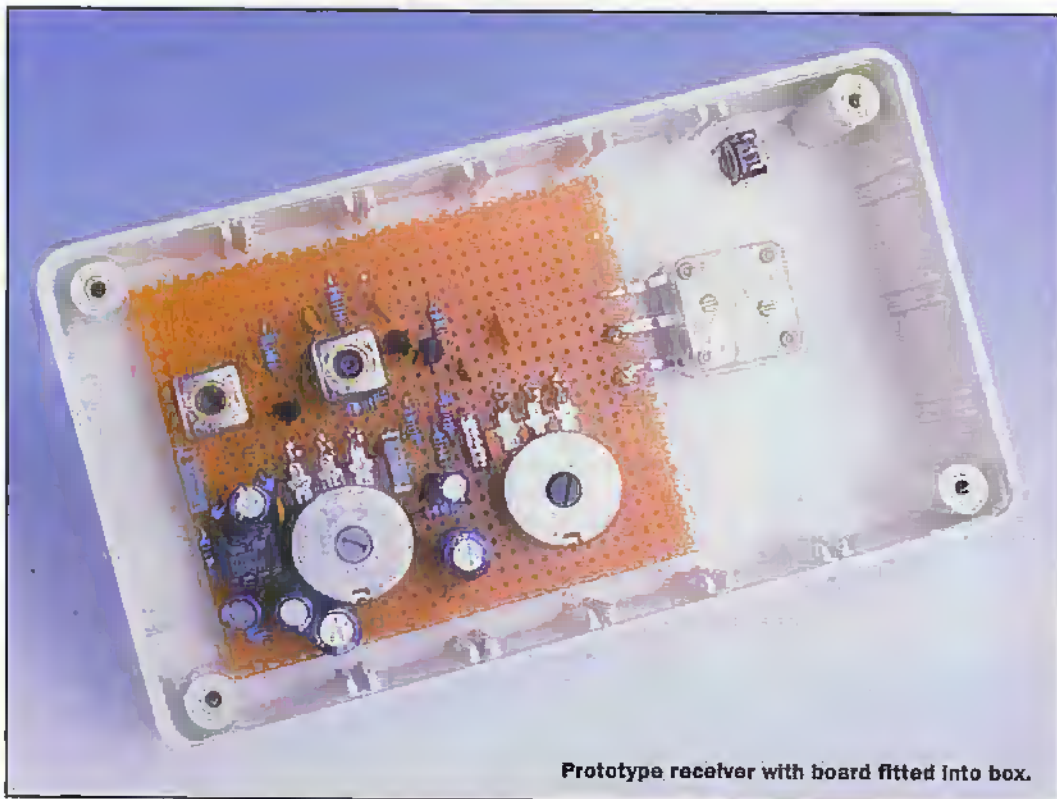
Tuning Range

The range of frequencies to which the receiver will tune is determined mostly by the

setting of L2. Using the tuning can specified it should be possible to tune from around 6MHz to upwards of 16MHz taking in several of the shortwave broadcast bands. The tuning range can be modified if required by connecting small capacitors in parallel with VC1. The entire tuning range can be completely changed by fitting a different type of tuning can. For example, by changing L1 and L2 to a KANK333R type (Maplin stock code FD02C) it should be possible to cover the lower HF range. Some modification to other component values may be required. An additional lower value variable capacitor can also be fitted in parallel with VC1b to provide fine tuning control if necessary.

Other Ideas

The receiver has been designed to provide basic reception of short wave broadcast stations and should provide a good starting point for anyone building a radio receiver for the first time. As a result the circuit design has been kept relatively simple and the performance reflects this. Readers interested in experimenting with radio circuits may like to modify the design to provide enhanced performance. The circuit may then be suitable for receiving weaker, more narrow band signals such as those from amateur radio stations. For example, the tuning range could be narrowed to cover a much narrower frequency range, giving better bandspread. A vernier dial may be fitted such as stock code RX41U. Steps can be taken to improve the stability of the tuning network and to provide additional front end filtering. The list is almost endless. 



Prototype receiver with board fitted into box.

PROJECT PARTS LIST

RESISTORS

R1, 4, 7, 9	100R	4	M100R
R2	470R	1	M470R
R3	1k	1	M1K
R5, 10	10k	2	M10K
R6, 8	100k	2	M100K
R11	56R	1	56R
R12	1R	1	M1R
VR1	Pot lin 10k	1	FW02C
VR2	Pot log 4k7	1	FW21X

CAPACITORS

C1	Ceramic 1000pF	1	WX68Y
C2, 12, 16	GenElect 100µF 16V	3	AT40T
C3, 4, 6, 7, 9, 10	Ceramic 10nF	6	WX77J
C5	1% Polystyrene 100pF	1	BX46A

C8	Poly Layer 1µF	1	WW53H
C11, 19	GenElect 220µF 16V	2	AT41U
C13	GenElect 10µF 63V	1	AT77J
C14	MiniDisc 0.1µF 16V	1	YR75S
C15	GenElect 47µF 16V	1	AT39N
C17	Ceramic 470pF	1	WX64U
C18	Poly Layer 0.22µF	1	WW45Y
VC1	Min AM Tuner Cap	1	FT78K

SEMICONDUCTORS

TR1	MPF102	1	QH59P
TR2, 3	2N3819	2	QR36P
IC1	TB820M	1	WQ63T

MISCELLANEOUS

L1, 2	KANK3334R	1	FD03D
P1-7	DIL Socket 8 pin	2	BL17T
	Pin 2145	7 pins	FL24B

Photo 1. Pure water for drinking provided by an Oxfam funded deep well, Shinyanga, Tanzania (Courtesy Crispin Hughes/Oxfam)



Making the DESERT BLOOM

Douglas Clarkson looks at the technology involved in watering desert areas.

Introduction

An awareness of possible global climate change is prompting scrutiny of the world's water resources and also of technologies for using water efficiently. In the developed world, where water supplies have traditionally been taken very much for granted, there is not the same urgency to

strive to conserve and secure supplies of water. However, in many developing countries the primary challenge is very often to secure adequate supplies of water. This is also leading to heightened international tension, such as between the countries of the Middle East where common water resources are shared by a

range of countries – often with divergent political agenda.

This general concern for water resources has been expanded to include aspects of water quality: where water may be present but is increasingly polluted as a result of over extraction and agricultural and industrial activity. The concern over pollution of water resources, however, is not restricted to the developing world. The over use of nitrates in agriculture and the run off into ground water is giving cause for concern regarding aquifer water resources. Landfill sites are known to release a cocktail of harmful chemical agents including heavy metals into ground water systems as also do abandoned mine workings. Thus especially in the UK where landfill is still commonplace, there is little room for complacency.

The Resource

Table 1 indicates the relative distribution of water on planet earth.

Source	Percentage Distribution
Oceans	97.23
Ice Caps and Glaciers	2.14
Ground water	0.61
Freshwater Lakes	0.01
Other	0.01

Table 1. Relative distribution of water on the earth

Although there is abundant water on the planet, its nature and distribution does not often match the needs of a large and expanding human population. Often, it is difficult in areas to determine the true extent of ground water resources and to assess the amount of water that can be sustainably removed from them.

Increasing Water Dependence

The rapid expansion of irrigation during the 20th century has made world agriculture highly dependent for its yields on the use of irrigation. By the middle of the 1980's, it was estimated that 20% of all cultivated lands were irrigated and that this in turn contributes towards 40% of world food production. Looked at in this context, the world's food production is highly and increasingly dependent on supplies of water for irrigation. Figure 1 summarises this trend. What is more difficult to determine, however, is the level of productivity of irrigated land.

Balancing Technology

There is the temptation, to apply completely new modern technology to irrigation schemes and agriculture in general. Such an approach would include the use of large dams, pumping stations, automatic watering systems etc. Many such large schemes, however, have created severe social and environmental problems arising out of changes in the balance of ecological systems which have not been anticipated. Also the scale of such developments can be very much out of balance with the life styles and sustainable ecology of many regions. Thus large bodies of irrigation water especially in Africa have become host to mosquitoes and a wide range of parasites. The Aswan dam in Egypt

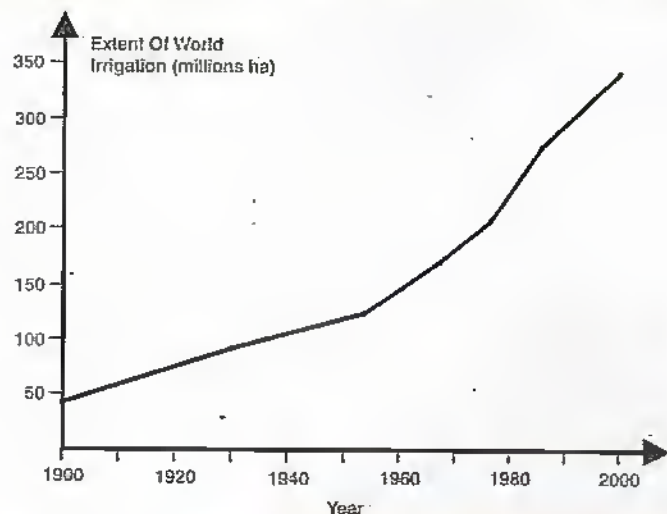


Figure 1. Increase with time in irrigated land for food production. The true rate of growth since 1985, however, is disputed by various observers.

is the subject of massive evaporation losses which effectively severely deprive agricultural land of water in the delta region. In particular some major schemes funded by the European Community in Africa have been little short of disastrous.

It is worth remembering, that irrigation systems have been in place since the dawn of civilisation – 5500 BC in Iran, at least 3300 BC in Egypt and 1200 BC in Peru as a small set of examples. The particular interest in many of these developments is that these represented essentially sustainable systems. In particular, it is worth mentioning the qanat as indicated in Figure 2. Qanats are channels which are engineered to draw from water supplies below the water table and transfer it to settlements often tens of kilometres from the point of initial supply.

They are essentially stone built conduits below ground that transfer water over long distances using gentle gravitational inclines. The benefit of such systems include the fact that they are essentially sustainable from ground water supplies and essentially require additional energy input to operate. Their construction, however, requires a large degree of social organisation and the evidence is that systems for a variety of reasons are falling into disuse. In 1961, for example, it was estimated that there were over 40,000 qanat systems in Iran but by 1984, only around half remained in use. This aspect of existing complexity of irrigation infrastructure in desert areas around the world is not widely appreciated.

Traditional systems of agriculture particularly in Africa can be surprisingly well adapted for sustainability. The practice, for example, in marking off small sections of cultivated land with low stone walls serves to reduce rain run off and increase the area of water actually absorbed by the soil. This can be critical in tipping the soil hydrology into sustainable use of aquifers or reverting to desert conditions.

Often improvements in agriculture and water use can be brought about by reviving ancestral knowledge that has been recently eclipsed by 'trendy' science and colonial introductions. This is the experience of the inhabitants of the Masvingo province of Southern Zimbabwe working within schemes supported by Oxfam. By restoring traditional drought resistant crops such as sorghum, planting water conserving trees to protect the soil and raised borders to make

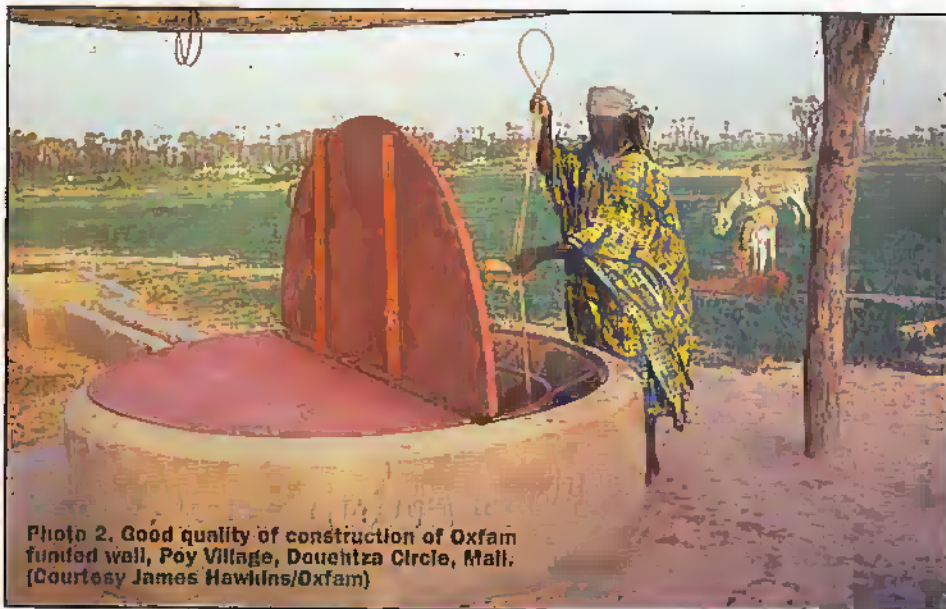


Photo 2. Good quality of construction of Oxfam funded well, Poy Village, Doughtza Circle, Mali. (Courtesy James Hawkins/Oxfam)

maximum use of precious water, trends towards the collapse of agriculture due to arid conditions have been reversed. Typically these schemes are more successful than grander schemes in which the people living on the ground have little interest.

Groups such as Intermediate Technology provide a wide range of technical publications covering a broad spectrum of topics relative to the developing world – including in particular water resources and related issues in agriculture.

Irrigation Practices

The principal types of irrigation include surface irrigation, aerial irrigation, sub surface irrigation and trickle irrigation. One of the key parameters to determine efficiency of irrigation systems is the so called water efficiency level which is basically the amount taken up by the crop in proportion to the amount applied to the ground. Where water is a scarce commodity, all systems of irrigation will seek to optimise water efficiency. Underground irrigation systems provide the greatest efficiency, as surface evaporation is minimised.

Such installations, however, are the most expensive to implement. It is very much the case that irrigation methods should be appropriate for the task in hand. Often in the developing world there is only

significant investment for cash crops grown for export while basic staple foodstuffs receive much less in the way of investment for land management and irrigation.

Measuring Soil Moisture

Often studies in hydrology to assess changing soil conditions require extensive studies of soil moisture. Appropriate measurement systems use a range of technologies. While there is always a requirement to undertake survey work using such systems, they are increasingly used to provide on line information for optimisation of irrigation systems. One basic but destructive technique is simply to collect a sample of soil and then weigh it before and after drying to determine its water content. This technique serves as a useful means of providing an absolute calibration of other measuring techniques.

A widely used technique is that of electrical resistance. Where significant levels of salinisation (salt deposition) occur soil resistance is lower. Excesses of temperature can also affect the accuracy of measurements. Another system, developed by the Institute of Hydrology in the UK, uses soil capacitance as a measurement parameter.

Remote sensing by satellite is also used especially in isolated locations with sparse vegetation cover. This can provide estimations of soil condition over areas of thousands of square kilometres and give advance warning of crop failures and impending famine. The principle employed relates to the reduced reflectance to visible and infra red radiation from wet soils and also with a dependence on the dielectric constant of the soil as a function of moisture content and texture.

Environmental Hazards of Irrigation

There has always been problems with artificial irrigation systems. One danger is that of water logging where excess water builds up in the water table which proceeds to rise to the surface of the soil so that plant root systems receive too much water. Also, this effect is coupled with salination where salt water content in the ground water is

affected by climatic conditions and results in dissolved salts being left behind in the top layer of the soil.

With dissolved salt levels less than 500 parts per million, no significant problems are normally encountered. Between 500 and 1000 ppm concentration, crops such as peas, potatoes, cabbage etc begin to become affected, while for levels between 2000 and 5000 only salt tolerant crops such as cotton and sugar beet can survive. One result of the process of salinisation is to make the soil hard and impermeable and consequently difficult for plant growth.

Often the process of salinisation takes place in coastal areas where over-recovery of ground water leads to infiltration of sea water. This arises from the extraction of non-sustainable levels of water – chiefly for agricultural use.

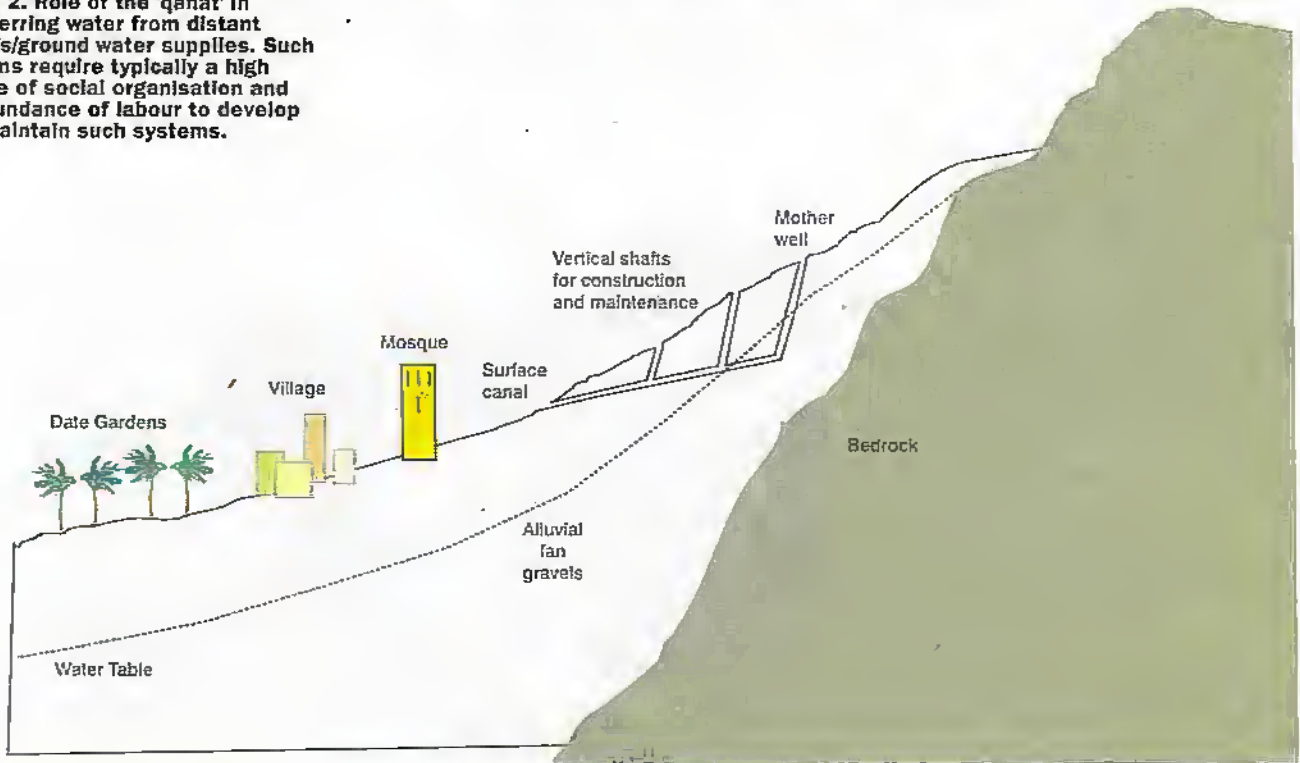
The basic problem of raising of the water table can be avoided by preventing excessive leakage from surface drainage channels. This can, for example, be implemented by lining channels with impervious materials, but this requires some degree of commitment and training by farmers. Where salinisation has occurred, remedies can be provided by lowering the water table and then flushing the soil with sufficient amounts of water to remove dissolved salts. Problems caused by years of prolonged soil abuse, however, often take several years to fully recover.

Worldwide an area five times the size of Spain is irrigated. Up to half of this land is thought to be affected by water logging and salinisation. In the Sindh province of Pakistan, for example, large areas of previously productive land have been transformed into a 'white desert'. Early colonial irrigation schemes, used to grow cotton, sugar beet, tobacco and fruit, were essentially unlined, and now poor maintenance as resulted in large volumes of water leaking into the water table which has since risen in many areas to the very surface of the land –



Photo 3. Installing locally made clay irrigation channel pipes as part of an irrigation system to minimise surface evaporation. (Courtesy Intermediate Technology)

Figure 2. Role of the 'qanat' in transferring water from distant springs/ground water supplies. Such systems require typically a high degree of social organisation and an abundance of labour to develop and maintain such systems.



creating areas of soggy marshland where nothing can grow. Excessive flooding which took place in 1992 made the waterlogging problem even worse. As part of its agricultural advice service, Oxfam is promoting the planting of Eucalyptus trees to assist in lowering the water table by the process of transpiration. A series of Eucalyptus nurseries are being established to provide a means of recovering 'lost' agricultural land.

Desalination – The water resource of the future?

Desalination is the process whereby pure water is separated from saline solution – brackish water or sea water. The World Health Organisation standard for the maximum level of dissolved solids in water is 500 parts per million with sea water, for instance, containing typically concentrations of 35,000 parts per million. Some water supplies in arid zones, however, can contain levels in excess of 1000 parts per million.

In response to growing demand for pure water, the total world capacity for desalination shows a rapid increase as indicated in table 2.

Year	1968	1977	1985
Total	1113	3708	6812

Table 2. Total global world desalination capacity in units of 1000 cubic metres per day.

The earliest modern distillation systems utilised boiling sea water and condensing vapour, with one of the first systems being constructed in Aden in 1895. There are around 8000 desalination plants worldwide, with around 60% in the middle east. The largest plant in the world produces 128

MGD (million gallons per day) in Saudi Arabia. One of the developing technologies related to distillation processes is that of Multiple Stage Flash where the saturated pressure of system is reduced to facilitate the evaporation cycle.

The technology of membranes, however, is becoming increasingly popular. While attempts to develop this technology are over 100 years old, reference to using membranes for this process date back into ancient history including in particular that of the Chinese period. There is little new under the sun! The mechanism of membrane technology utilised is that of reverse osmosis, where water is forced under high pressure across a membrane surface that prevents the passage of ions of dissolved salts as indicated in Figure 3. For medium salt concentration levels pressures used are around 20 bar (atmospheres) while for sea water the pressure is typically as high as 40 bar are required. Pumping at this high pressure is an energy intensive process.

The technology of using membranes effectively, however, relates to their proper management by chemical conditioning. Chemical agents are required to decontaminate membranes which have absorbed fine suspension particulate material that pre-treatment filter sections have not been able to remove. Chemical agents may also be required to prevent microbiological contamination within the filter system and also to prevent corrosion in connecting pipe work. This requires care in the development and use of such chemical.

One of the key aspects of any such process, is that of the comparative energy costs of various processes. Table 3 indicates typical values for a range of desalination techniques.

Process	Requirement (energy kWh/m ³ of pure water)
Flash distillation	37.0
Vapour compression	24.0
Electrodialysis	10.5
Reverse Osmosis	5.2

Table 3. Typical relative energy requirements of various desalination processes.

With technical developments during the 60's and 70's, reverse osmosis has become the major process compared with distillation methods. While the energy costs provide an indication of operating scenarios, reverse osmosis membranes have to be renewed at regular intervals and, in general, carefully monitored, so this can be a major additional cost of the process.

Desalination should not be seen as the mechanism that could necessarily in the short term play a major role in food production. While each tonne of industrial product requires in the region of between 200 and 500 tonnes of water for production, as much as 10 times this is required for agriculture. (It takes around 450,000 litres of water to produce an average family car.) Thus agricultural production relies heavily on sources of cheap water supply typically of a lower quality than used for industrial and municipal use. However, some desalination systems in Guernsey, have been developed to supply water for special high value crops such as tomatoes and lettuce.

Many island communities are highly dependent on desalination systems – especially in the Caribbean. For islands with very limited water supplies, desalination is often significantly cheaper than supplies shipped in by tanker. In Singapore, mobile systems have been fitted onto barges to travel around the coast to provide supplies to local communities.

Distillation processes can be especially appropriate where low grade heat is present as part of industrial processes or from power stations. Such energy can usually be effectively used in multiple flash distillation processes where water is evaporated in stages of decreasing vapour pressure.

True costs in relation to desalination processes are often difficult to determine – due perhaps to the various methods and approaches of calculating such costs. Industry experts point to a cost in the range US\$2.7 – 10.9 per m³ before 1978 to US\$1.7 – 2.4 per m³ afterwards. The significant lowering of cost is associated with the introduction of reverse osmosis technology.

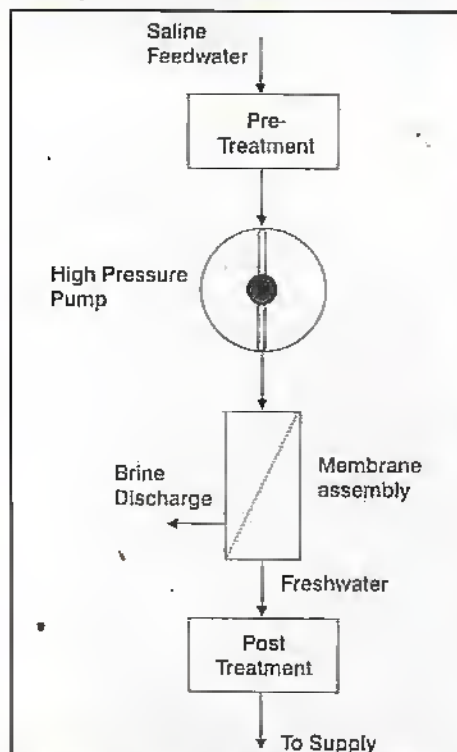


Figure 3. Process of reverse osmosis desalination. The initial sea intake is filtered to avoid particle contamination and pressures of around 40 bar (atmospheres) are required to drive the process.

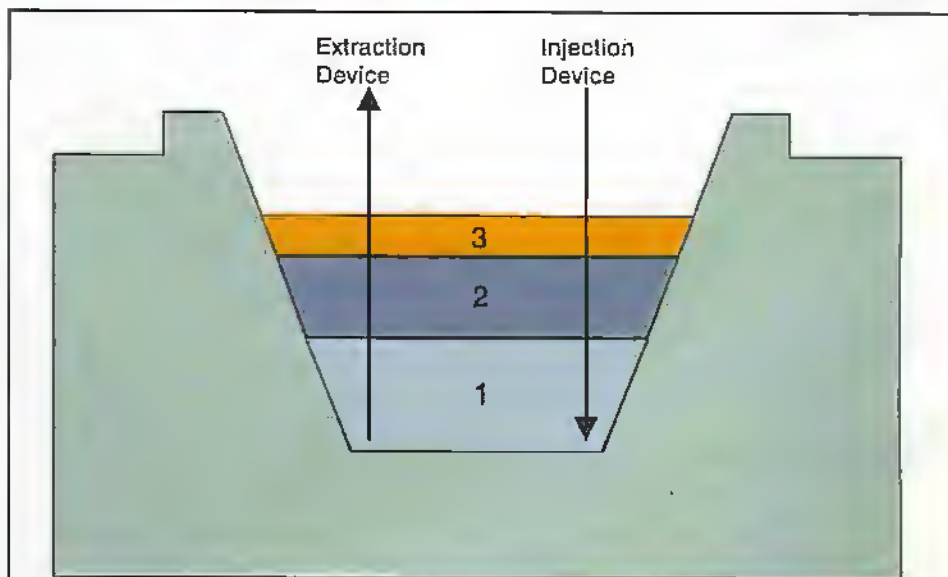


Figure 4. Detail of structure of a solar pond. Initially a non-uniform salination gradient is established to discourage heat re-distribution due to convection. Energy is then removed from the lowest layer which can reach temperatures around 85°C in typical desert conditions.



Photo 4. Applying water to irrigation channels indicated in photo 3. (Courtesy Intermediate Technology)

Solar Ponds

One of the technologies being investigated as an energy source for desalination and related processes in desert areas is that of the solar pond as indicated in Figure 4. In order to collect the equivalent of energy of a single barrel of oil, a thermal collector around 500 square metres will be required – assuming 50% efficiency in collection. Using conventional thermal collection systems this would be associated with large investment costs.

The solar pond is a cheaper way of achieving this. In the solar pond three distinct layers can be identified. The top layer is usually at a temperature close to that of the air, an intermediate zone is at intermediate temperatures while the lowest zone in conditions of high solar radiation can reach temperatures of around 85°C. An increase in level of salt content in the water with depth is established which prevents normal convection processes equalising heat within the solar pond.

Special injection and extraction devices can effectively remove heat from the lower hot layers of brine. The salinity gradient is maintained by adding water of high salt content to the lower layer while flushing the pond surface with sea water.

Experimental ponds have already been built up to areas of 6000 square metres. In

particular, Atlantis Water Desalination Systems of Berne, Switzerland have made extensive studies of the ergonomics of such systems – in the process operating a solar pond in Switzerland for over nine years. This is an excellent example of the application of science to develop a sustainable energy resource – and one achieved with significant government funding.

Water from Wind

One encouraging development within the wind turbine industry has been to use wind energy to power desalination systems. The German company Tacke Windtechnik, in association with desalination specialist Thyssen Stahlunion, has successfully demonstrated in 1995 a vapour compression desalination facility powered by a 60kW rated windmill on the island of Borkum in the North Sea. Studies of variable power loading of such wind turbines indicated that vapour compression systems would be more efficiently interfaced to wind turbines compared to reverse osmosis systems which prefer a high degree of uniformity of flow. The schematic of the prototype vapour compression system is indicated in Figure 5.

Details relating to the system are outlined in table 4.

Parameter	Value
Maximum power (windturbine)	60kW
Distillate flow	0.3 to 2m ³ /h
feedwater flow	0.6 to 4m ³ /h
power intake of compressor	4-32kW
power of heat coils	0-30kW
rotor diameter	12.5m

Table 4. Parameters of prototype TW60 and vapour compression desalination system.

Subsequently a larger plant has been installed on the Baltic island of Rugen, near the Polish border using a 300kW rated turbine.

California Drinking

Problems of increased population growth and a prolonged dry spell in California have prompted a series of desalination plants to be constructed for the Californian coast. About 50 MGD (million gallons per day) of capacity is being proposed which is a significant expansion relative to existing levels. Already the Marina Coast Water District in California is in the process of commissioning a 300,000 gallon per day reverse osmosis plant that will produce about 13% of the district's water supply.

The building of desalination plants, however, in today's increasingly environmentally conscious world, requires considerable levels of planning. Aspects considered include air quality, impacts on ground water extraction (saltwater intrusion), marine resource impacts from feed water intake and ocean discharge, energy efficiency and, last but not least, delivered water quality. Most systems are planning to utilise reverse osmosis technology due primarily to the attractive energy efficiency of such a process.

Emergency Water?

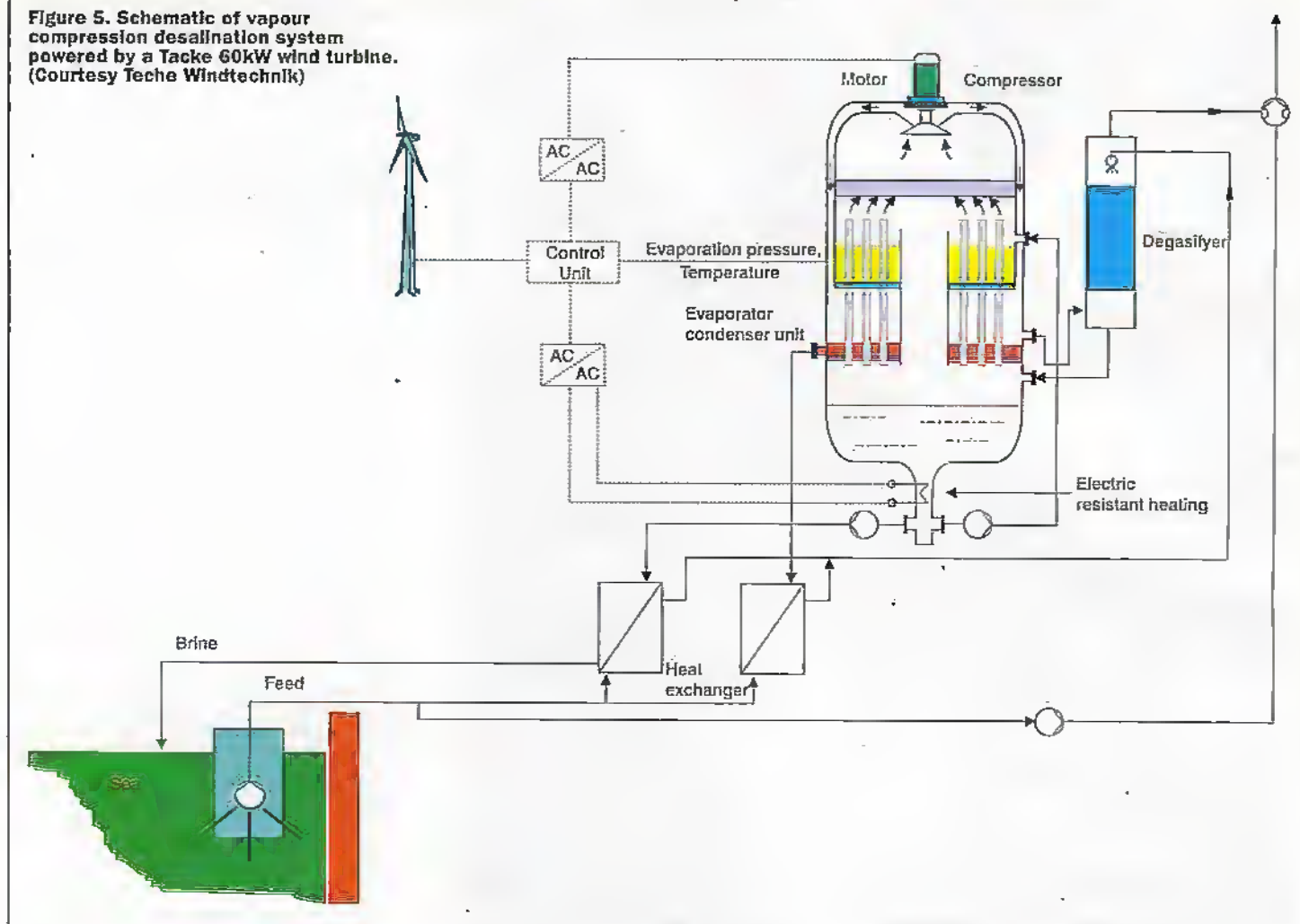
In order to produce drinkable water from sea water all that is required are a pump to establish a pressure of around 40 bar (atmospheres) and a suitable reverse osmosis filter. There is surely scope, if this has not already been done, to develop a small manually driven pump unit that can undertake just such a task, but with a capacity of only litres per day. Such a device could, for example, be a standard issue item for survival packs in life rafts and life boats etc.

Operation 'Desert-Bloom'

While the obvious approach to water resources would appear to be keep finding and using more and more water, the other option of reducing evaporation losses in the soil would appear at first sight not to have not been significantly investigated. The product 'Desert-Bloom', developed by Hydro-Soil International in the USA, would certainly appear to warrant closer scrutiny. The product was originally discovered in the 1970's, though its inventor did not then assign any commercial value to it. Since 1989 the product has been marketed by Hydro Soil. Its action the product binds to the silicate in the soil in its top 2 to 3 inches. Its action is to allow percolation of water down into the ground but reduce transpiration from the soil surface. Once introduced into the soil it appears to regenerate its activity and is not washed out of the soil by rainfall.

Its action reduces the requirement for

Figure 5. Schematic of vapour compression desalination system powered by a Tacke 60KW wind turbine. (Courtesy Teche Windtechnik)



water by increasing the overall efficiency of water uptake by the plants. It is also anticipated that such compounds could help with reducing the processes of salinisation of soil. To date applications include mainstream agriculture, domestic use, golf course watering etc. Products such as 'Desert Bloom' could therefore have a significant impact on improving water efficiency in agriculture generally.

Water on Chips

Aspects of water purity are central to the production of semiconductor chips. The various stages of etching and rinsing of silicon wafers, for example, depends on absolute purity of water supplies used. Minute sub micron specks of dust would completely ruin etch patterns and even ions in solution have the potential to degrade semiconductor gate properties. This

requires the preparation perhaps of the purest water on the planet which is undertaken using stages of ultrafiltration followed by special stages of reverse osmosis ion removing filters.

Indeed the growth of the semiconductor industry has accelerated advances in reverse osmosis filtering in order to improve the efficiency of such filters. Also the awareness of the intrinsic value of water has led to greater efforts to recycle water used in such semiconductor production processes and in the process reduce environmental contamination.

Water Recycling: Waste-not-want-not

As soon as a price is placed on water - all water becomes an economic commodity. In particular, waste water from industrial and domestic use is being increasingly utilised for agricultural use. The AVICENNE programme, headed by Belgium's Facilité des Sciences Agronomiques de Gembloux (FSAGx) is reviewing the use of recycled water for agricultural use. To date, however, standards of water treatment for this application vary significantly within Europe, with France (and Israel) having to date specific provision for waste water recycling. Apart from the obvious anxiety of bacterial and viral contamination of such waste water products, the heavy metal content of such supplies is a major source of anxiety - in particular of Chromium and Cadmium.

The project investigated the use of high yield algal channels (HYAC) for essentially

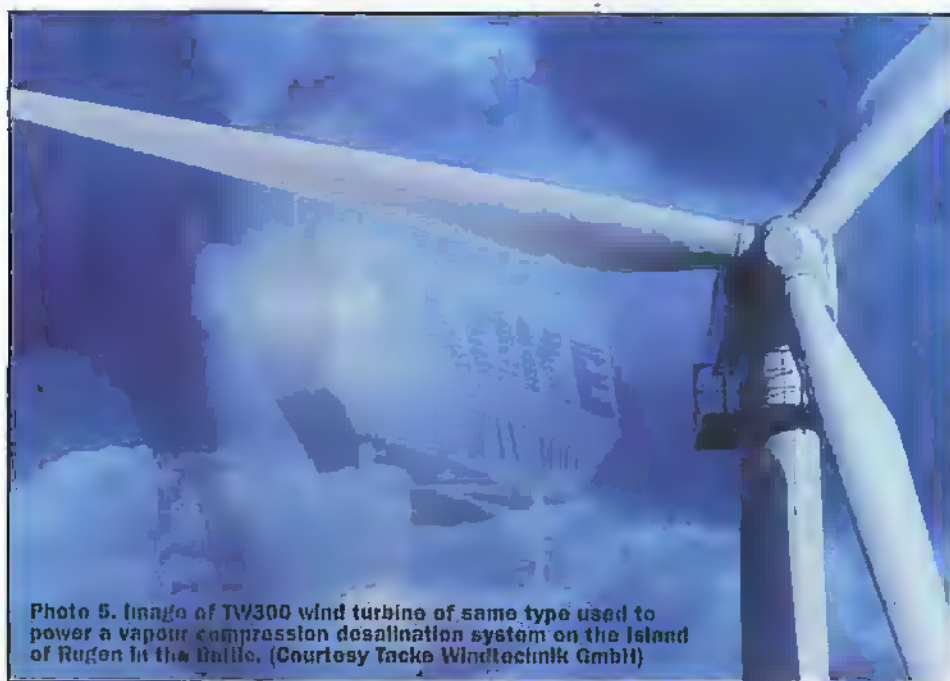


Photo 5. Image of TW300 wind turbine of same type used to power a vapour compression desalination system on the Island of Rugon in the Balearic. (Courtesy Tacke Windtechnik GmbH)

Photo 6. Irrigation Channel, Cusco, Peru.
(Courtesy Intermediate Technology)



algal growth to take up the heavy metal impurities. While this was seen as a desirable process, in Belgium it would be cheaper not to treat the effluent and pay a fine instead on the volumes of water not adequately treated. This indicates the better need for a regulatory framework within the European Community to control the recycling of sewage water.

The technique of 'epuvalisation', also researched by FSAGx in Belgium and other European groups, relates to the use of treatment of water waste by hydroponics – ie plants grown without soil. Using channels 50 metres long, plants such as tomatoes, cress and celery were able to treat water to a high level of purity – rendering it useable for irrigation for a variety of crops, bathing and consumption by animals. This is seen as essential in semi arid areas where the luxury of an automated sewage works cannot be afforded. European teams in Belgium and Portugal are developing systems for use in Morocco and Senegal.

Crop products grown on the hydroponic system contain high levels of heavy metals, and such products cannot be eaten by humans or animals or used to make compost for edible plants. Education, therefore, into correct management of such systems is a critical factor in their safe use. Such a technology can be seen as essential as a low tech, low energy but sustainable mechanism for improving the water quality for a range of applications – but excluding drinking water.

As supermarket shelves begin to increasingly become filled with produce

from far away exotic places, this may prompt better food safety monitoring of produce – not only to monitor residual levels of pesticide but also levels of heavy metals which may or may not be present as a result of use of irrigation water of dubious quality:

Artificial Rain

While in recent years the above average rainfall has perplexed the UK public, but pleased endlessly the water supply companies, in southern Italy there is serious alarm at changing weather patterns. With a predicted increase of 1°C in temperature by 2001, compared with the period 1951 to 1980 and associated with a fall by 20% in rainfall over the same period, researchers as part of the PIOGGIA project have been investigating the practicality of increasing rainfall by means of artificially generating condensation nuclei. As part of confirmation of predictions, rainfall in some southern provinces of Italy has already fallen by 30% by 1995 and in excess of this figure in Sicily and Sardinia.

This research, closely modeled on the Israeli model, uses silver iodide dissolved in acetone sprayed from under the wings of a light aircraft – forming a large number of minute crystals in the atmosphere that behave as ice crystals in the process of initiating rainfall. The results of initial studies indicates that as much as a 35% increase in rainfall is possible in specific areas – though in other areas, due to wind patterns and land/sea topography, the effects have not been evident.

The Institute of Hydrology

The Institute of Hydrology, based at Wallingford near Oxford, is one of four institutions that form the Centre for Ecology and Hydrology. The institute employs around 150 scientists and investigates the effects of land use – climate, topography and geology on the volume and character of surface water resources. Detailed climate modelling studies are currently in place for assessment of impact of Amazon basin deforestation on local and regional weather patterns, the possible effects on climate in case of loss of significant areas of permafrost in the arctic and how global warming could affect the Sahel region in sub-Saharan Africa. The work of the Institute is wide and varied and represents a centre of excellence in the UK within this increasingly important area.

