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IT'S ONLY THIS THIN
Win a Baygen Freeplay!

The Baygen ‘Freeplay’ wind-up clockwork radio has created a lot of interest around the world, especially among people in developing countries. Now it’s available in Australia, as we explain on page 18.

Dick Smith Electronics has kindly donated one of these novel (and practical) radios to us, to offer to our readers as a prize. We’ve decided to offer it to the reader who comes up with the most imaginative and/or interesting use for a wind-up radio. So if you’d like to be in the running to win it, fire up your imagination and see what you can dream up...

Send your entry to ‘EA Win A Baygen Freeplay Competition’, PO Box 199, Alexandria 2015. It should be posted no later than August 29, 1997.

This competition is open to Australian residents only. Entries received after the closing date will not be included. Employees of the Hansen Group or Dick Smith Electronics, their subsidiaries and families are not eligible to enter. The prize is not transferable and may not be converted into cash. The judges’ decision is final and no correspondence will be entered into. Description of the competition forms a part of the competition. The competition commences 23.9.97 and closes last mail 29.8.97. The winner will be notified by mail and announced in a later issue of Electronics Australia. The prize is one Baygen Freeplay radio valued at $149. Total prize value $149.

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On the cover

Sony’s new Glasstron head-mounted video monitor hasn’t reached the Australian market as yet, but our reviewer Louis Challis has been able to try out this advance sample. His reaction? Computer and video games will never be the same again. See his review starting on page 10. (Photo by Phil Aynsley)

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LETTERS TO THE EDITOR

RMS current monitor

Thank you for the excellent job you magazine did with the High Isolation Current Adaptor (Nov 96 issue). It is these articles that help small electronics companies like Fastron Technologies to educate and promote new technologies within Australia.

Because of the cost in promotion of new products most companies like ourselves will only promote when they hold the exclusive Australian agency for that product. Even when this is the case we still miss out on sales. One kit distributor for the high isolation current adaptor, knowing we were the distributor for the LEM HY10-P transducers, bypassed us and bought their stock on the international black market.

Now I see in the May 1997 issue another construction project using a LEM product, the RMS Current Monitor on page 57. The article refers to the first construction project, but when we get to the parts list on page 61 it tells people to buy the LEM LTA40P/SP1 from Farnell. This item is a standard product we carry in stock and hold the exclusive Australian agency for.

I have gone back through the last 12 issues of Electronics Australia and cannot find one advertisement from Farnell; but every second month there was one for Fastron Technologies. Yet you assist other companies from making profits from our endeavours.

I hope you can do something to stop this unfair situation from arising again.

Andrew Shaw
Sales & Marketing Manager,
Fastron Technologies
Dandenong, Victoria.

Our apologies, Andrew, and we appreciate your position. Hopefully publishing your letter will make some amends.

Mortified by fusing

I have just received the May issue of your excellent magazine and was mortified by the circuit of the RMS Current Monitor. I would have thought that after all the correspondence over the years in Forum re fuses/switches in neutrals of 240V mains connected circuits, that someone at EA would cast a cursory glance at circuits involving mains voltage.

In this circuit when in the 2amp range we have a fuse in the neutral which is extremely dangerous and highly illegal under any circumstance and a switch whose legality is questionable if it does not have a pole in the corresponding active conductor.

To make the situation safer and legal the circuit should be republished with the neutral connected straight from the input to the output and the active going through the fuse/relay contacts etc.

F.J. Thorpe
Narrabeen, NSW.

Similar criticism

I can hardly believe what I just noticed in the circuit diagram of Phil Allison’s RMS Current Monitor in your May 1997 issue: the device provides a 240V outlet, switched by a relay in the neutral line.

I admit I haven’t yet tried to follow through the PCB and overlay diagrams to check that they actually implement this insanity, but I suggest an urgent erratum either way.

David Brownridge
(via the BBS).

The designer replies:

I would like to respond to the intemperate complaints made by Mr F.J. Thorpe and others about my RMS Current Monitor, and allay any unnecessary fears about its safety. Firstly, the unit is not legally required to comply with the rules for domestic appliances as it is clearly a test instrument. Electrical authorities require no type approval for test equipment and expect that only the technically competent would own or use such items.

Secondly, the ‘extremely dangerous’ tag cannot be justified. When the 6.3A fuse protecting the 2A range fails, there is no reading on the display and until the fuse is replaced the neutral return path will be open at the GPO socket. There is no particular danger created by this, while any appliance plugged into the GPO will temporarily not work.

Thirdly, having the range switching circuit in the neutral line is not equivalent to placing a power switch in the neutral. As fully explained in my article,
the relay contacts assisted by triac arc suppression simply change ranges with­ out interrupting the load.

I agree that an appliance should have its power switch and any supply fuse in the active line to protect against large fault currents to earth. Using my RMS Current Monitor in no way interferes with this desirable arrangement.

Phil Allison
Summer Hill, NSW.

Birthday message

So — this hoary old magazine has lasted 75 years, and shows no sign of going belly-up yet. This is good for a freelance writer like me. Although I’ve been ‘working’ for Electronics Australia for something like 18 years now, I’ve never been employed by them. Yet life goes on in the Madhouse.

My files are littered with letters from defunct magazines — or worse, receiv­ er-managers. ‘Anyone having a claim against this company...’ or sometimes, ‘where can we send the photographs that were never used’. But dear old Granny EA kicks on.

You should see some of the twaddle that passes for electronics magazines over here in the USA. Who thinks it’s time we talk Jim Rowe into a US edition? We’d MURDER ‘em — how about it, Jim? Yaaayyyy!

Tom Moffat
Port Townsend, Washington.

And another...

Congratulations, on 75 years of continuous publication, from Wireless Weekly to today’s Electronics Australia.

Please find enclosed an old copy of Radio and Hobbies, dated August 1947, which was your 25th Anniversary copy. Now with this copy you’re celebrating the 50th year since it was published. Please keep this edition for the magazine’s historical collection.

Keep up the good work for another 75 years. Unfortunately I don’t think that I will be around to renew my subscription by then.

Reg Leahy
Shepparton, Victoria.

Thanks very much for the kind words, Reg, and also for the copy of the August 1947 issue. We’ll certainly keep it in our collection, as you ask.

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We welcome contributions to this column, but reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL

Welcome to our 75th Anniversary issue — and thanks!

This issue is a rather special one for us, as you might imagine, because it marks the magazine’s 75th Anniversary. We can trace its origin all the way back to August 4, 1922, when the first issue of a little radio magazine called Wireless Weekly went on sale in Sydney. It was from that modest beginning that today’s Electronics Australia grew, changing along the way from a weekly into a monthly and through a number of changes of name: to Radio and Hobbies in 1939, to the rather cumbersome Radio, Television & Hobbies in 1955, and finally to the present name in April 1965. The content material also changed, gradually becoming more and more focussed on the technical side of electronics as the technology itself developed and expanded.

Not many electronics magazines in the world can claim this kind of longevity, and we’re somewhat proud of the achievement. In those 75 years quite a few radio, television, electronics, communications and computing magazines have come and gone, both in Australia and in the wider world. To have survived this long, in a relatively small local market, seems in itself something of an achievement.

Hopefully at least one of the factors behind this survival has been the continuing efforts by the magazine’s editors and writers, over the years, to ensure that it evolved and adapted to suit the developing technologies and changing needs of its readers. I know that was one of the goals of my predecessor and mentor Neville Williams, and I’ve tried to follow it as well.

At the same time, all of us currently working on EA are also well aware that this kind of survival depends upon many other factors as well. Including, of course, the ongoing and practical support of our many readers and advertisers. Without these crucial groups of supporters, no magazine can survive for long at all, let alone for 75 years...

So along with a little pride, we’re also feeling a great deal of gratitude to you, our loyal readers, and also to the advertisers you attract. Please accept our sincere thanks, for your equally important role in this achievement — and please keep playing your role in the magazine’s survival!

In the meantime, settle back and enjoy what we’ve prepared for you inside, to celebrate this milestone. Along with all of the usual features, columns and departments you’ll find a special 32-page supplement in the centre, with articles looking back over the last 75 years and what has happened to both electronics and the magazine itself. I hope you’ll find them all both interesting and enjoyable.

Jim Rowe

PS: By the way, try not to miss next month’s issue either, because it will come with a special free copy of the 100-page catalog and reference book: Computers, Music and MIDI: The Bible, normally $3 from Moore Music.
Hitachi's Super TFT flat-screen monitor

Hitachi Australia has released details of their new flat screen LCD data monitor, now available in Australia. The monitor uses a new Hitachi patented technology known as In-Plane Switching (IPS) TFT, and is claimed to offer users for the first time the benefits of the wide viewing angle traditionally found on CRT monitors (with no colour shift) and extended resolution, plus over 16 million colours.

The new monitor features a display size of 13.3", equivalent to a screen area of a 15" CRT style monitor. Maximum resolution is 1024 x 768, with standard CRT multi-scan operation allowing 'on-the-fly' changes to other resolution modes such as 640 x 480 and 800 x 600 with accurate pixel reproduction. Microsoft 'Plug and Play' under Windows 95 is also supported, ensuring that the panel can easily replace an existing CRT monitor simply by changing the plug.

What also separates this new Hitachi monitor from older style TFT panels is its ability to display over 16 million colours using Hitachi's Frame Rate Control System (FRC). This system electronically creates colours that cannot be reproduced on other manufacturers' panels.

Measuring (with stand) a mere 365 x 315 x 199mm (depth of display is only 85mm) and weighing only 6kg the Super TFT monitor takes up only a fraction of the desk space of a traditional CRT monitor, important in today's shrinking office space era. Power consumption at only 45W is less than half that of a CRT monitor and DPMS power management further lessens power use in non-active times.

Active Subwoofer from VAF Research

South Australian hifi speaker manufacturer VAF Research has released its new DC-S active subwoofer for use in both home theatre and audiophile systems. The newest addition to its critically acclaimed DC-Series, the DC-S has been designed to provide true audiophile bass performance in a compact unit.

Pitch definition, texture and transient response are claimed to be superior to other products in its class. Low distortion and clear, detailed sound have been achieved, even at levels in excess of those required for domestic listening. This makes the new subwoofer suitable for extending the frequency response of existing speaker systems, and well as providing the important 'low end' components as part of a premium quality home theatre system.

Available only fully assembled, the DC-S measures 430 x 430 x 430mm and features a fully mitred cabinet made from high density MDF with all visible surfaces lacquered with two-part acid catalysed black lacquer. The enclosure is a bandpass type fitted with Hypersoft foam internal damping material. The drivers are two of VAF's 210mm fibreglass cone woofers, featuring a powerful magnet and motor assembly, multi-layer voice coil and large excursion capability.

The internal power amplifier is an advanced Class AB design delivering 180W RMS, and featuring a sophisticated control circuit with auto on/off. The design includes a second order low-pass filter with acoustic crossover frequency continuously adjustable between 40Hz and 125Hz, an additional fixed pole at 250Hz and a third order high-pass filter to limit cone excursion at subsonic frequencies.