Conclusion

Water is a very basic and necessary commodity and one which it is believed will become of increasingly significance on the world stage. This represents therefore one of the greatest challenges of the 21st century in terms of the management of existing resources and the sustainable development of additional supplies. In terms of technology, it is a problem waiting for a solution rather than a solution looking for a problem. There would appear, in particular, significant potential for further developing desalination technology to provide significant additional supplies of water using sustainable energy resources of wind, wave and solar power. These should be recognised as the emergent 'green technologies' of the 21st century and indeed technologies which have the potential for providing employment in the future.

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Notch Filters for INTERFERENCE REDUCTION

Joseph J. Carr explains the problem and a cure.

filter is a measure of the narrowness of the bandwidth, and is specified by the 'Q' of the filter. The Q is defined as the ratio of the center frequency (F_c) to bandwidth (BW):

$$Q = F_c/BW$$

For example, a notch filter that is centered on 50Hz, and has -6dB points are 48 and 52Hz (4Hz bandwidth) has a Q of $50/4$ or 12.5.

The notch filter does not remove the entire offending signal, but rather suppresses it by a large amount (Figure 2). The notch depth (see again Figure 1) defines the degree of suppression, and is defined by the ratio of the gain of the circuit at an out-of-notch frequency (e.g. F_a) to the gain at the notch frequency. Notch depths of -30 to -50 are relatively easily obtained, and deeper notches (e.g. -60 dB) are possible. Assuming equal input signal levels at both frequencies (which has to be checked, most signal generators have variable output levels with changes of frequency!), the notch depth can be calculated from

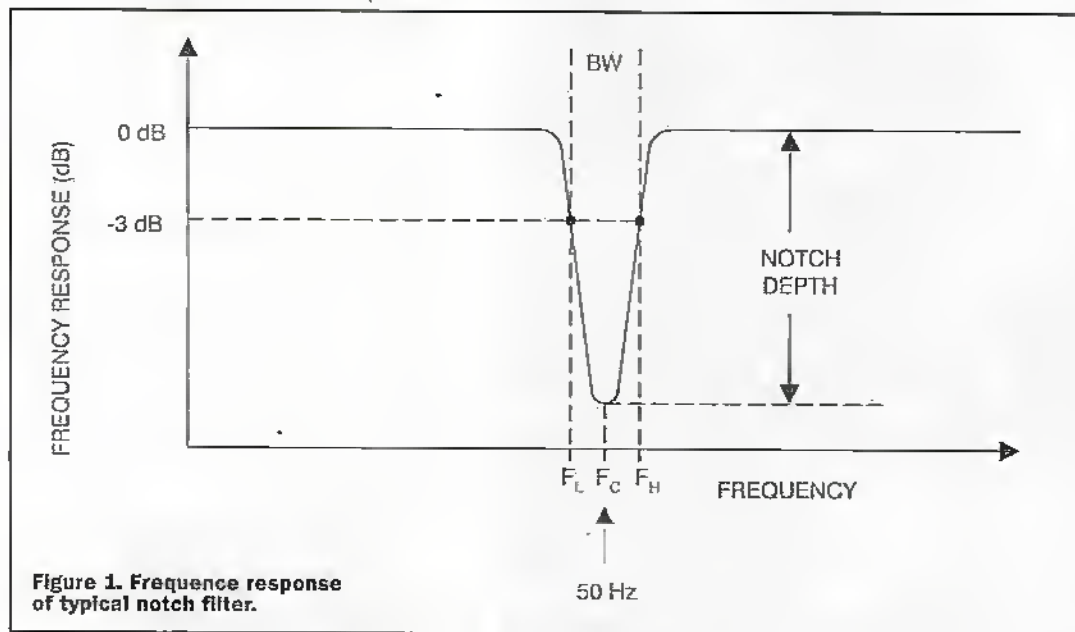


Figure 1. Frequency response of typical notch filter.

Introduction

One of the more difficult interference problems is in-band interference. In radio receivers the IF passband may not be totally effective in eliminating unwanted near-channel or co-channel signals. Alternatively, an undesired station may create a heterodyne beat with the desired signal. These spurious signals are generated in the receiver, and produce an audio tone equal to the difference in frequency between the two RF signals.

In medical and scientific instruments, radiation from the 50Hz AC power mains gets into circuits and causes problems. A medical electrocardiogram (ECG) recording has a peak amplitude on the order of 1mV, and requires a bandpass of 0.05Hz to 100Hz for proper recording of the waveform. Guess where the AC power mains interface is found - right in the middle of the band.

The usual solution to unwanted in-band interfering frequencies is the notch filter. The frequency response of a typical notch filter is shown in Figure 1. These filters are similar to another class, i.e. bandstop filters, but the band of rejection is very narrow around the center frequency (F_c). The bandwidth

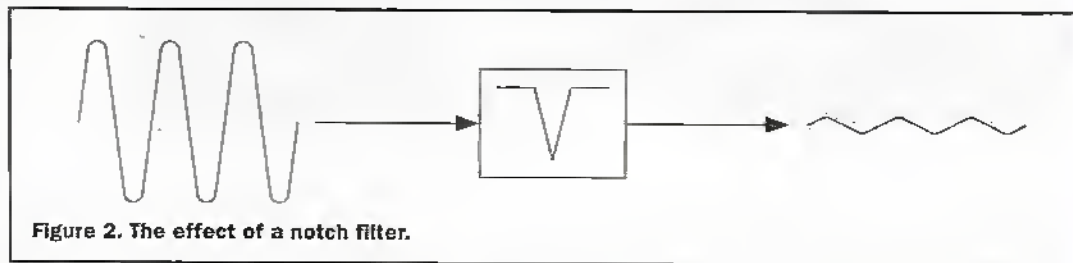


Figure 2. The effect of a notch filter.

(BW) of these filters is the difference between the frequencies at the two -6 dB points, when the out-of-notch response is the

reference 0dB point. These frequencies are F_L and F_H , so the bandwidth is $F_H - F_L$.

The 'sharpness' of the notch

the output voltages of the filter at the two different frequencies:

$$\text{Notch Depth} = 20 \text{ Log } (V_e/V_c)$$

The depth can also be calculated by applying the same equation using the filter input and output voltages at the notch frequency.

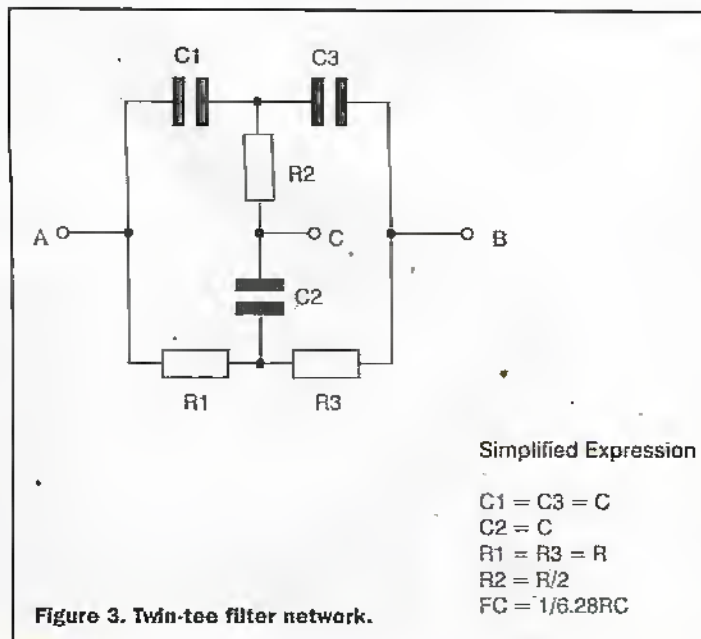


Figure 3. Twin-tee filter network.

Simplified Expression

$$\begin{aligned} C1 &= C3 = C \\ C2 &= C \\ R1 &= R3 = R \\ R2 &= R/2 \\ F_C &= 1/6.28RC \end{aligned}$$

Twin-Tee Filter Network

One of the most popular forms of notch filter is the twin-tee filter network, shown in Figure 3. It consists of two T-networks, consisting of $C1/C3/R2$ and $R1/R3/C2$. Notch depths of -30 to -50dB are easy to obtain with the twin-tee, assuming proper circuit design and component selection. Very good matching and selection of parts makes it possible to achieve -60dB suppression.

The center notch frequency

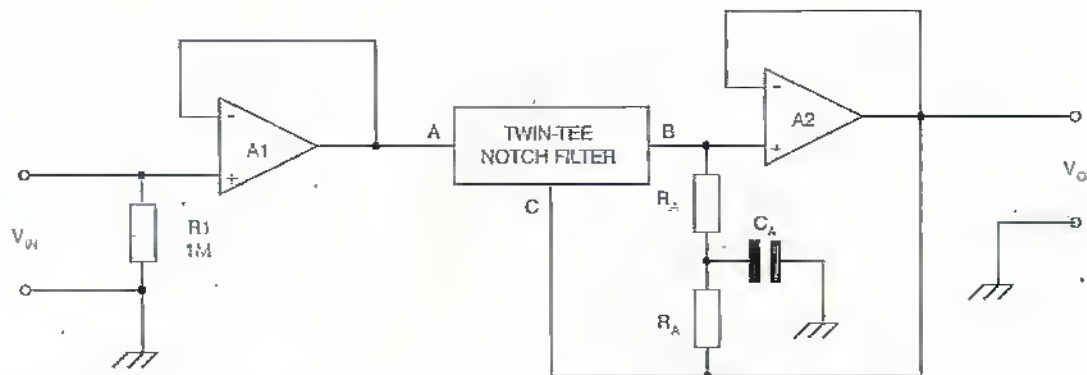


Figure 4. See text for values.

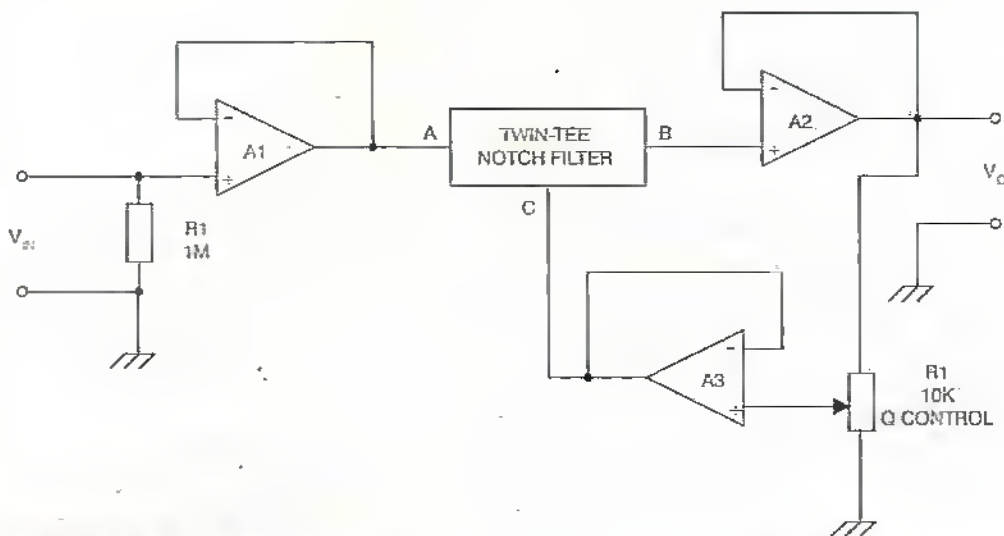


Figure 5. Variable Q notch filter.

of the network in the generic case is given by:

$$F_c = \frac{1}{2\pi} \sqrt{\frac{C1 + C3}{C1C2C3R1R3}}$$

We can simplify the expression above by adopting a convention that calls for the following relationships:

- C1 = C3 = C
- R1 = R3 = R
- C2 = 2C
- R2 = R/2

If this convention is adopted, then we can reduce the frequency equation to:

$$F_c = 1/(2\pi RC)$$

If these expressions, F is in hertz (Hz), R is in ohms and C is in farads. Be sure to use the right units when working these problems: '10kΩ' is 10,000Ω, and '0.001μF' is 1 x 10⁻⁹ Farads. In calculating values, it is usually prudent to select a capacitor value, and then calculate the resistance needed. This is done for two reasons: one is that there are many more standard

resistance values, and second potentiometers can be easily used to trim the values of resistances, but it is more difficult to use trimmer capacitors.

One of the problems of these

filters is that the depth of the notch is a function of two factors involving these components. First, that they are very close to the calculated values, and second, that they be

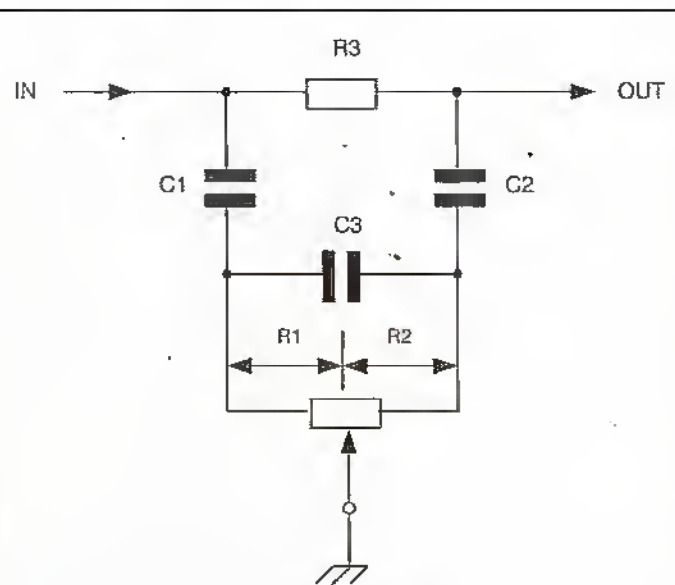


Figure 6. Variant of bridged-tee notch filter.

matched closely together. The capacitors can be selected at random from a group of a dozen or so 'mine run' capacitors of good quality, and matched to the required value using a digital capacitance meter such as those found on digital multimeters. Real odd values can be obtained by parallel or series connection of two or more capacitors. The resistors can be selected 5% metal film resistors or 1% precision resistors.

The order of priority of selection is to find those that closely matched each other, and only incidentally how close they come to the calculated value. Errors in the mean capacitance of the selected group can be trimmed out using a potentiometer in the resistor elements of the 'Twin-Tee' network.

When selecting a frequency source, either select a well-calibrated source, or use a frequency counter to measure the frequency. Keep in mind the situation described above where only a 21Hz shift produced a 38dB difference in notch depth! Alternatively, use a 6.3V or 12.6V ac filament transformer secondary as the signal source (*Warning:* The primary circuits of these transformers are at a potential of the ac line, and can thus be lethal if mishandled!)

Adjustable frequency notch filters can be built using the twin-tee idea, but none of the usual solutions are really acceptable. One implementation requires three ganged potentiometers or three ganged capacitors. Unfortunately, in either case at least one of the variable sections must be of different value from the other two, causing a tracking problem which spreads the notch. You might not notice a tracking problem in some circuits, but in a high-Q notch filter it can be disastrous.

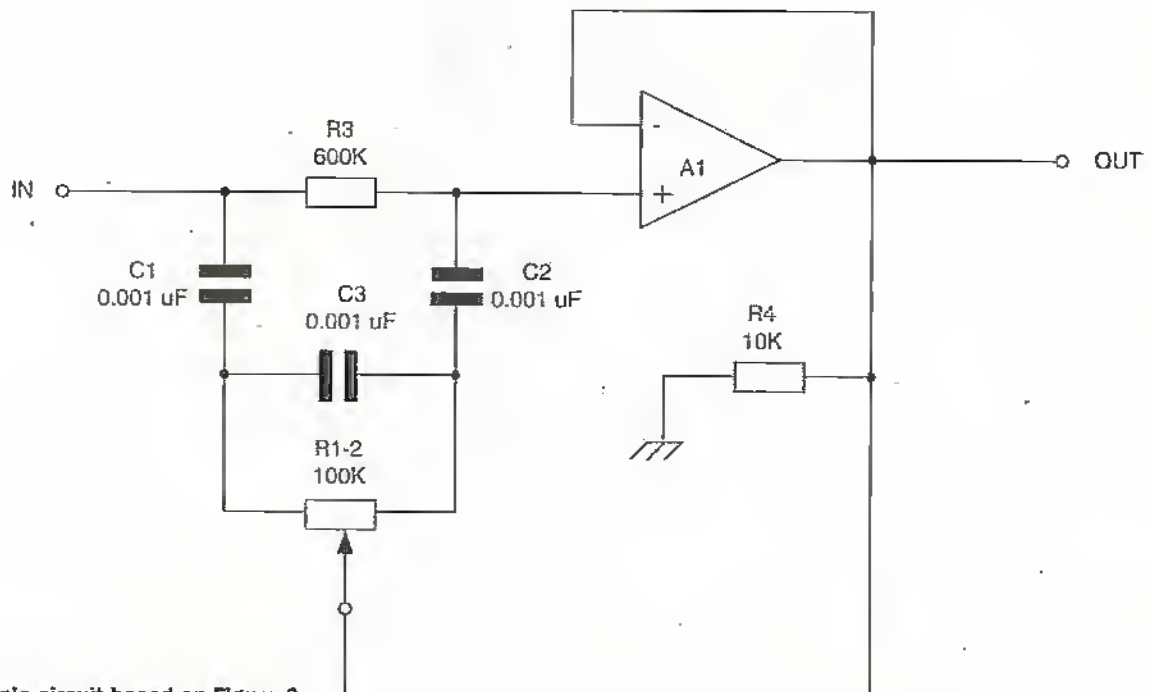


Figure 7. Sample circuit based on Figure 6.

Active Twin-Tee Notch Filters

Active frequency selective filters use an active device such as an operational amplifier to implement the filter. In the active filter circuits to follow, the 'twin-tee' networks are shown as block diagrams for sake of simplicity, and are identical to those circuits shown earlier; the ports 'A,' 'B,' and 'C' in the following circuit are the same as in the previous network.

The simplest case of a twin-tee filter is to simply use it 'as is,' i.e. use the filter circuits shown above. But the better solution is to include the twin-tee filter in conjunction with one or more operational amplifiers. There is one solution in which the twin-tee network is cascaded with an input buffer amplifier (optional) and an output buffer amplifier (required). These amplifiers tend to be non-inverting op-amps follower circuits. The purpose of buffer amplifiers is to isolate the network from the outside world. For low frequency applications, the op-amps can be 741, 1458 and other similar devices. For higher frequency applications, i.e. those with an upper cut-off frequency above 3kHz, use a non-frequency compensated device such as the CA3130 or CA3140 devices.

A superior circuit is shown in Figure 4. In this circuit, port-C of the twin-tee network (the common point) is connected to

the output terminal of the output buffer amplifier. There is also a feedback network consisting of two resistors (R_x) and a capacitor (C_x). The values of R and C in the twin-tee network are found from the equation above, while the values of R_x and C_x are found from:

Example

Design a 50 Hz notch filter with a Q of 8.

1. Select a trial value for C : $0.01\mu\text{F}$.
2. Calculate the value of R from the equation: $318,470\Omega$
3. Calculate $R/2$: $318,470 =$

$$159,240\Omega$$

4. $C_2 = 2C = (2)(0.01\mu\text{F}) = 0.02\mu\text{F}$.

5. Select R_x : $R_x = 2QR = (2)(8)(318,470\Omega) = 5,096\text{M}\Omega$

6. Select $C_x = C \cdot Q = 0.01\mu\text{F} / 8 = 0.0013\mu\text{F}$.

When Figure 4 was built using these values in the twin-tee network the null was close to -48dB deep using components hand matched using a low-cost multimeter.

A variable Q control notch filter is shown in Figure 5. In this circuit, a noninverting follower (A3) is connected in the feedback loop in place of R_x ,

and C_x . The Q of the notch is set by the position of the 10k Ω potentiometer (R_2). Values of Q from 1 to 50 are available from this circuit.

Adjustable Bridged-Tee Circuits

A variant of the bridged-Tee notch filter is shown in Figure 6. This circuit is often used in cases where the notch frequency is either variable or not known with great precision. One popular use for this filter is on radio receivers where it is

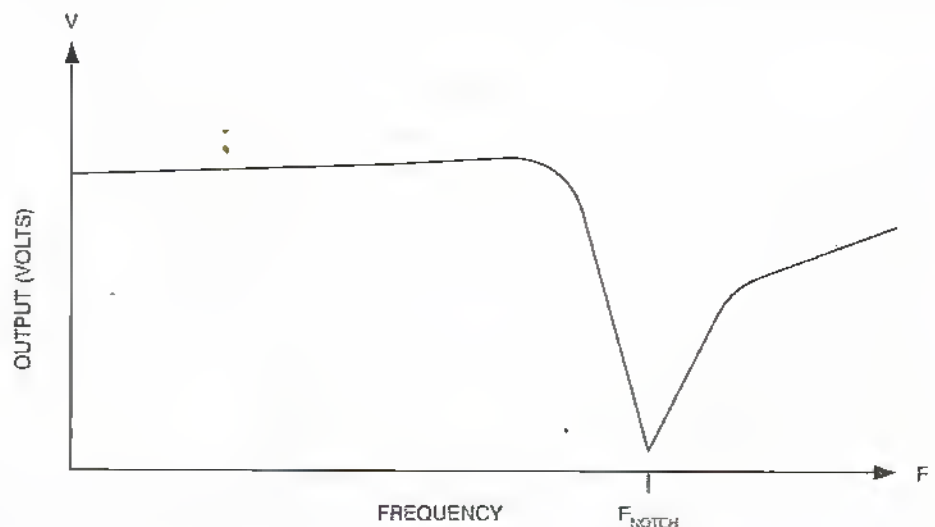


Figure 8. Response on circuit in Figure 7.

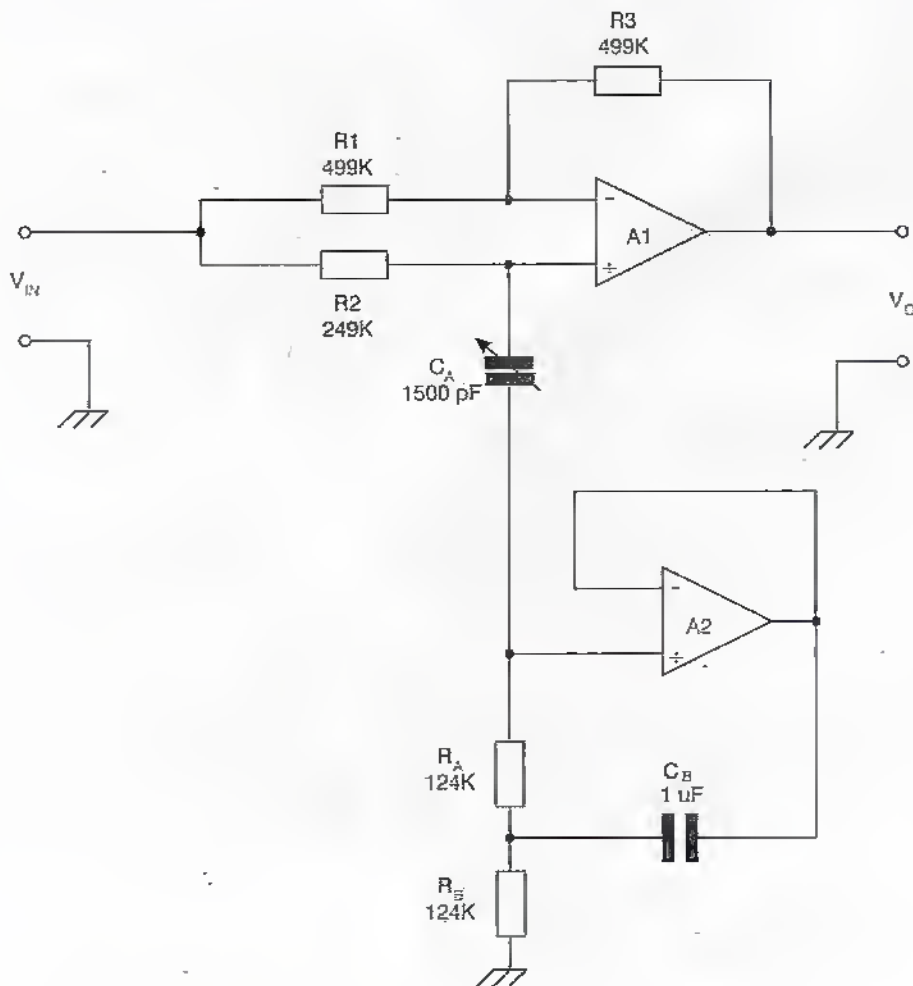


Figure 9. Gyrator or active inductor notch filter.

used to notch unwanted audio tones in the output. The notch frequency is given by:

Assuming:

$$C_1 = C_2 = C_3 = C$$

R1 and R2 are the wiper-to-end-terminal resistances of the potentiometer

Where:

F is in hertz (Hz)

C is in Farads

R1 and R2 are in ohms

A sample circuit based on Figure 6 is shown in Figure 7. This circuit will produce a notch between about 1.8 and 8kHz, depending on the setting of R1. A representative frequency response for this circuit is shown in Figure 8.

Gyrator Circuits

Another approach to notch filter circuits is shown in Figure 9. This circuit is sometimes called the gyrator or active inductor notch filter (it's also sometimes called the virtual inductor notch filter).

The notch frequency is set by:

$$F_c = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}}$$

the equation can be simplified to

$$F_c = \frac{1}{2\pi R_1 \sqrt{C_1 C_2}}$$

If the following conditions are met:

$$\frac{R_1}{R_2} = \frac{R_2}{R_1 + R_2} = \frac{R_2}{2R_1}$$

It is possible to use any one of the elements, C_1 , C_2 , R_1 , or R_2 , to tune the filter. In most cases, C_1 is made variable and C_2 is a large value fixed capacitor. The 1,500pF variable capacitor can be made by paralleling all sections of a three-section broadcast variable, with a single small fixed or trimmer capacitor. Alternatively, since most applications will require a trimmer rather than a big honkin' broadcast variable capacitor, it is also possible to parallel one or more small capacitor and a trimmer. For example, a 100pF trimmer can be parallel connected with a 1,000pF and

±70pF to form the 1,500pF capacitance required. Make sure that low drift, precision capacitors. Or you can match them using a digital capacitance meter.

Cautionary Note

Be careful when using any filter to remove components from a waveform. If the filter is not a high-Q type, then too much of the signal might be removed. In medical electrocardiograph (ECG) systems the signal has components from 0.05 to 100Hz, so 50Hz is right in the center of the range! Oops. To make matters worse, the leads have to be connected to the human body, so are unshielded at their very-ends. Interference from 50Hz is almost guaranteed unless care is taken. But filtering can take out components that assist the physician in making diagnosis, so is only used when it is unavoidable. On medical ECG amplifiers the filter is usually switchable so it can be either in or out of the circuit.

Sidebar

The active filters in this article use operational amplifiers. Figure 10 shows the normal pin-outs for 'industry standard' op-amps such as the 741, CA-3140, etc. The V- and V+ lines should be bypassed to ground with 0.1µF to 1µF placed as close to the power supply pins as possible.

ILLUSTRATION

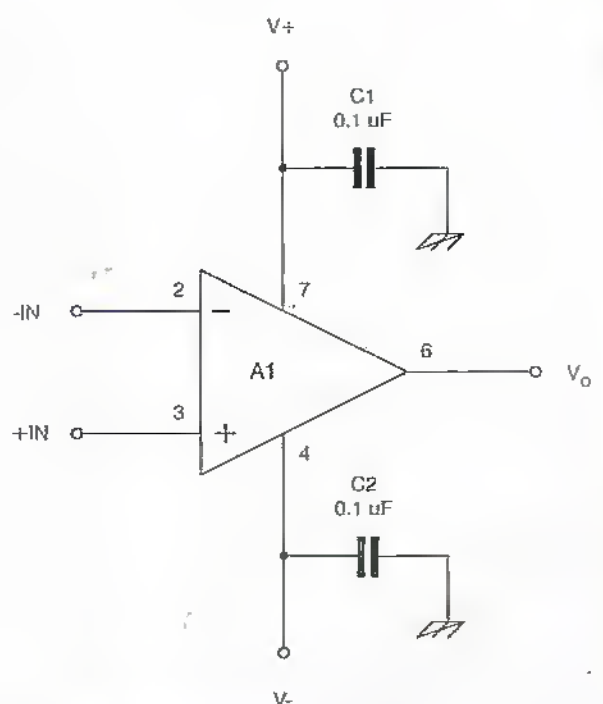
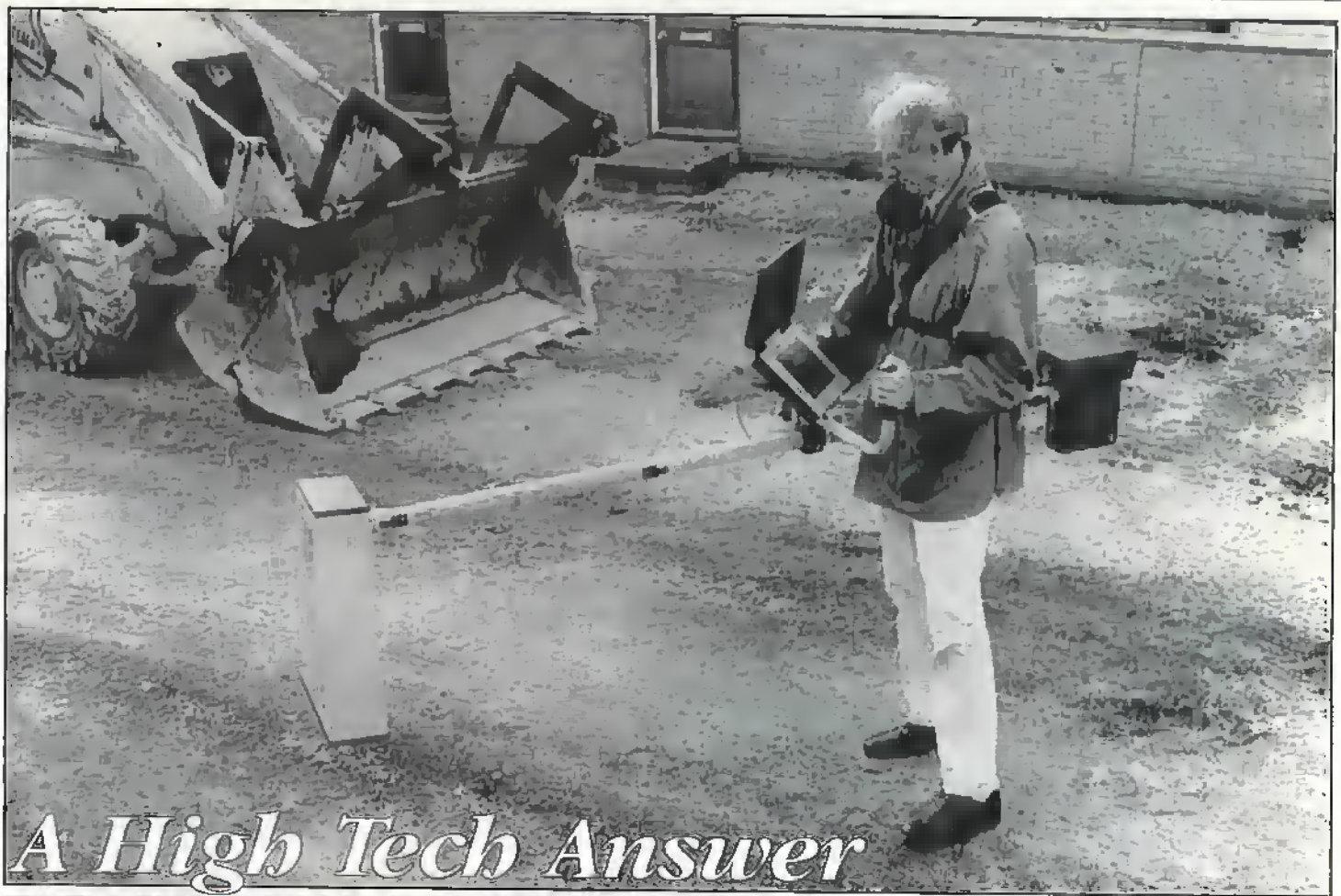


Figure 10. Standard IC Pin-outs.



A High Tech Answer TO BURIED TREASURES

SearchWell, a British firm, has launched a high-tech device that can save time, money – and even lives – by locating buried objects faster and more cheaply than rival systems.

This new product from SearchWell will make it easier to find and replace leaking water pipes by reducing the need to dig expensive exploratory trenches. It will also help prevent accidents involving gas, electricity and other services and will encourage the development of 'brownfield' sites by spotting foundations or dangerous contamination. Future versions will identify hidden faults in roads, bridges and similar structures and could detect plastic anti-personnel mines and other buried ordnance.

Ground Probing Radar

The SearchWell MPR50 uses a technology called 'Ground Probing Radar' in a radical new way. Though GPR has been available for some time, it has not yet become a standard exploratory tool because early systems were heavy, cumbersome and expensive. By contrast, this unit is quick to assemble, easy to use and costs around half the price of most existing products.

Weighing 12kg, MPR50 is mounted on a 1m, non-metallic boom and carried like a garden strimmer. A few seconds after each sweep, the user sees a 'slice' through the target area on a liquid crystal screen fixed to

the boom. This image indicates the depth of buried objects and can usually distinguish between overlapping ones. The system can accurately locate metal and other pipes up to 2m deep and often reveal whether plastic ones contain liquid.

Intended for use by a semi-skilled operator after brief training, this unit has a unique 'air-launch' antenna that enables it to be used over rough ground as well as roads and pavements. Unlike other radars, MPR50 uses a broad range of radio frequencies that can cope with a wide range of differing soil conditions.

Earlier Limitations Overcome

SearchWell is part of the high-tech community around Cambridge University.

"Though radar is often the best way to find things that are otherwise invisible," says Managing Director Andrew Cowan, "it is not yet widely used by construction firms and utilities." One reason is that it has been promoted as a 'magic eye' which can find objects in all conditions. The laws of physics make this impossible, because radar finds leaks by distinguishing between the

'signatures' of wet and dry soil so, for example, it is not the best answer if the ground is completely saturated.

A second problem is that the cost and complexity of earlier systems meant users could not establish quickly whether radar was the right tool for the job in hand.

The new unit solves this problem in two ways. It is cheap enough to be carried routinely in every engineer's vehicle, plus it gives results so fast that its value in a given environment can be determined almost instantly. It is also very practical as it can easily be manoeuvred round street furniture or carried across a busy road, minimising disruption to pedestrians and traffic.

Applications

Cowan predicts early sales to survey and consultancy firms (who wish to exploit the newest and best technology for their clients) and to utilities, construction and environmental organisations. Police forces are interested because the product is much more versatile than those used in high profile cases like that of Fred West. SearchWell hope insurance companies that handle accident and public liability claims will insist MPR50 is used whenever pipes or cables pose a risk.

The product is derived from systems used in two very demanding environments: measuring the thickness of polar ice to aid research on climate change and exploring Britain's most valuable hoard of buried treasure. Detailed engineering design was supervised by SearchWell's Senior Design Engineer Stuart Moore.

Founded in 1995 to develop and market MPR 50, SearchWell is now part of Tricorn

Group plc – a group of high-tech firms with special expertise in sensing and quality control equipment. Led by Chief Executive Roger Allsop, the group are building their activities in exciting technology areas in the UK and abroad.

There has never more need for a cheap, accurate and effective way to locate hidden or buried objects. Water companies want to find ageing or broken pipes – not least to fix leaks which allow up to 40% of treated water to run to waste.

Moreover, new 'trenchless' pipe-laying techniques can be safely used to replace them only if the position of existing pipes and cables is known accurately.

Surveying, construction and telecoms firms must check the position of electricity, gas and other services because hitting them is not just expensive but may be fatal.

Building on a previously-occupied site can also be hazardous because of unrecorded foundations or waste products (like chemical drums) underground.

But many services have been poorly mapped, and changing ground conditions can cause even quite new ones to move several feet from where they were laid. The state of buried assets can be even harder to establish. Water leaks may take weeks to show at the surface, while faults within materials can become dangerous before there is any visible evidence: examples include rust inside bridges or elevated motorways and the failure of a new tarmac to adhere properly to a road.

Digging or drilling is one answer, but it is expensive and time-consuming. A simple exploratory trench can cost £100 a metre or more: drilling a road or bridge to check for damage may mean closing one or more lanes for hours or even days.

There are several ways to find buried objects without physical intervention. The cheapest is the metal detector, but its value is limited by the fact that most new pipes and cables are plastic – as are many land-mines. Other systems only work well with particular materials. A major addition to the

armoury is Ground Penetrating Radar (GPR). Like all radar, GPR works by emitting pulses of radio energy that are reflected by changes of material in their path. Timing the return of these pulses indicates the shape, depth and position of objects. Since all materials have their own radar 'signature', GPR can often show what they are made of as well as where they are.

Not Just for Objects

Because radar detects interfaces, it is also good at locating cracks and fissures as well as objects like pipes and cables. This makes it valuable for examining the state of foundations, bridges and other built structures as well as in some police and military applications.

Despite these advantages, the acceptance of GPR has been relatively slow. This has happened partly because many 'first generation' systems were expensive and poorly designed. Traditional GPR products are heavy and must either be dragged along a surface or rolled on wheels – like a large lawnmower. Most are linked by trailing wires or umbilicals to a computer mounted in a vehicle, where data is processed slowly or has to be examined later off-site.

Easier to Use and Carry

SearchWell's MPR50 is a major advance which overcomes these limitations and adds important new features which are set to revolutionise the use of GPR in utility, building and other areas. It is mounted on a lightweight, 1m long non-metallic boom with the radar antenna at one end and the battery at the other. The product is supported on the user's shoulder and swung in an arc over the area to be explored – rather like a garden strimmer. A liquid crystal screen mounted on the boom provides the operator (a few seconds after each sweep) with a cross-section through the area being explored.

SearchWell have adopted a very practical approach to the design of the image and the

software which creates it. Some rivals use complex graphics to create a simple, map-like representation of pipes or other underground objects. This looks attractive but can suggest more information is available than is really the case. SearchWell have therefore chosen to present 'grey-scale' radar data which the company believe an experienced operator will quickly learn to interpret accurately – in rather the same way that a doctor 'reads' an x-ray photograph. "In cases like this," says Cowan, "the human brain is often a better tool than the computer."

'Air-Launched' Radar

The unit's radar is 'air launched'. This means it does not need to be in physical contact with the surface being surveyed and can therefore be used over rough terrain – giving it a role in exploring new sites and other unusual locations. The antenna can be removed from the boom and lowered into a trench or excavation to search for objects deeper than 2m, and it can be used vertically to explore bridges and similar concrete structures. Versions for other difficult or unusual environments are planned. One may be vehicle-based and designed to check the quality of road surfaces.

One of the unit's most important advantages stems from its special antenna.

Radars give the best results using high frequency signals, but these are absorbed by wet soil. Previous systems have dealt with this problem by making several 'sweeps' over the area to be surveyed using antennas working on different sets of frequencies. MPR 50's unique aerial emits a very wide range of frequencies that give the best possible result in most soil conditions.

MPR 50 is designed to be used by a semi-skilled operator after a brief training programme – the cost of which is included in the basic price of around £22,000.

Markets

Markets for the product include water, gas and electricity companies and the contractors who work with them: telecommunications firms and those involved with cable TV and similar systems; building, construction and civil engineering organisations together with surveyors and environmental inspectors. SearchWell is planning to work with a British battlefield clearance company to build a practical piece of mine detection kit based on this current technology.

An early version of the product helped explore Britain's most valuable hoard of buried treasure – the grave of an Anglo Saxon king at Sutton Hoo in Suffolk. It was also used by the Scott Polar Research Institute at Cambridge University to measure the thickness of polar ice during research on climate change. (BT)



Further Information

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Electronics in the MOTOR INDUSTRY

PART 4

In part 4, Mike Bedford looks at the electronics involved in Formula One racing and breaking the sound barrier.

Over the course of the last three months we've looked at some serious motors as we've investigated how electronics and computers are playing an increasingly important role in automotive engineering. In the first article in this series, for example, we looked at the microprocessor-controlled automatic transmission which is fitted to the Porsche 911 Carrera. This car boasts some figures which you might feel are pretty impressive – 300bhp, 174mph and 0-60mph in 6.0 seconds. But the Porsche looks positively pedestrian in comparison to the cars we're going to be putting under the spotlight this month. First of all, we're going to take a look at the electronics which helped Mika Hakkinen gain his first Formula One drivers' championship just a few months ago. This involves entering a world of cars with two and a half litre engines which produce 700bhp, which have a top speed of around 200mph and can accelerate from a standing start to 100mph and come to a halt again, all within around six seconds. But even this isn't the ultimate. We'll then go on to investigate the technology behind a car which has the power of 145 Formula One cars or 1,000 Ford Escorts. That's a car which is powered by two Rolls-Royce Spey 205 jet engines providing a total thrust of 50,000 pounds and a power of 100,000bhp. The car in question achieved 0-100mph in 4

seconds, 0-600 in 16 seconds and went on to be the first car to break the sound barrier. The name of this amazing car is Thrust SSC and the technology of electronics and computers played a vital role in its success.

On-board Electronics

After our coverage of electronics in production cars over the past few months, you'd be excused for believing that Formula One cars are packed full of microprocessors. After all, if the BMW 750iL saloon car has more processing power on-board than the Apollo 11 which took man to the moon, you might reasonably expect that McLaren's world-beating cars would have more processing muscle than the whole of mission control back in 1969. But it doesn't take long to realise why this isn't the case. Priorities are obviously very different and much of the processing power on an executive saloon is used to provide luxury and convenience features such as in-car entertainment systems, cruise control and sophisticated air conditioning, none of which have any place in F1. But other systems such as traction control and active suspension systems would seem to be even more necessary in a Formula One car, which is pushed to the absolute limits, than in a standard road car. If you follow motor racing to any extent, you'll be aware that these systems were indeed

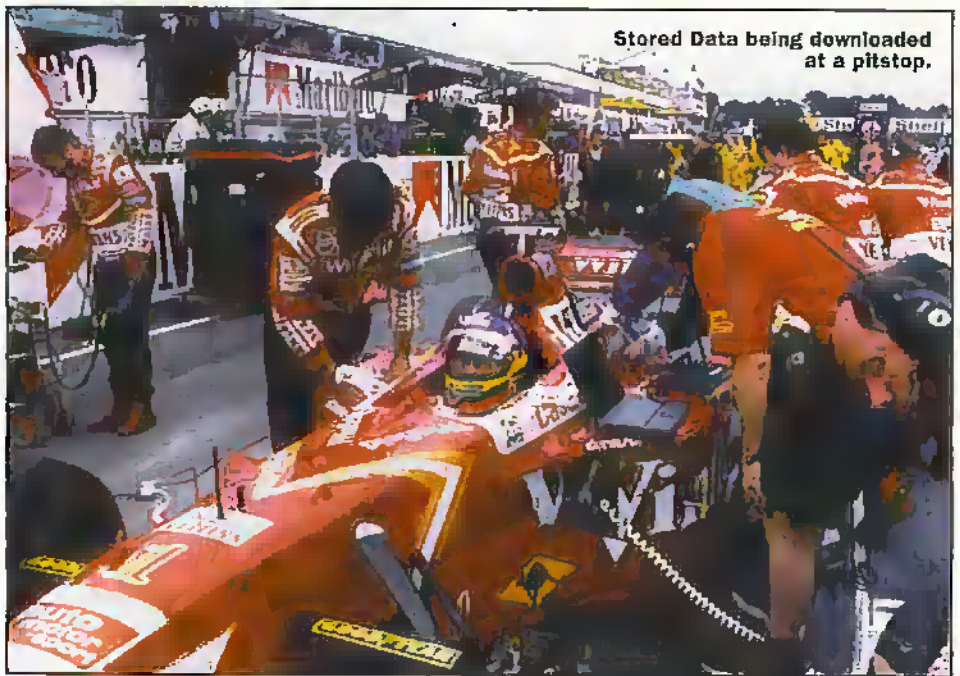
introduced by many of the F1 teams in the early 90s and that their presence in today's luxury saloons is due, in no small part, to that pioneering work. You'll also know why these systems are no longer to be found in racing cars, namely because the FIA, Formula One's governing body, banned all such systems within a couple of years of their introduction. The reason, of course, was to put the onus back on the driver and prevent the sport becoming one in which the team with the best technology wins, irrespective of the skill of the drivers. With traction control, for example, all the drivers would have to do at the start of a Grand Prix is to floor the throttle and release the clutch. There would be no chance of stalling, nor of spinning the wheels, each car would move away from the grid at the maximum possible acceleration. Changes in position during the vital first few seconds of the race would be few – if you were on pole you'd almost certainly remain in the lead – and the spectators would be robbed of one of the most exciting parts of the race. This isn't to suggest that F1 cars are devoid of clever electronics. As we'll see, the presence of on-board electronics and microprocessors is now vital to success, but things are very different from within the realm of production cars.

Data Logging & Telemetry

Undoubtedly the most publicised use of on-board electronics in Formula One is in conjunction with the telemetry systems. If you've ever watched an F1 Grand Prix you can't fail to have noticed that these systems

seem to provide the teams' engineers with sufficient real time information about the car out on the track to plan pit strategies, and give advice to the drivers on how to drive given the current condition of the tyres, the brakes, the engine or whatever. Exactly what is monitored on the cars varies from one team to another and the teams keep their cards close to their chests for obvious reasons. However, it's not far short of the mark to say that if it can be measured, it is measured, and this can require some very specialised sensor technology. Having to survive in the harsh environment of a Formula One car places some severe constraints on the sensors but, nevertheless, the technology for measuring temperatures, pressures, flows, acceleration, rotational speed and the like is reasonably well established. But measuring some of the other variables requires remarkably sophisticated techniques. Take, for example, the measurement of the ride height, something which is critical if full advantage of the car's aerodynamics is to be realised. One such system, which can measure the ride height to within 0.2mm at race speeds, is manufactured by Pi Research Ltd. and interfaces to their 5Star data logging system which is designed for F1 and American Champ Car racing. The system uses a 5mW laser and a DSP to derive the height from the received signal. In fact, an F1 car has three sensors, two at the rear and one at the front so that pitch and roll values can also be determined. Another example of Pi's rather more specialised sensor technology is their high precision tyre monitoring system which can measure the pressure of each tyre to an accuracy of 0.1 PSI. Of course, it isn't possible to hard wire a sensor on a rotating wheel so each of the tyre sensors transmits the pressure to a small radio receiver on the car which interfaces to the data logging system.

Having collected the vital information, the next step is to transmit it to the pit crews via telemetry. Because of the difficulties associated with transmitting a high bandwidth signal to the pits from a moving vehicle anywhere on a track, until quite recently, telemetry systems operated at a

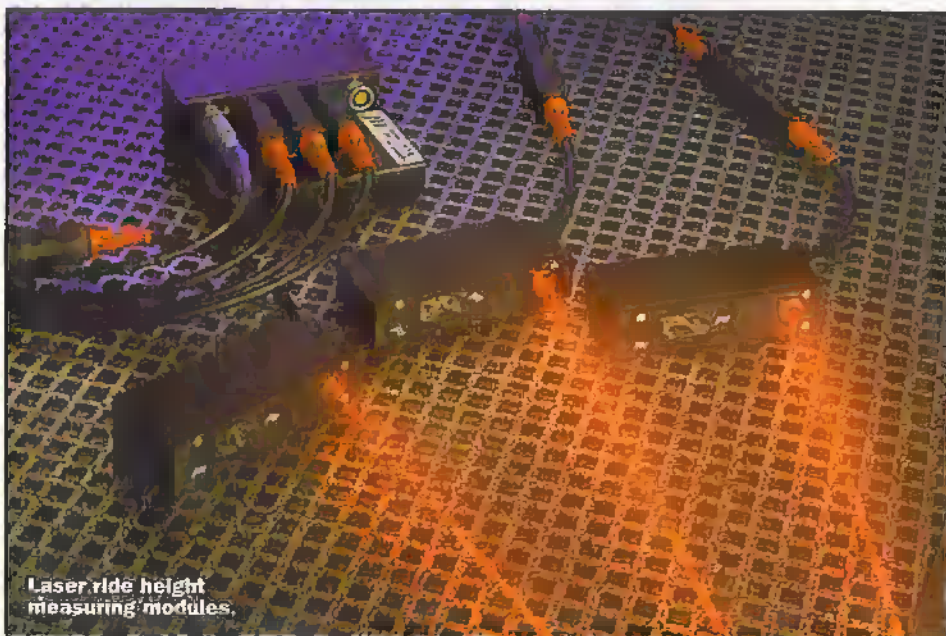


Stored Data being downloaded at a pitstop.

couple of levels. A small amount of vital information – that which might be needed immediately – was transmitted continually via UHF radio, and a larger volume of more detailed information was transmitted in bursts using a microwave link as the car travelled down the pit straight. But even this dual system didn't allow everything which the on-board systems collected to be made available to the pit crews. So, the remaining information was collected and stored on the car until it made a pit stop then, as the tyres were changed and fuel taken on board, this data was downloaded via a cable. However, developments by Pi Research Ltd. in conjunction with radio modem company Telkon has permitted the Williams team to receive data at up to 2Mbits per second from virtually anywhere on the track. The system employs direct sequence spread spectrum data transmission in conjunction with forward error correction. In addition to the high rate of data transfer, this technology provides a relatively interference tolerant link which is virtually impossible for a competitor to intercept.

Set-up

But telemetry information isn't used only during the race – it has many other uses. For example, by studying exactly where and how hard they braked on the corners and correlating this with the resulting lap times, drivers are able to fine tune their performance on a particular track. You may have noticed, for example, that the Jordan team use flat screen displays, provided by Hewlett Packard, the team's prime IT sponsor, to permit the drivers to view data from within the cockpit when parked in the pits between qualifying runs. Telemetry is also a vital tool during the hours of testing which the Formula One teams undertake during the closed season and between the races to improve their cars or to try out new components. And it's also a key element in setting up the cars prior to a race. Once a team has made any final alterations to their cars and shipped them to the venue of the next race, the engineering decisions are still far from over. In addition to having to decide on the choice of tyres – a decision which is based primarily on the weather – the engineers also have to decide on how to configure dozens of vital elements of both the chassis and the engine. Critical elements include the relationship between down force and drag, the balance between over-steer and under-steer, and the ride height. And in virtually all areas, a compromise is called for. In the case of down force and



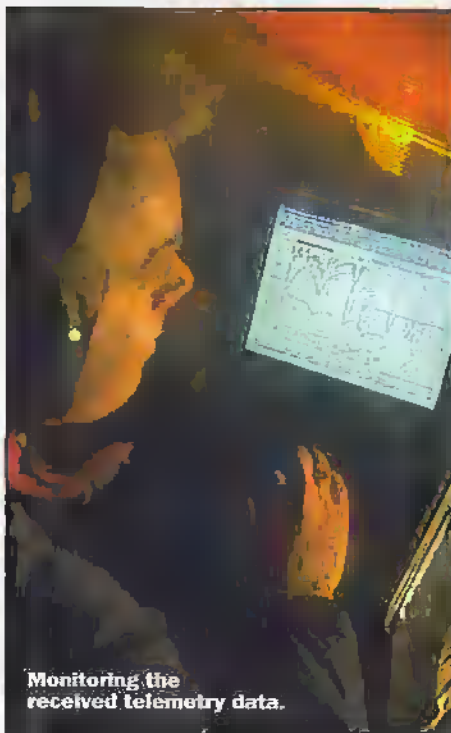
Laser ride height measuring modules.



Radio modem allows data to be received from virtually anywhere on the track.

drag, for example, down force is improved by increasing the amount of wing, but whereas this will improve handling on corners, the increased drag will reduce the top speed on the straights. Prior to the introduction of on-board data collection, the set-up would have resulted from a dialogue between the driver and the engineers. But today, data logging allows a driver's subjective views to be replaced by hard facts and figures. This set-up, of course, is dependent on the track so much of this has to be carried out on the basis of data collected during the Friday practice sessions and again during the qualifying sessions. And whereas you might not think differences between one track and another would make much difference to the set-up, there's a vast difference in the way a car would be set up for a street circuit like Monaco and a track with high speed straights such as Hockenheim. Not that changes to the set-up have to be momentous to make a difference – don't forget that the difference between clinching pole position and getting second place on the grid can be as little as a hundredth of a second. When cars are so evenly matched, tiny changes to the set-up can make all the difference between success and failure.

What makes the pre-race set-up even more of a challenge, however, is the time constraint. Although the FIA rules no longer places a limit on the number of practice laps, there is, nevertheless, a time limit on the practice sessions and each driver is also limited to using 40 dry and 28 wet weather tyres over the course of the race weekend. But technology has come to the fore in an attempt to circumvent these regulations. The first line of attack is the use of simulation. If you're limited to how long you can spend on the actual race track trying out different set-ups, then prior to the Friday practice sessions, engineers attempt to optimise their cars using simulators. But these are not the F1 simulators of the type you can buy for your



Monitoring the received telemetry data.

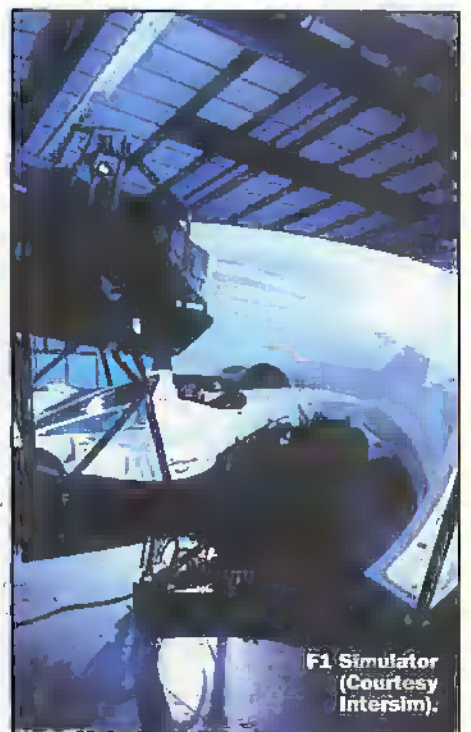
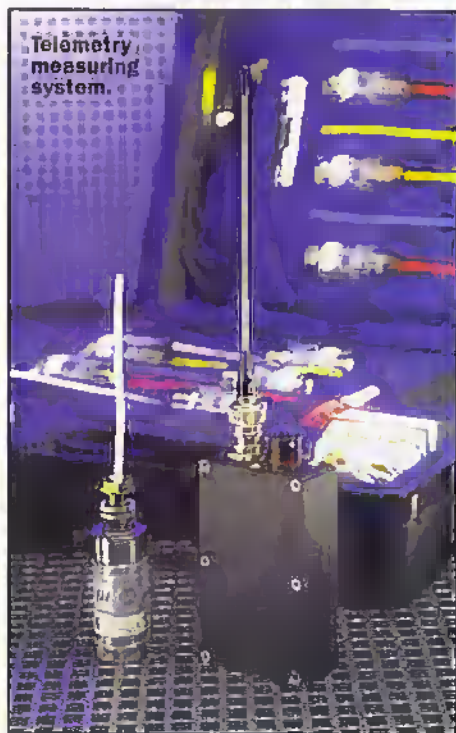
PC, these are detailed engineering simulators which are driven using simulated drivers. If a change in the set-up reduces the lap time then the engineers can be reasonably confident that the improvement was, indeed, due to that set-up change as opposed to an improvement in the driver's performance. The use of simulated drivers also means that the exercise can be carried out without the drivers being present. After all, it's a fair bet that Ferrari's set-up engineers can't quite match Michael Schumacher's driving ability. Simulation is, nevertheless, rarely as good as the real thing and in practice, the results of the simulation exercise tend to be used simply as starting points for the set-up on the actual track. But even here, technology is lending a helping hand. As a second best to racing a real car on the real track, some teams – Jordan, for example – are now gaining extra practice laps by running a real car on a simulated track. Let's look at how this works. Data for the best couple of laps for each of the drivers, collected during the practice sessions, is transmitted back to the Jordan HQ at Silverstone. From this data, the driver's actions are extracted and a detailed map of the track is derived. All this information is then used to drive the practice rig – essentially a real car in which the wheels have been replaced by servo mechanisms and additional servos are attached to the body. When driven using the telemetry data, the car is subjected to exactly the same forces as it would encounter on the actual track. This way, lots of additional laps are clocked up overnight on the Friday and the optimum set-up details are transmitted back to the on-site team who will set-up the car for Saturday's qualifying session.

Information Overload

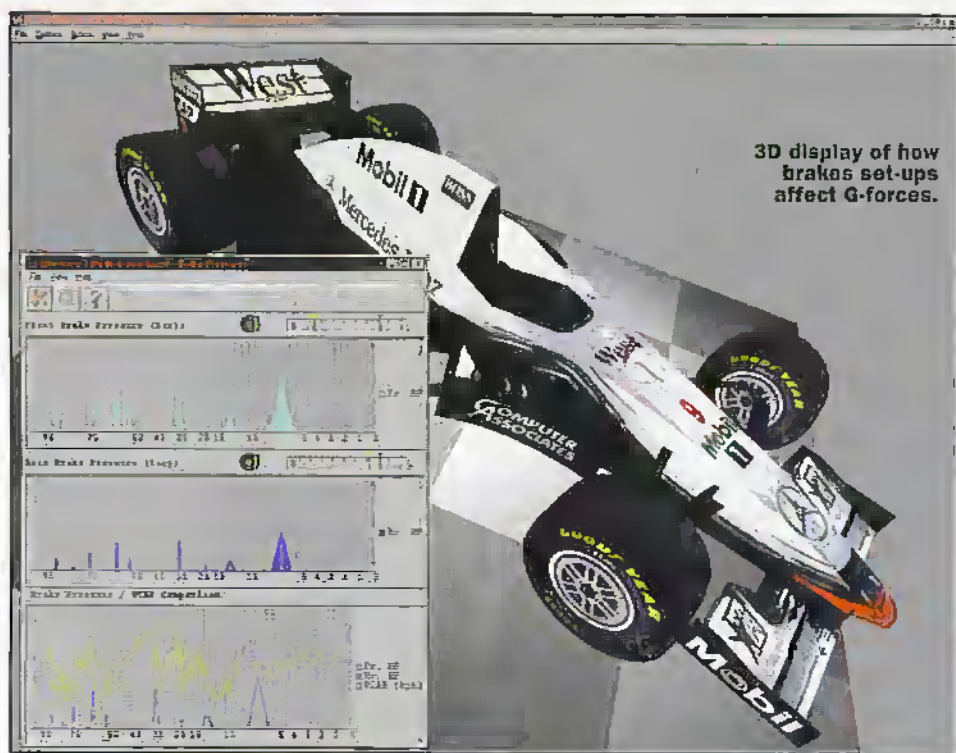
We've already seen that cars are now able to transmit data back to the pits at a massive 2Mbits per second and, needless to say, at this rate vast volumes of data are soon built

up. Specifically, 500Mbytes are recorded over a race weekend and a team can collect up to 20Gbytes of data during a season. As with so many other areas of data collection and analysis, the problem of information overload cannot be overlooked. The vital information is in there, without a doubt, but extracting it from all the other data can be a major problem. Clearly software tools are essential as is evidenced by the McLaren teams use of Unicenter TNG from Computer Associates (CA). Interestingly, this package wasn't designed specifically for McLaren, nor for motor sports. In fact, CA refer to it as an "enterprise management tool for heterogeneous computer networks" and go on to say that "Unicenter TNG revolutionises enterprise management by providing a business perspective to the management of all enterprise resources. It lets administrators answer business-relevant questions: Are we able to process orders? Why is accounting slow? How secure is my customer information?"

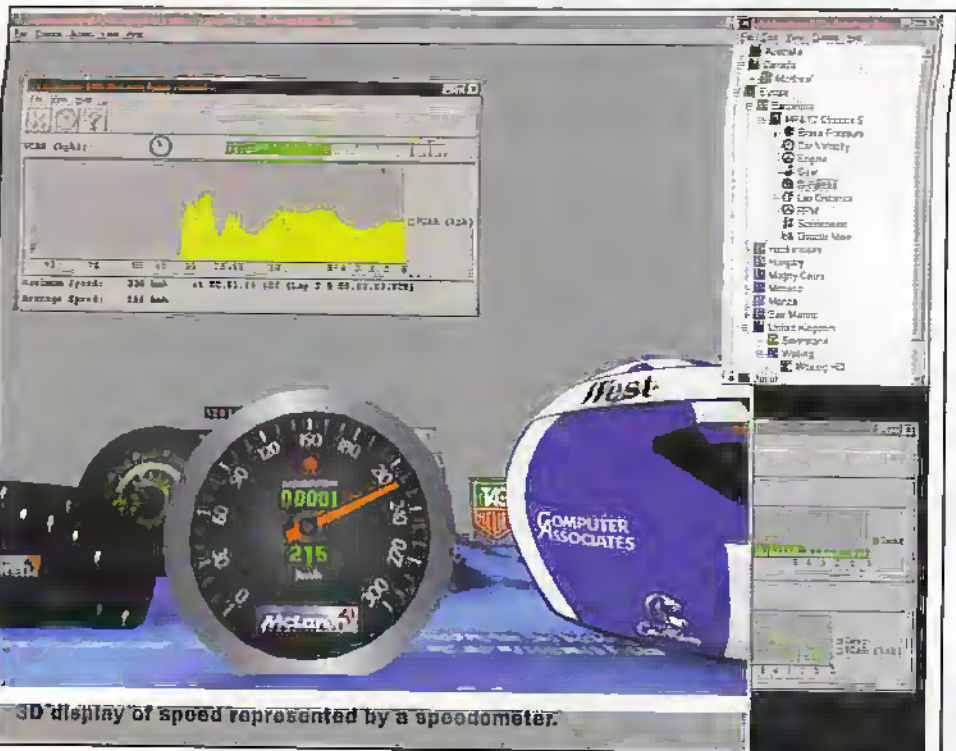
But McLaren boss Ron Dennis, gives an example of a very different way of using the product. "By utilising CA's advanced technology, we will have a more visual analysis of a car's overall performance data. Unicenter TNG will enable the West McLaren Mercedes engineers to view various performance points, providing a sophisticated visual means of analysing the car's behaviour." Dennis went on to say, "Telemetry monitoring of Formula One cars is not new. What Unicenter TNG will bring to the track is a synergistic view of performance data. Our engineers can compare critical data to identify casual relationships. For instance, they can use the 3D display of the car to see how different brake set-ups affect G-forces, or how engine RPMs correlate against throttle". CA and McLaren are now working on a project designed to capture and analyse historical data on the car's performance. The data is stored in CA's Jasmine object database and



F1 Simulator (Courtesy Intersim).



3D display of how brakes set-ups affect G-forces.



3D display of speed represented by a speedometer.

allows engineers to get answers to questions such as "how were the cars set up last time we drove on this track in similar conditions?". According to McLaren partner co-ordinator Richard Carmichael access to historical information will be invaluable both before and during a race. McLaren's archived data was previously held in flat files, making it almost impossible to compare data from various races. To answer historical questions engineers had to print out the data and carry out comparisons by hand. And with the vast amounts of data involved, this could be an almost impossible task. McLaren plans to use the multimedia and networking capabilities of Jasmine to display data in the pit garage linked over a wide-area network to the team's headquarters in the UK. "This way, when a test engineer

at the track wants to see the car's settings for a run performed three weeks earlier on the same track, Jasmine's multimedia capabilities empower him with immediate information," said Paddy Lowe, McLaren's Head of Vehicle Technology.

McLaren will also be using Jasmine to drive multimedia applications in their VIP Club tent. This will allow their visitors to understand more of the technology of Formula One through the use of multimedia and animation. "Racing enthusiasts love the kinds of technological detail such as gear ratios and cornering speeds that we will be able to combine with the 3-D animation of the car on the race track," said Jay Huff, CA's European Director of Advanced Technology. "Jasmine will bring it all to life, including personalised touches, such as a commentary by the race-car driver."

Simulation

We've already seen something of how simulation is used, prior to a race, for setting up the cars but the technique goes far beyond this. As in so many fields of engineering, simulation is an essential element in the design process. And with the Formula One teams now involved in the mad dash to produce new and improved cars for the 1999 season, computational flow dynamics (CFD) will be coming to the fore. With just three to four months to design a car, it just isn't feasible to build and test 100 many physical prototypes. Instead, ideas must first be tried out using simulation. Only then will a part-sized model be built and tested in a wind tunnel and eventually a full-sized car manufactured and tried out on the track.

The Benetton team, for example, rely on CFD software from Fluent Europe Ltd to simulate the flow of air over their cars and hence determine the amount of drag and down force and to shed some light on flow-induced forces. According to Ross Brawn, former Technical Director with Benetton, "The ability of Fluent software to read CAD data directly from our CAD system and quickly produce accurate results gives our engineers early access to a wealth of information. This enables us to make the best use of expensive testing time and accelerate the overall development cycle". CFD is now a very common technique in F1 but Benetton were the first team to adopt it, something, it's been suggested, that played no small part in helping them clinch the 1994 and 1995 Driver's Championship and 1995 Constructor's Cup. Michael Schumacher, on the other hand, will probably have somewhat different views on the principal reason for Benetton's success during those years.

But it isn't just the F1 teams who have an interest in simulating racing cars. One Formula One enthusiast was so keen to find out what it would be like to get behind the wheel of an F1 car that he paid simulation experts Intersim some serious money to build him a full motion simulator. The driver sits in an accurate, full-sized replica of a Formula One car. The equipment in the cockpit is, in the main, comprised of actual racing car components and includes the paddle type gear change controls on the steering wheel and authentic foot controls. The complete car is mounted on a six-axis hydraulic-powered motion base which can achieve a maximum acceleration of 3.5G and allows the driver to feel the forces on the car during acceleration, braking and cornering. A wrap-around display consisting of a nine feet toroidal screen provides a 160° degree field of view in the horizontal plane and 40° vertically. Turning to the computing side, the simulator is powered by a Silicon Graphics Onyx 3D graphics supercomputer with four R10000 196MHz processors and 128Mbytes of main memory which drives a Seos Prodas 3000 projection system with three video projectors. Intersim has demonstrated the simulator to a number of the Formula One teams in the hope of providing simulators for driver training, rather like the airlines use full motion simulators for training pilots.

Of course you don't have to pay this sort

of money to experience some of what Damon Hill felt in bringing his Jordan Mugen Honda to victory, against all odds, in the Belgian Grand Prix last year. A number of F1 simulators are available for the PC and some of the software houses are at pains to point out that these are far more than just toys. UbiSoft, publishers of F1 Racing Simulation and Monaco Grand Prix Racing Simulation 2, target their Formula One simulations at enthusiasts as opposed to traditional games players and this means that the accuracy of the simulation is far more important. Certainly sitting in front of a 14" monitor will never rival the experience of the wrap-around screen of the full motion simulator but UbiSoft do have a good deal of confidence in the accuracy of their model. The simulation was developed in conjunction with Renault, former engine suppliers for the Williams team, and the

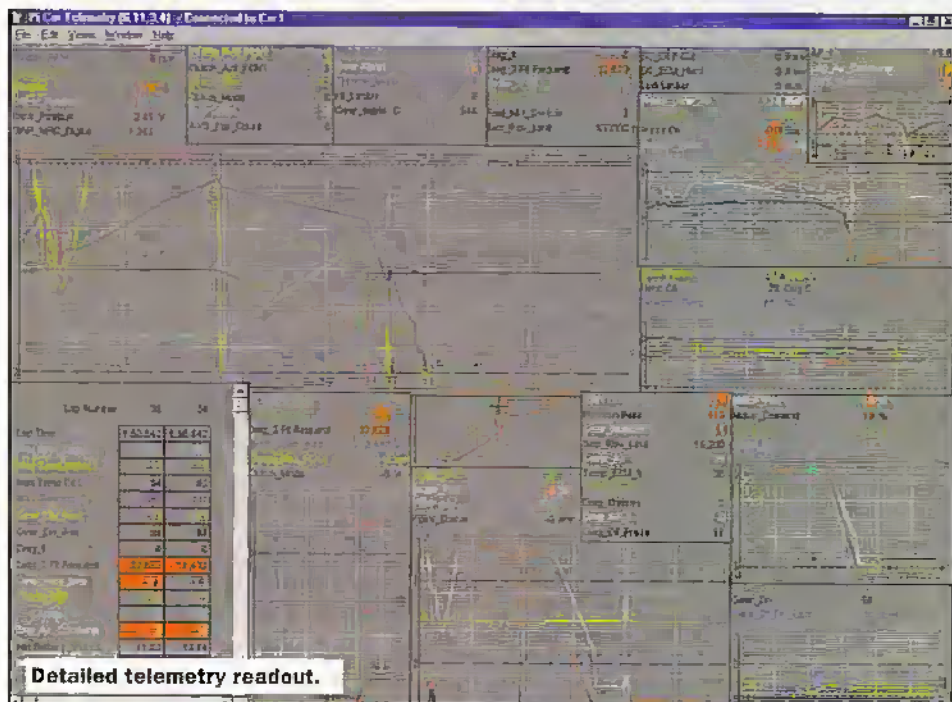
software house even enlisted the support of drivers Jean Alesi and Heinz-Harald Frentzen. With a classic computer game, you'd reasonably expect that the in-house developers and testers would be able to outperform a novice. After all, they'd have had lots of practice, learning the quirks and idiosyncrasies, learning the tricks of the trade, in short learning how to play the game. But not so when Alesi and Frentzen sat in front of the screen. After a little bit of fine-tuning of the parameters – essentially setting up their cars – both the professional drivers, even though they were novices on this particular software package, were consistently achieving lower lap times than the developers – exactly what you'd expect if the software genuinely simulated the feel of a real Formula One car. Needless to say, this is something which UbiSoft are not slow to point out.

The Sound Barrier

I guess you probably already know quite a bit about the Thrust SSC supersonic car from the intense media coverage 18 months or so ago. The car, you'll recall, was designed under the leadership of the previous land speed record holder Richard Noble who had taken the title from America in October 1983 in a car called Thrust 2. But for this new attempt, Noble contented himself with a management role, passing the baton to RAF test pilot Andy Green. Green actually became the fastest man on earth on 25th September 1997 with a speed of 714.144mph. This was still well short of the sound barrier and with money starting to run out, doubts were expressed as to whether the team would reach its goal. With very little time remaining before worsening weather conditions would curtail all activity at Nevada's Black Rock Desert, on 13th October Andy Green became the first man ever to travel faster than the speed of sound in a ground-based vehicle. Interestingly, it was one day short of fifty years since Chuck Yeager went supersonic in the air for the first time. But Green's turnaround was 49.6 seconds over the hour so this historic event didn't actually set a new record according to the FIA rules. Two days later the ThrustSSC Team were back in action, and this time they achieved their objective – reaching Mach 1.020 to set a two-way average speed of 763.035mph and securing a place in the history books. Well those are the facts as you could have read them in just about any newspaper in the Autumn of 97, but where do electronic and computer technology come into the picture? First of all let's consider the problem.

One of my favourite quotes about the world land speed record was made by David Tremagne of *Motoring News* "Attempting the world land speed record is a bit like two-stepping blindfolded and barefoot along a 100 feet high barbed wire tight-rope, carrying a glass of nitro-glycerine and simultaneously delivering a political speech a bit like it, but a damn sight more difficult". But this view was expressed back in 1981 when the record stood at a 'mere' 622.407mph. Needless to say, an attempt at 760mph, an attempt which involved the car going supersonic, would be significantly more difficult. In fact, Ron Ayers, aerodynamicist for the Thrust SSC team had originally vowed to have nothing to do with the project, not wanting to have the guilt of the driver's death on his conscience. Making a car which is fast, very fast indeed, is not a major problem. What is much trickier is keeping it in contact with the ground. And it's not just that the car would fail to clinch the land speed record if it ended up flying. Cars, of course, are not intended to fly so if they do leave the ground, they don't stay in the air for very long. Instead, they come crashing back to the earth with disastrous consequences. But all this doesn't apply only to supersonic cars, it applies to all fast cars. The challenges of supersonic travel were much greater and the problem was compounded by the fact that nobody had ever done this before.

As a car moves it compresses the air in front of it to form pressure waves. If you're travelling below the speed of sound these



Detailed telemetry readout.



3D display for throttle pressure.



The Thrust Supersonic car.

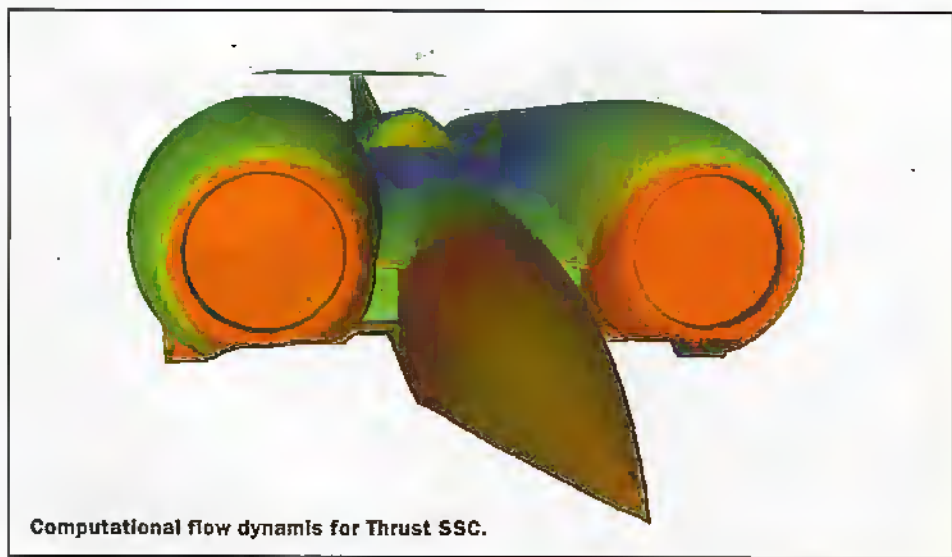
pressure waves simply move away from the car getting gradually weaker with distance. If the car were to approach the speed of sound, however, things are quite different as the car quite literally catches up with the pressure waves. At the speed of sound, the pressure waves fan out to form a so-called Mach wave and a sonic boom results. This has been a common experience in the realm of aircraft for over fifty years and since there's plenty of room around the aircraft, the shock wave dissipates. With a vehicle travelling along the ground, however, things could well be very different. Certainly it seemed there was every possibility that the shock waves would bounce off the ground and lift the vehicle or even that the waves would cause structural damage to the car. On the other hand, perhaps the merchants of doom were wrong and there was nothing to worry out. The daunting fact was that, in the early days of the Thrust SSC project, nobody knew for sure ... until computational fluid dynamics came to the rescue, that is. To cut a long story short, let's just say that the overall shape of the Thrust SSC was based on little more than a gut feeling. Not only that, but in some ways it went against conventional wisdom on what a very fast car should look like. Computational fluid dynamics, in conjunction with wind tunnel tests on a scale model, were used to put the design through its paces before work on building the car was even started. Amazingly, in spite of the 'back of a cigarette packet' nature of the initial design exercise, the basic shape was exonerated and fears over the effects of sonic waves were laid to rest.

Safety First

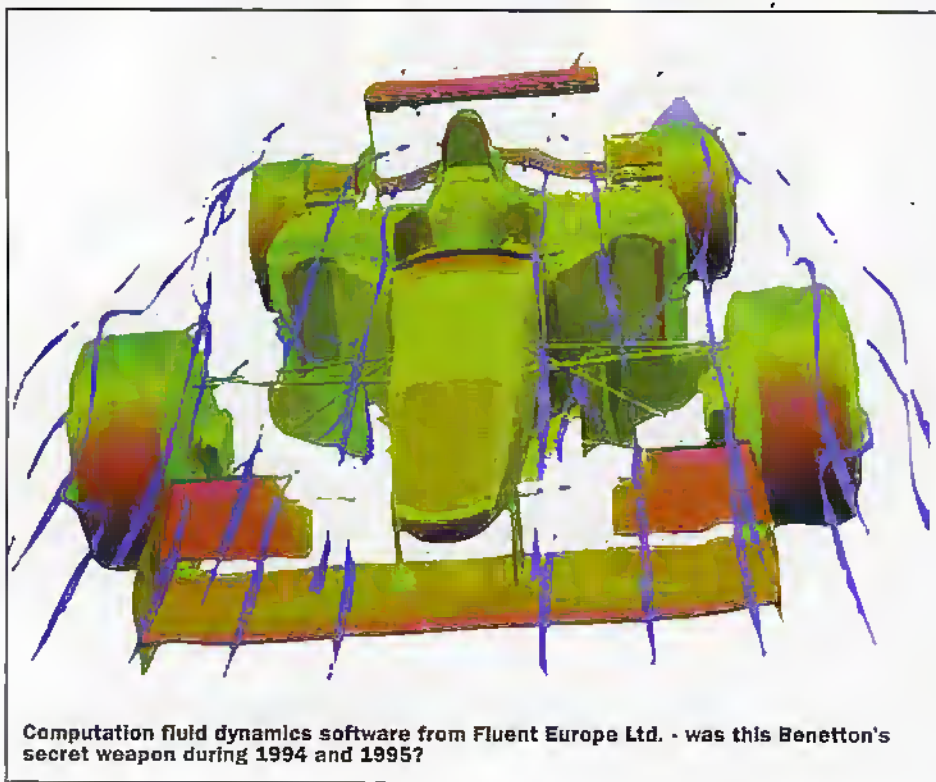
Just as automated driver aids are banned in Formula One, exactly the same rationale is applied to the land speed record. Unless the driver actually drives the car, in the generally accepted meaning of that word, then any record attempts are invalidated. And this means that automated systems don't get a look in on cars designed to challenge the world land speed record. This didn't mean, however, that Thrust SSC had no sophisticated electronics on-board. What it did mean is that, as with F1, the intelligence is all used for diagnostic purposes and for ensuring the safety of the driver.

Having looked in some detail at how

telemetry is used in Formula One, we won't labour the point by looking in mind-numbing detail at Thrust SSC's data collection system. Suffice it to say that no less than 147 sensors across the car measured the wheel dynamics, brake temperatures, pressure on critical parts of the structure and the harmonic structure of the bearings to name but a few. The primary use of this system is as a safety aid. After all, the amount of power available on Thrust SSC was absolutely staggering and any dangerous situations had to be detected and acted upon immediately. If such a critical condition was detected, the processor systems would automatically



Computational flow dynamics for Thrust SSC.



Computation fluid dynamics software from Fluent Europe Ltd. - was this Benetton's secret weapon during 1994 and 1995?

about the run, killing the engines within a fraction of a second. A classic example would be the loss of one of the two jet engines which are fitted to either side of

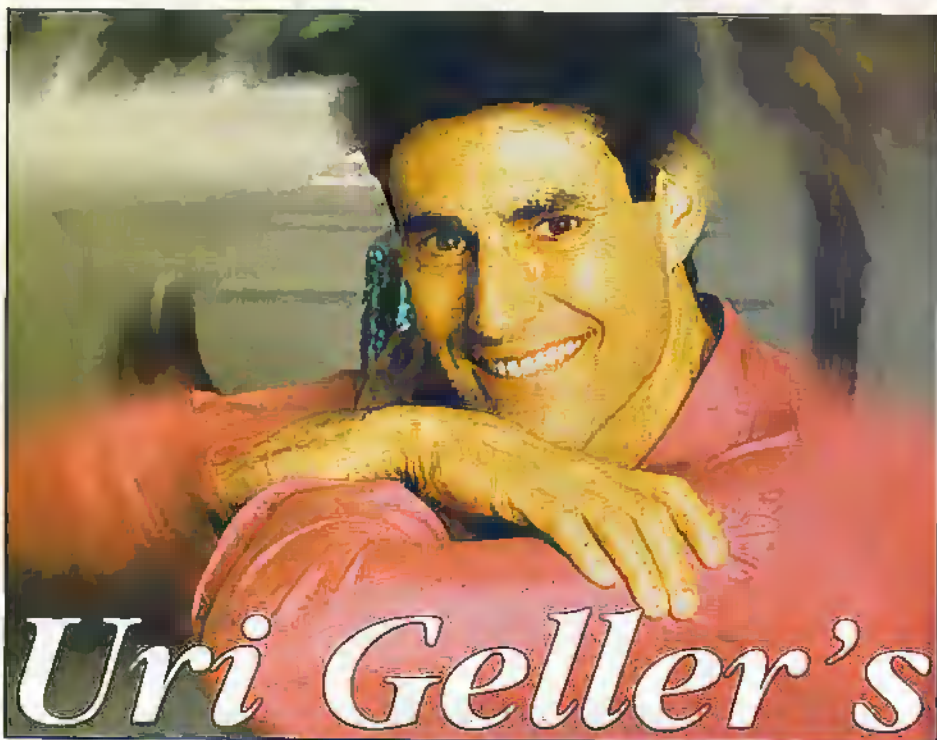
the cockpit. With full thrust on one side of the car and no thrust at the other side, the car would veer wildly off course, in fact, it would probably go into a destructive spin,

writing off a million pounds worth of car and killing the driver. In addition to its use for safety purposes, the data collection system also operated in conjunction with telemetry to transmit key parameters to the pit-station trailer where engineers and other interested parties could view them in real time. And finally, a full dump of all the data was written to a 2Mbyte data pack which was analysed after each and every run.

Despite the fact that the major emphasis of Thrust SSC's on-board electronics was to make the car fail safe, it did have one automated system which was given the OK by the FIA. This is one system which wouldn't be allowed in Formula One - active suspension. But unlike the case with motor racing, it's probably fair to say that active suspension isn't just an added extra, it's absolutely essential at supersonic speeds. If the nose of a supersonic car were to rise by just a half of a degree, the car would flip over backwards hitting the ground with phenomenal force. On the other hand, if the nose were to dip, the car would attempt to bury itself in the ground with equally disastrous consequences. Thrust SSC's microprocessor-controlled active suspension system was used to keep the car level to within the necessary safety limits and it's probably true to say that Andy Green owes his life - and his place in the record books - to this particular bit of technology.



The Thrust SSC Cockpit



Uri Geller's EXTENDED REALITY

Presidential Coincidence

When I met Senator Albert Gore (as he was then) in Geneva in 1987 I had the feeling that, as I said on page 365 of *The Geller Effect* (1987) he was "a man who could well be a future U.S. president" And so he could. If President Clinton fails to complete his current term, for whatever reason, then he will be. And if Clinton remains in office until the next election, the chances are that Vice President Gore will be the Democratic candidate.

Naturally, I would like my prediction to come true. Yet I am not sure that even if I were eligible I would want to run for the job of president in the year 2000. For, by one of the strangest strings of coincidences in history, every single American chief executive elected at twenty-year intervals between 1840 and 1960 died in office, whether naturally or unnaturally. Here's the list:

- ◆ 1840. William H. Harrison was the election just months after the Battle of Tippecanoe, at which he was said to have been cursed by one of the native chiefs he had defeated. Just a few months into his term of office, Harrison died from pneumonia, aged 68.
- ◆ 1860. Abraham Lincoln, re-elected in 1864, was shot dead the following year.
- ◆ 1880. James Garfield was assassinated before he had completed his first year in the White House.
- ◆ 1900. William McKinley was also assassinated within months of his inauguration.
- ◆ 1920. Warren Harding was not assassinated, for once. All the same, he did die a premature death at the age of 57.

◆ 1940 F.D. Roosevelt was not assassinated either, although there was at least near-miss. However, he did die in office during his fourth term.

◆ 1960. John F. Kennedy suffered the most public and controversial assassination of all time - a case that many believe to be still unsolved.