The DC-S is fitted with left and right line level RCA inputs, and also stereo speaker-level binding post inputs. The sensitivity for maximum output at 30Hz is 100mV RMS (line inputs) and 1V RMS (speaker inputs) respectively. A level control is provided to match speakers with sensitivity up to 100dB/watt. The rated maximum SPL is 110dB at 1m, at 35Hz.

The DC-S is priced at $1000, plus $23 for fully insured freight. For more information circle 143 on the reader service card or contact VAF Research at 291 Churchill Road, Prospect 5082; FREECALL 1800 818 882 or (08) 8269 4446 (Web site at http://www.vaf.com.au).
HP launches its PhotoSmart photo system

Hewlett-Packard has officially introduced to Australia the HP PhotoSmart PC photography system, claimed as the first PC photography system designed for home users.

The new PhotoSmart system includes a photo printer, photo scanner, digital camera and photographic papers, all designed to allow home consumers to take original digital photos or scan in existing photos, slides or negatives and then edit or reproduce those photos at home. HP says the system offers a new level of flexibility and creativity, enabling users to make professional-looking prints, reprints and enlargements of photos that can be incorporated into personalised greeting cards, calendars and postcards.

All three HP PhotoSmart PC photography products come with Picture It!, Microsoft Corp.'s new image manipulation software. Picture It! enables home users to edit and enhance photos easily in a variety of creative ways, including cropping out unwanted elements, removing 'red eye', adding borders and clip art or merging several photos together for a collage or other project.

The first product to be available is the HP PhotoSmart digital camera. The HP PhotoSmart photo printer and photo scanner are expected to be available later this year. Each component in the system may be purchased separately. The components support multimedia PCs running Windows 95.

As noted in this column a couple of months ago, the HP PhotoSmart digital camera allows users to download their pictures to a PC instantly. Using removable HP Photo Memory Cards, which are available in 2MB or 4MB configurations, it allows users to take an unlimited number of photos. Built around an all-glass, seven-element lens, it is designed to capture images in any of three resolutions—normal, fine or superfine. The camera is equipped with an integrated flash and features automatic focus and exposure control and an automatic date and time stamp.

The HP PhotoSmart photo printer is designed to provide users with professional-quality prints that look and feel as if they came from a professional photo-finishing lab. The printer features a straight-through paper path designed for thick photo papers. The printer uses six ink colours (in two tri-chamber cartridges) to deliver richer, smoother colours and the subtle tones associated with photos. The printer prints a 20.32 x 25.40cm photo in five minutes and a 10.16 x 15.24cm photo in 2.5 minutes.

The HP PhotoSmart photo scanner scans existing photographic prints, or 35mm negatives and slides. The scanner comes with software that allows the user to preview a scanned photo in order to balance colours, correct exposures and flip or rotate images before completing the final scan. The scanner will allow a user to preview the image on-screen in about 10 seconds. It completes a typical scan in less than a minute.

HP's PhotoSmart photographic papers are available in matte and glossy finishes. Photos printed on these papers are virtually indistinguishable from traditional photos. In addition to the photographic papers, HP also offers PhotoSmart Greeting Cards and Note Cards (with coordinating envelopes), which can be printed on both sides, and HP PhotoSmart Post Cards.

For further information on HP products and services, call 131347 (no STD area-code required).

12-channel GPS receiver is sensitive

GME Electrophone has announced the release of the Garmin GPS 12XL, a 12-parallel channel GPS receiver designed especially for fishermen, hunters and hikers who navigate with GPS in the most challenging environments.

The GPS 12XL has all the advanced features that have made Garmin the best selling name in handheld GPS. Coupled with a high performance 12-channel receiver, this is claimed to result in a GPS receiver that allows people to explore places they never thought possible.

The GPS 12XL uses the powerful PhaseTrac12 engine to gather data from the GPS satellites, for quick and reliable first-time initialisation. Its increased sensitivity to weak satellite signals and over-sampling of stronger, existing signals is also claimed to give consumers more precise position information, faster than ever. The GPS 12XL will also maintain satellite lock under the most difficult conditions, including dense tree canopy and urban obstructions.

Unlike other 12-channel handhelds, the GPS 12XL allows for simple one-hand operation and can be complemented with an external antenna. Additionally, an internal lithium battery back-up keeps your data safe when the unit is turned off for long periods.

Other significant GPS 12XL features include a backlit LCD display for clear visibility day or night, and up to 12 hours of operation from four AA batteries.

The sensitive receiver at the heart of the GPS 12XL is protected by a rugged, compact case that features the same tough construction as Garmin's military models, which are required to meet stringent government specifications.

For more information circle 142 on the reader service card, contact your local GME Dealer, or GME on Sydney (02) 9844 6666.

ELECTRONICS Australia, August 1997 7
WHAT'S NEW IN THE WORLD OF ELECTRONICS...

Mini systems include SRS '3-D'

Kenwood's new XD-750 and XD-700 mini sound systems feature an extra large, informative fluorescent display panel that is designed to be both attractive and functional, and also a range of technological innovations including Sound Retrieval System (SRS) 3-D sound system technology. SRS 'brings out' the ambience found in most stereo program sources, and processes the signals so that the listener's ears and brain believe the sound is not just coming from two speakers, but a multitude of sound sources. (SRS is a patented system of SRS Laboratory in the USA.) In addition to SRS the new Kenwood XD-700 and XD-750 offer a colour choice of either silver (XD-750) or black (XD-700) and both provide an output of 100 watts RMS per channel. They also incorporate a three-disc carousel CD player with play exchange feature, a full logic control twin auto reverse cassette deck with Dolby B noise reduction, an electronic tuner with 40 memory presets, and three-way speakers.

For lovers of karaoke both the XD-750 and XD-700 mini systems also incorporate two mic inputs. A full function remote control addresses all functions of the systems. The XD-750 and XD-700 both carry an RRP of $899, are covered by a two-year warranty and are available at selected dealers. For further information circle 144 on the reader service card or contact Kenwood Electronics on (02) 9746 1888.

10-disc CD changer for cars

Kenwood's latest release 10-disc CD changers, the KDC-C810 and the KDC-C710, are designed to accompany any CD player-receiver or cassette-receiver with CD changer control. Ultra-compact and silver in colour, the new models can be mounted in your vehicle horizontally, vertically, or even at an angle of 45°, allowing you the choice of an accessible or remote position for the changer.

Both the KDC-C810 and KDC-C710 have been designed to withstand the rigours of the road. The 'Balanced Floating Mechanism' is claimed to cushion crucial areas so that they withstand the disruptive forces associated with modern car travel, resulting in smooth, uninterrupted operation.

The KDC-C810's new DRIVE (Dynamic Resolution Intensive Vector Enhancement) circuit is claimed to improve fidelity by removing quantisation noise from small signals. Using an array of special low-pass filters, DRIVE is said to achieve 20-bit equivalent resolution. In the DAC section, the digital/analog converter raises the oversampling rate - resulting in lower high-region distortion and smoother sound reproduction.

The KDC-C710 features Digital Pulse Control (DPAC II), combined with a balanced floating mechanism, eight-times oversampling and Digital Servo System. Both changers are covered by a 12-month warranty and are available at selected Kenwood car audio dealers. For further information circle 141 on the reader service card or contact Kenwood on (02) 9746 1888.

Panasonic has upgraded its very successful faxtam dubbed the 'SuperPhone' and called it the 'SuperPhone 2' (UF-S2AL). The upgraded unit features a hands-free speakerphone which allows users to speak on the phone while using both hands to continue with other tasks. Panasonic claims it's compact size (266 x 231 x 95mm) makes it ideal for replacing a conventional phone handset in the home.

The function buttons of the SuperPhone 2 have been rearranged to make specific functions easier to access, and there have been some cosmetic changes made. The unit now also has 20 pages of out-of-paper memory for faxes.

Other convenient fax features include automatic fax/phone switching, 64-level halftone capability and remote reception. The SuperPhone 2 automatically detects if a call is a fax or phone call and switches to the appropriate mode.

The digital telephone answering machine has no tape so message access is fast. As well as taking messages from callers, messages can be left as memo items for other members of a household. The SuperPhone 2 can also be used for call screening but has the ability to recognise specific callers and allow the phone to override the answering machine.

The Panasonic UF-S2AL SuperPhone 2 is available from leading electrical and communications retailers for an RRP of $999. For further information contact Panasonic's Customer Care Centre on 132 600.
Respected US speaker firm JBL has now introduced a new series of speakers for the domestic market, which it says ‘breaks the established rules of home hi-fi and lets people finally take control of their every sound requirement’. The company has called its new range the Control Series, and basically they’re a line of compact monitor speakers engineered for both music and movie reproduction in and outside the home.

The compact size of each model and special multi-use mounting bracket supplied with the Control monitors allow convenient fixing in almost any location. The special shielding on indoor models also means they are ‘television safe’. The Control Series models are also rugged, both electrically and physically, and designed for tough treatment. Despite this they are claimed to provide exceptionally clear and powerful full-range performance. The full-range models use JBL’s well-known titanium dome tweeter, while the driver handling bass and midrange in the three two-way Control models features a cone made from a poly-laminate material.

The sub6 and sub10 active subwoofers in the Control Series feature amplifiers with 60W and 100W RMS power outputs respectively.

The Control Series comprises four models of monitors and two centre channel speakers, designed to make the design ideal for use in home cinema systems. Recommended prices range from $299/pair for the Control CM40 to $699 for the Control sub10 subwoofer.

For more information circle 145 on the reader service card or contact Convoy International on Freecall 1800 251 995.
Video & Audio: The Challis Report

SONY’S ‘GLASSTRON’ ON-HEAD MONITOR

This month our reviewer Louis Challis has been trying out an advance sample of Sony’s innovative Glasstron ‘MultiMedia Scope’ — a head-mounted colour display which projects a large-screen ‘virtual image’ in front of the viewer’s eyes. There’s only an NTSC version of the Glasstron as yet, and it’s only being sold in Japan; but we thought you’d be interested in learning what it’s like. No doubt a PAL version will be available here, in the not-too-distant future...

It’s now more than 25 years since Sony pioneered the development of its ubiquitous Walkman ‘personal audio’ systems. When Akio Morita, Sony Corporation’s far-sighted director, pushed the development single-handedly past his unsupportive fellow directors, few people would have realised either how fast, or how far, the ‘personal electronics’ revolution would progress.

Now with more than half-a-billion Walkmans, in the form of progeny or look-alikes on belts or in hands, pockets, cars and planes around the world, the revolution shows no signs of slowing down.

While you already know all that, have you ever stopped to think that what Sony did for ‘personal audio’ has not yet been replicated in the video domain?

Now of course there are plenty of miniature LCD TV sets, and innumerable LCD games and modules in the hands or pockets of the younger generation. The problem with those games or TV sets is the limitation imposed by the software. It is either restricted to one game, or somebody else’s choice of TV programs. Even if the program is to your liking, it’s unlikely that the timing will necessarily suit you.

Always the innovators, Sony decided that what it had done for audio it could probably repeat with video. What Sony developed may not necessarily have been precisely what they expected, and as always, came with some unexpected twists. The need was clearly there, as was the market demand. That demand was slated for dramatic growth following the release of the impending DVD revolution.

Supported by play stations which constituted a further market segment, Sony funded an R&D program which ultimately led to the release of the Glasstron, which is one of the most unusual products that I have been called on to review.

The Glasstron

When Sony announced the release of the Glasstron in Tokyo last June, the press release extolled its virtues. The publicists extolled ‘its vivid dynamic images, which the viewer could enjoy privately without disturbing those around them’.

The appearance of the Glasstron is unusual. It consists of an unusually thick mask-like set of glasses, which are suspended from an adjustable frame which clamps onto the top of the viewer’s head. The mask-like component is translucent, with a degree of transparency which is controlled electronically.

Looking at it on your head (or better, somebody else’s head), you’d never guess that it contains two sub-miniature 17.5mm LCD black display panels, each of which contains 180,000 pixels. Although these panels are truly miniature, their viewed size is effectively magnified through the clever integration of reflective half mirrors and concave half mirrors, which are combined with an electronically controlled LCD shutter. (See Fig.1).

The resulting display is then projected onto a fully reflective mirror at the back of the headpiece. Whilst Fig.1 indicates that the spatial separation between the viewer’s eyes and the apparent image is two metres, that is an indicated figure — which illustrates the optical magic of the Glasstron’s visual display system.

In reality, the distance between the viewer’s eyes and the image is only a few centimetres. But the optics artificially expand the apparent spatial separation so as to fool you into believing it is two metres, and with a display size which simulates that provided by a 130cm television set.

Fig.1: The optical system used in Sony’s Glasstron enlarges the image from each 17.5mm LCD panel, to create a large ‘virtual’ image suspended about two metres before your eyes. Each panel has a resolution of 180,000 pixels.
Two main components

The underlying design concept of Sony's Glasstron is radically different to what you or I might have imagined. The unit has two major components:

The first and more obvious is the functional adjustable mounted 'headband'. This provides positive and stable support for the Glasstron display unit in front of the viewer's eyes.

The second and less obvious component is the 'power box', which generates the display signal and provides additional video display and audio signal control for the head mounted display unit. The power unit also provides the critical input termination points for video, audio and external electrical power, or alternatively a poten Lithium ion battery for portable use. With its external DC power pack connected, the Lithium ion battery can be recharged by the power unit.

Before discussing the range of combined video/audio sources now available, it is important to consider some of the more pertinent aspects of the Glasstron's underlying design philosophy. It is apparent that in developing the Glasstron, the primary market on which the designers have focused their attention are children and teenagers.

Following Sony's release of the CD Video units in Japan, and subsequently the Sony Playstations — both of which have been aimed squarely at the teenager market — the company was ready to expand that market in preparation for its development of battery operated DVDs.

On the basis of market research, it was convinced there would be significant buyer resistance from wealthier parents, who would be the most likely source of finance for the purchase of Glasstrons. Those parents would undoubtedly wish to impose a strict time regime on the use of the Glasstron based video, or game systems.

In order to allay the anticipated parents' fears, Sony integrated a programmable keypad with five keys, which provide a reasonably effective security code control function. At the time of purchase, the parents may thus enter the key code, and thereby limit the use of the Glasstron unit to those times, or occasions, when they are present and approve.

Supplementing the controls on the power unit, an additional small cable mounted controller has been placed in the middle of the cable which connects the display unit to the power unit. This provides the wearer with the means to electrically change the degree of transparency of the unit's liquid crystal shutter. When optimally adjusted, you have an illusionary screen where the screen appears to be hanging in free space, well displaced in excess of a metre from your head.

Whilst some of the set up controls are incorporated into the power unit, the majority of functional controls are integrated into the small cable-mounted plastic controller. In addition, an unusual sub-miniature tip, ring and sleeve socket is integrated into the module to accept a matching plug for a miniature pair of 'in ear' (or fontopian) headphones. This was one design feature which I had difficulty in reconciling, as I believe it would have been far simpler and more pragmatic to have integrated a set of headphones, or even extended ear pieces, into the sides of the headband. I believe that that approach offers more practical ergonomic features and advantages, when compared with the approach that Sony has adopted.

The review unit

The review unit provided to us was not equipped with its rechargeable Lithium ion battery, which normally provides up to two hours and 20 minutes of viewing time. That time and the capacity has been deliberately selected to match the nominal maximum playing time of most DVD video discs. NTSC format DVD discs have of course been available in Japan since last December, and have more recently become available in the USA.

The review Glasstron was a Japan-market NTSC version, equipped with a 100V AC to 7.5 volt DC power pack. Whilst the voltage presented no problems, selecting appropriate software was slightly more difficult. Much to my surprise, though, Sony didn't have a DVD player available; this would clearly have been first choice.

I didn't have the cheek to ask other companies to supply their DVD players to assess a competing firm's product. In the end I decided to use a Pioneer Laserdisc player, for which a large range of excellent software is readily available. More significantly, that software includes some outstanding laser test discs, which provides a direct means to assess both the video and audio performance.

When I unpacked the Glasstron, I discovered that it is a reasonably well-conceived unit with some outstanding design features. The most critical of these is the flexibility of the headband design, which ensures a stable and secure mounting of the display on your head.

As marketed, the Glasstron comes equipped with two different types of interconnection cables. These are designed to provide direct connection to either a Sony Play Station, or a conventional VCR, a Laserdisc or a DVD player, as required.
THE CHALLIS REPORT—SONY'S 'GLASSTRON' MONITOR

Trying it out

I plugged the Glasstron's power pack into a 100V AC transformer, and its stereo audio/video interconnection cables into the Laserdisc player. Then I placed a Laserdisc in the player, and activated the Glasstron.

With the display unit firmly mounted on my head, I initially observed an illuminated screen on which white 'Kanji' (Japanese) text was visible on a bright blue background. Regrettably, I don't read Japanese. Only later I learnt that the display warns the viewer about a range of self-imposed viewing restrictions, and qualifications relating to the adaptability, and sale use of the Glasstron.

In the absence of an English handbook, and with considerable good fortune, I pressed the correct button on the cord and advanced to a different set of text. Pressing the button yet again, I was presented with a darkened display on which there was a horizontal white line, with three crossed short vertical bars superimposed.

Closings my right eye, I saw only the horizontal line. When I closed my left eye, I saw only the three short spaced vertical lines. Although I didn't know it at that time, I had correctly interpreted the test procedures through which it is intended that the viewer check out his (or her) suitability for viewing the Glasstron display. In the event that the viewer is unable to optimally align the display, the Japanese instructions exhort the viewer to take the unit back to the shop from which it was purchased.

I pressed the control button yet again, and I was viewing the video signal provided by the Laserdisc player. With the two ear pieces correctly inserted into my outer ear canals, I had a good picture and full stereo sound.

BIG pic, but good

The first thing I observed, that the outer edges of the picture were outside the range of my vision, and even when the display was readjusted, other sections of the display were out of view. Other members of my family experienced the same problem.

I adjusted the rotary video contrast control and hey presto! I had an excellent picture.

The disc I chose to initially view was a 'Reference Recording Video Standard Disc' (LD 101). Whilst the picture was by no means up to the standard of my Sony Profeel Monitor, it was nonetheless reasonably good. The colour balance was excellent, and by using the appropriate clips from the 'Reference Recording Test Disc', I was able to confirm that I had somewhere between 340 to 360 lines of horizontal resolution and just over 300 lines of vertical resolution.

I checked out the audio bandwidth, and considering I was using the miniature 'in ear' earpieces, I still had a bandwidth of better than 30Hz to 10kHz (+/-10dB).

Clearly, the designers had taken the appropriate trouble to ensure that the main performance parameters are good.

In a short space of time, I was so entranced by the video that I found it difficult to be deterred by minor limitations in the video optical system performance.

At that point, I applied a temporary halt to my activities, and placed business before pleasure. I used the wide range of special video test patterns that the 'Reference Recording Test Disc' provides to confirm the Glasstron's major features.

Summarising...

Once correctly adjusted, the Glasstron provides a good (but by no means an outstanding) video signal. It is however considerably better than what I have come to expect from portable battery operated, pocket sized LCD TV sets.

The Glasstron happily displays a 16:9 letterbox format video signal. Best of all, it provides the ability to selfishly pander to your personal taste with either a video, or game without disturbing others. It should be noted that wearing glasses does not constitute an impediment, and there is sufficient clearance between the face of the Glasstron and your head to comfortably accommodate glasses.

Sony have not yet released a PAL version of the Glasstron. At this point of time, they are not even marketing the compatible NTSC version of the unit in America. Don't be disheartened, though — sometimes in the not too distant future they will do both.

By the time they do, I expect that they will have optimally adjusted the headband sizes to suit the different physiological features found in Australia.

If they simultaneously resolve the minor limitations imposed by the current earpieces and connect them directly to the headband, I am sure they will have a winner on their hands.

The problem will undoubtedly be that parents will not wish their children to use them — because they'll want to use them themselves.

Sony PLM-50 Glasstron 'MultiMedia Scope'

A head-mounted video monitor, providing a large colour 'virtual image' floating in space a couple of metres in front of the viewer. Display unit measures 200 x 120 x 260mm; accompanying power box measures 51 x 41 x 139mm.

Good Points: Good quality image, well balanced in terms of colour rendition. Excellent for private viewing, yet gives 'big screen' impact...

Bad Points: As yet, only sold in Japan (NTSC version, as tested). Currently earpieces are separate and not integrated with the head-mounted display. Image can extend beyond range of vision.

RPP: Not available here as yet. Price of NTSC version sold in Japan roughly equivalent to A$1050.
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DIGITAL EDITING WITH
THE APPLE/AVID ‘VES’

Video editing systems based on personal computers have been around for a while, although setting up such a system has generally been pretty complex — and expensive. But Apple Computer and Avid have now put their hi-tech heads together and come up with the Video Editing System, an integrated and easy to use non-linear video editing system for the pro and the dabbler alike. Barrie Smith has been trying one out...

by BARRIE SMITH

I'd like a dollar for every film and video editing device that I've set my knees beneath and my eyes upon. There's been muttering Moviolas, spinning Steenbeck editing tables, bewildering Betacam systems and of course, the latest — Avid and Media 100 digital editing suites.

But these have all been pro, high end editing equipment for 16mm and 35mm film and 1/2" Betacam tapes. What about the amateur video maker, battling with VHS, Video 8 and the new DVC digital camera format? What has the keen amateur been using to edit tape?

A range of options has been around for a while, beginning with itchy trigger fingers, keen reflexes, a combination of replay and record machines to perform simple assembly edits — leading right up to complex computer-based solutions requiring dedicated software, video in/output cards and tons of mucking around.

Now in my book many of the latter are fine — if you are computer wise and are prepared to make plenty of ill-advised buying decisions, followed up by re-investment. But few consumer computer editing systems are 'systems' — one package of hardware and software, devised by the one manufacturer and designed to operate harmoniously.

Apple and Avid’s answer to this problem is the Video Editing System or ‘VES’.

Promises...

With the VES approach it's claimed you can edit 'straight out of the box'. For the purposes of the review, Apple provided me with a Macintosh Performa 6400 200MHz tower unit, strapped with 24MB of RAM and a 2.4GB hard drive. Avid’s Cinema software is supplied on CD-ROM, while the video card that would do all the hard work is pre-installed.