Ronald Reagan was elected in 1980 and served out two full terms despite very nearly being shot dead a matter of weeks after his inauguration in 1981. So he will go down in history for, among other things, breaking the 20-year death cycle. Or did he? True, he stayed alive, but a very serious attempt was made to kill him so it could be claimed that the mysterious cycle is still at work. The bullet only missed his heart by a few inches. By comparison, only one other president who was not elected in a 20-year interval year also died in office. (It should be mentioned that Presidents Truman and Ford also escaped assassination attempts). Seven in a row die in office, the eighth very nearly did, and the ninth... We must wait and see.

Is it all just 'Coincidence'? We may never know, because coincidence is something you cannot really prove or disprove. Yet there are those who are not so sure that all those presidents died in office purely by chance. In 1966 a group called the Society for the Investigation of Recurring Events met in New York to discuss the matter.

Some fairly strange suggestions were made. An astrologer pointed out there had been a Jupiter-Saturn conjunction in each of the terms of the presidents who died in office, somebody wondered if the sunspot cycle had anything to do with it noting that the interval between the deaths was close to the average length of a double sunspot cycle.

The most serious attempt to clear up the mystery was made by the respected psychologist Dr Stanley Krippner, who is best known for his pioneering work on dream telepathy, which I will tell you about in a future issue. He pointed out that presidential assassins over the years had quite a lot in common. They tended to be paranoid schizophrenics, loners from broken homes with an unusual haired of authority.

Krippner reckoned that since the president of the U.S.A. was the most powerful person in the world, the ultimate authority, at least for Americans, at whose desk the buck stops, there might well be a cycle of about twenty years in which tensions among the nation's misfits built up to a peak. The death of the president, natural or otherwise, serves as a kind of catharsis and calms everybody down - until tensions begins to build and a new cycle gets under way.

As for the sunspot cycle, this unquestionably does exist, and there is good evidence that major world events - especially violent ones - tend to cluster around peaks in the cycle. Recent examples include the Soviet invasions of Hungary, Czechoslovakia and Afghanistan, all in years of solar maxima.

Far-fetched? There only seem, to be three explanations for the 20-year presidential death cycle:

Coincidence. But how many presidents elected at 20-year intervals are going to have to die in office before this can be ruled out. Isn't seven (Plus a near miss) enough?

The Tippecanoe curse. We don't know enough about curses to be sure what they can or can't do - if anything. But why would a defeated native chief only curse every third or fourth president, and not all of them?

There is a genuine cycle, which operates more or less as described by Dr. Krippner.

I think the first or third of these has to be the right one, but I wouldn't like to bet on either of them. We shall just have to wait and see if the deaths in office continue. Oh, and by the way, there will be a Jupiter-Saturn conjunction a few months before the 2000 election...

One way and another, my advice to any of my American friends who might be planning to run for the top job is - wait until 2001. You never know.

Uri Geller's novel *Ella* is published by *Headline Feature* at £5.99, and his *Little Book Of MindPower* by *Robson Books* at £2.50, and *Jonathon Margolis' Uri Geller Magician or Mystic?* by *Orion Books* at £17.99.

Visit his live website camera at urigeller.com and e-mail him at urigeller@compuserve.com

PROJECT



Low Cost BENCH TEST AMPLIFIER

Gavin Cheeseman describes a low-cost bench amplifier with a couple of extra features.

When developing or fault finding electronic circuits, it is often useful to have access to a low power audio amplifier that can be connected to the circuit to confirm that it is operating correctly and to trace possible problem areas. In this article, we look at a simple low cost test amplifier with a wide range of applications. The amplifier is fundamentally a mono unit, as this is often all that is required for test purposes. However, an additional amplifier may be added for use in stereo applications if required. The design is intentionally open ended so that it may be customised to suit individual needs.

Circuit Description

Figure 1 shows the circuit diagram for the amplifier. Regulator RG1 provides a stable 9V supply for the ICs, and LD1 provides a power on indication. Supply rail de-coupling is provided at the input to the regulator by C1. Further supply filtering is carried out after the regulator; C2 and C3 de-couple IC1 whereas C12 and C14 are used for IC2.

There are four amplifier inputs via terminals P3 – P6 with P7 – P10 providing the associated input 0V connections. Variable resistors VR1 – VR4 allow the input level to be adjusted as required. The inputs are effectively combined via R2 – R5

and fed to the inverting input of operational amplifier IC1. Capacitor C4 acts as a DC blocking capacitor. Resistors R6 and R7 provide a half supply reference for the op-amp. C5 helps to prevent noise entering the system at this point. The gain of IC1 is determined mostly by the values of R8 and R2 – R5. Capacitor C7 reduces the gain of the circuit at high frequencies. The output of the op-amp (pin 6) is coupled to the next stage via C6. Variable resistor VR5 allows the signal level to be controlled at this point. The maximum level is determined by the value of resistor R9.

The next stage, comprising R10, R11, VR6, VR7 and C8 –

C11 operates as a basic tone control circuit. VR6 is a treble control and VR7 affects the bass response. Capacitor C13 provides inter-stage coupling between the tone controls circuit and power amplifier formed by IC2 and associated components.

There are three outputs. Terminal P11 provides access to the signal at a low level before the tone controls and power amplifier. The main power amplifier output is at P15 and an attenuated output suitable for driving headphones or an external power amplifier is provided at P14. Terminals P12, P13 and P16 are intended as output 0V returns.

Building the Circuit

The circuit may be constructed using matrix board either with or without copper strips. As with most high gain circuits, some care is required with regard to component layout. Unwanted coupling between the amplifier output and input via supply rails or due to proximity should be avoided. With this in mind, it is useful to lay out the circuit in a similar component order to that shown on the circuit diagram. Where possible star earthing techniques should be used. In particular the +V2 and 0V connections to IC2 should be kept separate to those for IC1 and associated components. The position of the de-coupling capacitors is also important. The capacitors should be connected as close as possible to the associated IC. Hence C2 and C3 should be mounted near to IC1 and C12 and C14 in the area of IC2.

Other components should also be mounted close to the associated IC and long wiring runs between components should be avoided. All of this serves to reduce the possibility of unwanted noise and oscillation.

It is recommended that DIL sockets are used for the ICs. This avoids the possibility of overheating the IC's during soldering and facilitates easy replacement. Be sure to observe the correct polarity when fitting electrolytic capacitors and semiconductors. If incorrectly connected, there is a high chance that the components will be damaged and may even explode. The polarity of electrolytic capacitors is usually marked with a negative (-) symbol on the component body close to the negative lead. The

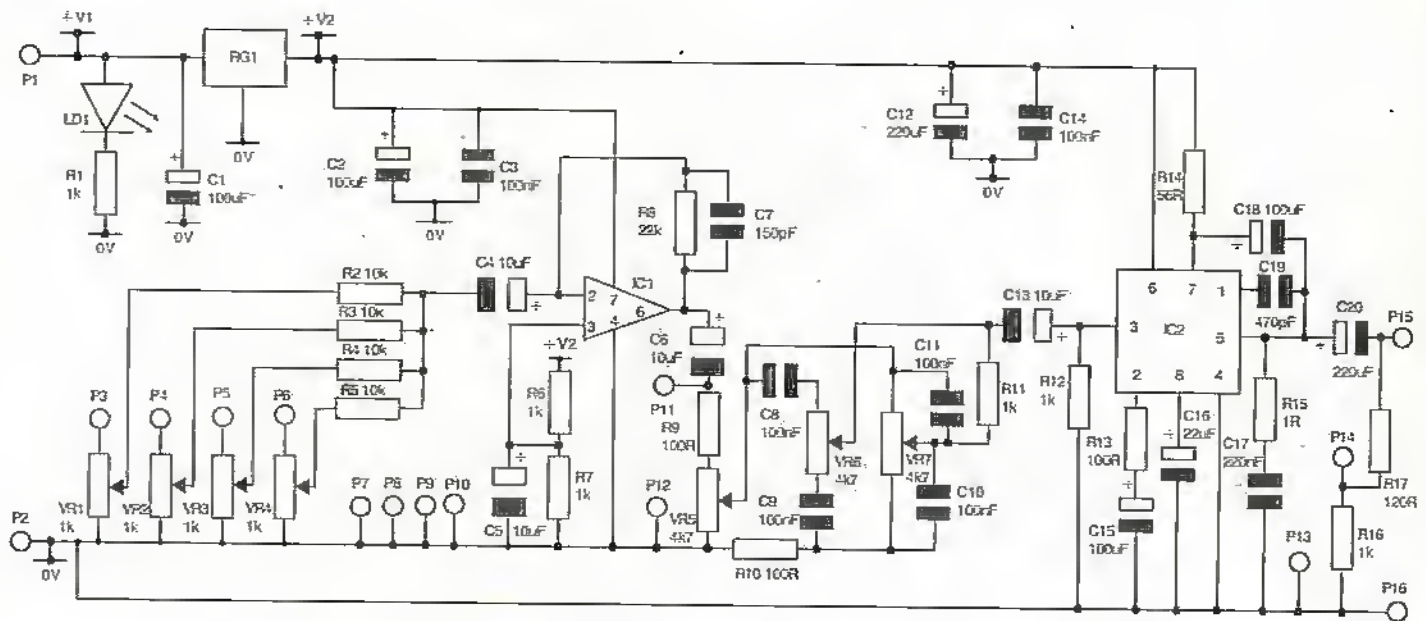


Figure 1. Bench Test Amplifier Circuit Diagram.

negative lead is also normally the shorter of the two. The polarity of LD1 may be determined by the length of the leads and/or shape of the case. The anode is normally the longer of the two leads and the cathode may be marked by a flat edge on the component case. This is illustrated in Figure 2.

The variable resistors may be mounted either on or off of the circuit board. The wiring runs should be kept as short as possible to avoid unwanted signal pickup. This is particularly important where the devices are mounted off board.

The IC and regulator pin-outs are shown in Figure 3. Once construction is complete it is recommended that visual checks are carried out to ensure that the components are connected correctly and that there are no problems with the soldering.

Testing

It is recommended that the basic functionality of the circuit is tested before the board is installed into a case. It is advisable to wear eye protection when applying power if the circuit is not enclosed. Components in even low power amplifier circuits have been known to launch themselves when incorrectly connected or if instability is present! Although this is a relatively rare occurrence if the circuit has been fully checked, it is best to apply caution.

Figure 4 shows the wiring diagram. The circuit is designed to operate from a 12V supply. The supply must be capable of delivering at least 400mA and is connected between P1 (+V) and P2 (0V). It is recommended that a suitable fuse is fitted in series with the +V supply line to minimise damage in the event of a fault. To test the amplifier you will require a source of audio or an AF signal generator. Adjust VR1 - VR4 to minimum and set VR6 and VR7 to the centre position. As the amplifier is AC coupled, level control, VR5, should be set to minimum before applying power to the circuit, in order to avoid a switch-on 'pop'. After power is applied, VR5 should initially be set to the centre of its travel for testing purposes. If you have a multimeter, it is useful to measure the power supply current at this stage. The current should be considerably less than 100mA without a signal applied. Any more than this suggests a problem. If everything appears to be OK, apply a signal to the input of the amplifier between P3 (input) and P7 (0V). The level should not exceed 775mV RMS. Slowly increase the setting of input level control VR1. As the control is rotated, the signal should be audible from the loudspeaker connected to the amplifier output. Adjusting the master volume control (VR5) should also affect the output level. If all

is well check the operation of tone controls VR6 (treble) and VR7 (bass). There will be some interaction between the bass and treble controls. This is normal in a simple passive tone control circuit of this type. Disconnect the input on P3 and sequentially connect it to P4 - P6 to check that these inputs are working correctly. Also check that an attenuated output is available between P14 (output) and P13 (0V).

If an oscilloscope is available, it may be useful to check the waveforms at P11 and P15 to ensure that there is no unwanted instability at the output. If you do not have access to an oscilloscope, a rough distorted sound from the amplifier may also suggest that instability is present. If this is the case, re-check your layout for unnecessarily long wiring runs and proximity of input and output components. Sometimes slight changes in component and wiring layout can make a lot of difference. Once everything is working correctly, then the circuit board may be installed in a suitable case.

Housing Considerations

Almost any case of an appropriate size to fit the circuit board is suitable. If a metal case is used, it may be necessary to take extra precautions to ensure that

an earth loop is not created between the input and output sockets via the case. Of course, this is not a problem with plastic cases although these do not provide screening.

RG1 and IC2 should be kept away from any material that may be damaged by high temperature. This is really a precautionary measure as the operating temperature of the IC should not be excessive. The actual operating temperature will depend on the output power level, duration of use and the ambient temperature. It is recommended that free air flow is allowed around the IC to facilitate cooling. A small heatsink can be attached if necessary but in most applications, not enough heat will be generated to warrant this. Similarly a heatsink may also be attached to RG1 but this is normally only necessary where the amplifier is being used continuously.

The circuit has been designed to be relatively versatile and the front panel layout may vary depending on specific applications and housing arrangements. It is up to the user to determine the type of input sockets required. You could use four 3.5mm jack sockets or alternatively fit a range of different sockets to allow for a wide variety of input connectors. Examples are BNC, XLR, DIN and so on. A balanced input may be provided using a transformer as shown in Figure 5.

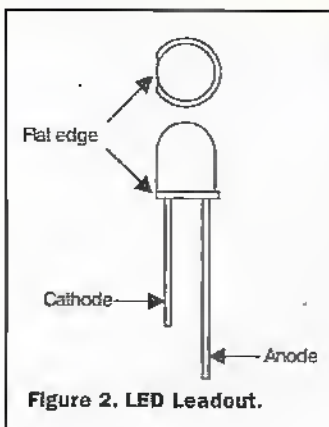


Figure 2. LED Leadout.

In all cases screened lead should be used for the connections as this reduces stray signal pickup. The input signal should be applied to the centre conductor and the screen connected to the appropriate input 0V terminal.

Similar considerations apply to the output sockets. If required a switched jack socket may be connected to the output to allow the connection of an external 8 ohm loudspeaker. The connector should be wired such that the internal speaker is disconnected when a plug is inserted into the output socket. This is illustrated in Figure 6.

Using the Amplifier

The amplifier lends itself to a wide variety of uses. The unit is ideal as a go/no go tester for audio frequency transducers such as microphones and guitar pickups. These are simply connected to the input of the amplifier and the output monitored directly. When testing microphones it may be sensible to use a pair of headphones to avoid unwanted acoustic feedback. The input to the amplifier is quite sensitive and is adequate for most applications. If you require more sensitivity, the gain of IC1 may be increased by raising the value of R8. However, it is best to avoid very high values as instability may result.

Similarly some readers may prefer a different response from the tone controls. The frequency characteristics of the tone control circuit may be modified by varying component values. Probably the easiest way to achieve this is to change the value of capacitors C8-C11.

Together with a suitable AF signal source, the amplifier may help to locate faults in low

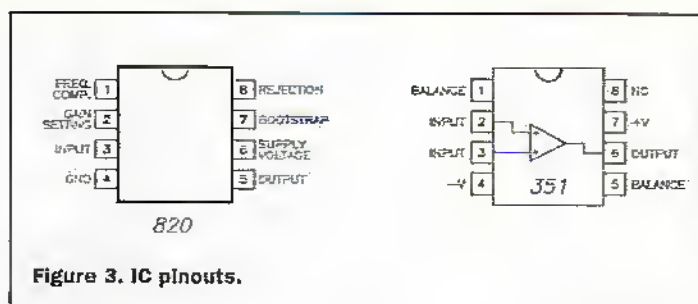


Figure 3. IC pinouts.

power audio circuits. The signal source is injected at the circuit input and the amplifier is connected to the outputs of individual stages in the circuit. In this way, it is often possible to determine in which stage a fault has occurred. Comprehensive AF signal generators with variable frequency, output level and wave-shape are available off the shelf (see the Test and Measurement section of the Maplin catalogue). Alternatively, simple oscillators are relatively easy to construct and may be installed inside the test amplifier case (more of this later).

In signal tracing applications of the type described, care should be taken to ensure that the input impedance of the amplifier and the voltage levels involved are appropriate for the

circuit being tested. It is recommended that signal inputs to the amplifier do not exceed line-level. An additional resistor may be fitted to one or more of the inputs to provide some additional attenuation if required. This modification is very simple to carry out and is shown Figure 7. The value of the resistor will depend on the amount of attenuation required when the input level control is set to maximum. For example use of a 1k resistor will provide approximately 6dB of additional attenuation at the input and will also increase the input impedance. The amplifier is not intended to be connected to inputs with a DC offset although a small offset in the order of a few mV should not be a problem.

Different input signals may be

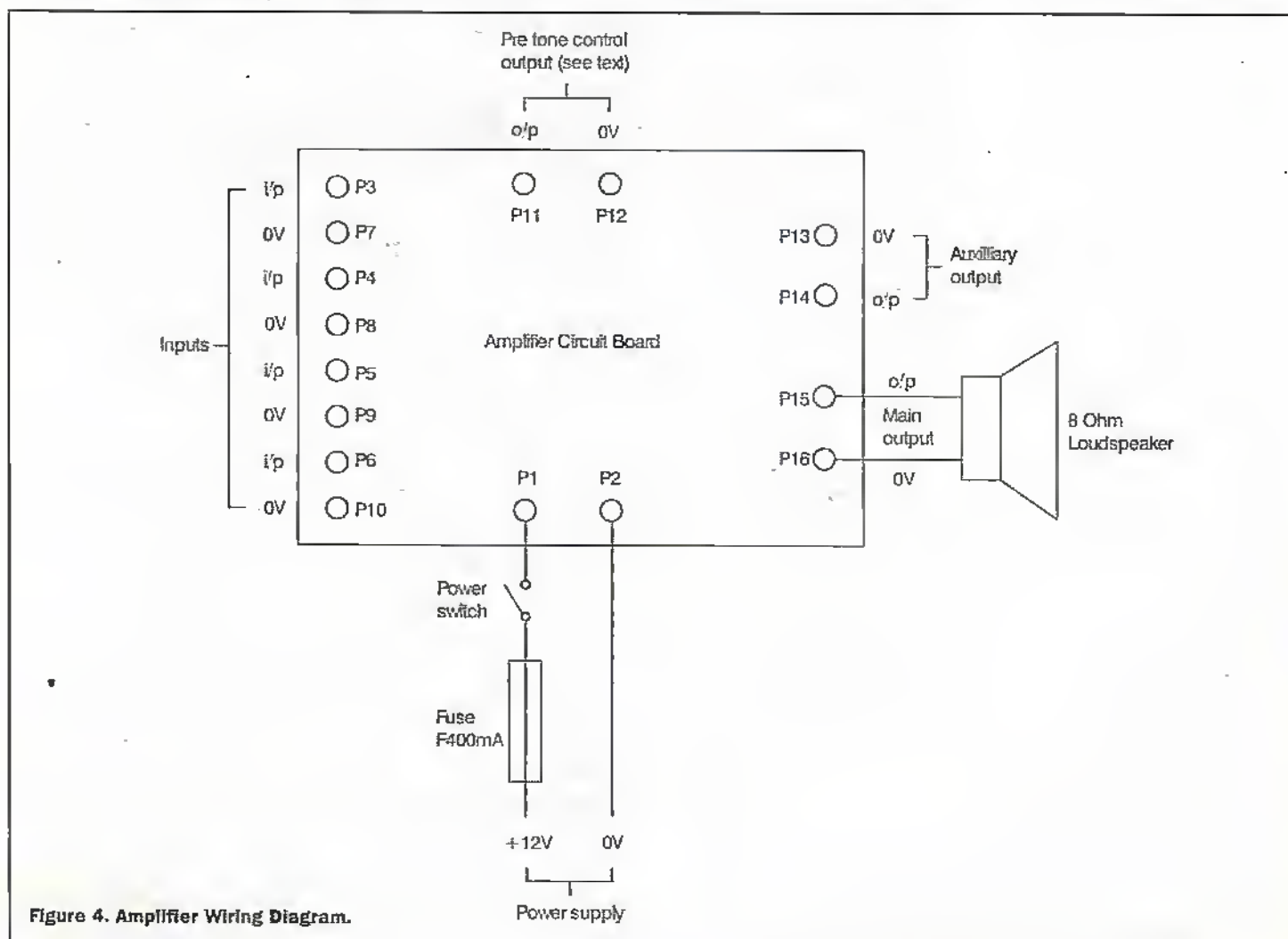


Figure 4. Amplifier Wiring Diagram.

applied to each of the four inputs simultaneously if required. The level of each signal can be controlled using VR1 – VR4 and the signals are combined at the input of IC1. This is useful if you are switching between different signal sources and wish to avoid continuously swapping the input leads. Using the output from P11 (output) and P12, the circuit may also be used as a simple mixer to drive other external equipment. For example the output from up to four microphones can be applied to the input of the amplifier and combined. The output at P11 can be used to drive an external power amplifier. The tone controls are not intended to operate on this output. If you need to adjust the tonal quality of the signal then the output may be taken from P14 or P15 depending on the required level.

The amplifier can be used to test sound sources such as cassette and CD players on a channel by channel basis. Alternatively the left and right channels may be fed into different inputs and combined. For example the left channel could be connected between P3 (input) and P7 (0V) and the right channel between P4 (input) and P8 (0V) as illustrated in Figure 8. The output signal will depend on the phase of the two input signals but is usually adequate for monitoring purposes.

Stereo Version

Although the unit is generally intended for mono applications, there should be no reason why

two amplifier circuits cannot be housed in the same case for stereo reproduction. As long as you do not need to control the

volume and tone of each channel independently, dual potentiometers may be used for VR5 – VR7. In this way the left

and right channels are controlled simultaneously saving on potentiometers and front panel space. Of course, a set of loudspeakers or stereo headphones would be required. It may not be appropriate to mount two loudspeakers in the case due to size and separation considerations. It may, however, be useful to install a single internal loudspeaker to allow the amplifier to be used in mono configuration when the external speakers or headphones are not connected. In this case the output sockets should be wired such that the internal speaker is disconnected when the appropriate external output is in use. This approach may appear simple but is nevertheless effective.

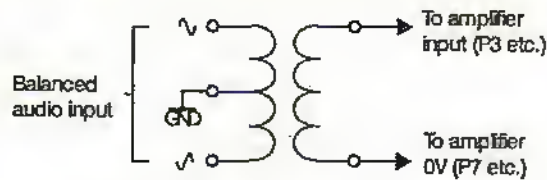
Other ideas

For those readers who like to experiment, it may be useful to add additional features to the amplifier to make it into a versatile test set. These features have not been included as part of the basic design as requirements vary considerably.

If you are interested in radio, you may wish to add a simple AM detector circuit to one of the inputs. This will enable AM receiver IF outputs etc. to be monitored and could be useful when designing or repairing radio circuits. In its simplest form this may be nothing more than a diode and a capacitor connected to the input. Some additional buffering may be advisable to prevent the amplifier input from excessively loading the receiver IF stage. Other types of demodulator could also be added. The complexity of these varies depending on the type of transmission being demodulated and the frequencies involved. Readers wishing to experiment in this area are referred to the Books section of the Maplin catalogue.

As mentioned, it may also be useful to include a simple oscillator to enable a test signal to be injected into other pieces of equipment without the need for an external signal generator. For signal tracing purposes at audio frequencies, the output from the oscillator need not be particularly sinusoidal and a fixed frequency (usually 1kHz) will often suffice. Even a simple square wave oscillator with a variable output level control may be suitable. There are many designs for circuits of this type.

If the oscillator is housed in the same case as the test amplifier, problems may be



AF isolating transformer (e.g. HX82D, FD23A etc.)

Figure 5. Using an audio isolating transformer to interface to a balanced input.

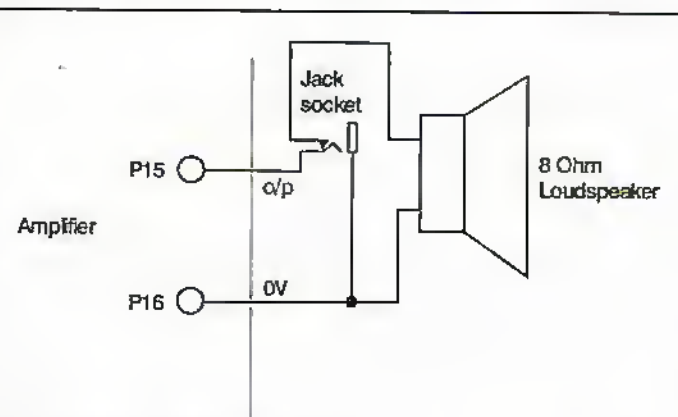


Figure 6. Connection of an external speaker output socket.

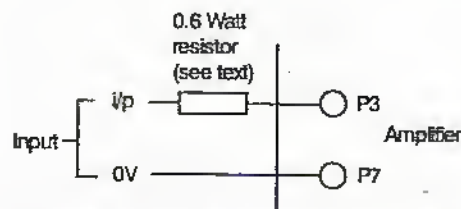
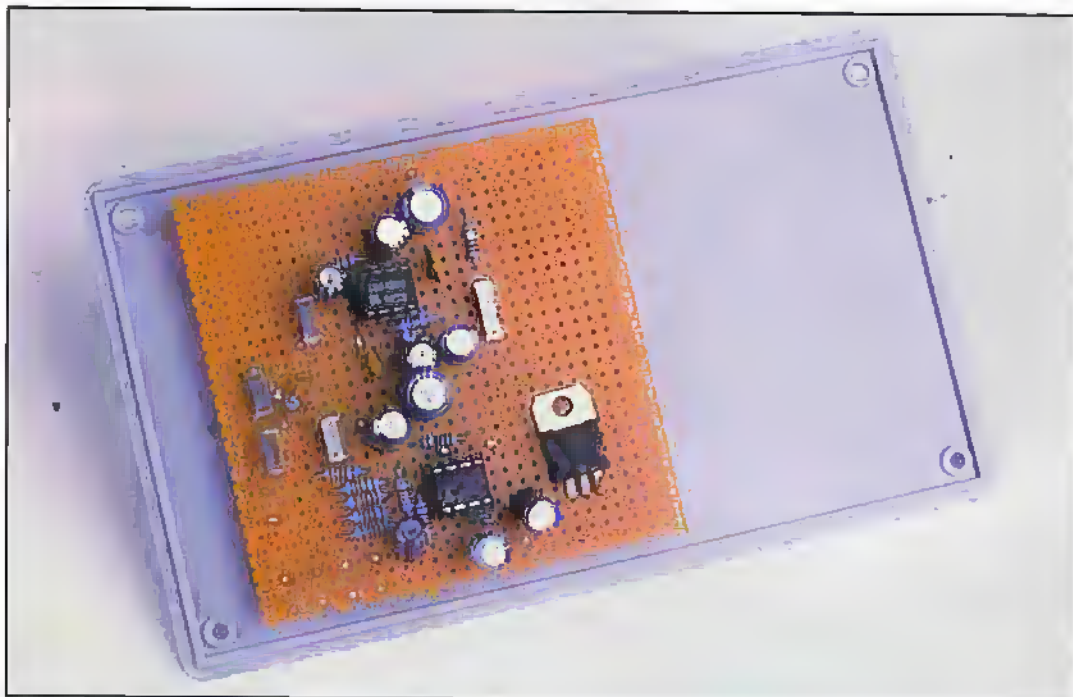


Figure 7. Use of a resistor to attenuate the input level.



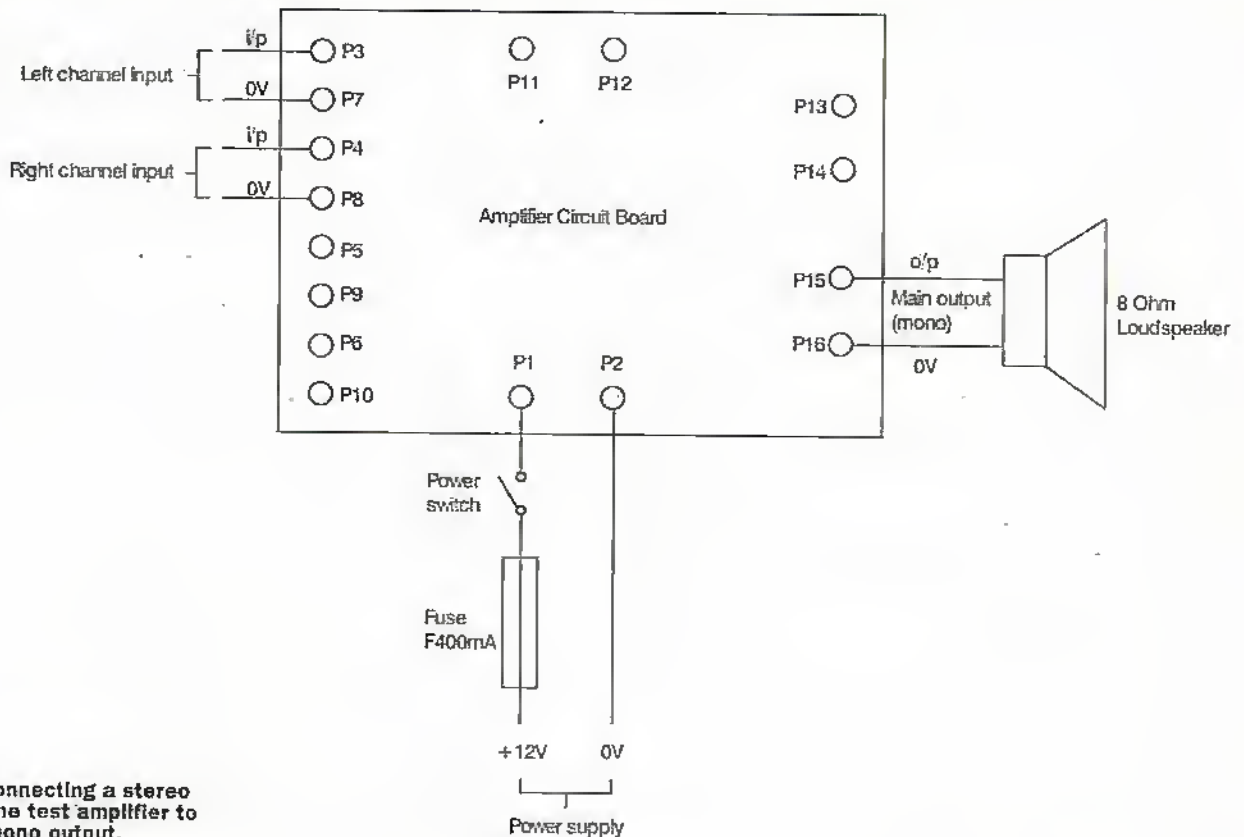


Figure 8. Connecting a stereo source to the test amplifier to provide a mono output.

experienced with signal breakthrough into the amplifier circuit. Where necessary, this can usually be overcome by screening. A simple method is to mount the oscillator in a separate metal box inside the case of the test amplifier. If arranged correctly the output socket may be brought out directly on the front panel of the amplifier without the need for any exposed internal wiring.

Of course, care must be taken to ensure that the output level from the test oscillator is not excessive for the circuit under test. Injecting a high signal level into a sensitive circuit will tend to overload it giving false results and may even result in damage to the equipment being tested.

Input Impedance

The input impedance of the circuit is determined mostly by VR1 – VR4 which have a nominal value of 1k. In some applications a higher input impedance may be required. If

this is the case a simple buffer circuit based around an operational amplifier IC may be used ahead of the amplifier input. A typical example is shown in Figure 9 and may be applied to a single input (P3,

P4, P5 or P6). It is worth noting that by its very nature a high impedance input will usually be more prone to picking up noise and unwanted signals. Therefore, use of adequate screening becomes more important than ever. Some additional input filtering may be advisable. The value of test amplifier capacitor C7 may also be increased to cut the top end response where necessary.

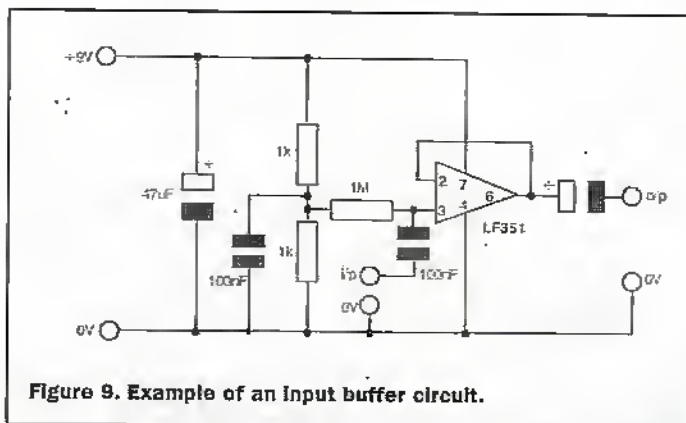


Figure 9. Example of an input buffer circuit.

Finally...

We have covered a few applications for the test amplifier but there are probably many more. If you do not have an audio amplifier on your test bench, why not give the project a try. You may wonder how you ever got by without it!

PROJECT PARTS LIST

RESISTORS

R1, 6, 7, 11, 12, 16	Min Res 1k	6	M1K
R2-5	Min Res 10k	4	M10K
R8	Min Res 22k	1	M22K
R9, 10, 13	Min Res 100R	3	M100R
R14	Min Res 56R	1	M56R
R15	Min Res 1R	1	M1R
R17	Min Res 120R	1	M120R
VR1-4	Pot Lin 1k	4	FW00A
VR5-7	Pot log 4k7	3	FW21X

CAPACITORS

C1, 2, 15, 18	GenElect 100µF 16V	4	AT40T
C3, 14	MiniDisc 0.1µF 16V	2	YR75S
C4-6, 13	GenElect 10µF 63V	4	AT77J

C7
C8-11
C12, 20
C16
C17
C19

SEMICONDUCTORS

LD1	LED Red	1	WL27E
RG1	L78S09CV	1	UJ55K
IC1	LF351N	1	WQ30H
IC2	TBA820M	1	WQ63T

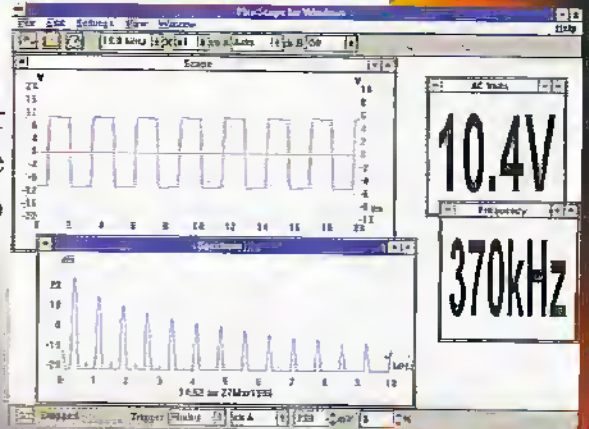
MISCELLANEOUS

P1-16	DIL Socket 8 pin	2	BL17T
	Pin 2145	16 pins	FL24B

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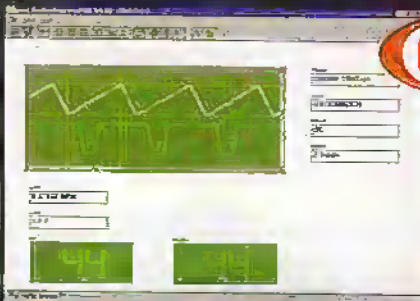
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Figure 1. Roundabout lights and LEDs.



Engineering in A ROUNDABOUT WAY

Stan Young describes the electronic and electrical aspects of a model carousel. Mechanical details for the project will be found in *Model Engineer*, issue 4087, on sale 12th February 1999.

In 1988 the writer was seeking an activity to occupy his retirement years. As an engineer involved in precision electro-mechanical engineering, it seemed that an ideal solution would be to use his acquired skills in creativity, ingenuity and manual dexterity. To this end he decided to build a model of a fairground roundabout to a scale of 1/24th. This would involve intricate work in wood, metal, plastics, glass and electronics, all of which seemed to fit the bill exactly.

The aspects of the design of interest to *Electronics and Beyond* readers lie in the three principal assemblies of the model, namely:-

1. The roundabout electrical supplies and flasher electronics.
2. The control module (which operates the drive motor, the lamps and the organ music production)
3. Inter-cabling.

The Roundabout

This is illuminated by a number of miniature 12V, 1W LES lamps, there being 108 of these distributed above the 30 horses and six cockerels, and fed by a dual-feed ring main. The supply is 36V AC 50Hz from a 230V/36V

dual secondary transformer, one secondary being input to diametrically opposed points across the ring of lamps around the roundabout (Figure 3A). The organ lamps are driven from the other secondary winding output (See Figure 3B).

Multi-core ribbon wiring is extensively used (see Figure 4) to enable neat grouping of the wiring and to facilitate the use of 5-pin connectors at each junction of the 'roundings' (These roundings must be separated during dismantling of the roundabout). The flashing LEDs on the 'roundings' are also fed from the ribbon.

A further 39 lamps are arranged around the organ to illuminate this central feature



Figure 2. Organ lights.

(see Figure 2 & 3B). All of these lamps are arranged in groups of three in series; all groups of three being in parallel and supplied at 36V AC. The 108 roundabout lamps are supplied via slip rings at the centre, see Figure 3A. (The slip rings and brush assembly were from a car alternator!) There are two main reasons for grouping the lamps in three's:

1. A failed lamp could be easily traced since only one of three would be at fault (as opposed to the Christmas tree lights problem!).
2. The current carried by the slip rings was reduced to approximately 3A. (If the 108 roundabout lamps were in parallel from a 12V supply, the current would be approximately 9A)

Heat shrink sleeving was used for electrical joints (RZ59N) and 2mm silicone rubber sleeving (CC98G) for 'Universal Joints' at angled crankshaft connections for the tide drive mechanism (see Figure 4).

The 12 peripheral panels around the model (the 'roundings' which carry the words or pictures) each have 2 coloured LEDs of 3mm diameter (see Figures 1 and 3). Each pair are caused to flash alternately from a 'flip-flop' circuit in the top zone of the roundabout (see Figure 4). The flasher

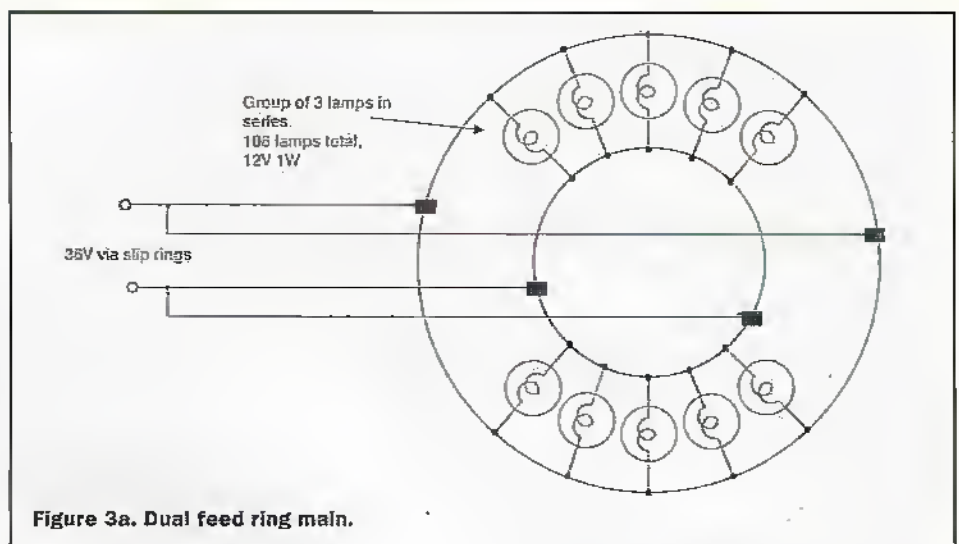


Figure 3a. Dual feed ring main.

circuit is energised by a battery which is connected via an ultra-miniature relay (FM92A) from the 36V AC supply, rectified, smoothed and through a 820Ω dropper resistor in the coil supply to obtain the required coil operating voltage (see Figure 4A). The flip-flop is driven from a 9V PP3 Nickel Cadmium battery which is applied to a 'battery life extender' circuit (using a RC4190N) via the relay (see Figure 4A). The output is fed to the flip-flop unit 'A' shown in

Figure 4A resulting in a voltage of 2V being supplied to the LEDs in two groups of 12 in the 'roundings'. Various colours of LED were used to enhance the artistic effect. There is a make/break socket in the 9V battery supply allowing recharge with the battery in situ.