A Mac Perofema, as used in the review. With imported video clips consuming 55MB per minute, a big hard drive is obviously the go for this kind of work!

The rear of the CPU was densely populated with video and audio inputs and outputs. Camcorder (or VCR) video signals are accepted in composite form (RCA inputs) or S-video via the usual four-pin connector, while the audio (L+R) information is taken in via RCA inputs. When outputting the edited material to a VCR or TV you again have the choice of RCA and S-video connectors.

In working with moving images and sound you can use the usual monitor (in my case a 15” AV unit) connected, or hook up a TV of any size to the computer’s video and audio outputs. At the time I had a 70cm set patched in — a luxurious way to edit video!

Due process

It was time to fire up the Avid Cinema software. The on-screen display resembles a collection of filing cards, indicating the post-production stages you face: Storyboard, Bring Video In, Edit Movie, Effects, Titles, Sound and Send Movie Out.

The lucid manual advises novice editors to access the Storyboard mode. When you do so, and up comes a display. On the left side is shown your various video clips, with the right carrying descriptive text. This approach is possibly more suited to someone planning to shoot a movie — or for those who intend to edit in a structured fashion. I come from the 'bash and crash' school, having shot enough movies to do most edits in the camera, then planning the final edit by repeated previews of the virgin footage.

Next step is Bring Video In — into the Mac, that is. Once you've selected the video source (composite, S-video, etc.) you simply run the replay source (camcorder, VCR etc) and a quarter-
Home video making has become a popular family activity. Maybe with such systems as the Apple/Avid VES, home editing may follow.

Screen display of the action appears on screen; at the same time stereo audio issues forth from the Mac’s speakers. It’s as simple as that.

Interestingly, the S-video input is processed in Motion JPEG and takes account of the separate chroma and luminance signals — so effectively, the data when digitised is different from an incoming composite signal. At the end of the process a true S-video signal is output again.

The codec used was Motion JPEG, because it allowed single frame edits to be accomplished — unlike MPEG1, which relies on interframe compression. VES’ Motion JPEG relies on intraframe compression, so occasionally you see artefacts such as aliasing on straight lines. But for the most part, the quality exceeds that of a VHS to VHS dub. But we are ahead of ourselves...

Press an on-screen Record button and you’re away. Finished dubbing the action? Press Stop. Below the action display now appears your video clip (and sound) as an extended bar on a timeline, next to a dinky icon of a camcorder. A thin purple strip at the lower edge of the video clip’s bar indicates the presence of original sound; if you prefer (and often a camcorder’s audio pickup is only annoying ambience) it can be deleted. Below the camcorder timeline are ranged three more: titles, narration, music/effects — and each can be moved anywhere.

Avid suggest that you transfer your video clips as separate scenes, stop/starting the replay camcorder or VCR when ‘OK’ takes roll up on the tape. This approach withholds unwanted material and helps keep the clip file sizes down.

The Avid Cinema approach to editing is non-destructive; if, in the editing process, you remove action at the head or foot of a scene in your edit, the original material remains (unseen) on your hard drive. This approach makes sound sense — although you have to have a massive hard drive, as five minutes of video and sound will occupy 275MB of storage. That’s five minutes of original uncut material — so, if you have ambitions of editing a half hour of tape down to a tight five-minute final edit, look forward to the system gobbling up 1650MB of drive real estate!

Other material required to construct a polished ‘movie-mit-sound’ demands extra hard drive storage. This may consist of narration or music (five mins = 53MB), sound effects (30 secs = 23MB). Of course, the final edited movie data must also be accommodated, with five minutes of the final edit requiring a further 375MB.

A quick calculation tells me our finally edited five-minute movie, with say 25% narration, a dash of sound effects and let’s say 50% incidental music could quickly eat up 400-500MB.

One saving grace is that if a scene is repeated, the file is not duplicated — only its edit ‘marker’.

**Cut and polish**

So we’ve copied all the footage we need. Let’s do a cut. By now we have a number of separate clips on the timeline. Clicking the on-screen PLAY button will deliver a preview of the dubbed footage, with all the separate scenes smoothly running in sequence. And this
Digital Editing with The Apple/Avid ‘VES”

The introductory storyboard display in Avid Cinema.

is the trick to it: if the separate clips abut each other, they will simply cut from clip to clip, on screen. Move one away from its neighbour and black will appear between. Move the last clip along the timeline and insert it between clips 2 and 4 — then scene 6 becomes scene 3. You’ve just made an edit!

Run the assembled sequence and the progress is: scenes 1, 2, 6, 3, 4, 5, etc. The wise ones call it ‘non-linear’ editing.

You can move any scene to any spot on the timeline; the preceding and succeeding scenes shuffle down and retain replay order. If you were editing on a linear system (such as a Betacam edit controller) and you needed to move a scene out of sequence, you would have to redub all the scenes after the edit point.

Old-time editors dealing with brimming baskets full of separate film clips had the wonderful freedom of being able to drop a scene into the final cut at any point, needing only to remake a cement splice or two. Without knowing it, they were engaging in non-linear editing.

Like to trim a clip’s top and tail? If you select it, ‘grab handles’ appear at each end; push or pull one handle and the work screen shows the action as you run past it. Stop on one frame and that’s your new edit point. Frame accurate! I worked with some old tape from one of my pro productions, with display SMPTE time code on the VHS tape, and was delighted at the ease with which I could perform frame accurate edits...

An interesting function is ‘Split Clip’. This allows you to cut into a clip anywhere, thereby making two scenes out of one. It comes in very handy when you want to move things around in extravagent fashion!

Like to dissolve between scenes? Move to the Effects mode, select Dissolve from the list (there’s also Book Turns, Barndoor wipes, etc etc.), decide on the length of it — and simply Apply.

Tilting is another ‘post’ chore the keen editor will want to pursue. Go to Titles mode and once the specific clip — or interval of black is selected — you type in the title text, choose its alignment (centre, top etc), font and size, colour, whether you want it to scroll in from the side, top or whatever. Click on Apply and the title appears as a clip on the timeline dedicated to titling. At this stage you can reposition the title clip relative to the main action video clip and super the title over any part of any scene...

The sound side

Time for music? And effects and voice? Here the possibilities explode. You can record a live voice as you run the final edit, drop in a slice of prerecorded narrative, cue in sound effects (a library of various effects is provided) or run background music (acquired from CD or an external tape recorder) as well as importing AIFF or (Mac) SND audio files.

Now you may think this is the end of it. But you only have an edited and sound embellished movie — on the computer. Run it and you’ll see what happens as you witness effects such as wipes and dissolves — and watch out for the scrolling titles! Because you have assembled the movie in RAM and disk, and the computer has to deliver it to the monitor from this source, effects and titles demand massive amounts of processing power — so the image stunts and halts when these sections are encountered.

But surely you want to view your cre-

The display in Edit mode. Note the timeline and components for picture editing, titling and sound mixing, at the bottom.
The Apple Video System is bundled with PowerPC processor-based Mac models having a PCI expansion slot (such as the 5500 or 6400 series). The price is around $4700 (ex monitor).

The software/card Avid Cinema package (RRP $995) can be purchased and installed in a Mac with built-in composite or S-video input and a PCI expansion slot (such as the 7500, 7600, or 8600 series), 24MB of RAM, Macintosh system software version 7.5.3 or later.

**Apple/Avid Cinema VES**

A non-linear AV editing system based on a Macintosh personal computer.

**Good points:** Comes as an integrated hardware and software system, to simplify setup. Easy to use, capable of impressive video manipulation. Motion JPEG encoding allows frame-accurate editing.

**Bad points:** Limited to VGA image resolution (640 x 480 pixels). Processing time increases significantly with overlaid titles.

**RRP:** Video card & software $995, computer around $4700 less monitor.

**Further Information:** Apple Computer Australia, 16 Rodborough Rd., Frenchs Forest 2086. Freecall 1800 025 355.

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**And the quality?**

The end result is surprisingly good. I have seen (and made, to my shame) far worse VHS to VHS copies using a pair of VCRs. With Avid Cinema-made tapes you don’t see excess colour shifts evident in the latter process, nor losses of definition — and of course, the sound is identical to the original, having been handled in a digital domain.

What you do see is occasional instability of verticals and aliasing of horizontals, presumably products of the compression process. But you also see perfect titles and beautifully timed, exquisite visual effects.

For anyone needing a post-production answer for consumer level video, this has to be the answer. And it would be invaluable for the pro wanting to make a trial edit on a production, to show the client — complete with voice, music, effects.

**Other points we can make are:**

- You can save movies to videotape or as QuickTime files optimised for presentations, World Wide Web sites or Internet exchange.
- Motion JPEG compression and decompression is employed, so allowing frame accurate edits.
- Up to 30-frames-per-second (fps) Motion JPEG compression/decompression at 320 by 240 pixels.
- Vertical and horizontal interpolation and filtering for high-quality output of up to 640 by 480 pixels.

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**ELECTRONICS Australia, August 1997**
BAYGEN’S FREEPLAY: A WIND-UP RADIO!

Manufactured in South Africa, the Baygen ‘Freeplay’ wind-up radio has attracted a lot of attention around the world because of its obvious benefits to people in developing countries. It’s now available here in Australia, from Dick Smith Electronics stores.

by JIM ROWE

You’ve probably heard of the Baygen Freeplay; it was the subject of a TV documentary and articles in various overseas magazines, a year or two ago. British businessman Trevor Baylis came up with the idea after visiting remote areas in Africa; he saw that it would be a tremendous step forward for people in developing countries to have radio communications, but realised that in many cases providing power on a day-to-day basis for even a small transistor radio would present insurmountable problems. Even when batteries were available, they were too costly.

Surely it would be possible, he reasoned, to produce a radio powered by a hand-wound spring motor (an updated version of the kind used in clocks and early gramophones) to drive a small DC generator? On his return to the UK, developing such a radio became his mission. He obtained development funding from the British Overseas Development Administration, and assistance from engineers and designers in both Europe and the USA. Soon the first prototypes were produced, to prove the idea, and Mr Baylis also found investors to set up a manufacturing plant in South Africa — to provide much needed jobs as well as radios.

Since then the Baygen project has apparently gone from strength to strength. The factory set up near Cape Town to produce the radios has deliberately been organised with 60% of its staff drawn from organisations for the disabled, and is producing around 500,000 radios per year.

The Freeplay radio has been endorsed by over 20 international and humanitarian organisations, ranging from the Red Cross to the United Nations. Crown Agents in the UK have ordered 60,000 units, and companies in over a dozen countries worldwide have applied to manufacture the radio under licence.

Of course the Freeplay is mainly intended for people in developing countries, to provide a way for them to keep in touch with events in their own country and the rest of the world, with virtually zero running costs. However since it uses no energy apart from ‘muscle power’, it’s also an outstanding example of environmentally friendly technology. There’s also the advantage that it can be taken on holidays or trips to remote areas, without any worry about batteries suddenly becoming flat at an awkward moment.

These features, along with the novelty factor, have made the Freeplay very popular in developed countries as well — at least when supplies have been made available, as has now happened here in Australia. And presumably the Baygen organisation doesn’t mind selling some of the radios in developed countries, because it keeps the factory busy and probably also provides a certain degree of subsidisation, to allow the radios to be kept affordable by those in its primary markets.

In Australia the Freeplay is now available via the Dick Smith Electronics chain, for $149.00.

What it’s like

So what is this genuine latter-day clockwork radio like? As you can see from the main photo, it looks a bit like one of the valve portables of the 1960’s, and is about the same size and weight. It measures 345 x 245 x 141mm, and weighs in at a fairly hefty 2.8kg. Needless to say, the receiver section of the ‘works’ accounts for very little of that size and weight. At least half of the bulk, and somewhat more of the weight, is contributed by the spring motor and generator module — as you can see from the internal photo. The generator itself is visible at the ‘inner’ end of the module, with its wires leading to the radio section. Interestingly, in contrast with old-type spring motors which generally had a very solid metal frame, the
As you can see, the spring motor-gearbox-generator module takes up a good half of the volume inside the case. The radio operates for about 40 minutes from a full wind of the spring.

Frame of this spring motor/generator module is made from moulded plastic. The spring motor itself apparently uses a carbon-steel spring, and is of the 'B' wound configuration for high energy storage capacity.

The generator is integrated with the motor in the module, together with what is apparently a three-stage gearbox. To be honest we didn't try to look inside the module, because husky spring motors can be fairly dangerous — as you can see, there's a label on the module warning against opening it. (I remember slicing my finger open fairly deeply as a kid, trying to dismantle an old gramophone motor!)

The spring motor/generator module in the Freeplay can be fully wound comfortably in about a minute (about 58 turns of the handle), and will then run the radio for about 40 minutes. The small generator seems to produce a fairly constant 3V DC, and happily supplies the approximately 30-50mA required by the radio.

The radio section of the set is essentially all built into the end of the case at the opposite end from the spring motor. It's a reasonably basic but sensitive three-band superhet design, tuning the medium wave band from 520 - 1600kHz, the shortwave bands from 5.8 - 18MHz, and the FM band from 88 - 108MHz. As usual medium wave reception is via an inbuilt ferrite rod antenna, with the other two bands using a telescopic rod.

The tuning dial is of the vertical linear type, mounted behind the front panel. Type, and the available volume inside the case gives the Freeplay a well-rounded and satisfying acoustic output, despite its modest electrical output capability.

In use, the Freeplay gave a good account of itself. The radio performs quite well, and there's really no problem in having to rewind the spring every 40 minutes or so. The spring motor produces an occasional small thudding noise as it unwinds, especially when it's nearing the end of the wind, but this doesn't detract significantly from the reception.

In short, our reaction is that the Baygen Freeplay is both a novel idea, and also quite well made. It's not exactly cheap as transistor radios go, but on the other hand it's likely to give you reception for many years with zero running costs. You can feel virtuous as well, for both helping provide practical radios to developing countries, and also not polluting the environment with dead batteries.

Baygen FreePlay

A three band (AM/FM/shortwave) transistor radio powered via a 'wind-up' clockwork spring motor, driving a small DC generator.

Good points: Zero running costs — you provide the power. Excellent for developing countries, remote areas. Environmentally 'clean'. The receiver is quite sensitive and provides good tone.

Bad points: Not cheap, but you're helping to support a worthy cause. Spring motor makes the occasional thud.

RRP: $149.00
Available: Dick Smith Electronics stores. DSE will also deliver to your door if you order via 1300 386 644.

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ELECTRONICS Australia, August 1997 19
INSTRUMENTS ON ADEOS
GIVING EARTH A ‘PHYSICAL’

Japan's new Advanced Earth Observing Satellite is the latest addition to the flotilla of orbiting 'birds' training their scientific instruments back at Earth, rather than neighbouring planets. In this case it's carrying a raft of new instruments, designed to help our understanding of exactly what human industry and commerce is doing to our planet — and hopefully help find answers.

by GEOFF McNAMARA

The technology that has provided us with close-up pictures and other data of the distant planets of our solar system is undeniably spectacular. The result is an ever-improving knowledge of worlds other than our own. But with an increasing list of potential global catastrophes facing our own world, this same technology has now been turned on Earth. In an attempt to understand the Earth as a planet, spacecraft have been placed into Earth orbit looking down with eyes sensitive to a wide range of the electromagnetic spectrum. The latest addition to this flotilla of
Earth explorers is also the most elaborate and advanced. Appropriately called the Advanced Earth Observing Satellite, or 'ADEOS' (and I apologise in advance for the number of acronyms used in this article), this Japanese spacecraft carries an impressive arsenal of international instruments that is giving the Earth a comprehensive and long-overdue stocktake.

The driving force behind ADEOS is Japan's National Space Development Agency (NASDA). With a primary objective to monitor changes in the Earth's atmosphere and on the surface, NASDA contributed two core instruments, while so-called 'announcement of opportunity' instruments were contributed by NASA, the French space agency CNES, Japan's Ministry of International Trade and Industries and the Environment Agency of Japan.

ADEOS is a 3.5-tonne spacecraft as big as a caravan and capable of generating 4.5kW of power. By the time the 3m x 24m solar array is deployed, the spacecraft measures some 11 x 29 metres. This is a large satellite!

ADEOS is made up of two main components: the mission module, which carries the scientific instruments, and the bus module which carries the support subsystems. By having the instruments thermally, mechanically and electrically independent of one another, integration and testing was made easier and faster.

**Hi-res viewing**

One of the two core instruments, the Advanced Visible and Near-Infrared Radiometer (AVNIR) has been designed to observe land and coastal regions in the visible and near-infrared bands of the spectrum. The instrument consists of a Catadioptric Schmidt optical system which gives minimal aberrations over the 5.7° field of view. The telescope's mirrors are made from low expansion materials that weigh up to 70% less than conventional mirrors.

AVNIR looks at an 80km wide swath of the surface as the satellite orbits the Earth. Depending on the spectral band used, linear-array CCDs with 5000 and 10,000 pixels allow a high resolution of 16 or eight metres. The 80km by 8m strips are combined to provide detailed images of the Earth’s surface. The resulting data is then compressed by 10% prior to transmission to ground stations.

The second core instrument is the Ocean Color and Temperature Scanner (OCTS), an optical radiometer designed to measure ocean 'colour' to study chlorophyll, and thermal emission to monitor temperature of the oceans. This information can be used to keep tabs on the amount of chlorophyll and dissolved substances in the water, and for determining primary production in the ocean and studying the carbon cycle.

OCTS achieves a highly sensitive measurement of ocean colour and temperature, using eight visible and four thermal spectral bands. Because it measures the temperature along a 1400km wide swath, OCTS is able to measure the same area on the surface every three days, which means short-term changes in temperature and other phenomena can be monitored in detail.

Six smaller instruments complement the data collected by AVNIR and OCTS. NASA contributed an instrument known as NSCAT — for NASA Scatterometer — which provides information on the wind speed and direction over the Earth's oceans. This is valuable data since, while such information is regularly gathered by ground stations over the continents, aside from the occasional (and often unreliable) reports contributed by ships at sea, little is known about wind currents over the oceans. With three quarters of the Earth covered by water, NSCAT data will play a major role in helping to understand global wind currents.

NSCAT works on the principle of reflection of microwaves off the ocean's waves. An array of six 3m-long antennas radiate 14GHz microwave pulses towards the surface. Two 600km wide swaths separated by 330km are scanned. The ocean waves, or more correctly 'roughness', present at the time results from the prevailing wind conditions. The reflected radar cross section therefore provides information on ocean wind speed and direction.

Since NSCAT makes 190,000 measurements each day, the result is 100 times more data than has ever before been gathered. Such data should improve our ability to forecast weather, and help us understand global phenomena such as El Niño.

**Ozone layer**

Prominent in southern hemisphere countries' media is the hole in the ozone layer. This environmental hazard is the target of the Total Ozone Mapping Spectrometer (TOMS). TOMS monitors the amount of ozone in the atmosphere by comparing the albedo, or reflectivity, of the atmosphere in three pairs of spectral bands, with the reflectivity of the Earth's surface at a longer wavelength which is unaffected by the atmosphere.

In addition to ozone, TOMS is also able to monitor the amount of sulphur dioxide in the atmosphere, which is an indication of volcanic activity on the Earth's surface. This information is valuable since it is expected that eruptions such as Mount

ADEOS was launched into orbit via an H-11 vehicle, from Tanegashima Space Center in Japan.
Adeos giving Earth a ‘Physical’

Pinatubo in June 1991 are likely to have climatic effects. The French space agency CNES contributed an instrument called POLDER — Polarization and Directionality of the Earth’s Reflectances. POLDER looks at the way sunlight is reflected off the Earth’s surface, oceans, clouds and aerosols. POLDER researchers are investigating several phenomena, ranging from the way aerosols interact with clouds to influence the Earth’s greenhouse effect, to the way vegetation on land and in the oceans helps maintain the level of carbon dioxide in the oceans.

POLDER consists of a wide-angle lens, a filter/polariser wheel and a CCD array. The filter wheel permits scanning in eight narrow spectral bands and at three polarisation angles.

While most of the instruments aboard ADEOS are collectors of information, the Retroreflector In Space (RIS) is nothing more than an open box with reflective inner surfaces mounted on one corner of the spacecraft. Lasers aimed toward the satellite from observatories on the Earth are reflected by RIS. By studying the reflected beam, scientists will be able to monitor the composition of the atmosphere.

Because ADEOS orbits the Earth from pole to pole, it experiences a sunrise and sunset every 101 minutes. Watching these romantic scenes is the Improved Limb Atmospheric Spectrometer, or ILAS, an instrument designed to monitor the level of ozone in the atmosphere above the Earth’s poles. As the Sun ‘passes through’ the Earth’s atmosphere, as seen from on board ADEOS, ILAS looks at the known spectral properties of the centre of the Sun’s disk in the infrared (1610 to 850nm) and near visible (781 to 753nm) wavebands.

Because of the geometry of ADEOS’s orbit, ILAS is able to make vertical profile measurements of the Earth’s atmosphere above high latitudes. In addition to monitoring the ozone content, ILAS also measures related substances and temperature and pressure.

Finally, the greenhouse effect is now under scrutiny from ADEOS using the Interferometric Monitor for Greenhouse Gases (IMG). While it’s understood which gases are causing the greenhouse effect, and that these gases are largely produced by human activities, the precise sources and how serious they are remains uncertain. There are two main sources that IMG is searching for: deforestation and biomass burning. It is IMG’s task to locate and measure these sources by monitoring the global and regional variation of trace gases.

IMG is a Michelson Fourier Transform Spectrometer that uses two mirrors and a beam splitter. One of the mirrors is fixed, while the other travels along a 10cm track on magnetic bearings. By varying the relative positions of the two mirrors, an interference pattern is produced. The interferogram produced is Fourier transformed to obtain a spectrum.

These eight instruments are currently observing the Earth’s surface, providing us with a comprehensive assessment of our planet’s current environmental status. The ADEOS mission will take three years, at the end of which scientists should be in a much better position to assess just what effect we are having on the Earth’s environmental system, and how to repair the damage.