A dimmer switch (FQ10L) is used to control the brightness of the main tungsten lamps. The LED's will only flash when the applied voltage level to the tungsten lamps causes the relays to operate, thereby connecting

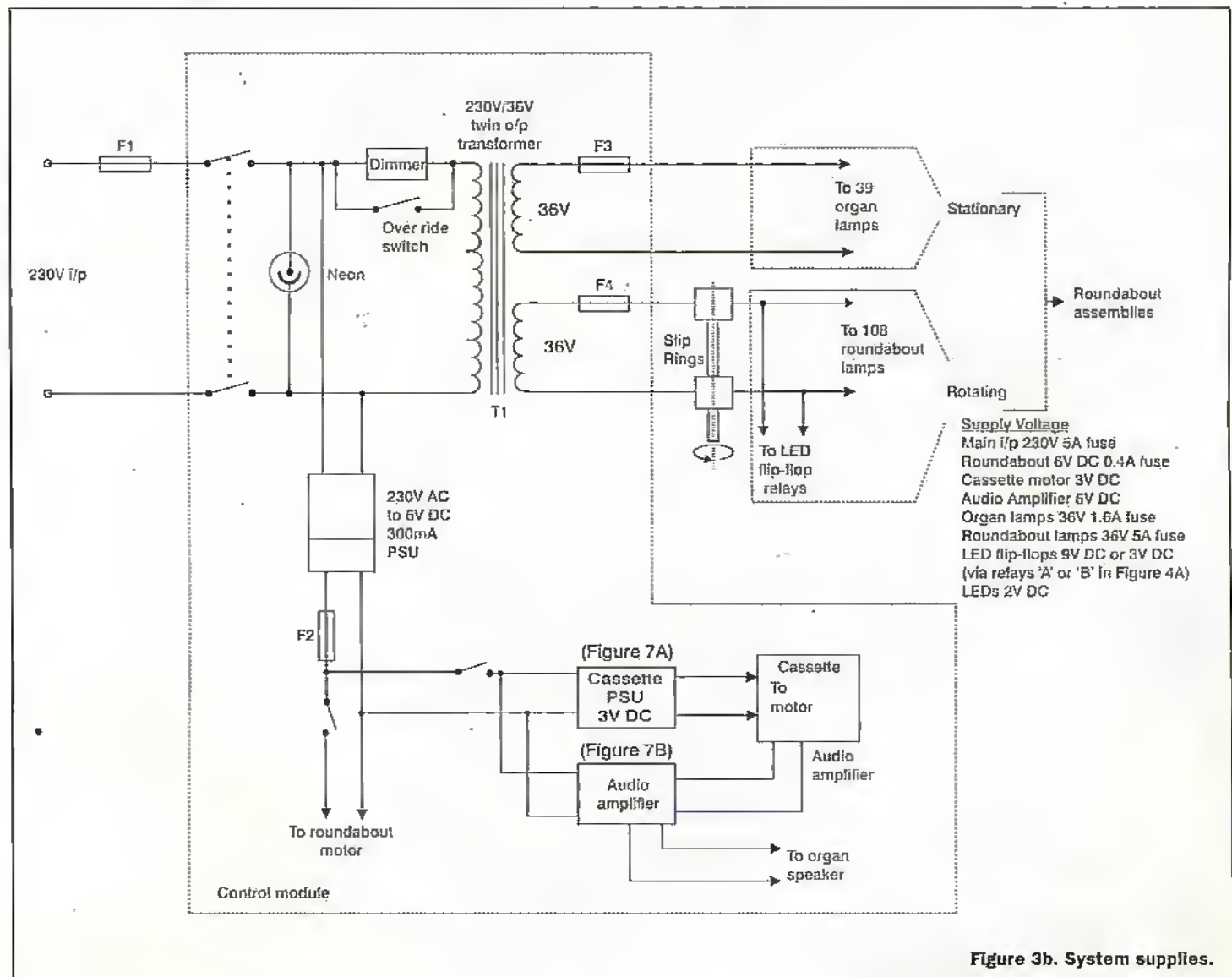


Figure 3b. System supplies.

Figure 3. Roundabout and control module.

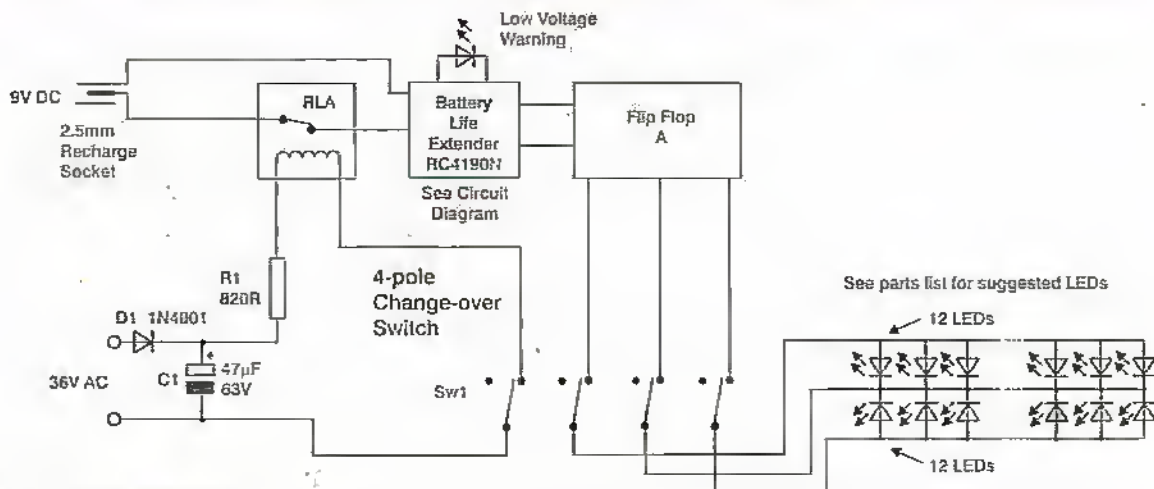


Figure 4a. LED flasher system.

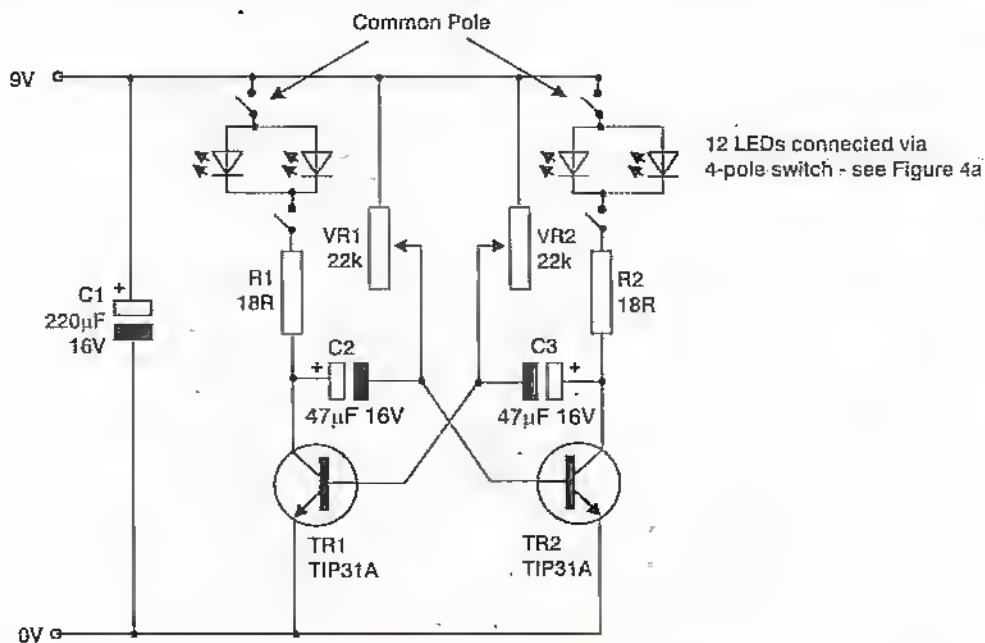


Figure 4b. LED flasher circuit.

Figure 4. LED flip-flop assemblies.

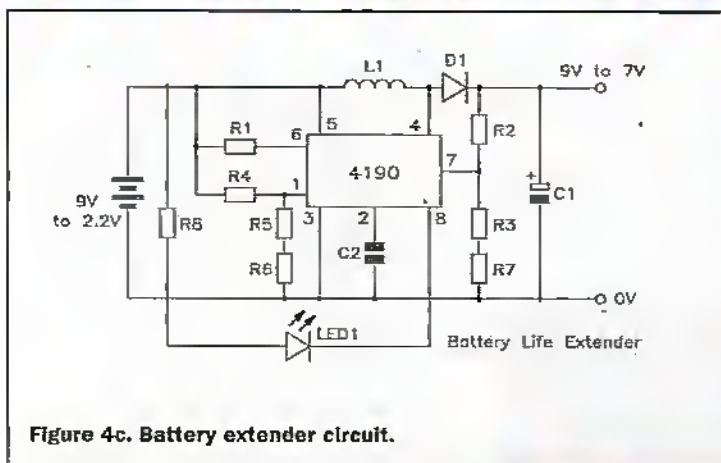
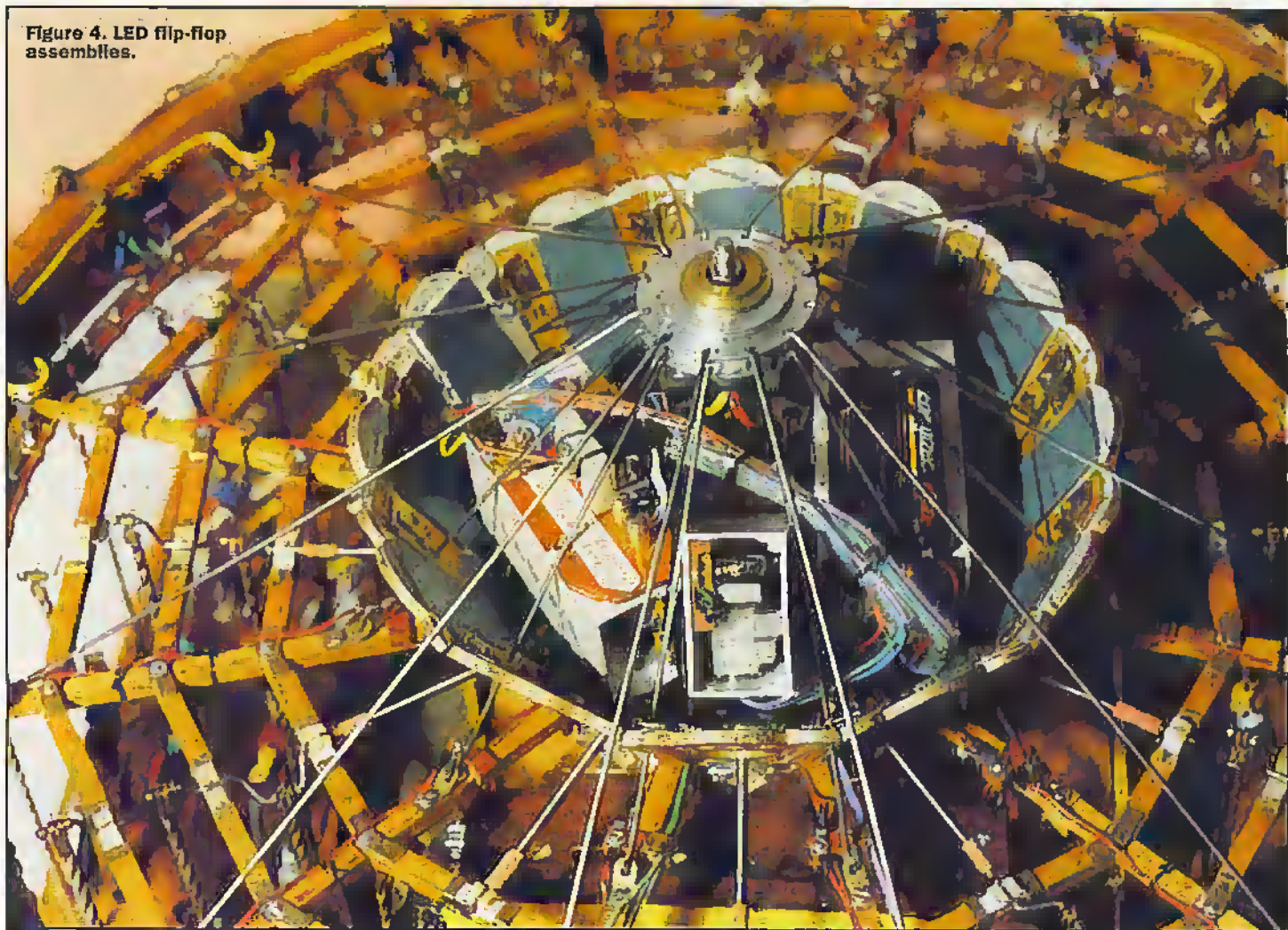


Figure 4c. Battery extender circuit.

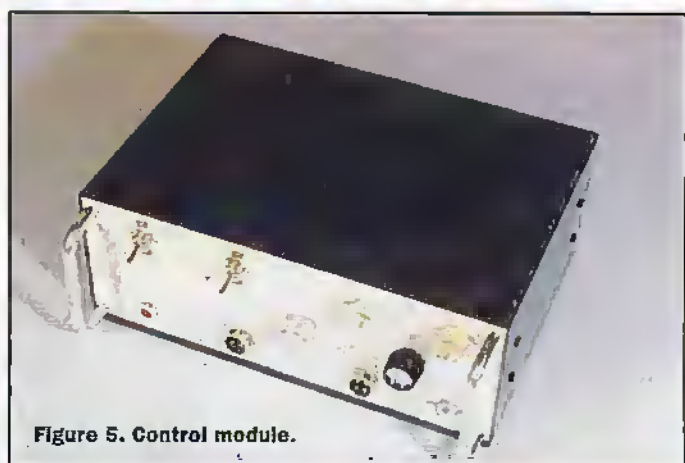


Figure 5. Control module.

the relevant battery to the flip-flops. (Care must be exercised when associating a dimmer with an LM317 as the waveform may cause malfunction of the LM317.)

The Control Module (See Figure 5)

This provides the supplies for:

- a) The main tungsten lighting (including dimming).
- b) The roundabout motor supply.
- c) The audio output to the speaker housed in the organ.

Power supplies are derived from a 230V 50Hz mains via a toroidal transformer yielding two secondary outputs of 36V (see Figure 3b). The dimmer provided in the 230V

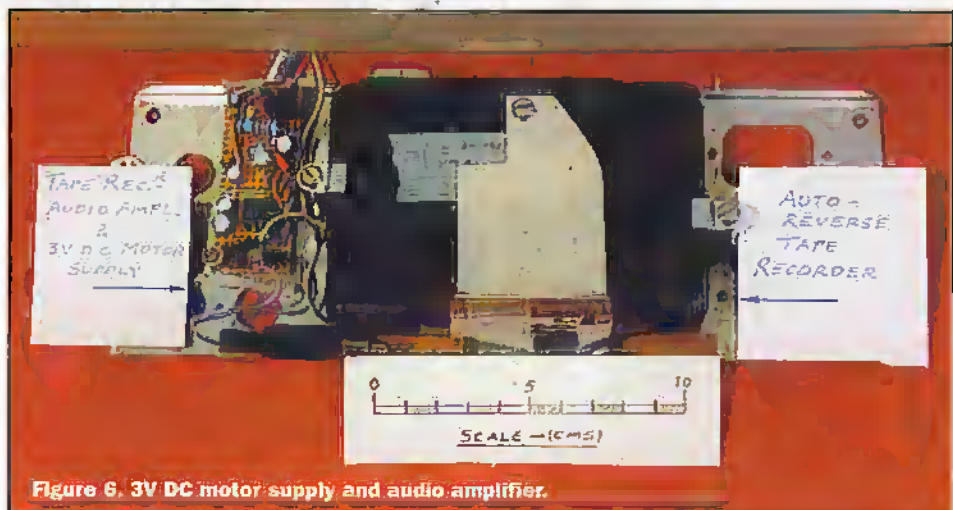


Figure 6. 3V DC motor supply and audio amplifier.

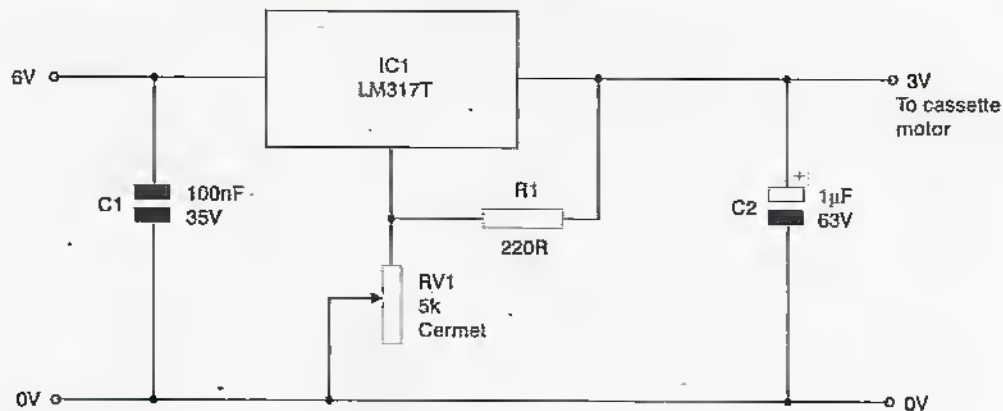


Figure 6a. Cassette motor supply

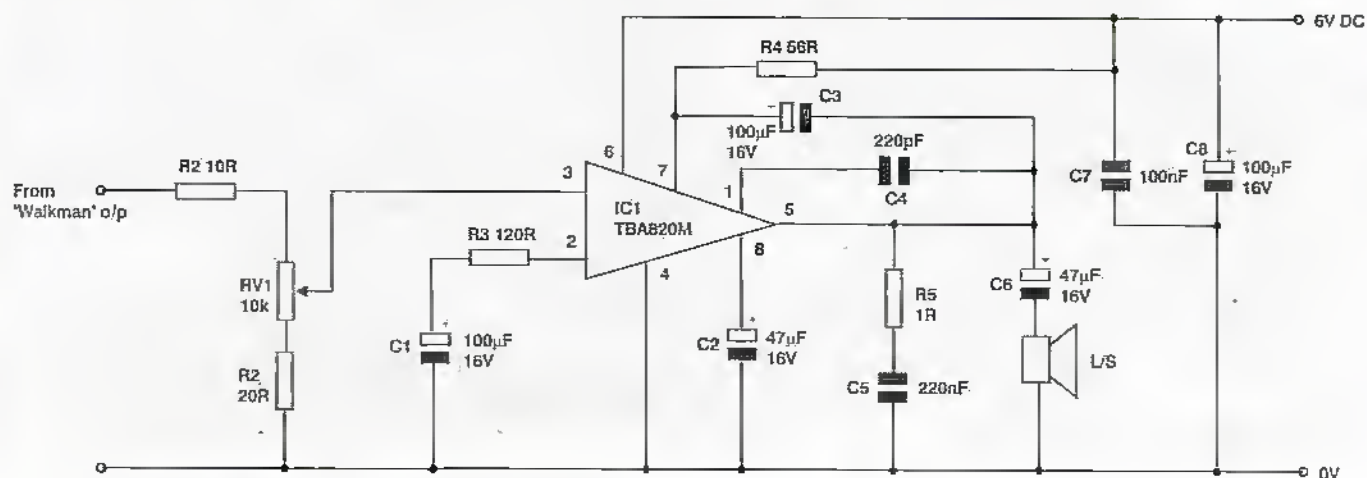


Figure 6b. Audio amplifier for cassette output.

supply gives an output which is less than 230V (due to waveform distortion) but this results in an extended lamp life due to under-running without noticeable reduction in light output. To date all 147 lamps have run for

approx. 50 hours (about 7400 lamp-hours) without a single failure. An over-ride switch is provided in case of failure of the dimmer and allows the full 230V to be applied to the transformer primary winding (See Figure 3b).

A motor supply is obtained from a 300mA power supply XX09K (see Figure 3b) giving outputs of 3V to 12V DC from a 230V AC input. This was set to 6V DC to run the main drive motor of the roundabout.

The 6V output is also used to run the 3V DC tape motor via an LM317T (UF271E) circuit (see Figures 6 and 6a). The tape player is a reversing cassette unit built into the control module (see Figure 7).

The output from the tape player is amplified using a TDA820M circuit and associated components (see Figure 6 and 6b). The control module is housed in a steel instrument case with handles (model 2610/180, order code XJ34M) with all knobs, indicator lamps, connectors, fuse holders and switches from Maplin stock (see Figures 5 and 8).

Inter-cabling

Four cables are needed as shown in Figure 3:

1. 230V mains 3-core, to the rear of the control module, terminating in a Eurosocket HL16S (this cable is shown coiled in Figure 3).
2. 36V AC from the front of the control module to the rear of the roundabout for lighting (4-way sockets FK24B).
3. 6V DC from the front of the control module to the rear of the roundabout for main motor supply (2-way sockets FK22Y/HF97L).

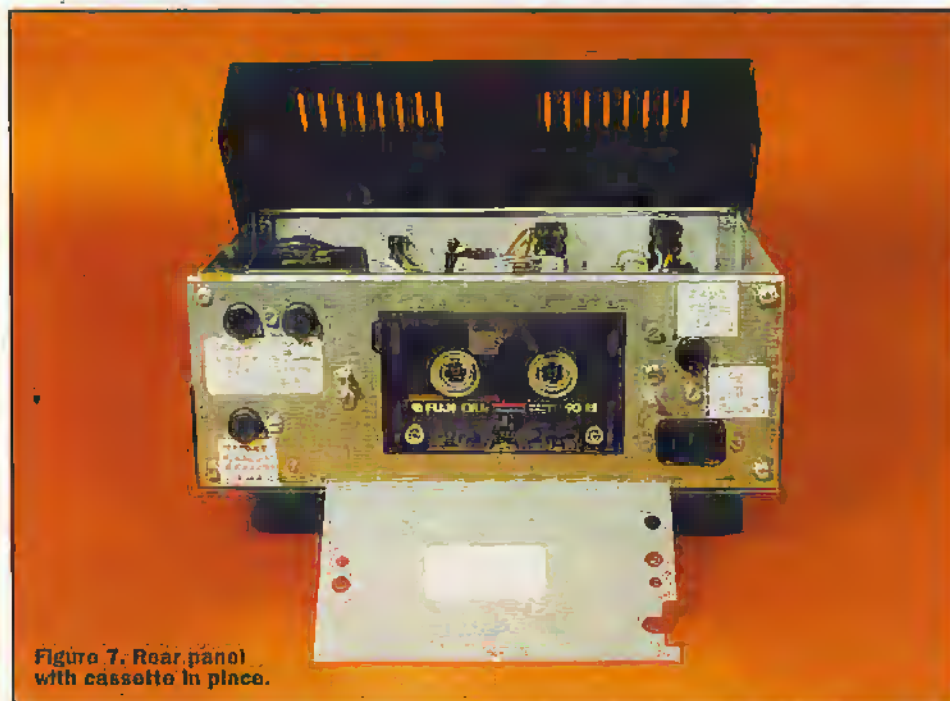


Figure 7. Rear panel with cassette in place.

4. Audio output from the front of the control module to the rear of the roundabout for organ speaker input (lockable mono-jack plug FV03D/2-way and audio socket FK22Y).


Again all connectors and cables were obtained from Maplin stock.

Summary

The complete model roundabout measures 19 inches (483mm) in diameter by 11 inches (280mm) in height and rotates at 6 rpm. The initial build took 3,500 hours over 5 years with a further two years of improvement. The ornately decorated horses and cockerels execute a conventional galloping motion and are accompanied by genuine Gavioli organ music – the whole illuminated by 150W of miniature lamps.

The model is used to give talks to various organisations, such as schools, community centres, Probus Clubs and professional institutions.

The writer gratefully acknowledges the basic design parameters of motors, gearing and wooden structures provided by Model Fair Designs of Mr Vic King, Oxford. This design was modified by the writer to provide

improved bearings, lamps supplies, wiring, unique art work and plastic moulded horses and cockerels of traditional design. 

Mechanical details for this project will be found in Model Engineer, Issue 4067, on sale 12th February 1999.

Stan Young was formerly Chief Installation Engineer of Laser Systems Group, Ferranti Ltd., until 1989. He is a B.Sc. Chartered Engineer, Fellow of the Institution of Mechanical Engineers and a Fellow of the Institution of Electrical Engineers.



Figure 8. Front panel with switches and knobs.

SUGGESTED PARTS LIST

CASSETTE PSU – FIGURE 6A

RESISTORS

R1 Min Res 220R M220R
RV1 Cermat 5k WR41U

CAPACITORS

C1 Minidisc 100nF BX03D
C2 Minelect 1µF 63V. VH03D
IC1 LM317T UF27E

AMPLIFIER FIGURE 6B

RESISTORS

R1 Min Res 10R M10R
R2 Min Res 20R M20R
R3 Min Res 120R M120R
R4 Min Res 56R M56R
R5 Min Res 1R M1R
RV1 Pot Log 10k FW22Y

CAPACITORS

C1,3 Minelect 100µF 16V VH13P
C2,6,8 Minelect 47µF 16V VH11M
C4 Ceramic 220pF WX600
C5 Polyester 220nF BX78K
C7 Polyester 100nF BX76H

SEMICONDUCTORS

IC1 TBAB20M WQ63T

MISCELLANEOUS

L/S Suitable 8Ω Speaker

BATTERY LIFE EXTENDER

RESISTORS

R1 Min Res 1M M1M
R2 Min Res 110k M110K
R3 Min Res 12k M12K
R4 Min Res 910k M910K
R5,6 Min Res 130k M130K
R7 Min Res 13k M13K
R8 Min Res 470R M470R

CAPACITORS

C1 PC Elect 47µF 25V VH32K
C2 Ceramic 47pF WX52Q

SEMICONDUCTORS

D1 1N4148 QL80B

L1 Choke 1mH WH47B
LED1 Low Current 5mm Red UK48C

LED FLASHER SYSTEM FIGURE 4A

RESISTORS

R1,2 Min Res 820R M820R

CAPACITORS

C1 Minelect 470µF 63V AT84F

SEMICONDUCTORS

D1 1N4001 QL73Q
LEDs (Bi-Coloured 3mm LEDs) 24 UF96E

SYSTEM SUPPLIES FIGURE 3B

T1 Toroidal Trans 160VA YK21X
F1,4 20mm Fuse 5A DA02C
F2 20mm Fuse 400mA CZ93B
F3 20mm Fuse 1.6A CZ98G
Dimmer
AC Adaptor 300mA XX09K
Panel Neon Red BK52G
2610/180 Case XJ34M
12V 1W LES lamps 108 off WL75S
Heat Shrink Sleeving as reqd RZ59N
2mm silicone rubber sleeving as reqd CC98G
4-pole C/O Switch FH08J
Ultra Min Relay 1 FM92A
Eurosocket HL16S
4-way Sockets as reqd FK24B
2-way Sockets as reqd FK22Y/HF97L
Lockable Mono Jack Plug FV03D
Dimmer Switch FQ10L
9V PP3 NiCd Battery VN52G

FLIP FLOP CIRCUIT

RESISTORS

R1,2 18R 1W
2 x 36R Min Res in parallel M36R
VR1,2 22k Horz Preset UH04E

CAPACITORS

C1 220µF 16V GenElect AT41U
C2,3 47µF 16V GenElect AT39N

SEMICONDUCTORS

TR1,2 TIP31A QL15R

REVIEW

Virtual Build CHESS PIRATES GOING LOCO

Paul Freeman-Sear returns to his Lego building days but this time in a virtual world with a review of three packages from Lego Media International, a separately based company set up to develop media products.

Creator

One of the great problems in building anything in Lego bricks is the frustration that might ensue when you don't have the correct bricks to finish the job. Translate your building prowess to the computer screen and you are limited no longer. Creator, launched at the end of last year in time for Christmas does just this. Create what you want with standard Lego parts and place them in a typical Lego scene taken either from stock urban situations or even pick your own roadways and buildings and you are ready to experience the action.



When you've finished, click on Play and the whole thing comes alive complete with urban sounds. Imagine you are in a helicopter and you can 'fly' over the action and view at any angle with a day or night time scene.

This is where I found it thoughtful of the creators, you can set your play town to run using a real clock with a day/night cycle or introduce night at the scene at the press of a button with

the lights coming on at dusk. Clever!

As with all Lego Media products it is easy to install. On the first run you can go straight into the tutorial. It goes without saying, this is for the kids in the household (honest) and really,

the lower age end is limited only by comprehension and basic command operation of a computer. However I am sure adults will be interested in looking over shoulders.

When building up a model, opening the 'toy box' icon will reveal a variety of options including the type of 'Lego World' you want to build in, and the type of preset model buildings you would like to place in your scene. These include a lot of the standard models you can buy with real bricks. Then we go on to the types of bricks at your disposal and of course in the colour you want. The action of fitting bricks together is helped by shadows for correct placement and you get a clicking sound effect of the bricks locking in place.

There is a whole range of vehicles to choose from. Set them up with a driver or pilot on their predetermined path in the air or on the roads and away they go. Action bricks will hinge, rotate, give off sounds, flash and illuminate all at you're programmed command.

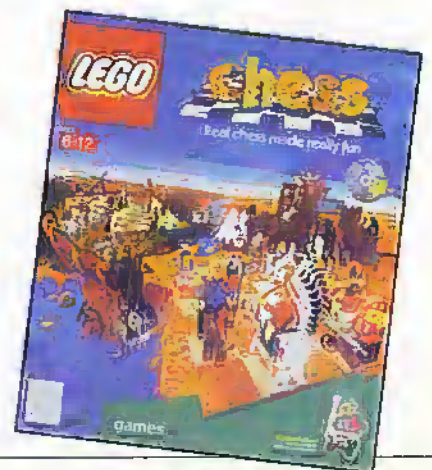
If you are looking for more spectacular action, there are 'Destructa' bricks. These fiendish little bricks, if placed within your model or if placed on their own in the play scene will explode at the mere click of a mouse button. A more pre-planned approach is to program the detonating mechanism with timed or random fuses. Is this fun or not?

And when you have made a model to be proud of you can save in the usual manner. The building instructions of your favourite model can be printed out and given to friends.

I would thoroughly recommend this one at \$34.99.

Chess

Now this is a game to revive the stimulus of strategy and thinking power of children. I remember how mentally refreshed I was after a game of chess years ago. And so it was with this one from Lego. With the excellent standard of tutorial over, should your children need it, a game can now commence. You have the option of choosing real images of chess pieces or replacing them with Pirates or Wild West characters and with a choice of background. Once started, the game progresses with running commentary/advice on what you can or can't do. Either playing against the computer or a friend, the board can be viewed from many angles using real time 3D technology. Having said that, moving one of your chess pieces to some of the fanciful angles might just be a little bit difficult. If you are playing a friend on the same computer, the board will rotate for each move. That's neat! A game is also possible over the Internet.



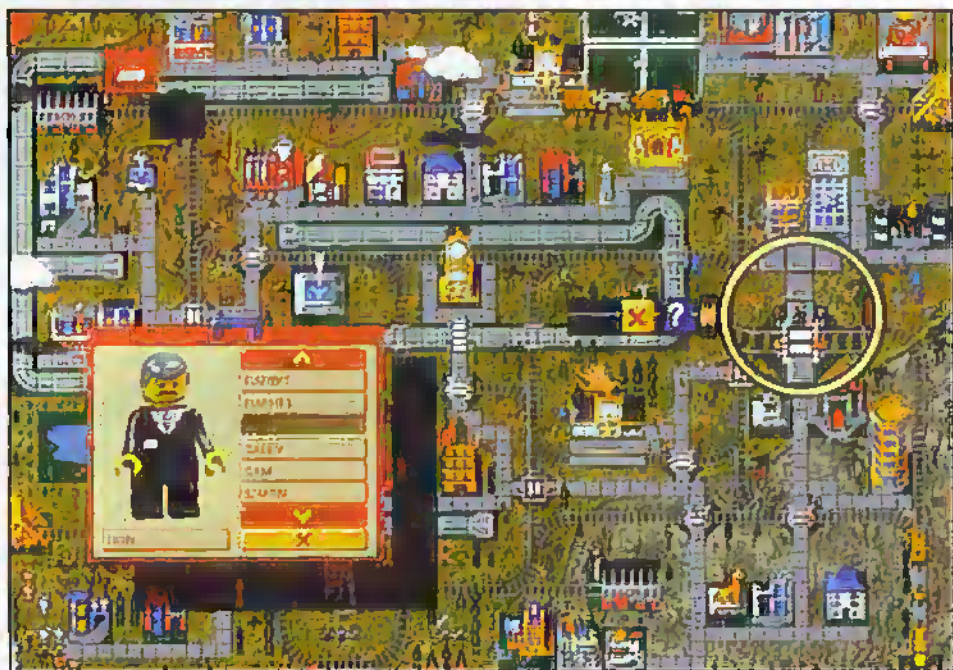


Meanwhile back at the board, clicking on your intended chess piece and indicating the square to move to, the chess piece will walk to the new position. In the event of you taking your opponents chess piece, an animated sequence begins from one of over a hundred different battle sequences in cartoon. The game can be customised according to the level of ability of the player. So starting at basic level winning against the computer will give the child confidence to move on.

Chess is an excellent way to encourage and develop forward planning for children. Well done to Lego for its attempts to revive and reintroduce this ancient game to young ones. Suggested Retail Price guide £29.99.

Loco

Playing trains on a computer has a different ring about it. The trains based in this package are different from using a normal layout or indeed what you might expect. It is loosely based on the Lego System train concept. You can choose a variety of basic engines, carriages and a huge variety of buildings and trackwork. Starting with a choice of basic backgrounds, the track can be laid out albeit with fixed tight curves, points, crossovers and straight sections. When you are ready you can encourage the trains to come out of the sheds and stream around the track, with that now familiar awful sound, I'm sorry to say of the mid west American 'Casey Jones' steam whistle - oh dear! Has anybody ever heard of British sampled sounds? You can alter the points ahead of the train, change the signals to stop, go or reverse otherwise the train will stop at a red light.



Curiously, children can network up to nine PCs with Loco and they can send pictures and sounds on the train to whoever else on another PC or indeed to their friends on the Internet via a Lego Loco server. Is this package really for kids? They can also create their own postcard designs and send to their friends externally by e-mail or internally to various Lego characters on your layout. Postcards can be accessed from the 'Post Office'. Yes this is a post office building that you take from your buildings selection and place on your layout. Clicking on the post office will make available to you everything you need to create your postcard. Any cards received from your friends (by E-mail) can be put into an album, a virtual one of course.

Although this is an amusing starter

package for the kids to experiment with track circuits and basic train control mechanisms, this is not one for the more serious enthusiast. It also seems to be an exercise in showing children how to communicate by postcard mail using a train to take your mail on screen to fictional characters or by e-mail to real friends. Depending on what the original idea was behind this software, the model railway design concept is a good one and has huge potential for the serious designer if appropriate software was out there. Sounds like both parties should get their heads together for some serious software to incorporate some real images of models in 3D of course..

Suggested Retail Price £24.99

And finally....

The only reservation I have with all these software titles and it's not just Lego but many educational software titles, is on the voice output. It wouldn't have taken much

to use English accents and a good stock of plain English phrases for the British market. Perhaps I'm not 'cool' enough in these now warmer climates and it's only adults that worry about such things!



Basic computer requirements for all of these packages:

PC only
166 Pentium or above with Windows 95 or above
16M RAM Min
50M Free space
3D Graphics card (Advised)
Soundcard

Optical Radar for Early Cancer Diagnosis and a New UK Centre for Lung Cancer Research

Cancer is the biggest killer in Britain, causing 25% of all deaths. Nobody can be certain that they won't be affected by some variant of the disease. Treatment may require surgical removal of tissue or specific drug treatments, but whatever the individual circumstance 1 in 3 of us will develop it during our lives. There may be a 1 in a hundred thousand billion chance of two things going wrong simultaneously in a cell but as there are about 100 trillion cells in the human body there is a high statistical chance that it will happen sooner or later. So when scientists announce any step forward in this fight the media will often hail this discovery, and quite understandably. Results from the American drug Tamoxifen suggest that it prevents breast cancer in high-risk women, and coincides with the announcement of 'gene p-53' which may protect against the toxic side effects of chemicals in tobacco

RESEARCH

NEWS

Dr Chris Lavers looks at a lasting legacy to the popular entertainer Roy Castle who died from lung cancer.

smoke. More recently, news that two drugs (angiostatin and endostatin) can kill tumours in mice caused a great deal of excitement, and a 5-fold rise in shares value for US company Entremed. Given in combination, a tumour's blood supply is cut off, and appears to be effective against all solid tumours, including breast, colon and lung. Pioneer research using this therapy is taking place at

Mount Vernon hospital in Middlesex and in the USA.

Tragically the three main UK cancers lung, breast, and bowel claim about 37,000, 14,000 and 12,000 lives respectively annually. Rather than trying to find a single treatment to combat all cancers, research has focused on investigating a specific cancer cell's weakness, and then developing a drug that will target that cell.

Early diagnosis of cancer is clearly very important. Two prototype sensors developed by Dr. Peter Andretzky at Germany's Erlangen University, will help to do this by measuring how skin scatters light to reveal both healthy tissue and tiny melanomas growing below the surface. A spectral radar, or modified optical fibre interferometer, measures a vertical skin profile by light scattering and is sensitive enough to show the effects of moisturising cosmetics (Figure 1). In principle this spectral radar may measure skin cancer with a 50µm resolution, conventional ultrasound accuracy is approximately 0.15mm and gives no tumour details. In the US alone it is estimated that skin cancer affects nearly 28,000 people each year, killing 6000. If spotted early, tumours can usually be removed by simple surgery. An important medical aim in experimental dermatology, or skin studies, is to quantitatively measure alterations of the skin in an early state. These alterations occur on the surface of the skin as changes in topology, texture and morphology visible as changes in skin light scattering.

The spectral radar is a fibre sensor for acquiring human skin

Comparison between human skin with different moisture content



Optical Metrology Group - Chair for Optics - University of Erlangen
Prof. G. Häusler, M. W. Lindner, A. Schütz

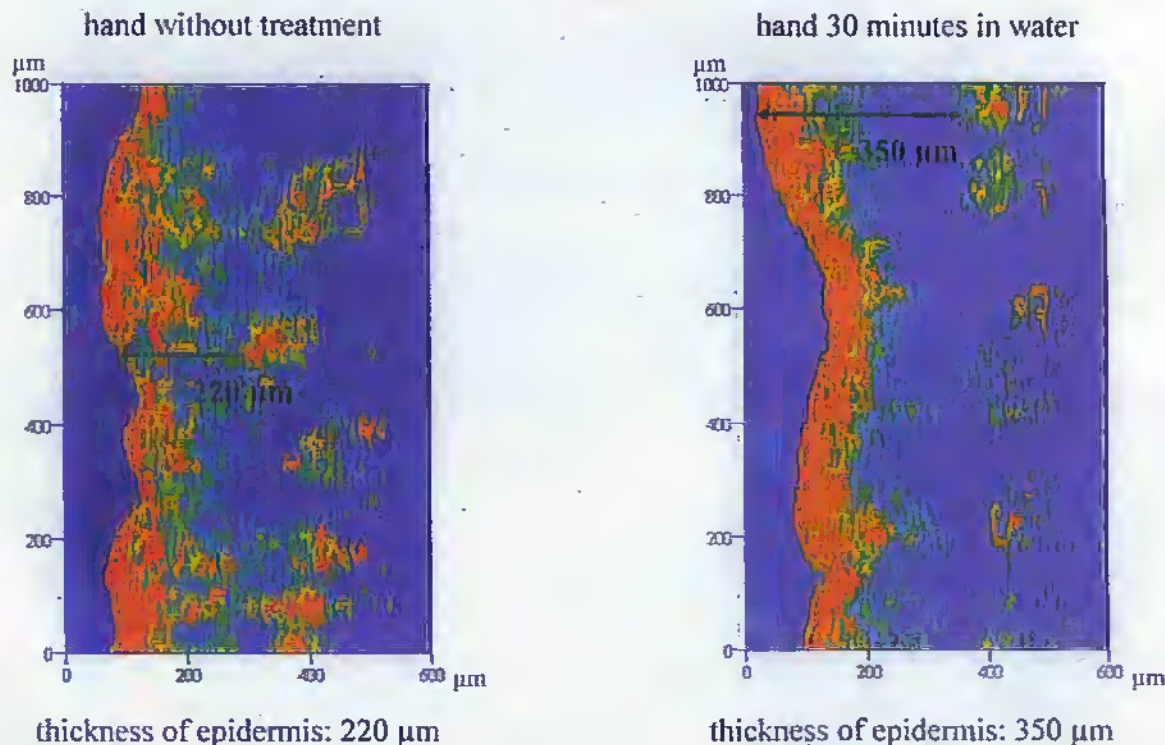


Figure 1. Spectral radar detects moisture changes in skin.

morphology. The scattering amplitude $a(z)$ along a vertical axis from the surface into the body can be taken in one exposure and is called an optogram. A broadband light source (10mW Superluminescent Diode, SLD, with peak emission at 840nm) is focused onto the skin.

Backscattered light is combined with a reference signal. Different wavelengths are separated by a spectrometer with a resolution of 0.05nm, and a 1024 photodiode array. The array output is processed with a Fourier transform and calculates both amplitude and scattering site location. The dynamic range and spatial resolution are

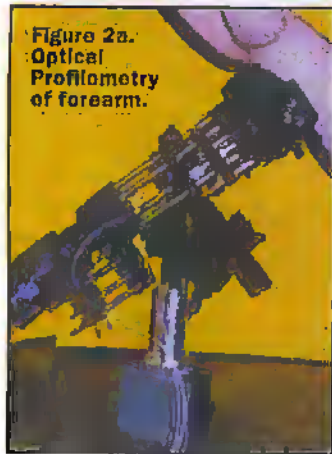


Figure 2a. Optical Profilometry of forearm.



Photo 1. Roy Castle.

-79dB and 10 μ m respectively. The Coherence Radar extracts height information (profilometry) from white light correlograms. In vivo measurements of human skin, where the sensor is brought to the patient are possible (Figure 2). The sample area is 4 x 4 mm, and the skin profile takes only 15 seconds.

The clinical relevance of in vivo data has been demonstrated in dermatology: Andretsky succeeded in measuring skin cancer in comparison with healthy skin. Both show different backscattering properties. With the spectral radar he measured layer thicknesses which vary only in scattering coefficients.



Figure 3. Spectral radar.

In vivo measurements with the fiber optical coherence radar

Finger

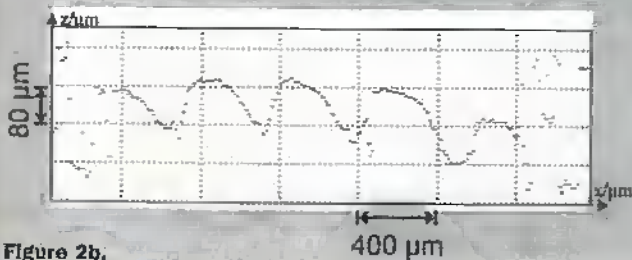
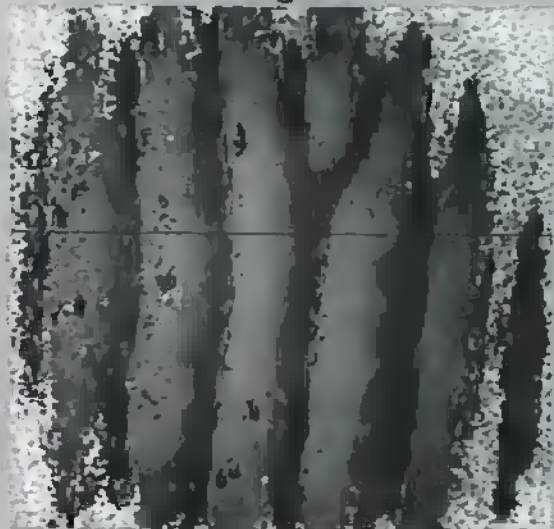


Figure 2b.