Geoff McNamara is a freelance science writer based in Sydney, and a regular contributor to EA. He extends thanks to Michael Box from the University of New South Wales, and Hideo Hasegawa from NASDA, for their help in preparing this article.
MEMO

To: Jim Rowe
From: Gary Johnston & the rest of the Jaycar crew

Dear Jim,

Please accept our best wishes for the celebration of 75 years of electronics publishing. I have been a continuous reader since 1962. Indeed, Electronics Australia (or Radio, TV and Hobbies as it was known then) was a seminal influence in my decision to make a career in electronics. Like many others here at Jaycar I turned a great hobby into a great career!

So thanks, to you and your staff from all of us here for producing a really good read month after month, year after year.

Kind regards
Gary Johnston.

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Product review:

VELLEMAN LCD HANDHELD SCOPE

Priced at just $449, the Velleman LCD portable scope makes this type of handheld instrument affordable for hobbyists and service technicians on a tight budget. It’s limited to frequencies below 500kHz, but offers a range of practical features such as true-RMS voltage measurement, a marker-based time and frequency readout, an ‘intelligent’ auto-ranging mode, plus built-in test tone and PC data link facilities.

by ROB EVANS

Regular readers of Electronics Australia will probably have noticed a number of recent reviews of LCD-based portable instruments from well-known instrument manufacturers such as Fluke, Tek and HP. If you’re like us, you would have found both their features and performance very impressive indeed for such compact instruments — but from a non-professional or hobbyist point of view, really had to put them on the ‘when I win the lottery’ shopping list, despite their competitive prices.

On the other hand, if you don’t really need the high-end features and performance offered by these devices, the idea of a low cost portable LCD-based instrument with a limited bandwidth may be appealing.

Clearly, Belgium-based manufacturer Velleman Components has seen a market niche here and responded with its HHS5 digital Handheld Scope, a compact LCD oscilloscope offering a maximum sampling rate of 5MS/s and a wider range of features than a comparable benchtop scope. The HHS5 is available from Jaycar stores throughout Australia for just $449 (not including accessories), and at that price appears to be in a league of its own in the handheld scope arena.

Of course what you don’t get for that price is the very high performance electronics and extremely rugged construction of the big-name handheld scopes. But on the other hand, you don’t get the four-digit price tag either...

In practice the Velleman HHS5 can display repetitive signals up to around 500kHz (at an effective sampling rate of 5MS/s) and single-event signals of up to about 100kHz (at 0.5MS/s), with the usual 8-bit resolution. Other than that, it offers a standard 1MΩ/20pF input, an A/D converter accuracy of +/-2 bits, and a maximum input voltage of 100V peak — or 600V with an x10 attenuating probe. This and the fact that the HHS5 also has a built-in (variable output) sinewave generator makes the instrument quite suitable for a wide range of both hobbyist and semi-professional field work, where a portable but low-cost handheld scope is needed.

The HHS5 measures 230 x 130 x 43mm, weighs around 600g (without batteries), and has a slightly unusual T-shaped case with a 64 x 128 pixel LCD readout occupying the upper section plus an array of 16 ‘bubble’ pushbuttons taking up the lower area. The buttons control the usual range of digital scope functions (scaling, trigger levels, hold, and so on), while many have double functions that are activated when the unit is in a particular operating mode.

The LCD itself has its far right-hand section assigned as a settings and data readout area, while the displayed waveform appears in the remaining region with a vertical resolution of six bits — which is all you can get from 64 pixels, of course. While the limited LCD resolution is probably one of the significant cost-saving compromises used by the Velleman designers for the HHS5, we couldn’t help but feel that this really does limit the instrument’s practical resolution/accuracy, and therefore usefulness. It’s doubly taunting when you consider that the unit actually stores the full eight bits of data for each sample.

Nevertheless, when we installed a charged set of six NiCad batteries in the unit and performed a series of test measurements, we found that the Handheld Scope’s display delivered sufficient resolution for most adjustment and monitoring jobs typically found in a hobbyist or field environment.

This was helped to large degree by the (full eight-bit resolution) measurement data appearing in the right-hand section of the display, which can be configured to read the waveform level in peak or true-RMS voltage, or in decibels (0dB = 0.775V). DC measurement with a variable zero-set function is also avail-
able, and one particular screen mode offers a set of four adjustable marker lines (two horizontal and two vertical) with matching data readouts supplying voltage, time and frequency data.

The other way the Handheld Scope’s full vertical resolution can be realised is through its pseudo-RS232 PC upload link, which transmits all 96 8-bit waveform samples via a 3.5mm phono socket in the top of the unit, each time the instrument is turned on. With a special phono plug-to-DB9/25 serial adaptor lead (a wiring diagram is included in the manual) — see the example screen shot shown here.

Called (not surprisingly) ‘Handheld Scope’ the software is written for Windows 95, and for those that do not have access to the internet, is now available for downloading on our bulletin board system (BBS). Phone (02) 335 0612 to connect with the EA BBS, and look for HHS5.ZIP in the Technical Software file area (number 170).

At this point we should point out that using the Handheld Scope in the normal free-standing way is really quite straightforward and intuitive. The

Two examples of how 'uploaded' data from the Handheld Scope can be presented on a PC. Above is a screen shot from the Windows 95 software available from Velleman’s web site (and EA BBS), while the waveform shown on the left was produced using standard comms and spreadsheet software.

### Specifications

- **Max sample rate**: 5MS/s for repetitive signals
- **Input impedance**: 0.5MS/s for single-shot signals
- **Max input voltage**: 1MV/20pF
- **Vertical resolution**: 100V peak (AC + DC)
- **Linearity**: 8-bits (six on LCD display)
- **LCD display**: +/-1 bit
- **dB measurement**: 64 x 128 pixels
- **True RMS measurement**: -73dB to +40dB +/-0.5% accuracy
- **DC measurement**: 0.1%y to 80V 2.5% accuracy
- **Timebase range (div)**: 0.1%y to 180V 2% accuracy
- **Input ranges (div)**: 20to 2us (in 1, 2, 5 format steps)
- **Sinewave output**: 5mA to 20V (in 1, 2, 5 format steps)
- **Squarewave output**: approx 1V RMS (adjustable) at 400Hz

Operating buttons are well laid out and control the scope’s various functions in a logical manner, allowing measurements to be taken quickly and easily. We were particularly impressed with the unit’s ‘auto-ranging’ mode which uses the Auto trigger setting, and rapidly scales both the timebase and vertical range to match the incoming waveform.

The auto-ranging mode works extremely well and is clearly the preferable way to use the HHS5 Handheld Scope during normal measurements. An added bonus of this feature is that it automatically avoids the misleading effects of screen aliasing and multiple sampling that can occur when the timebase is incorrectly set.

Other than that, the Velleman Handheld Scope offers a range of other practical features including a data/waveform hold button, a waveform dwell function, selectable trigger slopes, a variable-output sinewave generator (400Hz), a fixed squarewave output to aid probe calibration, switchable AC/DC input coupling and an input ground reference button. We found all of these features easy to use, and only needed to refer to the supplied manual to confirm the operation of a couple of the button’s secondary functions.

The manual is small but nonetheless informative and concise, by the way.

If we were able to pass on a ‘wish list’ to the Velleman designers though, we would probably include an external trigger input (which would be particularly handy for data logging and PC control), a battery level monitor facility, and finally a two-way RS-232 serial link so that the PC could receive sample data on a ‘request’ basis (this would make any support software very much more effective).

On the other hand, as this unit is priced at a fraction of other handheld scopes, perhaps a wish list is somewhat inappropriate...

The Velleman HHS5 Handheld Scope is available from your nearest Jaycar store for $449. As you would expect, Jaycar can also supply the necessary accessories such as a x10 scope probe ($39.50), suitably NiCad batteries ($4.50 each), plus a compatible mains-powered adaptor/charger ($15.50). ♦

**Velleman HHS5 Handheld Scope**

**Good points:** Low cost and easy to use.

**Bad points:** Limited bandwidth, display resolution. **RRP:** $449 (batteries and probe not included).

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Amplifiers arriving in cardboard boxes, and the longest repair job in history!

Most of this month’s column is devoted to a collection of interesting servicing stories from a reader who began his career at the tender age of five — and is now rather despondent about the future of our industry. I’m sure you’ll find his reminiscences as fascinating as I did. There’s also a story from my own bench, about a fault in ‘high-end’ video gear that turned out to be far more familiar than I feared...

For the past year or so, I have been involved with a committee that is charged with planning a new training curriculum for electronics technicians. One of the problems frequently mentioned is the complete lack of any fault-finding instruction.

Students learn all about the various building blocks and sub-assemblies that go to make up electronic equipment, and after four years they would certainly know how any piece of gear worked. But never once in their courses do they get to handle a complete radio set, let alone a television receiver!

In future, the well-trained technician will know all about tuning circuits, local oscillators, IF amplifiers, audio amplifiers and power supplies. The student will have to put all of these together by himself if he is going to recognise a simple radio set. It does not bode well for the future supply of trained servicemen.

All of this came to mind while I was reading through this month’s first story. It’s a contribution from Mark van der Eynden, of Mount Waverley in Victoria. Mark’s contribution is virtually his life story in servicing, and in many ways it parallels the story of many other servicemen. Most of us began as hobbyists and graduated to full time servicing.

Mark’s career began at the early age of — but I’ll let him tell his own story...

I have a few servicing stories that your readers may find interesting. They spread over quite a few years, so a bit of background is required to understand the circumstances surrounding them. I call them collectively ‘The best of the worst’.

I have been involved with electronics for most of my life. It began on my fifth birthday when I received a ‘Philips Electronics Kit’. By the age of six I had learned to solder and was being paid to solder plugs onto earphone leads. They didn’t come already attached in those days.

My father was the manager of an electrical goods shop which had a service department upstairs. So from about the time I was eight I spent my school holidays in that service department, doing odd jobs and learning what I could until I was able to do simple repairs all by myself.

Worst home job?

One of the servicemen on the staff at that time undertook a job which I call ‘The worst home job ever’. It involved an AM Radio/Cassette which had chewed up a tape and gagged on it. This was a very common occurrence with the early C120 tapes and/or el cheapo cassettes. The tape would wind around the capstan until there was a large wad jammed there...

Due to the tightness of the jam, the tape could not be removed. The usual trick was to take the back off the unit and turn the flywheel backwards until the tape became loose enough for it to be removed. Some frequent complications were with units where the front came off rather than the back, and others with fixing screws located in the cassette chamber, underneath the jammed cassette.

This unit was of the ‘front comes off type’ with the more unusual aspect being that the three knobs (volume, tone and band switch) were on that panel and had to be detached before it could be removed. Each of the knobs was recessed into a small aluminium extrusion which made them hard to get at.

The home fixit man had managed to get the screws undone, but had baulked at the knobs. His solution was to run a can opener through the aluminium extrusion! As you can imagine, the knobs were a press fit and Mr Fixit’s lack of this knowledge had him pay about one third of the retail cost of the unit for a new case, just to remove a jammed cassette...