Underarm

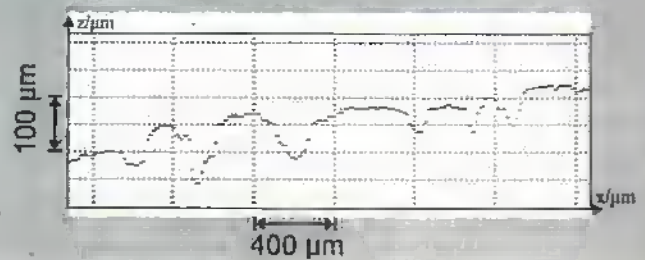
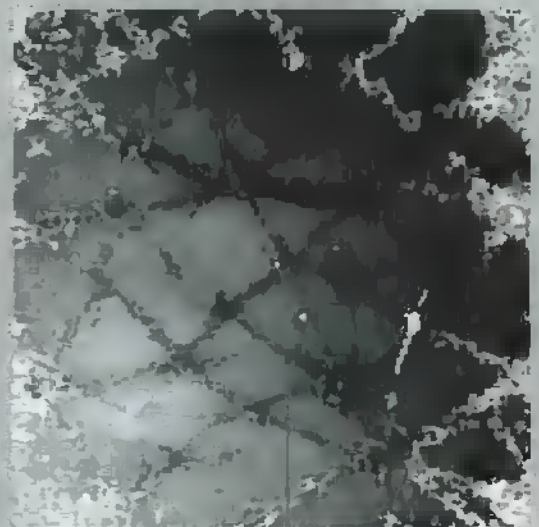




Figure 6. Roy Castle Lung Cancer Centre.
Credits: University of Erlangen and the Roy Castle Lung Cancer Foundation.

Peter says "the coherence radar is used for optical coherence profilometry, the measurement of the 3-dimensional topology of the human skin. The coherence radar acquires in vivo 3D topology of the skin. The spectral radar also developed at our Institute is applied in optical coherence tomography (OCT), for the measurement of the 3D morphology of skin."

A mobile and compact spectral radar has been built (Figure 3). Measurement of a forearm displays deep 60µm wrinkles and shallow 30µm wrinkles. Shallow wrinkles decrease with increased skin age. Processes such as wound healing, the effects of cortisone applications and cancers are encoded in the topology of the skin. Andretzky's group measured the moisture content of human skin in the hand. Figure 1 shows a comparison between a skin optogram before and after moisturising. The epidermis of normal skin is ~ 240µm. Skin cancer increases backscattering by the accumulation of melanin. In a melanoma melanin the epidermis extends to ~ 400µm.

The thickness of the stratum corneum of human skin can be measured, firstly in vitro and then in vitro after surgery. Optograms show the thickness of the hand ~160µm, and 50µm on the back. Optograms are confirmed by histological images. The spectral radar can distinguish normal skin from a malignant melanoma which scatters more than normal skin.

Lung cancer kills a person every 15 minutes in the UK. At present in the UK, lung cancer has the highest male mortality rate, and in women it is now second only to breast cancer. Sadly this is changing for the worst, as in some parts of the UK lung cancer in women has overtaken breast cancer. In 80% of cases, lung cancer detection occurs beyond effective treatment, resulting in a high mortality rate and a poor overall survival rate. One cause is radioactive Radon gas which seeps out of the ground and into homes, responsible for about 1 in 20 lung cancer deaths. Whole areas of Cornwall, Devon, Derbyshire, and Scotland are worst affected. Radon occurs naturally in the Earth's crust as

part of the Uranium decay chain. It is known that Czechoslovakian and East German Uranium miners circa 1950-1970 had a high risk of developing cancer. Latest research suggests that 50,000 people live in homes with unsafe Radon levels. However, smoking is generally accepted as the most frequent cause of lung cancer, and yet many people (about 4000 a year) suffer from it without ever having touched a cigarette, like Roy Castle.

At the Roy Castle Lung Cancer Foundation researchers are working towards early diagnosis and elimination of lung cancer, improved patient treatment, family support, and health education to help give up smoking and ensure that children never start. The Lung Cancer Fund was founded in 1990 to raise public awareness of lung cancer and initiate a programme of research into its development, prevention and management. In 1993 the idea of an International Centre for Lung Cancer Research was conceived, and Roy Castle, recognised Christian musician and popular TV host (Record Breakers) was approached to

give his name to a £12,000,000 appeal to build, equip and run the Centre. He was one of the best-loved and respected entertainers this country has ever known. His showbusiness career spanned 40 years encompassing television, film, theatre and cabaret. He was shocked to find that there wasn't a single research centre in the world dedicated exclusively to the study of this disease. Since Roy's death in September 1994 (aged 62) his widow Fiona has worked tirelessly and with great enthusiasm to further the development of this charity. The Centre was completed in May 1997 and opened to research scientists in October following fitting out of the laboratories. It took 15 months to build, at a cost of £4,000,000, with estimated running costs of £2,000,000 p.a., and apart from a grant of £150,000 has been funded entirely from public contributions. Phase 1 was completed at its grand opening ceremony on May 11th earlier this year by Sir Cliff Richard, and includes a molecular biology (genetic) laboratory, an

epidemiology unit, a lecture theatre, seminar rooms and other teaching facilities. Dr Judith Youngson, epidemiologist and Associate Project Director, has the role of identifying individuals who are at most risk of developing cancer. She will also investigate exposure to cancer causing agents in the workplace, diet, family medical history and areas of residence for clues about environmental and social factors. Current criteria will help select men and women who may develop the disease and these will be seen annually in Foundation funded clinics. Detailed questionnaires will be complemented by lung samples which will be studied for genetic code alterations using sophisticated technology in the laboratories. Mutations are caused by carcinogens in tobacco smoke and other agents. Over time a series of unknown genetic mutations takes place until enough cell damage occurs to make it malignant and a cancer starts. Seven thousand high risk individuals will be monitored for 10 years and will help to identify mutations occurring in lung cells before and after the final step to malignancy, diagnosing cancer before it happens or at least in its early stages. This is a realistic long term hope and one which will transform the management of lung cancer. If early lung cell changes are found, high risk individuals could be predicted and screening programmes made possible, rather than waiting until a tumour has formed.

The Roy Castle Lung Project and Centre is the only purpose-built centre for lung cancer research in the world. The first scientists who started work in Liverpool University have now transferred to the Centre. Already they have identified an abnormal genetic area in lung cancer. Two of the major problems with lung cancer are that it can quickly spread from the lung into other parts of the body and tumours can grow at a phenomenal rate. However, elderly patients have markedly slower tumour growth and fewer secondary tumours. The Foundation has funded three years research at Manchester and Dundee Universities to provide valuable information in developing therapies which may 'slow down' blood vessel formation in or around lung cancer. Future objectives for the Foundation include the identification and eradication of risk factors,

screening programs, and readily available literature and counselling.

If you would like to send a donation or want to know more about the Roy Castle Lung Cancer Foundation then contact them at 13 Stratford Place London W1 (tel 0171 355 1257). E-mail: roycastle@enterprise.net
E-mail: pfa@undine.physik.uni-erlangen.de

Forthcoming Electronics and Electronics related conferences

IPOT The Image Processing and Optic Technology conference will occur between the 17th and

18th of February 1999 in Hall 11 at the NEC Birmingham. Open times: Wednesday 0930-1700, and Thursday 0930-1600. This will be the premier event for the image processing industry and brings together the largest gathering of imaging and optics professionals in Europe. The conference is free to all visitors. Tickets are available by calling the conference hotline on: 0182 617744 or by pre-registering now on the world-wide web at www.ipot.com.

"Microscopy of Semiconducting Materials" will take place between March 22-25 1999 at Oxford University. Areas to be covered include: bulk and thin film

semiconductor characterisation, effects of semiconductor processing treatments, and the assessment of finished electronic devices. Special sessions will focus on developments in high resolution imaging, specimen preparation, superlattices, and quantum structures. Contact: The Institute of Physics, 76 Portland Place, London. Tel: 0171 470 4800.

"The International Space Station: Creating New Opportunities." A 4th International Space University (ISU) Symposium will be held in Strasbourg, between 26-28 May 1999. Contact: Mr P French, ISU, Strasbourg, France. Fax +33 0388 65 54 47. 



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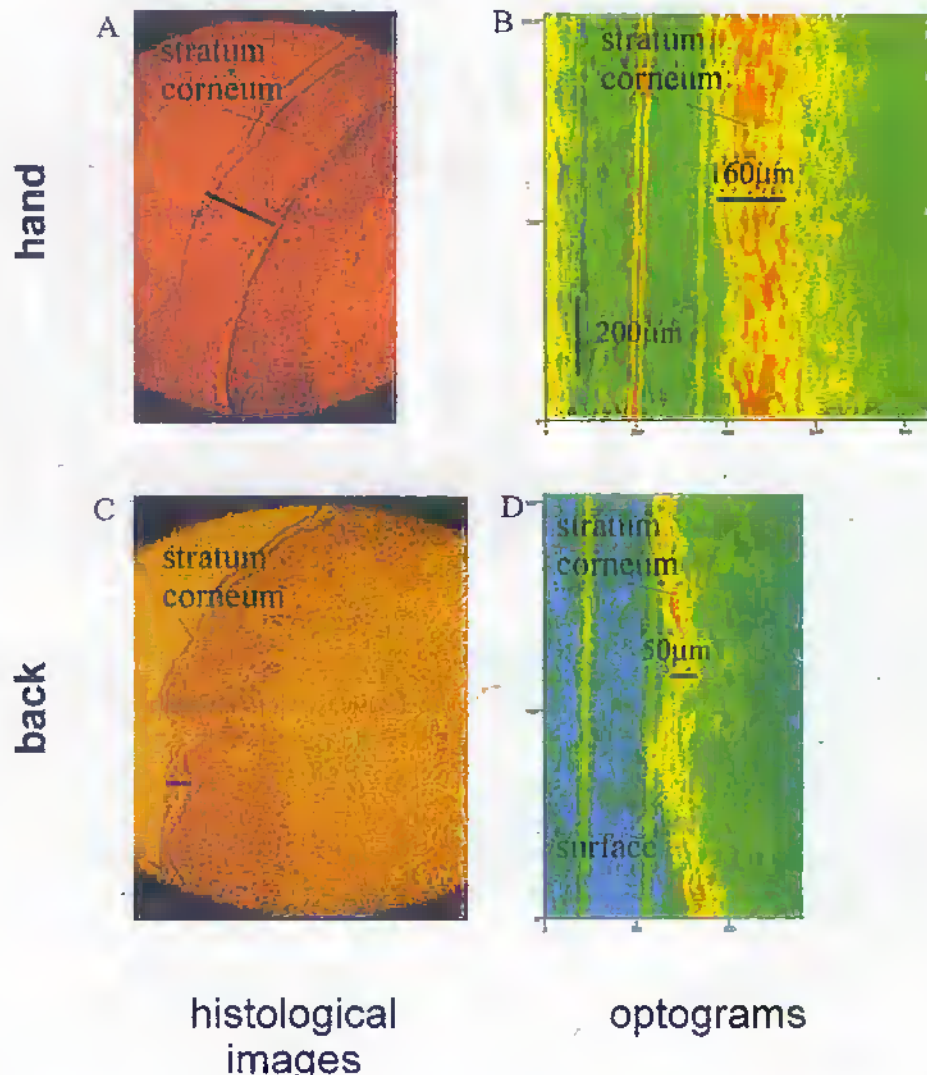


Figure 4. Optograms of human skin measured by Spectral Radar.

PROJECT



Charge Current	R2
50mA	47R/0.25W
100mA	18R/0.25W
200mA	6.8R/0.25W
300mA	3.9R/0.5W
400mA	2.7R/0.5W

Table 1.

The DC supply can be either hard wired on to the board, via two pins, or it can be applied via a standard internally switched power jack. Note that this socket has to be fitted because of the internal switch which disables the hard wired connection when a suitable plug is inserted – if there is no socket then there is no connection to the hard wired pins. The input DC can be within the range 6.5V to 21V, and is dependent on the battery voltage. The min/max supply voltage for a particularly battery voltage is shown in Table 2.

If you do not use a DC voltage in the range specified for the battery voltage you are charging then the circuit does not function properly. The LED does not illuminate if this is the case.

Construction

This is very straightforward but you do need to select your desired charging current to select the value of R2 – all the values as specified in Table 1 are included in the kit. It is quite possible to make a multi-charge current device by using a double pole multiway (6-way) switch and mount the resistors on the switch. This would make it a very versatile and compact charger that can be used from a car cigarette lighter socket. I would recommend the fused version (BV46A) lighter plug which also features an LED.

T1 is mounted on a small-finned supply heatsink. If you do mount the charger in a small box then the LED would ideally be mounted off the board. Remember to take care that you

K7300 CHARGER FEATURES

Charges NiCd or NiMH batteries

Selectable charge current 15mA to 750mA

8 Selectable battery voltages 1.2V to 9.6V

52min fast charge

14 hour normal charge

Automatic charge/discharge

K7302 CHARGER FEATURES

Charges NiCd or NiMH batteries

Ideal for in-car use

Can be used with a wide range of mains adaptors

• LED charge current

Selectable charge current

K7302 Charger

This charger is very simple and is ideal for the beginner to electronics. Figure 1 is the circuit diagram with charging controlled by series transistor

Universal BATTERY CHARGER

by John Mosely

Velleman produce several battery chargers for both Nickel Cadmium and Nickel Metal Hydride types, so this month we look at two from the range. K7300 is a universal charger and discharger with automatic operation, while K7302 is a very simple type that is particularly suited to charging batteries from a car battery, via the cigarette lighter.

T1 and current limiting resistor R2. R2 is determined by the desired charge current, and can be selected to give a charge current ranging from 50mA to 400mA (see table). D1 provides

protection in the event that the circuit is connected to the DC supply the wrong way, and C1 provides additional smoothing. A LED indicates that the circuit is connected.

Battery Voltage	Supply Voltage	
	Min	Max
1.2V	6.5V	10V
2.4V	7.5V	11V
3.6V	9.6V	12V
4.8V	10.5V	13V
6V	12V	15V
7.2V	13.2V	16V
8.4V	14.5V	17V
9.6V	15.6V	18V
10.8V	16.8V	19V
12V	18V	21V

Table 2.

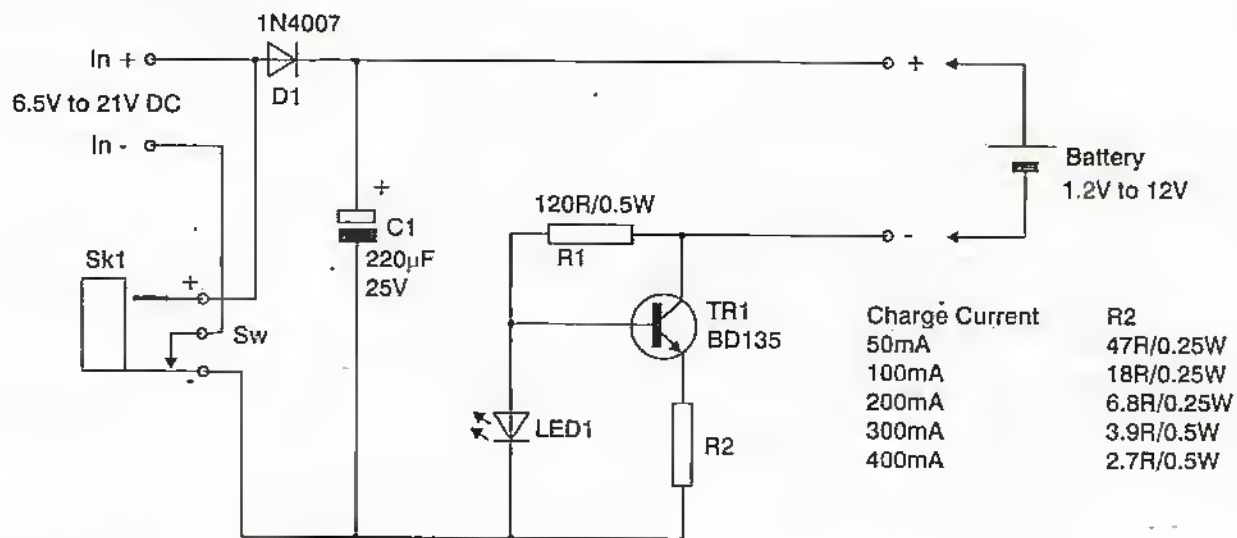
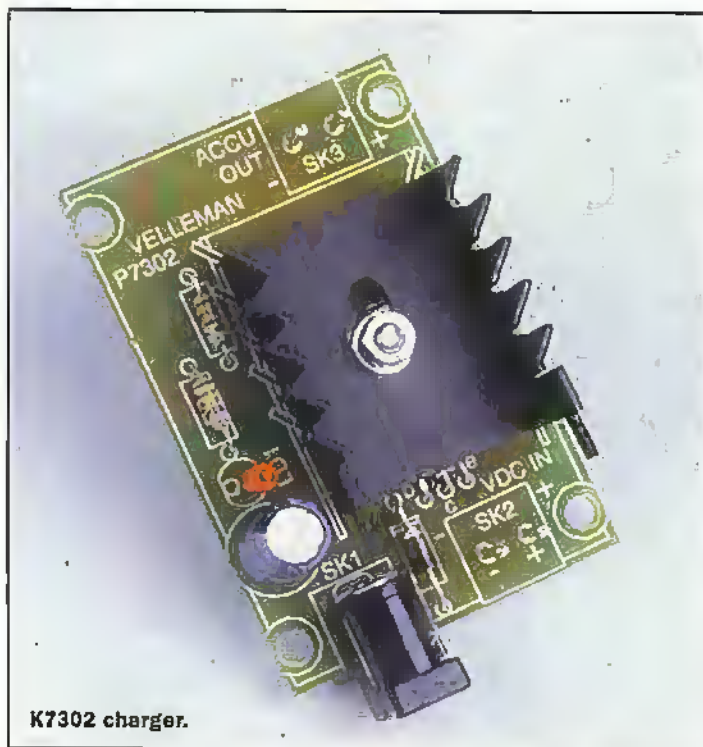


Figure 1. Circuit diagram of K7302 charger.



Testing

I used a variable 1200mA power supply (order code VN10L) to charge 4 x 'C' cells, with the output voltage set to 12V, and a value of 6.8Ω for R2 which gave me a charge current of about 180mA. At this value, T1 got warm. If you do use the kit to charge higher voltage batteries, then you may have to build a suitable DC power supply, but this could include a multi-tap transformer such as WB07A to cover various battery voltage ratings. If you mount the charger in a case then remember to select one that provides adequate ventilation.

K7300 Charger/Discharger

This kit is a universal automatic charger/discharger version, and

is more sophisticated than the simple K7302 as it can be set for various battery voltages and charge currents. The circuit (see Figure 2) includes a selectable charge time of either a standard 14 hours or a fast charge of 52 minutes. On-board jumpers are used to select the time, the battery voltage and the charge current. Prior to charging, the circuit will fully discharge the batteries, to ensure maximum life for the batteries. When SW1 is pushed, the red LED illuminates and the circuit goes into its discharge mode with the batteries discharged via R38, a 10Ω 10W resistor, and T2. This resistor does get quite hot during this mode. When the batteries are sufficiently discharged the red LED extinguishes and the circuit flips to the charge mode and the green LED illuminates. Note that the design requires a 15V 800mA DC power supply to operate.

get the diode, LED and electrolytic capacitor round the correct way.

Depending on the battery type and numbers will influence the type of battery connector. A standard battery connector such as HF28F can be soldered to the board and then connected to a variety of battery boxes to suit the desired batteries.

Remember that ideally to get maximum life from the batteries you should charge at a current value 1/10 of the charge capacity of the battery. If you decide to charge at a faster rate, then more care with charging times will need to be exercised, and preferably, to discharge the battery prior to charging.

PARTS LIST - K7302

RESISTORS

R1 0.5W 120R
R2 See table

CAPACITORS

C1 220µF 25V Electrolytic

SEMICONDUCTORS

T1 BD135
D1 1N4007

LED1 Red 3mm Low Current

MISCELLANEOUS

DC Jack 1
PCB Pins 4

OPTIONAL EXTRAS

Case
Mains Adaptor to suit Battery Voltage
2-Way 6-pole Switch
Battery Box
12V Cigarette Lighter Adaptor BY46A

Construction

Start by soldering in the wire link, which is supplied, followed by all the small wattage resistors, diodes, Zener diodes and the one preset pot. Next comes the IC sockets, the capacitors, the big 10W resistor and the small low power transistor T1 and the three-legged voltage reference source LM385-2.5. Next fit the two LEDs, and the jumper pins. LED mounting kits are included so that the LEDs can be mounted on to a box panel if required. Be careful when cutting off the desired number from the strips

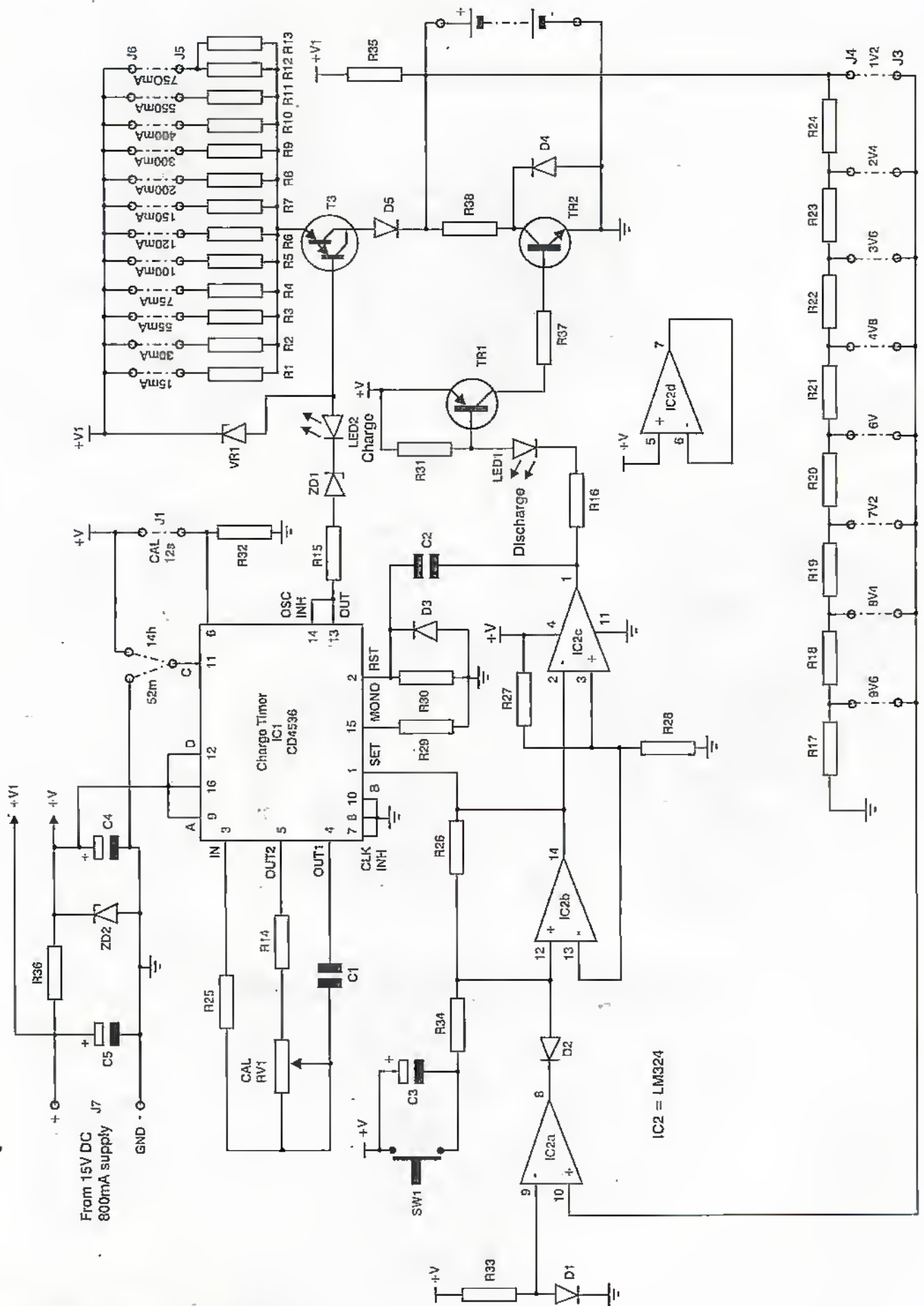


Figure 2. Circuit diagram of K7300 charger.

PARTS LIST - K7300

RESISTORS (all 0.25W except where marked)

R1	82R
R2	47R
R3	22R
R4	18R
R5	12R
R6	10R
R7	8.2R
R8	6.8R
R9	4.7R
R10	3.3R
R11	2.2R
R12,13	3.3R
R14	100K
R15	470R
R16	2K2
R17	120K
R18	15K
R19	22K
R20	33K
R21	47K
R22	82K

R23	150K
R24	470K
R25,26	10K
R27	3K3
R28,29,30,31,32	10K
R33	1K
R34	33R
R35	1M
R36	82R 0.6W
R37	270R 1W
R38	10R 10W
RV1	220K

CAPACITORS

C1,2	47nF
C3	1µF
C4	10µF
C5	1000µF

SEMICONDUCTORS

D1,2,3	1N4148
D4,5	1N4001

ZD1	6.2V Zener
ZD2	12V 1.3W Zener
T1	BC557
T2	BD327
T3	BD676
IC1	CD4536
IC2	LM324
VR1	LM385-2.5
LD1	3mm Red
LD2	3mm Green

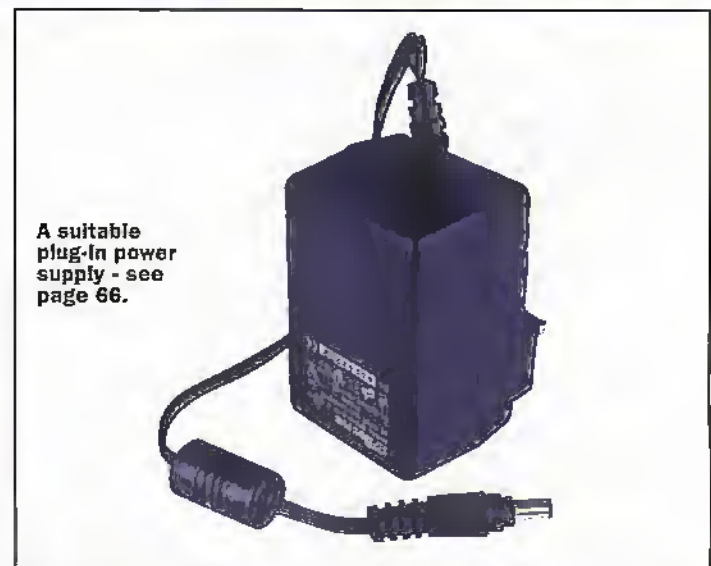
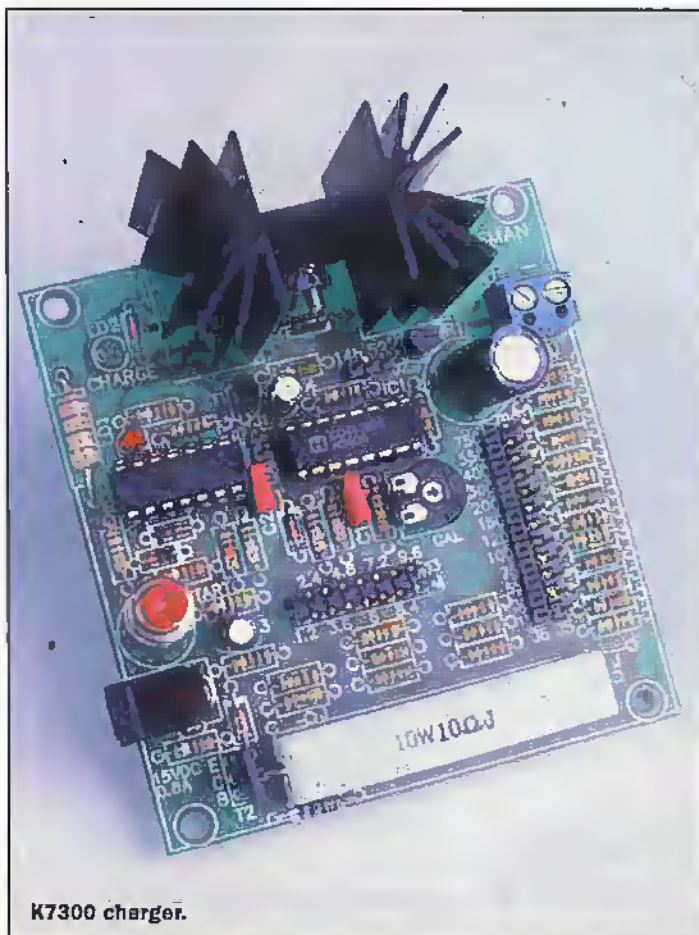
MISCELLANEOUS

J1	1 x 2-pins
J2	1 x 3-pins
J3,4	2 x 8-pins
J5,6	2 x 12-pins
J7	DC socket
SW1	1-p Push-to-make Switch
	Heatsink
	16-pin DIL Socket
	14-pin DIL Socket
	Battery Connector
	Suitable Power Supply Case

supplied as it is very easy to damage the plastic housing surrounding the pins. Use a sharp craft knife to cut the plastic housing. Next fit the DC power socket, the push switch and the power transistors T2 and T3. T3 is mounted onto a vertical mounting heatsink, which is held to the PCB by two self-tapping screws. If you do intend to mount the PCB in a box then the push switch can be mounted on to a box panel or side. When selecting a box

remember to select one that allows easy access to set the voltage, charge current and charge rate. Also select one that has sufficient ventilation or drill sufficient holes in the box near to the heat generating components.

Ensure that the Zeners, diodes, LEDs and electrolytic capacitors are mounted with the correct polarity. The PCB is densely populated so be careful when placing components and check all solder joints to avoid solder bridges.



Setting-Up

The timer circuit needs to be set, and this is a very simple adjustment. Jumpers are placed over the 'CAL' pins, the '52min' (quick charge setting) pins and the 1.2V selection pins. Connect a suitable DC power supply to the board and turn the trimmer RV1 to mid position. Push the switch button SW1 and the green LED should light. After 12 seconds the LED should go out. If it is not 12 seconds then adjust RV1 by rotating the pot clockwise to increase the time or anti-clockwise to reduce the time. When you are satisfied with the time setting remove the 'CAL' link and set the other links for the desired battery voltage etc.

In-Use

I used a set of 4 x 'C' cells with the current set to 200mA, and the timer set to quick charge (52 mins) to evaluate the board. Pressing the switch started the cycle with the green LED

coming on for about 30 minutes and then the circuit flipped to the charge mode, when the red LED came on. After approximately 52 minutes the red LED went out. I then set the charge time to 14 hours and pressed the push switch again and left the set-up over night. Again this all worked well. For the test batteries, this charge current was too low in the quick charge mode - 750mA would have been a better bet. Remember that it is generally believed that batteries when charged in a fast mode should not be charged to their full capacity in order to maintain an acceptable life span.

Conclusion

The choice of kit is very much dependent on your requirements, but both work extremely well and are excellent value for money.

Maplin Order Code Price

K7300 Charger	VY43W £14.99
K7302 Charger	VY44X £6.99

Words of SCIENCE

PART 6

CompuSpeak

In part 5, Gregg Grant explains how computers have broadened and enhanced our vocabulary.

Introduction

In the Times newspaper of the 24th January 1998 Simon Jenkins, in an essay entitled 'A Ludlite's Lament,' bemoaned not only the passing of his ageing computer, but also of its operating system. Having long regarded MS-DOS as the 'Old High Gothic' of computing, he now, he informed his readers, had to come to terms with the Newspeak of Windows. He simply could not believe that a decade of software development could produce a system which was worse than that which it was about to replace!

Almost three weeks later, on the 13th of February, the financial journalist Peter Day informed listeners to the Today programme that Nerd was no longer the in-word to describe those with a propensity for computers. In America, Day reported, 'Mouse Trained' has become Newspeak for Nerd which, according to the ninth edition of the Concise Oxford Dictionary is 'US slang a foolish, feeble, or uninteresting person.' Whether the Mouse-trained will also be regarded as such remains to be seen!

CompuSpeak differs little from our mother tongue, for it too contains buzzwords, complicated initials, acronyms and coinages. What's more it adapts, adopts and generally re-invents itself at such a pace that, every so often, yet another Dictionary of Computers hits the bookstands, as table one but briefly illustrates. Many more such

tomies - large and small - could be added to it, all containing new additions or interpretations of what's gone before.

Add to these, books dealing with modern science and technology in which there are glossaries of terms, and you've even more explanatory material to wade through. So let's begin by looking at some of the more commonly used terms and discover how they've impacted on our everyday working lives.

Judging by the way many computer words and expressions are thrown into peoples' workday conversation, you'd be forgiven for thinking that they are making their living in the computer industry. Frequently, however, this isn't so. What you've come up against is the 'let's impress 'em' syndrome that we noticed in Part Five. How can we be sure of this? Simple - look at the length of the words thrown around, and the possible difficulties some people may experience in pronouncing them.

One example of this is alphanumeric - in other words the Indo-Islamic numerals and Roman letters used in this article - and another is architecture. This last is CompuSpeak for the layout and interconnection of a computer's internal hardware and the logical relationship linking the Central Processing Unit (CPU), the Memory and the Input/Output (I/O) devices. At its simplest, this concept can be illustrated by figure one.

It's also used in a similar way as regards the circuit pattern layout of an Integrated Circuit, or (IC), the ubiquitous 'chip.' There are, of course, different types of architecture. Closed architecture is only compatible with hardware and software from a single supplier. Open architecture on the other hand is exactly the opposite, being compatible with hardware and software from any of a number of suppliers. Finally there is Distributed architecture, used in Local Area Net (LAN) technology. This architecture uses shared access methods on bus or ring LANs. We've also, you may have noticed, dealt with four of the most common sets of initials used in CompuSpeak in the last couple of paragraphs.

Algorithm is another well-used word of the would-be technological hip. When challenged however, few such people can explain that this seemingly complex word simply means a set of step-by-step instructions used in problem solving. Algorithms of course have their own language - ALGOL, or Algorithmic Language - which uses such techniques for technical and mathematical applications.

Algorithms can be pictorial too, in which case they're known as Flowcharts, first developed by the team that created the Electronic Numerator, Integrator, Analyser and Computer (ENIAC), in the mid-1940s. At that time - understandably - there was no standardised procedure for cracking problems using a computer. Consequently the team - led by the mathematician Herman Goldstine - came up with the idea of pictorial representation. Goldstine reasoned that this would be a fairly foolproof method of encouraging clear thinking and accurate planning.

The sequence of operations to be either applied or carried out, are designated by particular symbols. Those shown in figure two date from 1986; those in figure three from the Multimedia or Hypermedia world of 1997. Both terms simply mean using more than one form of communication, illustration or expression. A good example of an algorithm is Newton's algorithm for 'discovering square roots.'

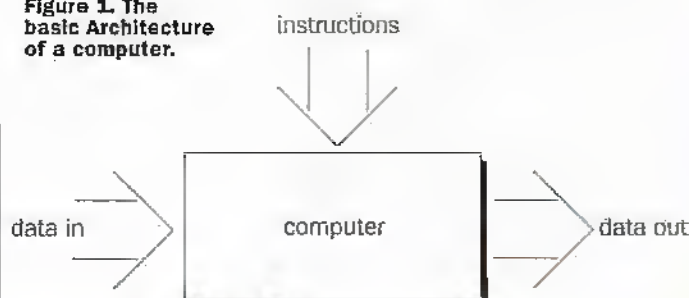
Heuristic is another word which frequently appears in CompuSpeak. The dictionary defines this word as 'proceeding to a solution by trial and error' and that's not at all a bad definition. Put another way, it's a set of procedures used to crack a problem which is less exact - and so less certain of success - than an algorithm. In short the system - like the rest of us - learns from experience. Not that you'd gather this from those that use the word in everyday situations!

Year Publication

1966	Charles J. Sipit's Computer Dictionary, published by W. Foulsham & Co., Ltd.
1975	Jeff Maynard's Dictionary of Computer Terms, published by Newton-Butterworth.
1986	Barron's Dictionary of Computer Terms, by Michael Covington and Douglas Downing. The flowchart in figure one comes from this tome.
1989	The Hamlyn Dictionary of Computing, by S.M.H. Collin, published by the Hamlyn Group.
1997	Microsoft Press Computer Dictionary, 3rd Edition.
1997	Webster's New World Dictionary of Computer Terms, 6th Edition.

Table 1. Some Computer Dictionaries 1966-1997.

Figure 1. The basic Architecture of a computer.





process



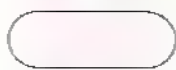
input/output



communication link



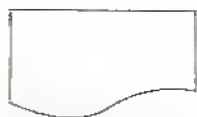
decision



start, stop,
or interrupt



display



document



punched card



merge



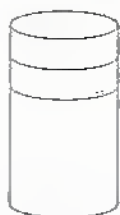
magnetic tape



online storage



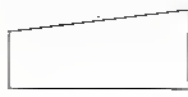
sort



magnetic disk



manual operation



manual input

Figure 2. Flowchart symbols, circa 1986.

The Size of the Matter

Sentences such as '...employing the latest VLSI technology' litter many computer advertisements. Their creators - presumably - are of the view that the punters either know what they're talking about or can readily find out. Yet it's size in reverse they're talking about, hidden in the initials, and knowing that these initials stand for Very Large can hardly be called a great help. Let's look at them again.

ICs of course have all their active and passive components built into a small piece of semiconductor material by chemical and etching techniques. This is fairly well known. What is less well known is that all ICs fall into specific bands.

- 1 **SSI:** This is the abbreviation for Small Scale Integration, the latter word meaning 'the combining or adding parts to make a whole.' ICs at this level contain between one and tens components.
- 2 **MSI:** This stands for Medium Scale Integration, which produces ICs with between 10 and 500 components in their makeup.
- 3 **LSI:** This is integration for grown-ups. Here, we're talking Large Scale which - whilst it doesn't exactly mean telephone numbers - is nevertheless anywhere between 500 and 10,000 components.
- 4 **VLSI:** As noted earlier, this is Very Large Scale stuff, whose ICs can contain

anywhere between 10,000 and 100,000 components. Almost as many in fact as were used in the original computers

- 5 **SLSI:** This is Super Large Scale, where the numbers begin to get more than a little out of hand. This type of IC would contain something in excess of 100,000 components.

New Things

What we've been looking at so far are those words, initials and abbreviations which are the common coinage of CompuSpeak. Two other words long part of the currency of this language are Hardware and Software, neither of which require any explanation whatsoever, even among those who work them to death in their daily interactions at home and in the

workplace. However, what about new words and expressions such as Bridgeware, Firmware and Wetware? Where - and how - do they interact with good old H and S?

- 1 **Bridgeware** is the hardware - or software - used to facilitate easier transfer between computer systems. This can be done by altering a number of factors such as changing translation or the file format.
- 2 **Firmware** on the other hand is either data, or a program, permanently stored in a memory IC such as a Read Only Memory (ROM) or an Erasable Programmable Read Only Memory (EPROM). This last is an IC which can be erased with ultra-violet light and then re-programmed again via a voltage applied to a write pin and data applied to the IC's output pins.
- 3 **Wetware** is used in the writing of software which, in conjunction with hardware, makes a computer such a useful tool. It's better known by its more common name of the human brain!

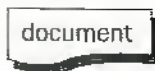
Overkill

Undoubtedly the most overworked word in CompuSpeak is Interface. Let's look at one dictionary's entry on the matter, that of the Concise Oxford. There are no less than three major explanatory sections on the word, the third one dealing with its use in computing. This is followed by a couple of short sentences of further explanation where computing is concerned.

By far the most interesting part however is the half-column inch following these entries entitled 'Usage'. This makes it perfectly clear that, in many of its forms, the word is simply a high-sounding synonym for boundary, meeting point, link, liaison, interact etc. Exactly!

Nor does it end there. Its universal functionality has become all things to all men in CompuSpeak also. In one dictionary on computing for example, there are no less than five entries, all of which bear out the Concise Oxford's strictures on the word. Not for nothing has the scene of toil become the interface rather than the coalface!

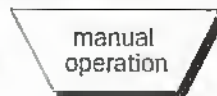
Another area where words, descriptive nouns, and other verbal attachments puzzle many people is mathematics. Indeed from the beginning the numbers game was regarded as little more than drudgery, which could well explain many of the words associated with it, a number of which we'll look into next month.



document



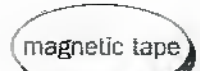
connector



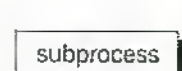
manual operation



display



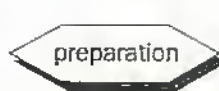
magnetic tape



subprocess



online storage



preparation



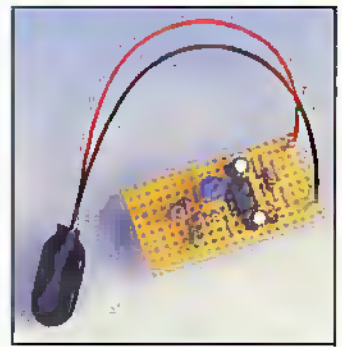
terminal

Figure 3. Flowchart symbols, circa 1997.

I have been reading the series on the PK Bio-Feedback Trainer and Movement Detector. I was particularly interested in the description of the Wien Bridge Network Oscillator described in the December issue, no. 132. This is because I required such an oscillator to be at the heart of an item of test equipment I was designing. The unit was to use a PP3 battery as a source of power, and so I was looking at a figure of 10 - 15 mA total power consumption. I decided also to use a lamp as a means of amplitude stabilisation, remembering that I had read somewhere that a distortion

Circuit MAKER

Alan Willcox describes a practical
100kHz Wien Bridge Oscillator.



there was still distortion. What was going wrong?

As the original idea to use a tungsten lamp as a means of distortion free amplitude stabilisation is American in origin I turned my attention to American literature.

The classic circuit of this type is from Linear Technology Corp., as shown in Figure 2. This uses a '327' lamp in conjunction with a feedback resistor of 430Ω. The distortion is 0.0025% at 2kHz and the oscillator uses less than 5mA. I don't know what the characteristics of a '327' lamp is, but it seems to be the one in most common use. There are many other examples using different lamps and feedback resistors. All however, have one thing in common. The feedback resistor is in the range 270Ω to 750Ω. The choice of a 1k preset is clearly a good one and is indeed often used.

Reference to the Maximum Peak Output Voltage vs Load Resistance characteristics for a TL081 shows that normal operation is not feasible with a load resistance at or less than 100Ω. The oscillator amplitude stabilises when the resistance of the lamp reaches half that of

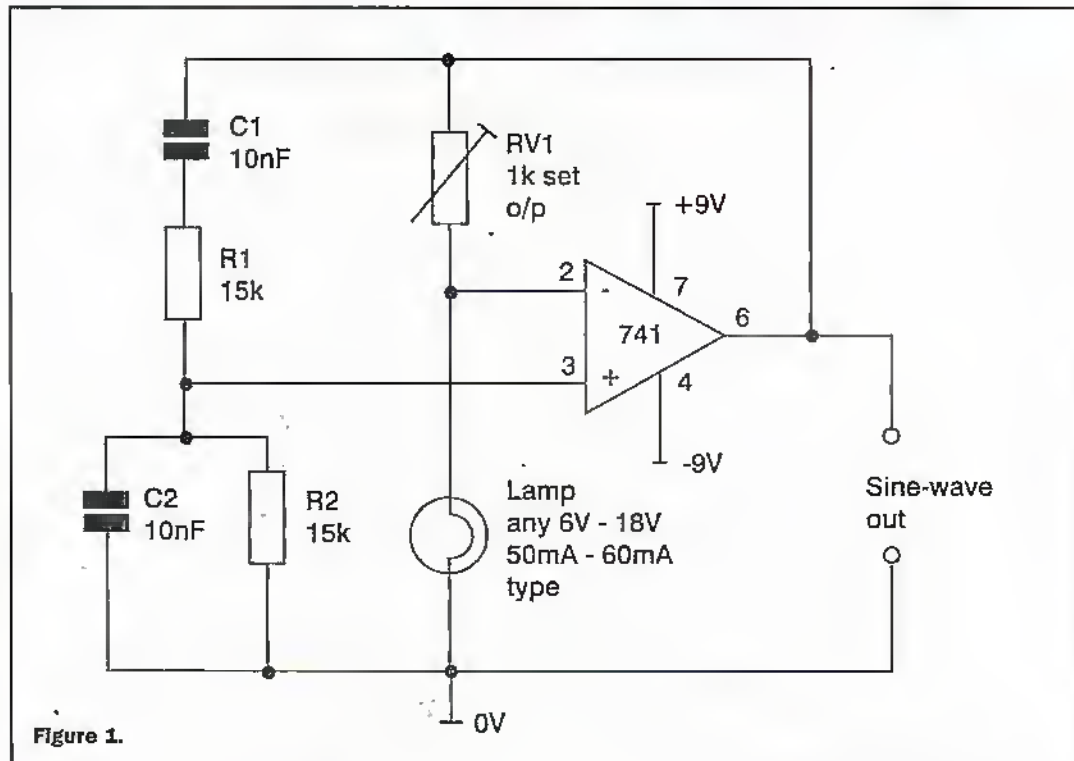


Figure 1.

figure of less than 0.003% was achieved with such a circuit, and also that the oscillator required only about 5mA current, so it seemed an obvious choice.

Consulting current literature it seemed that the standard practice was to use a 1K preset in conjunction with a bulb having typical characteristics of 6V-18V, 50mA-60mA in the negative feedback path - as shown in Figure 1. I did as no doubt your authors did, and in good faith went along with that, and for the bulb used a Maplin 12V 60mA (BT43) lamp - the type of lamp used in your PK circuit. Result - disaster. The waveform was looking more like a rounded square wave than a sine wave. In order to get anything looking like a sine wave the 1K preset was having to be set at less than 100 ohms. Current was going up and

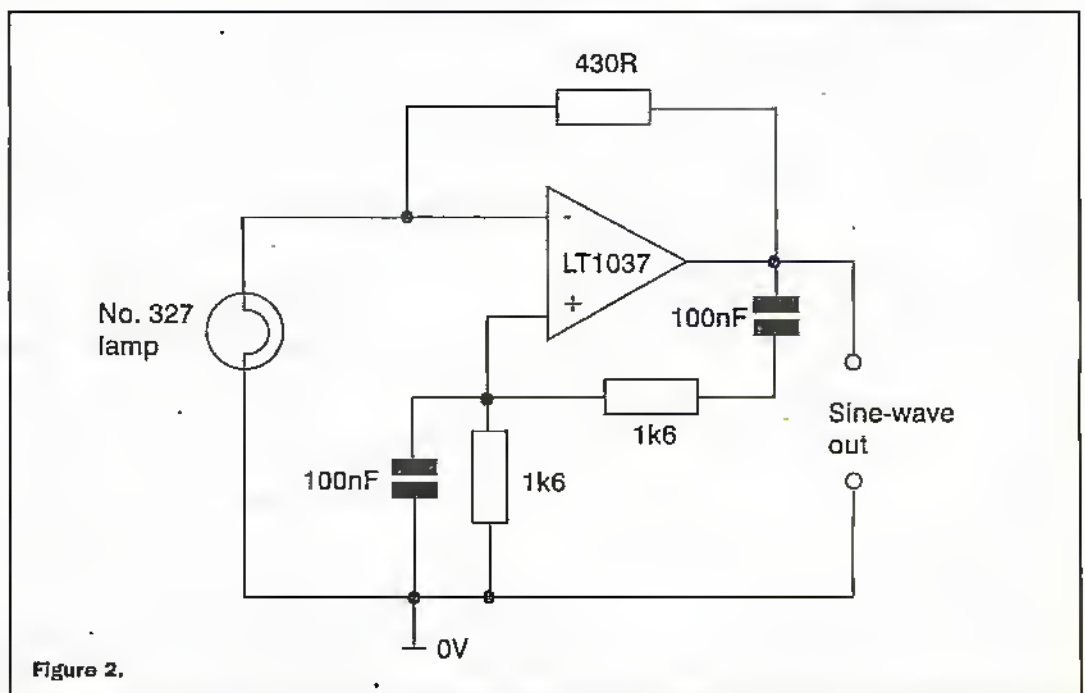
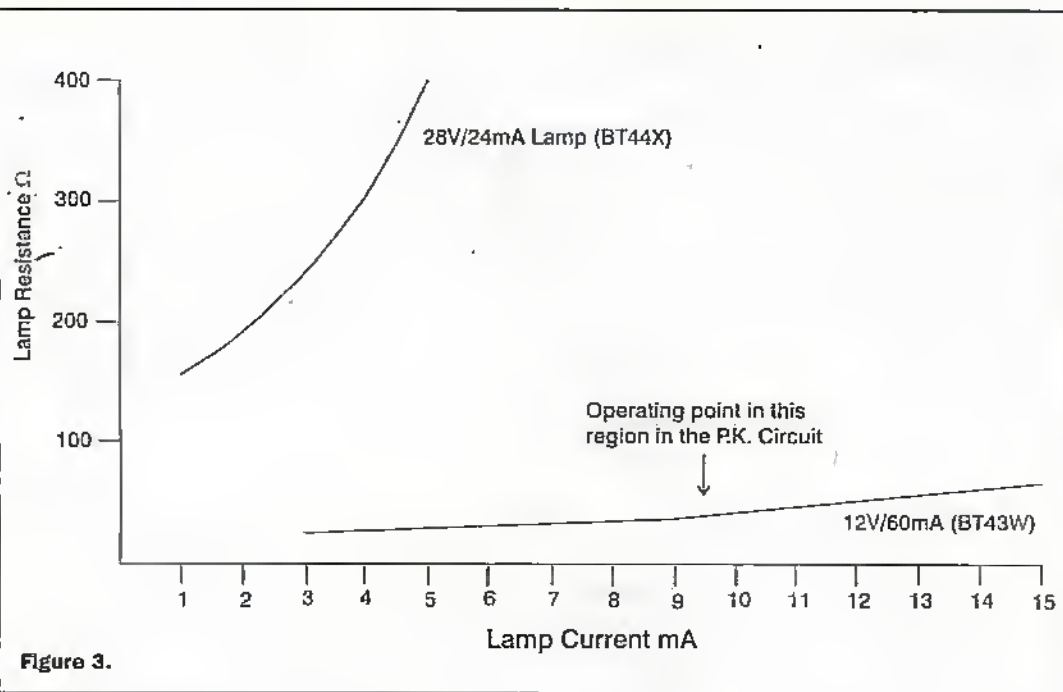


Figure 2.



current through the bulb is in the region of 9mA - 10mA. If the op-amp were to be operating within its normal parameters this would result in an output of about 2.5Vpk-pk. Note that although this 10mA point does show perhaps the most change of resistance, the rate of change (its slope) is small. Also, I suspect the oscillator amplitude is being limited, not by the bulb but by the out of specification loading of the op-amp. This would also make the amplitude sensitive to the supply volts.

Compare now with the characteristics of the BT44 lamp. The curve shows the region in which it is practical to use the bulb, and includes a resistance range from 150Ω - 400Ω. Considering that this has to be 1/2 the resistance of the feedback resistor, we have here the ideal bulb. If a 1k preset is

Figure 3.

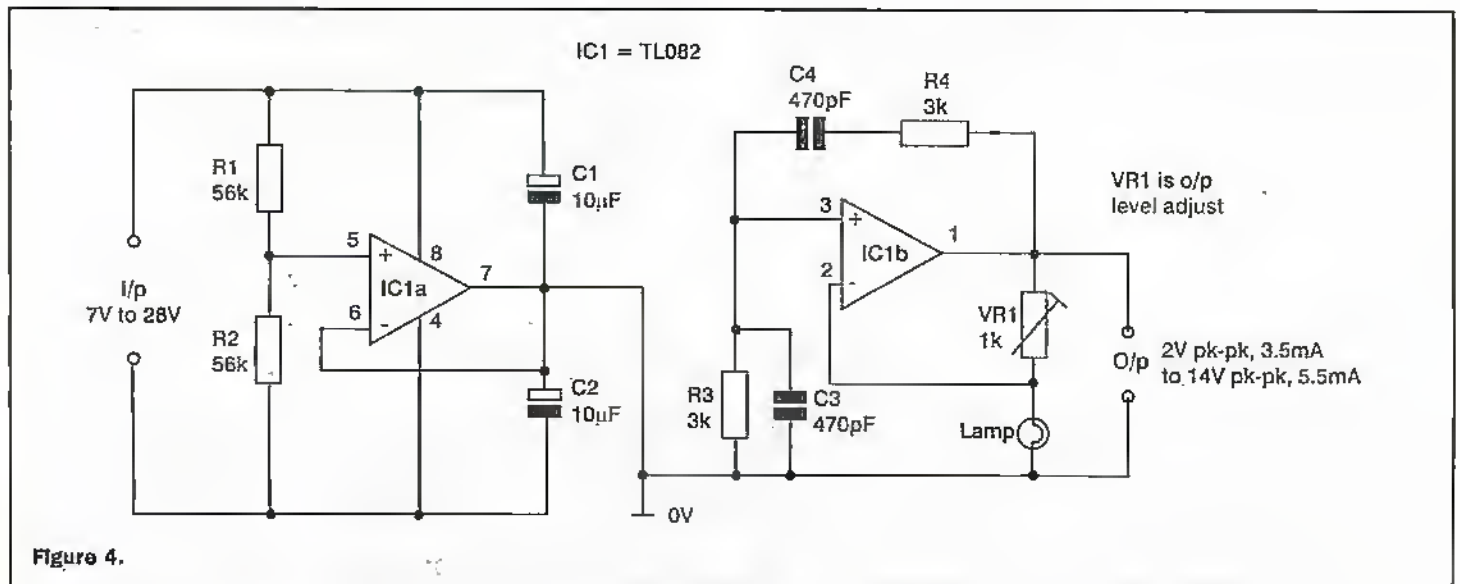


Figure 4.

the feedback resistor. In the PK circuit this is when its resistance has risen to 31Ω. The load resistance then, is $62 \div 31$, that is 93Ω - your poor little TL081 is hanging on by the skin of its teeth! Distortion is inevitable, hence the need to balance (not cancel) the distortion by the introduction of an offset null preset P2.

Clearly what's going wrong is the choice of bulb to use. After wasting considerable time, I worked out that if Jim Williams' (Linear Technology Corp.) design used a 430Ω feedback resistor, then the resistance of the bulb when the oscillator is running must be 215Ω. The oscillator as a whole only uses about 5mA, so allowing 1mA for the op-amp, the bulb current is approximately only 4mA rms. The bulb's cold resistance cannot be a lot less than 215Ω for it to rise to that value with just a couple of mA flowing through

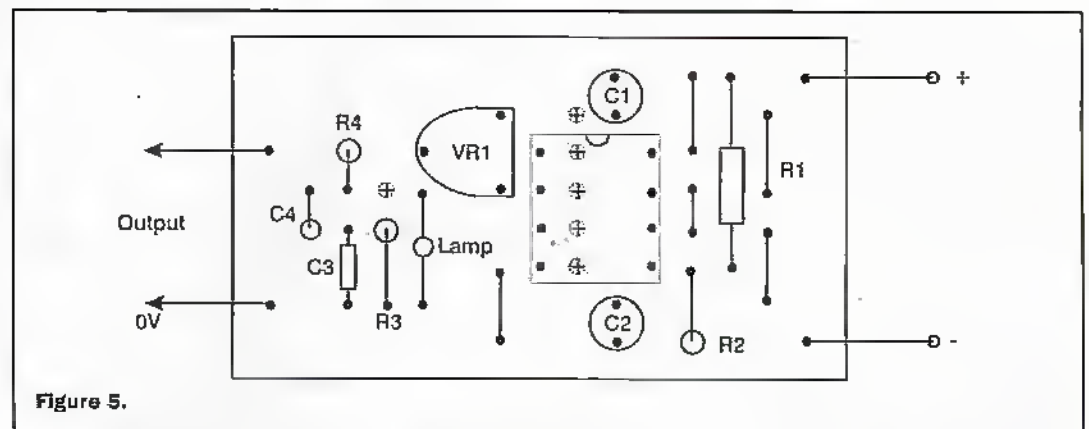


Figure 5.

it. I measured the resistance of Maplins BT44 lamp which is rated at 28V - 24 mA. It averaged at around 160Ω, and when wired up in place of other bulbs I had tried it gave perfect results. The very act of measuring its resistance of course increases it due to current from the meter, and so its cold resistance is somewhat less.

To clearly illustrate the problem, and its solution, I have plotted the IV characteristics of the BT43 and the BT44 to the same scale, shown in Figure 3. For the lamp to operate efficiently as a regulating device it must be used at a current level where it shows maximum change of resistance. The curve for the BT43 lamp shows that at 31Ω the

used for the feedback resistor the oscillator output can be set from 2Vpk-pk to 14Vpk-pk within the limitations of the power supply voltage. If the preset was set at say 500Ω then within less than a second on power up the lamp's resistance settles at 250Ω. It is quite fascinating to watch on the scope how quickly the output

jumps to a perfect sine wave, amplitude setting being dependent on the position of the feedback preset.

At the zero resistance end of the preset there is of course no oscillation, and at the other extreme there may be clipping of the output waveform, but the active area of the preset is not critical enough to warrant any fixed series resistors.

A practical circuit for a 100kHz oscillator operating from a single supply is shown in Figure 4. With the output set at 2Vpk-pk the total current drawn from the supply is only 3.6mA, and amplitude is stable from 7V up to 30V maximum. This makes possible operation from a single PP3 battery. A 12V supply will allow the output to be turned up to 6Vpk-pk, for a 18V supply 10Vpk-pk, and for 24V 14Vpk-pk. Total current drawn at 14Vpk-pk is 5.5mA. Distortion is negligible and will only occur if the output level is set higher than the supply will allow. The bulb then ceases to be effective and the output becomes dependant upon the supply. Operation below 2Vpk-pk is not advised. The current through the bulb is too small for it to function as an effective regulator. IC1a provides a split

PROJECT PARTS LIST		
RESISTORS		
R1,2	56k Min Res	M56K
R3,4	3k Min Res	M3K
VR1	1k Preset	WR40T
Lamp	28V, 24mA Bulb	BT44X
CAPACITORS		
C1,2	10µF 16V Elect	AT98G
C3,4	470pF Poly 1%	BX53H
SEMICONDUCTORS		
IC1	TL081	(AV62S)

supply rail and operates as a voltage follower. Total negative feedback means that the output is forced to be at the same potential as the non inverting input which is at half supply due to the 56K resistors.

A suggested layout using stripboard (JPC6) is shown in Figure 5. From past experience, it is imperative to use 1% polystyrene capacitors. If you need to operate at a different frequency then keep the 330pf to 1000pf values of capacitor and reduce the resonant frequency by just increasing the resistor values in the bridge network.

Discussing the capacitors has reminded me of a slight slip up on the part of Donald Aldous. He writes "That the frequency (referring to the resonant frequency) will be the one at

which both networks display equal reactance in C1 and C2." Since C1 and C2 are of equal capacitance then they will display the same reactance at any frequency. It is only the follow on point that he makes that is valid - that is, the resonant frequency is the one at which the reactance of the capacitors is equal to the value of the resistors. All of the above is not meant as a criticism of the authors, I am just passing on the results of my work in order to assist others. My criticism if any, is with the writers of books that contain these little circuit blocks which are so often riddled with errors. I can't begin to imagine how many people have tried the bulb solution and become disappointed with the results.

Historical Note

Max Wien conceived the network that bears his name in 1891. He was working on AC bridge measurements at the time and the question of oscillations would not have entered his mind.

With the invention of the triode valve by Lee DeForest in 1906, electronic amplification, and with it the possibility of oscillation, became a reality. It was not until 1936 that William Reddington Hewlett, armed with Harold S. Black's pioneering work on negative feedback and Nyquist's 'regenerative theory,' showed that Max Wien's network could be made to oscillate. Hewlett used a tungsten lamp as a distortion free amplitude limiting device, which survived a 50 year production run in the Hewlett-Packard HP200 series audio oscillator.

It was fifty years after Hewlett described his 'New Type Resistance-Capacity Oscillator' that Jim Williams brought together Wien's network, Hewlett's bulb and a modern op-amp to give the circuit shown in Figure 3. He was first to suggest a JFET in place of the bulb, but rejected it in favour of a CdS photocell which achieved a distortion figure of 0.0003%, i.e. three parts per million. 

NEW PRODUCTS • NEW PRODUCTS • NEW PRODUCTS • NEW PRODUCTS

We take a quick look at some interesting new products that are featured in the forthcoming new Maplin Catalogue.



You can now have all the advantages of switched mode power supply technology in a handy mains plug top case. These high power AC/DC adaptors are realistically priced and are available in a wide range of output voltages. Each can be used with a wide range of input voltages and include a short circuit protection system with automatic recovery. These power supplies are particularly suited to the Velleman universal battery chargers featured on page 58 of this issue.

SPECIFICATIONS

Output voltage tolerance:	5%
Input voltage:	90 - 265V AC
Operating temperature:	0°C to 40°C
Ripple/noise (V pk-pk):	1% (20MHz bandwidth)

Order Code	Output Voltage	Output Current	Max. Output Voltage	Price inc. VAT
PL61R	5V	2A	6.5V	£14.99
PL62S	7.5V	2A	8V	£14.99
PL63T	12V	1.6A	15-17V	£14.99
PL64U	15V	1.3A	17-19V	£14.99
PL65V	18V	1.1A	20-22V	£14.99
PL66W	24V	0.8A	26-29V	£14.99

Note: These are not available until 1st March 1999.

- Antex have introduced a new gas soldering iron, the GasCat (order code RD51F, price £25.49 inc. VAT), a compact pocket sized butane gas (lighter fuel) iron for all those applications where a mains powered one is unsuitable.
- The strong nylon casing will hold sufficient liquid butane for up to one hours continuous use, and is equivalent to a 70W mains iron. The iron is supplied with a 1mm soldering tip fitted as standard and a protective cap which has an integral flint lighter (good for 900 cycles per flint) and a pocket clip. A range of spare tips are available separately. The maximum torch temperature is 1300°C and the maximum tip temperature is 450°C.



For those meatier jobs the latest self-igniting soldering iron from Antex (order code UD16S, price £34.99 inc. VAT) is ideal, being equivalent to a 120W mains iron. The iron features a piezo

ignitor and a maximum torch temperature of 1300°C, and a maximum tip temperature of 500°C. On fill of butane gas (lighter fuel) will last up to one hour. A range of spare tips are available separately.

NEW PRODUCTS • NEW PRODUCTS • NEW PRODUCTS • NEW PRODUCTS

Last month when we looked at how to put Greek letters in scientific documents, I suggested that one way was to type the corresponding English letter, then select it and change the font to Symbol. If you're doing this frequently, however, this could get tedious but by using a macro, this can be reduced to a single key stroke.

Windows 3.1 and 3.11 included a macro facility but, surprisingly, Windows 95 does not. However, many Windows applications do support macros. I'll use Microsoft Office applications to illustrate the principles but you'll find that many other applications work in a similar way.

What is a Macro?

A macro is simply a list of commands. By executing the macro, each of the commands contained within it are executed in sequence.

Macros are normally executed by pressing the key combination which has been assigned to it or clicking on a toolbar button. To see how this works, let's take our example of turning the most previously typed English letter into its Greek equivalent.

An Example

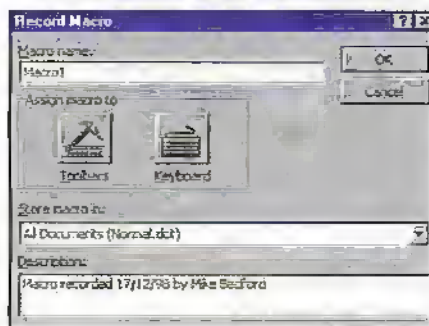
First of all, let's see how we'd do this manually in MS Word. After the English letter has been typed, the cursor will be immediately to its right. So, the first thing to do is to select that letter by holding down the shift key and pressing left arrow. With the letter selected, the symbol font is then selected from the font list box. This will turn the letter into its Greek counterpart but the character will remain selected. So, to put the cursor back to its original position for further typing, it is necessary to press the right arrow key. Finally, we need to re-select the font which was previously in use. Actually, that's a bit tricky but we can, at least, select the standard font in use in the document and this will work in most instances. Now let's define a macro to do all of this automatically.

From the Tools menu, select Macro > Record New Macro...

Software HINTS & TIPS

by Mike Bedford

If you're fed up at having to repeatedly type the same key sequences or clicking on the same buttons, you need a macro.



The Record Macro dialog box is displayed. A default name for the macro will be offered but type in EngGreek as a more meaningful name. You're offered the choice of assigning the macro to a key stroke or a toolbar. We'll assume a key stroke so press the corresponding button. You'll now be instructed to press the key combination you want to be associated with the macro - press Alt G (for Greek), then click on the Assign button and finally Close. The following tiny windows will appear on the screen, indicating that recording is in progress.

Now, execute the commands we've already identified as necessary to do the English to Greek conversion and when you've finished, press the Stop button on the macro recording window. You'll now find that this sequence of instructions will be executed whenever you press Alt G.

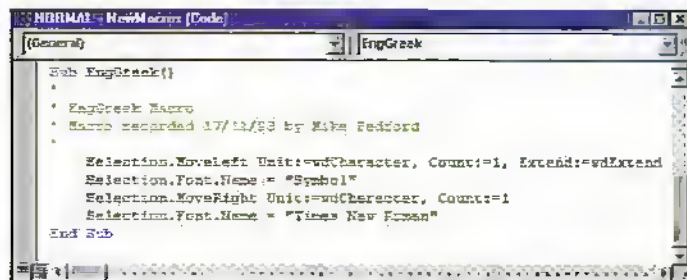
Write Your Own



The method we've just seen for defining and executing macros is similar in principle to that of recording and playing back a TV programme using a VCR. This will work in many cases but

there is a more versatile method of creating macros. First of all, though, let's take a look at how the macro we've just defined has been stored. From the Tools menu select Tools > Macros... Select the macro EngGreek and then click on the Edit button. A rather complicated looking window will be displayed but we'll concentrate on the list box which is reproduced here. You'll notice that this contains what appears to be a program, in fact it's written in Visual Basic. And if you're au fait with this language, you can edit the macro manually in this window.

In this example, the Visual



Basic commands are nothing more than key strokes and button clicks. However, it is a fully-functional language with all the normal sorts of facilities such as assigning values to variables, looping etc. What this means, of course, is that you can write some very sophisticated macros which can do far more than simply playing back keystrokes.

Macro Management

One thing I glossed over when I provided instructions on how to create the EngGreek macro

was where it ended up being stored. If you used the default settings it would have been stored in the default Word template and so would have been available in all files which you subsequently create or edit. Alternatively, you can choose to store the macro only in the document you're editing. If you're a frequent macro user, you might choose to store a handful of general purpose macros in the default template but keep the more specialised ones in the document to which they relate. Different packages will have different options as to where to store macros but it's wise to keep macro management in mind. Failure to do this would be equivalent to storing all your files in the disk's root with no regard to directory structure.

Beware Macros

Macros are clearly a very useful facility but their power can be misused. Since macros can be written in high level programming languages such as Visual Basic, they can do just about anything such as deleting files or wiping out the hard disk. They can also cause duplicates of themselves to be written to all files opened in

the package in question. This is the basis of the macro virus, now one of the more common types of computer virus.

This being the case, you should be wary of even opening a word processor or excel files unless you have some sort of virus scanning software. Microsoft Word provides some additional protection by warning you if a file you're about to open contains macros and gives you the option of disabling them. It is good practice to disable macros in this way unless you're 100% confident of the validity of the document.

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.

February 1999

25 February Smartcard, Olympia, London. Tel: (01595) 454545.

March 1999

10 to 11 March Softworld Accounting and Finance, Interactive Information Services, Grand Hall, Olympia, London. Tel: (0181) 541 5040.

19 March Windows 1999 Show, Olympia, London. Tel: (01256) 381456.

24 to 25 March Softworld for the Supply Chain, NEC, Birmingham. Tel: (0181) 541 5040.

31 Mar to 1 April Conference on Antennas and Propagation, IEE, University of York. Tel: (0171) 240 1871.

April 1999

3 to 18 April Edinburgh International Science Festival, Edinburgh. Tel: (0131) 220 6220.

13 to 15 April NEPCON Electronics, NEC, Birmingham. Tel: (0181) 910 7910.

20 to 21 April Intranet: EKPO 1999, Earls Court, London. Tel: (0181) 742 2828.

May 1999

17 to 19 May Cable & Satellite Mediacast 1999, Earls Court, London. Tel: (0181) 910 7931.

25 to 27 May Internet World UK Spring 1999, Earls Court, London. Tel: 0171 976 0405.

25 to 28 May Ninth International Conference on Metering and Tariffs for Energy Supply International, IEE, Conference Centre, Birmingham. Tel: (0171) 240 1871.

26 to 27 May Embedded Systems, Olympia, London. Tel: (0171) 681 1000.

June 1999

7 to 11 June 15th International Teletraffic Congress, IEE, Edinburgh International Conference Centre. Tel: (0171) 240 1871.

21 to 23 June People in Control an International Conference on Human Interfaces in Control Rooms, Cockpits and Command Centres, IEE, University of Bath. Tel: (0171) 240 1871.

12 to 15 June Seventh International Conference on Image Processing and its Applications, Manchester. Tel: (0171) 240 1871.

29 June to 1 July NEW YORK'S Telecom, NEC, Birmingham. Tel: (0181) 742 2828.

July 1999

26 to 28 July Third International Conference on Advanced AD and D/A Conversion Techniques and their Applications, University of Strathclyde, Glasgow. Tel: (0171) 240 1871.

August 1999

23 to 27 August Eleventh International Symposium on High-Voltage Engineering, London. Tel: (0171) 240 1871.

September 1999

1 to 3 September Ninth International Conference on Electrical Machines and Drives, Canterbury Christ Church College. Tel: (0171) 240 1871.

7 to 10 September Ninth International Conference on Artificial Neural Networks, IEE Conference on Artificial Neural Networks, University of Edinburgh. Tel: (0171) 240 1871.

Please send details of events for inclusion in 'Diary Dates' to: News Editor, *Electronics and Beyond*, P.O. Box 777, Rayleigh, Essex SS6 6LU or e-mail to swaddington@cix.compulink.co.uk.

What's On?



Digital TV Key To Wireless Revolution In Homes

The transition from analogue to digital television and video is the best opportunity yet to encourage consumers to welcome the concept of a high performance wireless network into their homes, according to electronic product designers Symbionics at <www.symbionics.co.uk>.

Michael Barkway, wireless data business manager at the Cambridge-based company, says digital TV will create even greater demand for an accessible standards-based technology capable of handling high rate data, digital video and audio in the home environment.

The advent of new digital video technologies – such as Interactive Digital Broadcasting, digital VCRs and camcorders – brings new pressures for the integration of the PC as a consumer appliance, linking together the new products seamlessly and wirelessly.

"There is an increasing need for a standard to link these new digital multimedia products in the home," explained Barkway, who is leading the company's development in this wireless data area.

"With the right technology, the consumer could download holiday videos from their camcorders to the PC for editing and then view them on the main household TV – without ever making a wired connection," explained Barkway.

"Nobody wants yet more cables in the home, so we are looking at high rate applications which can be developed using new standards in the 5GHz band such as Hiperlan and the emerging IEEE802.11 5GHz standard. Greater viewing choice is likely to lead to more households with two or three televisions, putting pressure on manufacturers to come up with a wireless solution which can 'pipe' the broadcast signal to several video devices," said Barkway.

The HomeRF Working Group has identified the need for low-cost home networking solutions and is working towards the new SWAP standard which will integrate voice and low rate data in the home.

A new group recently set up under the HomeRF umbrella is investigating the next generation of Home RF, code-named SWAP-Multi-Media (SWAP-MM). Symbionics has been closely involved with Home RF since its public launch in March this year and is actively working on the implementation of the first generation HomeRF systems.

Other technologies such as Bluetooth will also provide wireless connectivity. This newly launched consortium aims to provide short range data links to connect to the cellular phone.

"Bluetooth and HomeRF each address different markets but neither is capable of the bandwidths needed for digital video," added Barkway.

1... Limited Sounds The Death Knell For Audio Electronics

The audio electronics business is set to change dramatically with the vast majority of today's components becoming completely obsolete in the biggest step forward for the sector since the Compact Disc displaced vinyl. Digital loudspeaker technology, the holy grail of the audio industry, is set to cause the death of existing analogue audio electronics, causing a fundamental shift in the audio industry.

These are the views of Dr Tony Hooley, managing and technical director of 1... Limited at <www.uno.to>, the British company developing the world's first truly digital loudspeaker, speaking at DSP 98 at Sandown on 8th December 1998.

"A new breed of special digital-input/digital-output chips will be required which will much more closely resemble special purpose DSPs with integrated input/output (I/O). Chip makers need to respond to the impending shift in the market, before existing markets vanish in front of their eyes," said Hooley.

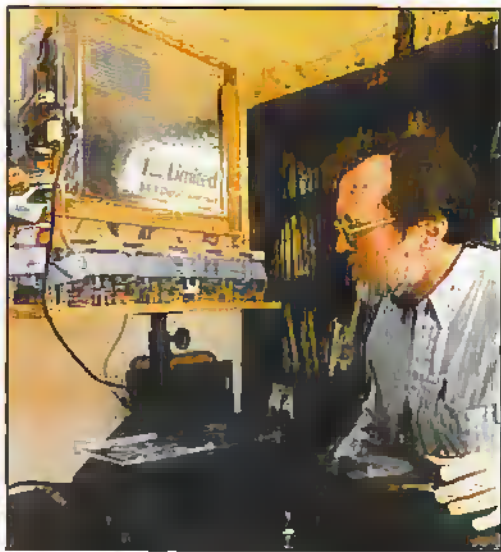
"Digital loudspeakers are destined to change the whole gameplan for the big audio electronics companies," he added. "The move to digital will be a rapid one and analogue audio will be quickly confined to the museum."

According to Hooley, digital loudspeaker technology will completely change hi-fi and audio electronics within the next five years or so. With programme sources starting out in digital form such as CD, digital audio broadcast, digital TV and digital video (versatile) disk there is no longer any need at all for analogue systems.

1... Limited's digital loudspeaker technology (DLS) takes digital signals direct from source as its input and emits digital pulses of sound as its output.

Any manipulation of the audio signal such as tone-control, equalisation and volume setting can be done entirely in the digital domain so no special purpose digital audio chips are required. Similarly there is no need for a power amplifier as the arrays of small acoustic transducers in the DLS are directly driven by low-power digital signals.

"Conventional loudspeakers are by far the weakest link in the chain between recording live sound and reproduction. Analogue loudspeakers are inefficient, expensive, fragile and require costly, hot, heavy and bulky amplification systems," said Tony Hooley, managing and technical director, 1... Limited.



COMMENT



by Keith Brindley

The King is Dead. Long Live the King

That old-timer of computing systems – indeed, almost the only thing (bar, probably, the monitor) that has been coincidental with the whole evolution of personal computing across the years – the floppy disk, is dead. Or so Apple and Intel would have us believe.

But is it? To find out we have to understand why Apple and Intel have reached that conclusion. You see, for computer makers and innovators like Apple and Intel, supporting technologies is always a problem. The fewer technologies there are to support, the easier it is to make computers, and the cheaper and better those computers can be. Over the years there have been many, many supported technologies coming and going. Every time there is a requirement to get data in to or out of a microprocessor, in whatever form, there has to be a supported technology: Serial ports, parallel ports, high-speed data interfaces, slow-speed data interfaces, internal upgrade card slots (ISA, Nubus, PCI) external upgrade card slots (PCMCIA, FireWire, flash ROM, flash RAM, flash Harry), and – yes – the good ole floppy disk. Problem is, when is the right time to drop support for technologies that are out-dated? There never is a 'right' time, of course, to do that. Whenever you drop support for a technology there's always someone, somewhere, who uses the technology and demands that it's supported.

Which brings us to the floppy drive. Proponents argue that it's a necessary technology: To many people, a computer without a floppy drive is a drawback. How do users transfer files from one computer to another? How do we keep data as archives for later use? How do they install software? Can you really use a computer without a floppy drive?

Yet, the floppy drive really is out-dated. Think about it. The floppy isn't big enough to archive much data. Once a whopping 1.4Mb floppy could have held much of the data we use all by itself. But these days things are different. A single scanned image (a photograph, say) is much bigger than that. A desktop published page is at least as big

Sound files can be many times the size. Only the odd word processed file or spreadsheet file will actually fit onto a floppy.

We use CD-ROMs to install software – there might be a couple of products around that still are supplied on floppies, but they are few and far between. Most programs these days absolutely demand CD-ROMs to install them (did you know that the latest beta of Microsoft's upcoming version of Office 2000 is supplied on six – yes, that's right, six – CD-ROMs?). For software like this, even the CD-ROM appears out-dated.

In fact, the only real use for a floppy today is to transfer files (albeit small ones) from computer to computer, and that, only occasionally. For all these reasons why a floppy is needed, however, there are several alternatives and as many reasons why it is not needed. The Zip drive is a well-known cartridge format, holding 100Mb on single floppy-sized media (a new 250Mb Zip format has just been developed, too). Other cartridge formats include SyQuest, Jaz and one, the SuperDisk, that can even read from and write to ordinary floppies in the same drive. Cartridges are ideal for archiving, or for transfer of data, and even for software installation, although the CD-ROM is unbeatable in its cheapness for this purpose. For data transfer when connected to a network (either local area, or Internet), there's really no need for even a cartridge system. So the floppy really is out-dated, and there are several alternatives that can do its job significantly better.

Apple's personal computer, the iMac, is the first mass-produced modern personal computer to have no floppy drive. Actually, the lack of a floppy drive isn't the only innovative feature that Apple included in the iMac. Another innovation is the standardisation for the Universal Serial Bus (USB). Personal computers have existed for a while now with USB ports, of course, so there's nothing new about that. What is new, however, is the fact that no other ports are included. No serial ports, no parallel ports, not even the usually Mac-standard SCSI port. Is using an iMac a problem because of these forward-thinking attributes? Well, no actually. The alternatives that exist and are being developed

alongside it are many times better than the legacy components Apple dropped when making the iMac. It's just a different way of thinking, that happens to be much better into the bargain.

Imagine the ease of making computers that don't need to support such interfaces. Imagine the resultant computer performance and quality, not to mention the lack of maintenance they require. Imagine the green faces of other computer makers still stuck with such legacy ports.

That's why Apple bit the bullet last year, and produced its best-selling computer the iMac without a floppy drive. Intel hopes to be able to keep up with Apple. Well, without exception that's what every computer maker hopes to do, ever since Apple brought out its first ever computer. For, later this year Intel hope to launch a range of motherboards that will not support a floppy drive, serial ports, or parallel ports. Not only that, Intel will cease support for legacy interfaces such as ISA slots and other outmoded technologies which Apple scrapped years back. When two major players like this make such steps – and face it, it's not often that Apple and Intel are in step together – the rest of the computing world will follow. If not immediately, within a year or so. Of that we may have no doubt.

In truth, the floppy disk is not quite dead yet. It is, however, on its death bed. As a storage medium these days it is quite useless. It can store only a mere megabyte or so of information, and as most data files these days are more than that, then it's easy to see it has little use. In terms of speed, it has none, being like a tortoise with a gammy leg. It's a dinosaur that needs to become extinct. So why do we hang on to it? We have no excuse any longer. Put the floppy disk out of its (and our) misery. If it's on its death bed, let it die. Don't prolong the agony. When the old dog is terminal you put it to sleep and buy a new one. Let's now run with the greyhounds. The problem is – which greyhound do we put our money on?

IMAGES

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



ESD Tools - ARE THEY IMPORTANT?

Tina Skinner, C.K Tools' product manager looks at the need for special tools to combat the electro-static problem with electronic components.

The electronics sector is one of the fastest growing industries of the twentieth century. As the world becomes more technologically advanced the necessity for more electronic equipment is constantly on the increase.

Semiconductor technology which has led to the production of the integrated microchip is the important invention that has brought about the new computer age. This intricate component is extremely small and is made up of layers of electrical circuits sandwiched between the thinnest insulations. This tiny piece of technology is complex, fragile and delicate, and as such requires the utmost respect when being handled. Mistreated, the microchip can easily be destroyed or damaged, often without any visible signs of damage.

The commonest cause of damage to a microchip is static electricity discharging through the component and blowing the circuits - it is estimated that each year in the United States alone over one billion dollars worth of microchip faults are the result of static - once caused, it is not repairable!

What is Static Electricity and How is it Generated?

Static electricity is one of nature's most flamboyantly displayed phenomena. It can not be prevented and its effects can lie dormant and undetected for a considerable time. Then without detection visually, or by test equipment, can cause damage which at best is inconvenient and at worst catastrophic. Many manifestations of static electricity are familiar to us, such as during a thunderstorm when lightning strikes to earth - the effects are instantly apparent and often quite substantial.

Static is a build up of electricity in the human body, an object or an article of clothing, which given the opportunity will leap from the charged object to earth. It can be generated by two surfaces rubbing together, creating a charge difference which is retained by both of the objects if insulated from earth. It is created in nearly everything we do, but as the body is not the best conductor of electricity, specially with many items of clothing being made from synthetic materials, the static is not able to find a path to earth, and remains in the body until it is provided with an opportunity to flow away in order to neutralise.

Combating the problems of Static Electricity

Within the electronics industry every precaution is taken to avoid the build-up of static electricity. Special materials, clothing and complex rules of behaviour are all designed to prevent its build up - protecting the component and the end-user. However, it still occurs, and often it is the tools that are used that cause the problem.

The scenario is, the production line operator is earthed to ground by means of a wrist strap and cable going to earth, and also by conductive shoes which are earthed to the floor. The circuit board is earthed to the bench, and the bench in turn is earthed. The component itself carries an electro-static charge, which is increased by the movement from the tray to the circuit board.

A pair of pliers, or what ever the tool used for transporting the component from the tray to the circuit board, is completely conductive. As soon as the product touches the component, static electricity which has built up within the component violently discharges through the component, the tool, the user's hand, and down the cable to earth. Thus destroying the component, and perhaps injuring the operator.

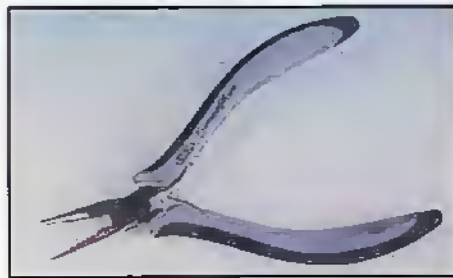
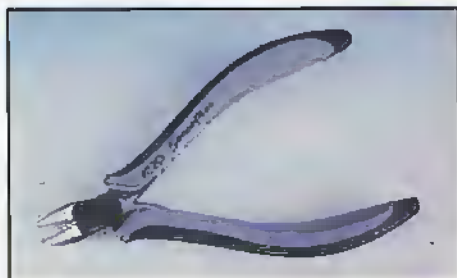
If on the other hand, the pliers used are insulated - the static load is retained. Now when the pliers pick up the component it is unaffected, but when it is placed on the circuit board the static electricity is immediately discharged through the circuit board, the bench and to earth. Again the component is now completely destroyed, or badly damaged.