On another day a fellow came into the shop to pick up his repair. He had been in twice before, but it was never ready. This was due to the manufacturer not delivering replacement parts on the promised dates, a situation that I’m sure still exists.

What made this day more notable was that the fellow lost his temper and KO’d my father, a man whom I have never seen use physical violence on anyone. The service department had never been a profit making venture; it was there to provide employment for four people and a service for the customers of the shop.

Thus, this episode caused the owners
to sell the service department, its staff and stock to another company around the corner whose sole business was servicing electronic equipment. After that, all customers requiring service to their equipment were referred to the business around the corner.

I was still employed, however, and amongst the things I got to do were repairs for 'Privileged Customers'. That's modern marketing speak for what we then called 'regular customers'. It meant that I got to look at various brands of equipment that were still under warranty.

The reason for this was that some companies, whilst marketing an excellent product which usually worked well, had no idea how to fix it if it broke down. This led to two distinct categories of problems. If it went away for repairs, it wouldn't come back for at least three months. Or if it did return promptly, it would still be broken when it was unpacked. Thus, I was able to have first look at the product and could repair many simple faults without having to send it away.

**Tackling an intermittent**

During this period FM radio appeared on the scene, but specialised service parts were still rather scarce. Down in the shop they had this new whiz bang AM/FM/SW radio cassette which had just been sold to a customer and was about to become my 'Worst Intermittent'.

The customer duly brought it back under warranty. It was returned to the manufacturer — who subsequently sent it back unfixed, with a credit note for a replacement set! My father asked me to look at the faulty unit, figuring that even if it took me a week to fix, there would still be a profit to be made in its eventual sale.

Turning the unit on revealed that it almost worked, but the sound was just terrible; a bit like an intermittent speaker. Clearly it couldn't be that easy, if the manufacturer had replaced it with a new set. I removed the back and found a circuit board of about one square foot — remember this was before ICs and surface mount.

A quick check of the speaker revealed it to be perfect. A bit of prodding around revealed that the trouble WAS an intermittent; but it was triggered by the sound coming from the speaker! And what an intermittent it was. If you turned the volume right down, it was sometimes possible to have normal sound. If you so much as touched the case the sound would drop in and out like nobody's business...

I determined that the problem was in the output stage by patching the pre-amp into another amplifier. This gave no sign of the intermittent. Also suggesting the problem was in the output stage was the fact that someone had spent a lot of time resoldering the entire output stage — not once, but several times.

Well, I couldn't think of anything better to do but to resolder everything again, in the hope of making it better or worse. Either way might enable me to locate the exact cause. Of course it wasn't to be that easy. At this point I put it aside to brew on the back burner.

A few days later, I decided to try resoldering the board whilst it was in a flexed position. I reasoned that the joint should then be either made or unmade, or at least be different to its state in the flat. Resoldering whilst 'flexing in' made no difference so I then tried resoldering whilst 'flexing out'. It was there I hit pay dirt.

I now had a unit that did not work most of the time, but could be thumped into action. It was the work of a minute to trace this to a particular transistor which, when removed, revealed one leg significantly shorter than the other two. Soldering this back in fixed the problem once and for all.

**A box of amplifier**

One day a customer arrived in the shop with a box containing an amplifier. He didn't mention the box or its contents at first; he just wanted to see and hear a new amplifier. When he had decided on his new purchase he asked my father rather sheepishly if we took trade-ins. My father said yes, and the customer put the box on the counter and opened it up.

Inside was a recent model amplifier. It was complete as far as one could see, except that every screw and nut that could be undone had been. It was to become 'the (almost) best home job'.

My father gave the fellow $10 trade in for the amplifier, for which he seemed grateful — although we couldn't get him to explain how the amplifier had got to be in this condition.

My first action was to put the nuts and bolts back in their correct places. This made the whole package a lot sturdier and also gave me a good idea of what was missing. Believe it or not, nothing had been lost and a cursory glance at the output stage revealed only the bias resistors had been replaced.

Mr Customer had apparently blown the output stage and decided to fix it himself. He noticed the cooked resistors and also gave me a good idea of what was missing. Believe it or not, nothing had been lost and a cursory glance at the output stage revealed only the bias resistors had been replaced.

He obviously understood the importance of those funny little washers between the transistors and the heatsink, but he must have misplaced them during the disassembly. So he improvised — cutting out nice neat squares of gaffer tape! Needless to say, a new set of output transistors (this time with mica washers) had the amp...
working as good as new.

Longest job ever?

My next story began just after I began working full time. I had spent a year at university studying electronics. However, due to the ‘politics’ and other problems at the institution I became disenchanted with the course, at the same time becoming more interested in computers.

I started work as a computer operator, but when people became aware that I could repair things electrical, a steady flow of jobs found their way to me to be fixed. Fairly early on a certain amplifier arrived on my bench and this was to become my ‘Longest job’.

The complaint sounded simple enough; it would work for about half an hour and then cut out. This amplifier was a four-channel one having DC coupling as a feature. I immediately suspected the output protection circuit was triggering, either because it was faulty or because of a fault elsewhere.

The owner was able to supply a circuit diagram, which showed that the protection circuit worked by mixing the outputs of each amp and then measuring the resultant voltage — disconnecting the speakers via a relay when the voltage exceeded a certain limit.

Checking this voltage revealed that it was drifting higher over time until it tripped the protection circuit. The cause of this drift was traced to one particular channel. The amplifier used one of those cheaper (cheap?) designs whereby almost every transistor was the same type, and checking the channel in question revealed one of these transistors was leaky.

Since there was another channel that was also drifting slightly, I checked it to find two more leaky transistors. I headed off round to the distributor and requested three replacement transistors but to my amazement, the chap behind the counter nodded, walked away, came back a few seconds later and GAVE me a handful of them!

I didn’t count that handful, but I remember that it still wasn’t quite enough to replace all the transistors of that type in all four channels. I checked all the transistors in the amplifier and replaced all of those that seemed to be the slightly leaky. I returned the amp to its owner explaining what had happened and asked him to bring it back if it gave trouble again.

Well, every couple of years the trouble did recur, whereupon it would be bought back and I’d replace some more leaky transistors. Very early in the piece I became suspicious that I was replacing transistors I had already replaced once before. But then, since they all had been out for testing, they each had the tell-tale signs of a soldering iron on the circuit board, so I wasn’t sure.

Originally I couldn’t find any data for the transistors; they were all of a particular early Japanese type. Later on (years on), I found an equivalent listed as well as data so I checked the specs and although a bit close to the wind voltage wise, these limits weren’t being exceeded. By this time I had begun using the equivalent type as my handful of originals was now exhausted. But the end was still not in sight.

Eventually the equivalents started becoming leaky and I was also losing my patience. I picked up my trusty data sheets and set about finding a replacement transistor with a bit more voltage headroom. I selected a BC639 (or was it a 640? it’s a while ago now...) and refurbished one channel in its entirety.

I ran this channel into a dummy load, (electric stove elements wired to produce about eight ohms) and checked the output produced by a signal generator on the scope. The signal was neat and clean, in fact slightly cleaner than the original transistors. What’s more important, it remained clean and stable for several days of intensive soak testing.

I replaced the transistors in the other channels and returned the amp to its owner, for what has proved to be the last time.

It had taken about 14 years from the first time I had seen the amplifier until the final repair and when I last checked it was still working perfectly. I wonder how many of these amps went to the tip after only two years of use?

Is the end nigh?

Well, that’s the end of my ‘best of the worst’ stories and I don’t expect to have any more. Why? Because I believe our ‘disposable’ society has reached the stage where almost nothing is worth repairing.

Example 1: I am often asked about VCRs with bad picture quality. “Is it the heads?” the owner asks. “I doubt it!” I reply, “they’re probably just dirty, bring it in and I’ll have a look for you”.

Months go by and I still haven’t seen the promised VCR so I ask — only to be told that they bought a new one. “Since it only cost $400 and had heaps of features the old one didn’t have”.

Example 2: Several times I have been asked about computers that exhibit strange disk errors when the battery was dead, it is only a matter of time before the whole thing packs it in. Anyway I picked up a Pentium with 16 megs of RAM and a two gig drive, for less than I paid for the old one!"

How can you compete?

I don’t know, Mark. I don’t think you can! And yet, there are still enough people around who are prepared to pay someone to fix their TV, VCR or whatever. The service industry is declining, but it’s not dead yet. (Fortunately so. This column would probably die with it, if the service industry collapsed!)

Now back to Mark’s other stories. We can all empathise with you about the tin-opener merchant. I think every one of us has come across a customer like that — including the character who, noting the angle on the head drum in his VCR, tried to straighten it up with a pair of slip-joint pliers!

Most of Mark’s tales are pretty much routine, except for the 14-year search for a reliable transistor. That one must go down as the longest hunt for a fault in electronics history! As you say Mark, we can only wonder how many of that particular brand and model of amplifier went on the tip, simply because no other serviceman was as patient and persistent as you.

Thanks for those stories, Mark. And I am sorry that you feel there is no future for you in the service industry. You sound like a resourceful technician who could make a living anywhere. Still, you know best and we wish you well in whatever you do in the future.

High-end anxiety

To finish up this month, I’ll give you a tale of woe from my own bailiwick.

In fact, the tale is quite disappointing. When it began I thought I would have a long and intriguing story for you, but it’s turned into a fizzle. Yet if the actual repair was nothing of any note, the facts surrounding it might be of interest to you.
My hobby is video production, and for editing I bought three of the best VCRs I could find. They are Panasonic NV-FS90 machines, Super-VHS types with all the bells and whistles (as the saying goes) and almost everything I need for editing and copying my tapes.

The main feature, from my point of view, is the 'Jog and Shuttle' facility. This gives me frame-by-frame control for accurate editing. And when this facility started acting up, I was thrown into a real tizz.

In detail, every time I pressed the Jog/Shuttle button, the machine would go straight into a 'frame advance' mode instead of the pause mode it was supposed to adopt. In this state neither the jog nor shuttle would work; although if I kept the button pressed, the jog and shuttle dials would respond normally. The normal pause button worked OK, except that I couldn't frame advance to the required edit point.

Oddly, the remote control carries duplicate jog and shuttle controls and these worked perfectly. So, whatever the fault was, it was associated with the front panel jog and shuttle board.

Since I have three of these machines, I felt it was wise to buy a service manual — although the first time I needed it, I found it not very helpful. The circuit diagram gives reasonable detail for the shuttle part of the system, but almost nothing about the jog facility. If the trouble lay in that part of the works, then I was going to be pretty much on my own!

My first action was to ask around among my friends, to see if any of them knew anything about jog and shuttle mechanisms and this machine in particular. As soon as I mentioned the model I was interested in, the response was almost universally "Oh! The FS90 is real 'top end' stuff — I've never touched anything like that'.

I even asked another friend who does touch 'top end stuff', and occasionally some professional stuff, yet even he had never heard of a jog and shuttle failing in just the way mine did. He did make one useful suggestion, though: if I could swap the jog and shuttle board with one of my other machines, and if the fault was swapped too, then a replacement board might be the easiest way to solve the problem.