As a result, there is only one solution. It is necessary to use ESD (Electro-Static Dissipative) tools. Totally the opposite to VDE (Verband Deutscher Elektrotechniker) products, which are insulated, ESD products gently allow the static electricity to flow from the component to earth at a controlled rate. The charge gently dissipates, at a rate which causes no damage to the component. As the pliers are picked up by the operator the static load is discharged through the hand before the component is handled, therefore eliminating any static discharge from tool to component.

How are ESD products judged?

It is necessary that the discharge is neither too fast nor too slow. If the discharge is too fast or 'hard' the shock may destroy or damage the component. If the discharge is too slow the static electricity might not discharge totally, ultimately having the same effect as an insulated tool.

C.K Tools has recognised the need for high quality ESD tools, and as such has introduced a wide range of ESD products in line with the ESD-protection measures, and national and international industry standards. ESD-protection measures avoid static flow from tools to components by discharging existing load through the body of the user to earth before the tool touches the component - for this purpose a resistance of between $10^6\Omega$ and $10^9\Omega$ is ideal.



Included in C.K.'s ESD products is the new Senso Plus range of pliers (now available from Maplin), specially designed with many benefits and design advantages for the end-user. Designed for strength and long life the pliers are manufactured from a high alloy special steel. The jaws provide an extremely smooth action for exact guidance of the jaws without the need for readjustment due to the precision box joint, and the induction hardened cutting edges ensure long life and maintained cutting ease. Resistant to rust, the pliers are individually mirror polished with easy clean surfaces.

The bowed and slightly longer than normal handles on this range of pliers have been

specially designed. Not only are they suitable to use with even the most sensitive circuit or component, but they benefit from a special soft 'two-component' technology used to create comfortable and slip free thermo-plastic

material compound grips. This eliminates the dangers of mistakes when working on intricate jobs, and offer a fatigue-free, comfortable use regardless of users hand or working position. In addition, the pliers action is consistently accurate regardless of repeated use, due to the precisely positioned spot welded double leaf spring.

C.K. also provide a range of ergonomically designed ESD Triton Screwdrivers (see Tools section of the Maplin Catalogue), which allow fatigue-free working with high torque turning. Lightweight and shatterproof, the screwdrivers are resistant to shock, oil, acid and extreme temperatures, and the special dissipative material is injection moulded around extra large tangs, giving greater blade and anti-slip handle security. There is also a range of ESD Super Slim screwdrivers, which benefit from all the advantages of the Triton range.

In addition to the screwdrivers and pliers, C.K. Tools even provides a special ESD pen.

For further information on ESD or any of the ESD products available from C.K. Tools, contact C.K. on Tel: 01758 701070.

Maplin stock a range of pliers and cutters from the C.K. SensoPlus range:

Type	Order Code	Price inc. VAT
Oval Side Cutters for hard (0.4mm)	NF60Q	£27.99
Oval Side Cutters for copper (1.2mm)/soft metals (0.6mm)	NF62S	£29.99
Oblique Cutters Standard	NF61R	£34.99
Oblique Cutters Extra slim	NF64U	£49.99
Flat Nose Pliers	NF65V	£23.99
Ultra Fine Snipe Nose Pliers	NF65W	£32.99
Snipe Nose Pliers - serrated jaws	NF67X	£23.99
Snipe Nose Pliers - smooth jaws	NF68Y	£23.99
Tapered Side Cutters	NF63T	£29.99

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- ★ LED Graph Circuits

TECHNOLOGY WATCH



One of the most interesting television developments of recent times has nothing – sorry, little – to do with the digital revolution, or big business for that matter. We're talking American-style community television – in other words, small low-powered stations designed to serve a very small geographic area. The UK has seen it before with radio, in the form of restricted-licence broadcasting. If you feel poorly-served by conventional radio – legitimate examples include ethnic communities in the big cities and university campuses – then you can apply for a licence. In the past, restricted-licence radio broadcasting has also given rise to short-term activities like Radio Cracker. These are charity fundraising stations that operate over the Christmas period. They operate using low-powered transmitters, which are available fairly cheaply from a number of sources in both kit and ready-built forms.

Community radio stations are highly regulated in the type of aerial fed by their transmitter, as well as, hardly surprisingly, the programme material they carry. Regulation, in this case by the Radio Authority, is important to prevent the corruption of society as we know it. Hence the government-funded demise of the pirate stations who were, no doubt, promoting all manner of subversive ideas as well as interfering with emergency service frequencies. However, regulation can go somewhat over the top. A Nottingham university station apparently had its knuckles rapped after a weather announcer reported that it was "pi...ing down". Swearing, interestingly enough, has never been heard even once on the slightly wider-audience Radio One – yep, the station that never gave a boozy rock star a pro-drugs platform. Oh dear me no...



Community Television

And so we now have community television, which is regulated by the ITC. Compared to radio, the restricted service licenses (RSLs) are rather more expensive, and the stations somewhat more expensive to set up. Even the non-refundable licence application costs a packet. As with community radio, however, there's a need. The first such station to go on the air, the commercially-operating TV12, is based on the Isle of Wight. There, you can't yet receive Channel 5 unless you've got a satellite dish. Indeed, cable TV hasn't yet arrived on the island. Regional television receivable by the Isle of Wight's estimated 126,000 inhabitants and countless holiday visitors, in the form of BBC South and the Meridian ITV franchise, tends to offer little offshore focus. After all, these services have to cater for most of southern England. "Nobody here's particularly interested in what goes on in Southampton,"

with Martin Pipe



TV12 serving the Isle of Wight.

according to station Managing Director Paul Meade – who, ironically enough, used to work for Meridian.

TV12, like other first-round RSL-TV applicants, had to meet a deadline imposed by the ITC. By that time – 30th September 1997 – 31 applications had been received, covering most major locations within the UK. The initial whittling-down of applications took into account various factors, such as ownership rules, competition and even whether the applicant was a 'fit and proper person' under the terms of the 1990 Broadcasting Act. Any competing applications were assessed in terms of the services they would provide to audiences, and whether they would 'meet tastes and interests not already met by existing services'. The initial application, which cost £500, also covers frequency planning. With the UHF TV band (470 to 860MHz, or 'channels' 21 to 68) now becoming rather congested with five terrestrial channels and onDigital, spectrum is at a premium. 14 of the prospective RSL-TV franchises were turned down because no such spare frequencies were available – if the services were started, interference could result.

Most of the successful applicants will be licensed for two years – ITV franchises, in comparison, are much longer. Four two-

year licences, including TV12, have now been issued. Shorter-term (56 days) licences will be issued for stations that want to cover special events, such as festivals. All licences are renewable subject to competition, according to the ITC. In many cases, viewers might need new aerials to watch the new services. Traditionally, television aerials were available in four types tailored to provide maximum gain over a relatively small portion of the TV band – installers erect the type that corresponds to the RF outpourings of the area's principal transmitter. These four types, or 'groups', are A (channels 21 to 34), B (39 to 53) and C/D (48 to 68).

Bearing in mind the scarcity of UHF spectrum, it's unlikely that a spare frequency within the main channel group will be available to a fledgling broadcaster. On the Isle of Wight, the four main channels (BBC1/2, ITV and C4) broadcast on channels 31, 24, 27 and 21 – in other words, Group A territory. Most aerials on the island would presumably be of this variety. TV12, however, is broadcasting considerably outside this band. On channel 54, to be precise; this would require a



group C/D aerial. It is for this reason – and Channel 5 – that group E (channels 39 to 68) and wideband/W (21 to 68) aerials were introduced comparatively recently. These will work over a broader band, but at reduced gain (over 1dB for group E, or 2dB for group W). TV12 recommend a wideband aerial to island installers.

Not Plain Sailing

I can see several problems here. So do the ITC warn all potential licencees if the channel likely to be allocated to them will be significantly different to the ones used by existing terrestrial services? First, not many people will be prepared to change their aerial, unless of course it will also bring in Channel 5. After all, there's no guarantee that a station's licence will be renewed after 2 years. Even if viewers do change their aerial for a broader-coverage type, its reduced gain might cause signals from the other channels to become weaker, resulting in grain. This will be true in

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PROGRAMME LISTINGS - WEEK 2

MONDAY	28th DECEMBER	PICK OF THE WEEK
1700 Sportsfile	2007 Gobhill Governor	KIDS VOTE
1730 Just Backy	2030 Day in Life	We turn the control over to local school children in Kids Vote. Representatives from two prominent businesses are put through their paces as the children ask probing questions. At the end, the business which the students feel deserves a bit of punishment gets pinged!
1800 DTV Show	2100 Rock 'n' Roll	RESOLUTIONS
1830 Sheeping Trail	2200 Rock 'n' Roll	The New Year is upon us, so we send our viewers out to find out what's in store for 1999. We talk to residents across the island about 1998 and look forward to the New Year, making resolutions along the way. If you're having a hard time deciding what you want to resolve to do differently next year, see what other Islanders have in mind in Resolutions.
1930 Along the Way	2230 Sea Goes on	STUDENT MARCH
1930 Horizons		Despite the soggy weather, students from the Isle of Wight College still marched down Newport High Street to get a message from local Councilors. In their final bid for a new college building, the students rally together and present hundreds of signatures to let the Council know just how they are feeling. We see TV12 cameras to catch the action and the excitement in Resolutions.
TUESDAY	29th DECEMBER	WORK EXPERIENCE WITH TV12
1700 Talking Technology	2041 Student March	A Media Studies student at the Isle of Wight College, Samantha, years of age and already an aspiring journalist. This is me. My name is David Edwards and I am just like many other teenagers who have dreams of stardom in the media. Today I have come to see the professionals at TV12 hard at work. In short, I volunteered my services and have been extremely busy all morning writing articles for TV12's magazine guide - Vision. This included my own interview with Paul Topping, which is featured elsewhere in this magazine.
1730 Kids Vote	2050 Resolutions	Last year, I was involved in a lot of voluntary work for Isle of Wight Radio. This was great but I knew I had to have a variety of experience if I was to succeed. By talking to Michelle Meade (one of my course tutors) and by showing her some of my work, she decided I would be of some help to the team at TV12. Now, a week later I am here - learning more and more about the media industry every minute.
1800 Island Focus	2100 Underground	So, here and now everything is happening around me. With only days until the initial launch broadcast (this article was written in October), interviews are being set up and feedback calls in from my eyes. Everyone else is making sure that all the aspects of TV12 are finished and ready for broadcast while I am wholeheartedly evaluating telephones.
1830 Headliners	2130 Underground	From where I'm standing right now, it looks as though TV12 is here to be a smash hit, and it's likely that many other communities will follow suit. Anything less than this is an amazing opportunity for those of you with an interest in TV. AD in all, it's a great experience. The staff are friendly, the work is interesting and I mean to be back soon.
1900 Collections	2200 In Vision	
1930 Behind the Spotlight	2230 Wilderness	
WEDNESDAY	30th DECEMBER	
1700 Sportsfile	2041 Gobhill Governor	
1730 Just Backy	2100 Day in Life	
1800 DTV Show	2100 Rock 'n' Roll	
1830 Sheeping Trail	2130 Rock 'n' Roll	
1930 Along the Way	2200 Sportsfile	
1930 Horizons	2230 Sea Goes on	
THURSDAY	31st DECEMBER	
1700 Talking Technology	2000 Student March	
1730 Kids Vote	2030 Resolutions	
1800 Island Focus	2100 Underground	
1830 Headliners	2130 Underground	
1900 Collections	2200 In Vision	
1930 Behind the Spotlight	2230 Wilderness	
FRIDAY	1st JANUARY 1999	
1700 Sportsfile	2007 Gobhill Governor	
1730 Just Backy	2030 Day in Life	
1800 DTV Show	2100 Rock 'n' Roll	
1830 Sheeping Trail	2130 Rock 'n' Roll	
1930 Along the Way	2200 Resolutions	
1930 Horizons	2230 Sea Goes on	
SATURDAY	2nd JANUARY	
0630 Local Information	1830 Headliners	
1000 Rock 'n' Roll	1900 Wilderness	
1100 Just Backy	1930 Behind the Spotlight	
1130 Wilderness	2100 Collections	
1200 Graphics	2030 Day in Life	
1600 Briefing	2100 Underground	
1630 Kids Vote	2130 Underground	
1700 Talking Technology	2200 Kids Vote	
1730 Along the Way	2230 In Vision	
1800 DTV Show	2300 QVC	

TV GUIDE (continued)
JUST BACKY
 16 year old Becky Webb presents this interview show that takes a teenagers' look at local characters and their several occupations across the island. Each week she interviews a variety of people to discover just why they are doing what they are doing.

TV 12 Listings. A fascinating insight into the island scene.

'fringe' coverage areas, which are located some distance away from the nearest transmitter. Viewers in such areas may be using the biggest and highest-gain aerials available to them, coupled with aerial amplifiers and other signal-boosting gadgetry. Losing gain by installing a broader-band aerial won't help matters! If viewers don't, however, opt to change their aerial, they may be rewarded with a very weak and snowy picture from their community station. This is because its transmitters will be low-powered. TV12, for example, has a 1kW transmitter. This feeds an aerial located on the same Rowridge mast as the ones that provide BBC, ITV and Channel 4 services to the Isle of Wight. The latter aerials, however, are each fed by a 500kW transmitter.

TV12's main transmitter provides adequate coverage over a 10-mile radius. This is sufficient for the centre of the island - specifically Newport, Carisbrooke, parts of Sandown, Shanklin, Cowes, Ryde and the West Wight. To cater for the rest of the island, the station has also submitted plans to build relay stations at Brading, Ryde and



Roger - TV12 Cameraman.

Venmor. They will come on-line if ITC give them frequency clearance. There may be another solution, though. If a cable TV network operates in the service area, it is hoped that the community channel will be carried. This is certainly true of TV12 - cable TV, according to Meade, will be coming to the area soon. Interestingly, some of the bigger cable networks have provided limited community broadcasting for some time. TV12 started broadcasting on October 31st - in other words, over a year after the original application. Part of this delay was attributed to obstacles introduced by the French broadcasting authorities, which claimed that UK transmitters might interfere with their services. Like all applicants that passed the first hurdle, it stumped up a further £3725 to the ITC. This paid for the second part of the application fee, the ITC licence fee and the Wireless Telegraphy Act licence fee. One shouldn't complain, however - ITV franchises pay out millions...

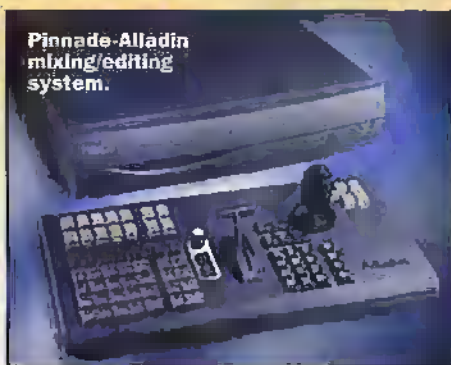
In all, TV12 estimates that its set-up costs amount to around £300,000. Its 1kW transmitter, which is generating interest amongst long-distance television enthusiasts on England's south coast, alone cost £50,000. TV12's transmitter and aerial are maintained by Castle - the privatised BBC transmissions engineering department that looks after the other terrestrial broadcasting equipment at the Rowridge site. TV12's annual budget is £250,000 - again, peanuts compared to mainstream broadcasters. The station plans to derive its funding from advertising, which is considerably cheaper than on Meridian. A 30-second prime-time advert costs a mere £15 per insertion (produced you book 100). TV12 will also produce adverts for local businesses, at prices starting from £95. Clearly, community

television will allow many businesses to indulge in TV advertising for the first time ever! At those prices, TV12 would have had to sell an awful lot of advertising in advance to get started - clearly this wasn't the case. Initial investment for the station came from Meade (who has a 51% stake), and local businesses - including the local newspaper publisher, a TV production company and Whitelink Ferries. TV12 hopes to get local sponsorship for any movies that it runs.

Run-on-a-shoe-string

To keep within their minuscule budgets, community TV stations have to be run very tightly. TV12 is no exception. It has 12 full-time and 3 part-time staff, all of which participate in multi-skilling. Its general gopher was trained how to use a camera, and even Meade himself edits some of the programmes. The station, which is based at Medina High School, also encourages help from volunteers - and not just amateur videomakers. TV12 certainly does seem to be actively encouraging input from islanders in other ways too. Its web site invites local news stories, programme ideas and feedback. Indeed, the programming is very localised as one would expect. Its 16-page TV guide, which is given away in shops, gives details of daily programming. TV12-produced programmes are aired between 5 and 11pm on weekdays. At weekends, additional programmes are shown at other times during the day.

TV12's own programmes appear to cover a wide variety of islander tastes. There have been shows on powerboat racing, antique collecting, Morris dancing, bell ringing and the Old Gaffers Festival. Programmes catering for more mainstream tastes include



The MOST you will pay for a 30 second commercial on TV12 is...

Typical cost for a 30 second commercial break.

£25

To find out more call (01983) 524745



Animal Quest (a look for unusual animals around the island), a sports show, and live music from local venues. Regular airtime is also given to local news and weather forecasts. When home-grown programmes aren't being broadcasted, TV12 transmits a mixture of local graphical advertising (known as 'telemessages'), Bloomberg (a satellite-delivered news/business channel) and QVC (home shopping). TV12 gets a commission from each Isle of Wight sale that QVC makes through the station, helping to swell its coffers. I can imagine that TV12's output will be fairly typical of what most community stations will offer.

Choice of Equipment

The tight budget also affects the choice of equipment available. Not for TV12 – or any other community station, for that matter. Thankfully, the latest generation of consumer digital camcorders are capable of broadcast-quality images. TV12 runs three Sony DV camcorders – one VX9000 and two VX1000s. For editing footage into programmes, three edit suites are available – at the time of writing, two were in use. One of these is a PC equipped with video capture hardware and Adobe Premiere non-linear editing software. With this type of system, which is becoming increasingly popular among professional and amateur videomakers alike, you capture video from the camcorder to the PC's hard disk as 'clips', and then piece it together on a 'timeline' on the computer monitor. The clips can be trimmed to an appropriate length, and joined with transitions (wipes, dissolves, etc.), or endowed with

TELL US WHAT YOU THINK

TV12 IS BEING SLAVED

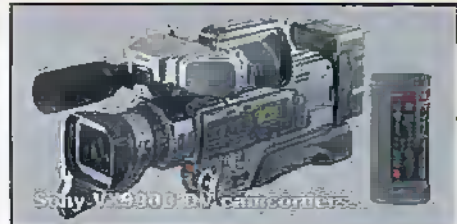
THE COST OF EFFECTIVE ADVERTISING

SPONSORSHIP

PROGRAMME	Start Time	End Time
12 NEWS	7.00	7.30
12 NEWS	8.00	8.30
12 NEWS	9.00	9.30
12 NEWS	10.00	10.30
12 NEWS	11.00	11.30
12 NEWS	12.00	12.30
12 NEWS	1.00	1.30
12 NEWS	2.00	2.30
12 NEWS	3.00	3.30
12 NEWS	4.00	4.30
12 NEWS	5.00	5.30
12 NEWS	6.00	6.30
12 NEWS	7.00	7.30

various effects. Titles and audio mixing are also catered for by Premiere.

Unfortunately, this doesn't work in real-time, and so there's a wait during which the video is processed or 'rendered'. After this, the edit can be played back in real-time through the capture card's video and audio outputs, or saved to a file. The second edit suite is another PC, which is used in conjunction with a complex professional-grade mixing/editing system known as Pinnacle Alladin. This, unlike Premiere, works in real-time. It achieves in hardware most of what Premiere does in software. The picture quality is very good. Just as well, TV12's general rule is to stay away from VHS quality at prime time. That said, one of its shows, Video Club, does put out amateur productions.



Mostly Digital

Despite its budget, TV12 is practically digital from camera to final transmission. It doesn't dump its programmes back onto video tape. Instead, they are converted into half D1 resolution MPEG-2 format and transferred to a big 9Gb hard disk. Three of these are sufficient to carry a week of TV12-originated programming. At the start of the week, the three disk drives are physically transported to the transmitter site – the existing pair are taken back to the studio, where they are rewritten with the following week's programming. This approach is much cheaper than a dedicated high-capacity leased-line between studio and transmitter. The MPEG files from the hard disk are played back in real-time, and converted into broadcastable analogue PAL format.

But what about live programmes, such as the weather forecast? These are encoded in MPEG, in real-time, at the studio and delivered to the transmitter via an ISDN dial-up line. Unfortunately, ISDN's low capacity means that weather reports only consist of still images (i.e. maps) accompanied by a voice-over! A scheduler system, which controls a switching matrix, determines which of the disk-stored programmes are transmitter, and when. The scheduler, which can be remotely updated from the studio, is also responsible for determining when QVC and Bloomberg are switched in for broadcast (these are derived from satellite receivers at the transmitter site). Although TV12 doesn't operate in Nicam, it does run a teletext service. The encoder is located at the transmitter site – the pages are updated via a modem. TV12 has three teletext data entry terminals, including the studio and local newspaper.

Making TV Advertising Affordable...

Welcome to the TV12 web site

This site holds lot of useful information about our unique blend of programming. To navigate your way around use the buttons on the left and the buttons below. For a taste of what we have for you click here.

TV12 website

E-mail your comments or suggestions to Martin.Pipe@whatnet.co.uk or 1ink.co.uk – Or look out for him online. His ICQ ID is: 15482544

Demon Guide for Parents

Demon Internet is rightly concerned about the use people – particularly children – make of the Internet. The Internet, of course, is the world's biggest repository of information, and access to much of that information is relatively free and easy, simply by surfing the World Wide Web, say, with your favourite Web browser. There's nothing wrong with that as a concept. As a research tool for children at school it's absolutely ideal – type a word or phrase that you want information about into a Search Engine (Yahoo, Lycos, Webcrawler, and so on) and seconds later you can be presented with many links to locate the information you want. For schools and parents, this means a relatively easy and cheap means of providing information that previously would have been too expensive to locate, if it could be accessed at all.

However, there's an inherent flaw with the concept, that many schools and parents have found to their concern. Not all the information available is the sort of information that children should be accessing. For example, while most information on the Internet is acceptable, there are many places that contain pornographic material.

Demon has produced a booklet *Practical Guidance for Parents and Teachers* which helps to identify those areas in which vigilance should be exercised when allowing children to access the Internet. It's a useful guide that everyone who cares for children who have Internet access should read. Rather than pinpointing particular Websites or areas that

children shouldn't access, it is a general guide to highlight areas for concern. Parents and teachers of any child or children who enjoy Internet access would do well to read it. Contact Demon Internet, on 0800 027 0127, for a free copy of the guide.

Electrifying

If you're looking to create cool Web pages with streaming multimedia content, look at <http://www.electrifier.com> where you'll find details of Electrifier Pro which is a brand new product that helps Web page designers fulfill their criteria easily and quickly. It features some really powerful Web creation tools, along with seamless integration with popular existing packages like Adobe Photoshop, Adobe Illustrator, Macromedia Freehand, Adobe PageMill, Microsoft FrontPage, NetObjects Fusion, and Macromedia Dreamweaver.

Integration, indeed, appears to be one of Electrifier Pro's main advantages. It supports an extraordinary array of content such as bitmap and vector animation, digitised audio, synthesised music such as MIDI, video, 3D, VR panoramas, and other animations, so can be used with just about any multimedia content you care to use. Alongside this, it utilises the most advanced compression available such as Sorenson Video, Intel Indeo, Qualcomm PureVoice and QDesign Music, to create the smallest files ready for the Web page.

Hooking into Apple's multimedia tool QuickTime, which is available on every major computer platform, Electrifier Pro allows industry-standard multimedia Web pages to be easily created, and viewable in any major Web browser on either

Internet or Intranet delivery systems, over a minimum of 28K modem lines, as long as the browser's QuickTime plug-in is installed. The fact that many users already have the QuickTime plug-in in their system means that sites formed with Electrifier Pro are easily accessible. We hope to take a closer look at Electrifier Pro in a future issue of *Electronics and Beyond*.

At the moment, the MacOS version of Electrifier Pro is shipping, and Windows version (95, 98, and NT) are under development. While it's not cheap (\$595, UK pricing to be confirmed at the time of writing), Electrifier Pro has the potential to be one of the most popular Web page creators ever available.

Manage those Mac URLs

If you use the Internet much, you'll know what a problem it can be to keep track of and control all those URLs you collect. While a Web browser allows the ability to keep and manage bookmarks or favourites, they don't do this with any particular aplomb, so there's a real opening for tools that do the job in a better way. For Mac users, at least, the better way is URL Manager Pro, which allows URLs you collect along the way to be stored in customised windows. In the windows you can store individual URLs in folders in hierarchies, much as the Mac works with ordinary files. Double-clicking a URL launches the helper application (Web browser, ftp utility, email program) you have associated with it. Helper applications can be manually linked from

URL Manager Pro at any time, or automatically linked by the Mac-standard InternetConfig system extension.

As nice and useful as its URL management capabilities are, URL Manager Pro has several other features that make it the invaluable tool it is. For a start, you can opt to link URL Manager Pro to the help applications you use such that they display an extra menu whenever they are active, which allows direct access to URL Manager Pro and its tools. As a result, it's a snitch to grab a URL from within the helper application and direct it straight to URL Manager Pro. With this menu you can create bookmarks for Web Pages from within, say, Netscape Navigator or Microsoft Internet Explorer. Further, you can add your own notes, grab all URLs on a Web page or in an email message, and even explore the Internet with a predefined set of Search Engines. Where most PC users are only just getting to grips with cutting and pasting URLs, Mac users with URL Manager Pro can do the whole shebang of URL management with just a few simple keystrokes.

URL Manager Pro can validate URLs, find and delete duplicates, supports Contextual Menus and Apple Data Detectors and, with the release of the latest version (version 2.5), is now MacOS 8.5 Sherlock-savvy which means that you can access Sherlock plug-ins to aid your searches on the Internet. URL Manager Pro is worth every penny of its \$25 shareware fee. Locate it and download URL Manager Pro at <http://www.url-manager.com>.

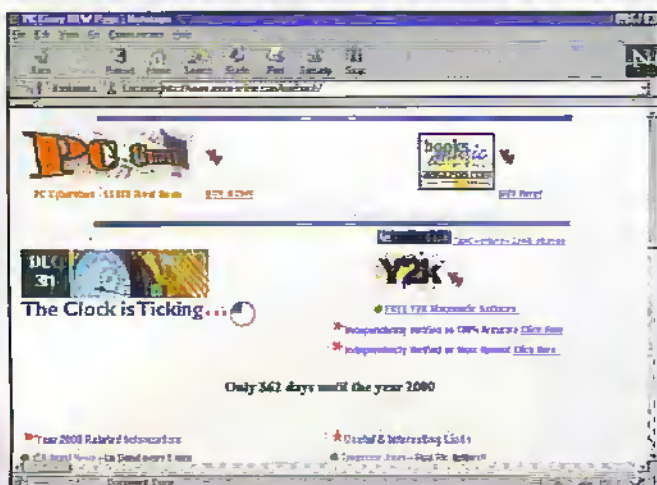
EWallet Target E-Shopping

US start-up Ewallet at www.ewallet.com is offering free software to enable online shoppers to store all of their credit card information on their PCs, saving them the trouble of typing it in each time they purchase something from the Web.

The company expects to earn revenue from advertising, and by directing shoppers to portal sites where they can search for merchandise.



PC Crazy Partners With Netsales To Open Fully-Stocked Internet Store



PC Crazy has cut a deal with Netsales to create a fully stocked Internet Store featuring more than 53,000 computer products. The store link is located at www.pccrazy.com and is now fully operational.

The Internet Store provides flexible ordering and delivery of hardware, boxed software, and computer books, as well as immediate

delivery of a large selection of software files via electronic download.

The store features daily product specials with reduced prices, and a customer support system staffed seven days per week. Netsales manages all store operations, including order processing, payments, product delivery, store updates, new product additions, and customer support.

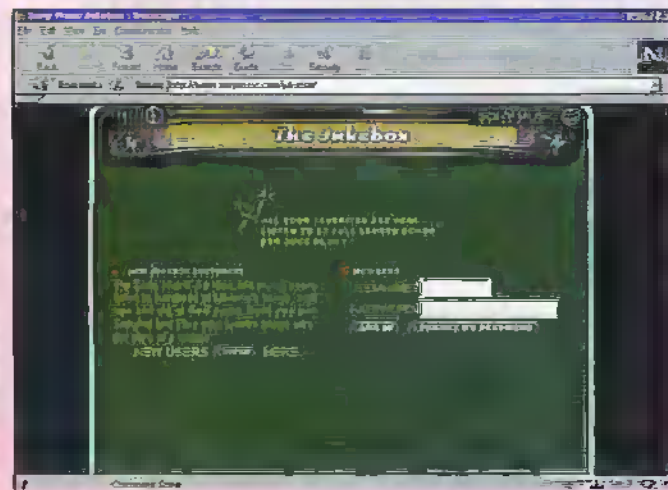
Sony Music Online Unveils the Beta Jukebox

Sony and RealNetworks have announced the Beta release of the Internet's first pay-per-listen jukebox, containing hundreds of songs available on-demand using RealNetworks RealPlayer. The beta release of the Jukebox can be accessed at www.sonymusic.com/jukebox.

The Jukebox, designed to accommodate the different

tastes and lifestyles of music fans everywhere, features hundreds of songs by favorite Sony Music artists that can be easily accessed on the Web.

To access The Jukebox, visitors will need the RealPlayer G2 or the RealPlayer 5.0 available for free download at www.sonymusic.com/jukebox and www.real.com.



Portals Are Dominant Online News Source



Almost half of online users now access news via search engines or directory Web sites, and 40% access news via online services, according to a report by Jupiter Communications at www.jup.com.

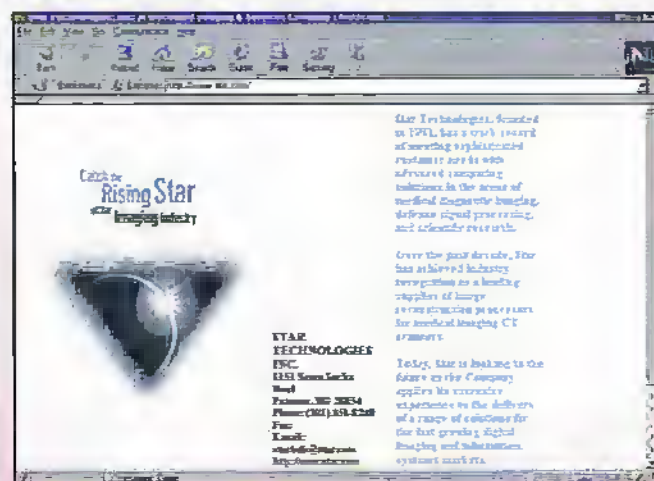
The report, which highlighted results from more than 2,200 online users about their online news consumption habits, revealed that online users are gravitating to the Web to collect top headlines and breaking news, but are spending an average of less than 10 minutes per session.

12% of those surveyed indicated that the Internet is where they go to collect

breaking news versus 9% that indicated they gravitate to the radio and 2% that identified newspapers. While the majority of consumers still choose broadcast sources for breaking news there is clear evidence that consumers are now logging on for breaking news.

With the majority of traffic coming online for headlines and summaries, Jupiter recommends that mainstream news providers adjust their editorial resources devoted to producing deep analysis online, and instead focus on developing content around major and breaking stories.

Internet Use To Increase By 70% By The Year 2000



Over two thirds of blue-chip companies will increase their use of the Web by the Millennium, a survey by Internet specialist Star reveals. Star at www.start.co.uk predicts an increase of over 50% in bandwidth required as a result of this increase.

Of the respondents, 33% plan to develop their own Web site or improve an existing one, while 25% want to develop an Intranet. Star also discovered that a third of companies expect to be installing Internet access to all staff over the next 12 months.

Oracle, Sun Team Up To Rival Microsoft

Oracle CEO Larry Ellison will not give up on his network computer concept. His company has just done a deal with Sun to develop new software for Internet computing while at the same time competing

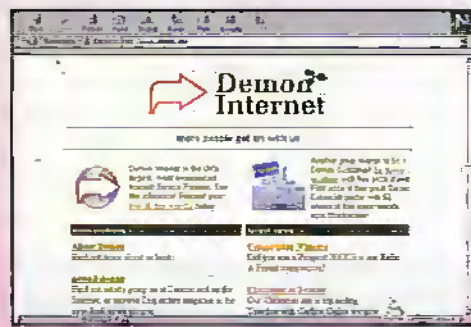
head-on with Microsoft's Windows operating system.

Internet computing, a term coined by Oracle at www.oracle.com, focuses on using browser software as the interface to all other applications.



Demon Internet Launches Safe Use Guide

Demon at www.demon.net has announced a free green cross guide to the Internet for teachers and parents. The guide offers a complete step-by-step approach to the different elements of the Internet and provides an easy to read and jargon-free guide to educational and safe surfing on the Internet with children. The free guide is available by calling (0800) 027 0127.



Internet To Become Faster And Video Rich

BT has launched a trial service called BT Interactive, which it reckons is the UK's fastest ever Internet solution. The service which started trials in west London in the new year is based on the latest asymmetric digital subscriber line (ADSL) technology and allows users to rapidly access a range of information services with data rates of up to 2Mbps. The trial will be amongst 900 users and last for around six months.

BT Interactive includes the BT View service, which utilises video streaming technology to provide users with unique video and audio-rich interactive sites developed for BT by TV, film and music companies including the BBC, Flextech, Carlton On-Line, Pearson Television, IIN, Ginger Media Group, Internet Movie

Database and many others.

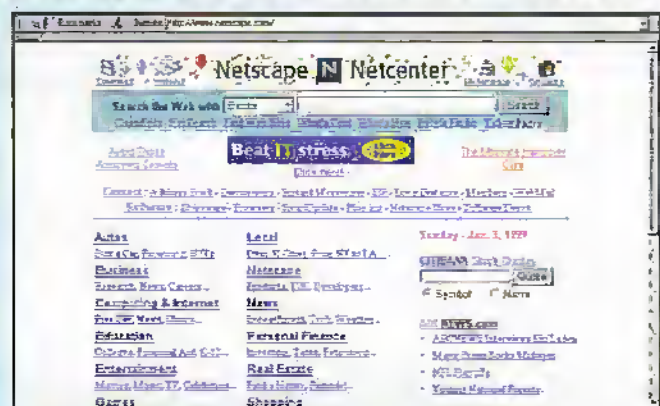
BT Interactive also offers tailored home and business packages. The home package includes fast access to BT Internet, online games network Wireplay, the LineOne range of news, entertainment and business information and a range of push channels from the Fantastic Corporation providing the latest news, entertainment and information.

Every iMac Has A Free Floppy

iMacFloppy.com at www.imacfloppy.com is a new and unique free Web based service that gives the iMac a floppy drive by using the Internet to easily transfer and store files. iMacFloppy.com was created to fill the void that has shocked many in the computer industry: Apple's bold decision to drop the built-in floppy drive from the stylish iMac.

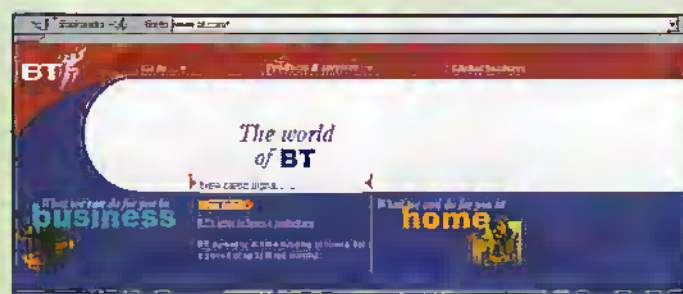


Netscape Unveils Next-Generation Browser



Netscape at www.netscape.com has introduced its next-generation browser software, dubbed Gecko, to Internet developers. Company officials

say the new product is faster, will fit on a single floppy disk, and is designed with a wide variety of smaller Internet appliances in mind.



Business users receive BT connect to business for business reports and market briefings, Solstra for on-line business training, LineOne for news updates and financial information and the Fantastic Corporation push channels to keep users informed of developments in a range of industries.

The new service exploits caching technologies so that

material is delivered as quickly as possible to the PC. This allows BT Interactive to provide the fastest Internet response available by storing popular pages in its central cache. BT claims that the material can then be accessed at a speed equivalent to reading material from a hard drive.

900 trialists are being offered the BT Interactive service for £30 per month, with no additional Internet phone bills. Existing PSTN lines will be adapted by BT for ADSL, allowing one telephone line to be used for both data and voice calls simultaneously, without any loss in data speed.

Further information about the BT Interactive trial can be found on the Web at www.bt.com.

RealNetworks Ships G2

The final release of RealSystem G2, the Internet media delivery system that provides broadcast quality video for the Internet is now available as a free download at www.real.com. RealVideo G2 includes Intel's Streaming Web Video technology, providing state-of-the-art production efficiencies for creating automatic multi-rate streaming video content and delivers significant video performance and quality improvements to Internet users.

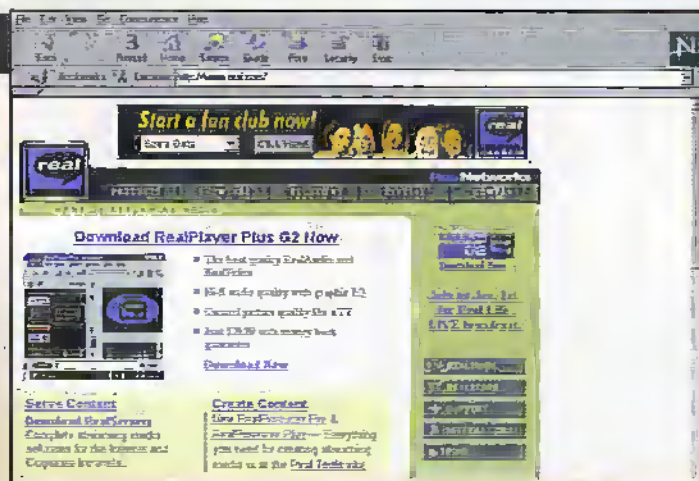
RealAudio G2 delivers 80% improved frequency response and stereo and near-CD quality capabilities over connection speeds ranging from 28.8Kbps up to corporate leased line. New SureStream transport technology delivers reliable and continuous end-user playback under real-world network conditions. With

SureStream, single media files now dynamically scale to deliver the highest quality RealAudio and RealVideo to users at all connection rates.

The first RealPlayer was released in 1995, and to date over 37 million unique users have been registered. Our total average download rate now exceeds 125,000 per day, an increase of more than 170% since the beginning of 1997.

Every week, over 145,000 hours of live sports, music, news and entertainment are broadcast over the Internet using our RealSystem technology. There are also hundreds of thousands of hours of content available on-demand.

RealSystem G2 also supports Synchronised Multimedia Integration Language (SMIL), the W3C standard for Web-based multimedia, which



enables rich multi-stream content to be delivered over typical modem connections with new data types such as RealPix, RealText and RealFlash, co-developed with Macromedia.

There are more than 70 RealChannels built into RealPlayer G2, including major brands such as CNN, ESPN, and the Wall Street Journal. Average

daily usage of the RealChannels increased 80% from August to September, and 150% since July. On average, there have been 300,000 session requests per day from RealChannels via the RealPlayer, and 500,000 online viewers requested RealChannels sessions on September 21, the day the Clinton Testimony was broadcast online.

Site Survey

The month's destinations

While we're not remotely sexist here at Electronics and Beyond, we have to say that this decidedly cagy Website (well, anything that advertises 'Software for Girls' must be rather dubious if not particularly un-politically correct), is actually quite cool. Mattel, the company that makes toys, specifically Barbie, has a site providing links to all the software it produces for the Barbie-using computer generation. Check it out, at <http://www.mattelmedia.com/barbie/>.



If we're going to look at a Web site that caters for one half of the child population, we'd better take a look at one that caters for the other half—boys. Now we know that it's not just boys who have a liking for all bodily functions (particularly the noisy and rude ones), but we guess it's probably boys that'll enjoy this one the most.

Yucky's Website at <http://www.yucky.com> is a rather neat introduction to all the gooey, splatty, whiffy, noisy and otherwise unpleasant features of the human body, and beyond.

Finally, a whole Website devoted to fungi is yours for the clicking, at <http://mycoinfo.com>. It's the world's first mycology e-journal, and provides some wonderful links to give you all the information you ever needed (and probably much more) about mushrooms and roadstools. It's a funny old world, isn't it?



in the pipeline

ELECTRONICS

and Beyond

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

Issue 136 will be on sale
Friday 5th March

PROJECTS

Sound Effects Switch
Compressor

Velleman Valve Amplifier
and Digital Pre-Amplifier
Telescope Drive System

FEATURES

3D Vision Software
Electronics in Cars
Using 7-Segment Displays
Words of Science
Signalling by Heliograph

Project Ratings

Projects presented in this issue are rated on a 1 to 5 for ease or difficulty of construction to help you decide whether it is within your construction capabilities before you undertake the project. The ratings are as follows:



PROJECT RATING 1 Simple to build and understand and suitable for absolute beginners. Basic tools required (e.g., soldering, side cutters, pliers, wire strippers, and screwdriver). Test gear not required and no setting-up needed.



PROJECT RATING 2 Easy to build, but not suitable for absolute beginners. Some test gear (e.g., multimeter) may be required, and may also need setting-up or testing.



PROJECT RATING 3 Average. Some skill in construction or more extensive setting-up required.



PROJECT RATING 4 Advanced. Fairly high level of skill in construction, specialised test gear or setting-up may be required.



PROJECT RATING 5 Complex. High level of skill in construction, specialised test gear may be required. Construction may involve complex wiring. Recommended for skilled constructors only.

Ordering Information

Kits, components and products stocked at Maplin can be easily checked in a number of ways:

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