So I bit the bullet and dismantled the front of the machine. Everything was fairly conventional until I removed the front panel. The jog and shuttle board came away with the panel and revealed a rather unusual plug and socket arrangement.

I would have anticipated a 'socket on a flylead' type of connection, but instead the 12 plug pins projected from the top of a rigid white plastic pillar approximately 20mm long, standing up on the end of the Timer Board. A 12-pin socket overhung the edge of the jog and shuttle board, hopefully in direct alignment with the plug on the Timer Board.

There was absolutely no flexibility in the connection. Even normal thermal flexing must have strained the pins and/or socket. I've never seen a similar connection in any of the VCRs I've repaired in the past, and I would not have expected it in a very expensive S-VHS machine.

The jog and shuttle components were mounted inside a diecast metal housing on the jog/shuttle board and there seemed no way it could be accessed for cleaning or adjustment. So I contented myself with checking the board for dry joints or other obvious faults.

At this point it began to occur to me that the fault just might be due to a faulty plug and socket connection. Have you ever heard of that one before?!

And so it turned out to be. I sprayed the pins and the socket with contact cleaner, gave them a quick tickle with a stiff brush, then reassembled the front panel and tested the machine. It was perfect!

So all of my worries about difficult faults in 'top end' equipment counted for nothing. You would think that after all my years in the service industry, I would have learned not to worry until I had proved the fault to be really difficult. In this case I was worrying myself into an ulcer, all for no reason at all.

They say "you can't teach an old dog new tricks". I'm beginning to think you can't teach an old dog ANY tricks!

I still don't know how the jog facility works. I suspect that it is associated with the photodiode and two phototransistors shown here in the circuit diagram. There is probably a segmented wheel between the diode and transistors, similar to the arrangement of wheels and diodes in a computer mouse. But since the whole assembly is inaccessible inside its diecast box, I don't suppose it matters much.

Well, that's it for this month. I'll see what I can put together for next time.

'Bye for now.
LOW COST VIDEO SECURITY MONITOR

As the prices of CCD cameras continue to fall, build-it-yourself video surveillance systems are becoming more viable. In this review we look at a dual-input 5.5" monochrome monitor that has all the features you need for a complete, inexpensive two channel system. We even found a few more applications for such a system...

by PETER PHILLIPS

A problem for most people building a video surveillance system is getting a suitable video monitor. A conventional TV set either needs a modulator to convert the video output from the camera to an RF signal, or you need to modify the set to accept direct video. As well, this arrangement can usually only work with one camera, and rarely has an audio channel.

This neat little monitor from Oatley Electronics is made in China and was originally sold as part of a complete surveillance system. It came with a CCD camera (with inbuilt microphone), mounting bracket for the camera, extension speaker and AC adaptor. We don’t know how much this system cost, but Oatley Electronics is now offering the monitor itself, without the peripherals, for $125. A six-pin mini DIN connector is also included.

A typical price for a suitable CCD camera is around $120, so by the time you add a DC power supply, a speaker and other attachments, you can have a complete single channel surveillance system for less than $300. Many readers will probably already have everything except a CCD camera, making the system even cheaper at around $250.

The monitor

Perhaps the most impressive feature of this monitor is its ability to accept two video/audio channels. Either channel can be selected from front panel pushbuttons, or, when set to AUTO mode, the monitor automatically switches between the two. The switching rate is adjustable at the front panel and is variable from one to 30 seconds.

Each ‘channel’ connects via a six-pin mini DIN connector on the rear of the monitor. Both connectors have lines for the video output of the camera, an external speaker, 12V DC (output) and a line level audio input to the monitor. The 12V DC output can power the camera and a microphone preamp.

This means you can have a setup like that shown in the block diagram, with each ‘system’ linked to the monitor via a six-core cable. We don’t know the current capability of the monitor’s output DC supply, but it’s likely it can also drive an IR light source. Oatley Electronics has a kit for a simple IR light source ($18) which takes around 30mA. A more powerful IR light source might need to be connected directly to the external power supply.

The monitor comes with an inbuilt microphone and speaker, with a ‘press to talk’ pushbutton on the front panel. To get two-way conversation, you need to add a microphone and preamp, both installed near the camera. A kit to do this is available from Oatley Electronics ($8). Also on the front panel are the power on-off switch, a volume control for the audio and three pushbuttons that select the AUTO...
switching function or either of the two input channels. Four LED indicators show power on and the selected input mode (Ch1, Ch2 or AUTO).

The monitor has video and audio output RCA connectors on the back panel for connection to a VCR. Also on the back panel are the DC input socket and adjustments for contrast, brightness and vertical hold.

Resolution of the monitor is given as 500 lines, which exceeds that of a typical CCD camera (380 lines). It measures 158 x 152 x 195mm (WHD) and is housed in a cream plastic case with a moulded recess as a carry handle. It weighs around 1.5kg.

The monitor operates from a nominal 13.8V DC power supply, and a complete single channel system takes close to one amp. Adding a second channel increases the current consumption, so a 2A supply is ideal.

**Test results**

For the purposes of this review, Oatley Electronics also provided a CCD camera and a 10 metre six-core lead with a DIN connector, along with the monitor. The lead has one shielded conductor (for the video signal) and four other conductors, giving the necessary connections for camera power, a speaker mounted near the camera, and a line level audio input back to the monitor.

This lead is not supplied with the monitor, but as already mentioned, a mini DIN connector is supplied so you can make your own lead. Information on the plug connections is included with the monitor.

We tested the system with a 12V 2A switch-mode power supply available from Oatley Electronics ($17). This supply is very compact and comes from a computer terminal case. The supply provided by Oatley Electronics for this review had an output voltage of 11.4V, but is easily adjusted to the specified 13.8V. The supply voltage is not critical, and the system works well with a supply voltage as low as 11.4V, with the contrast and picture quality improving marginally as this voltage is increased. This is probably due to the performance of the camera improving with an increased voltage, rather than that of the monitor itself.

Getting the system going took only a few minutes, and we were quite impressed with the results. For example, when the camera lens was adjusted and pointed at a page of eight-point type, we could easily read the text from the monitor.

We found the audio output level of the speaker at the camera was quite low, but more than enough for the purpose. You need to be within 100mm or so of the built-in microphone to get an adequate sound level at the external speaker. We didn’t set up a two-way audio channel, but found that an audio signal level of 200mV p-p back to the monitor gave a suitable sound level from the monitor’s speaker.

**Other uses**

While the monitor is intended for a surveillance system, we experimented with a few other applications. One that could appeal to those with ageing vision (like this reviewer) is to use the camera/monitor system as an aid to reading component values and part numbers in poor light conditions. Just hold the camera near the component and read the information from the screen. Writing that is otherwise illegible appears on the screen almost like magic!

As well, you can also often get a tiny CCD camera into places your head can’t go, so inaccessible components can be identified without the usual contortions. Another use is to inspect soldered joints. The camera supplied for this review has an adjustable lens, so in a dedicated inspection system, you can set the lens to give considerable magnification to show up those soldering faults. Holding an eyeglass or magnifying loupe in front of the camera lens gives even more magnification.

Professional inspection systems usually have a colour CCD camera, external lighting and a suitable lens. These cost thousands of dollars, but for less than $300 you get something similar with this simple system.

Because the whole system can run off a 12V lead-acid battery, you could also use it to inspect places that are otherwise inaccessible, such as ceiling cavities, pipe work and so on. For these and other similar applications you can put the camera in a glass jar to protect it. The glass jar can also be made watertight for inspecting the underside of a boat.

In summary, we believe this monitor is excellent value. It is small and light, making it useful for portable applications. It also works with the video output signal from a VCR or similar, making it useful as a workshop monitor. But when combined with a CCD camera, it has lots of applications, including video surveillance. Remember too, that a typical CCD camera works in infrared light, so you could set it up to monitor a baby or a patient, without needing external light other than an IR light source.

The review monitor was supplied by Oatley Electronics and has an RRP of $125. For more information, contact Oatley Electronics, PO Box 89, Oatley 2223, phone (02) 9584 3563, email oatley@world.net.

**Using the switching built into the monitor, you can easily switch between two different camera-speaker-microphone combinations. The monitor also operates from 13.8V DC, making battery operation quite feasible.**
Is the EMC Framework going to kill our small electronics manufacturers?

This month our main topic for discussion is one that we probably should have looked at earlier, but haven't: the SMA's EMC Framework, and its impact on the viability of Australia's small electronics manufacturers. Before we tackle that one, however, I have a couple of follow-up responses on our various discussions of EM fields and their possible health risks.

As I've noted here in recent columns, there hasn't been any shortage of feedback on the subject of EM fields and their possible health risks. It's obviously a subject that is of great interest to many readers, but I'm trying not to let it 'take over' Forum to the detriment of everything else.

This month, I'll present a couple of recent responses that I think you'll find of interest, and then pass on to a different subject — one that is really of great relevance and concern, even though we haven't given it much space as yet.

To begin, then, here's one of the two responses we'll look at to keep the EM fields and health topic simmering along. It comes from Mr Peter Ryan, of Wanganui in New Zealand, who is actually responding to the story in the May column from Bill Jackson, concerning the 'Pest Free' electronic pest deterrent device:

With reference to your article on the radiation from the 'Pest Free' in your Forum of EA May 97 issue, it was a breath of fresh air to hear that Australians believe in low frequency low level EMR — even if concerned about the side effects.

You will probably be surprised to learn that we don't have the problem here in New Zealand, as these low level pulses don't exist over here. A number of so-called state employed NZ experts last year appeared on a local TV program (Chl, 16 May 1996) called 'Fair Go' (not famous for being accurate in its presentation) and rubbished the whole concept, claiming that no electromagnetic waves were being radiated. They included the opinions of Mr Bruce Rapley, representing the Production Technology department of our local Massey University and a Mr Martin Gledall representing the National Radiation laboratories in Christchurch — a bit of a worry these experts!

On a more serious note, I am aware of the work of a small private research firm here in New Zealand that has for a number of years been working in this field and are using the assistance of some of the world's leading experts to confirm their findings. As a result they are discovering some most incredible benefits from using specialised low level, low frequency EMR in many applications.

It is interesting to note that most comment on EMR is negative. It is also very interesting to note that any good results from this field will effect the profitability of two of the wealthiest and powerful industries in the world, the chemical and medical industries — both of which are bugged with side effect problems with a number of their products.

I feel one must take a fairly neutral position when looking at complaints, because it appears a discrediting program is well under way, as more and more research is starting to take place throughout the world in this field. No reflection on your original complainant — the unit he complains about is very basic for this sort of application. I can assure you there is far more sophisticated equipment being used to understand and research this field.

I am convinced that the future includes the use of low level, low frequency EMR, cost effective and healthy products which are not far away and less chemicals and drugs.

I hope I have been able to show another side of the issue and thank you for Forum; it is an excellent and much needed platform for issues. Like many others I look forward to it each month. Keep up the good work, you are doing a great job.

Thank you for those comments, Mr Ryan, and for the kind words at the end. It's interesting that some positive potential uses are emerging for low-level low frequency radiation; can we take it that at least some New Zealanders believe that such radiation can have an effect on living cells, at levels below that which results in measurable heating? Many of our experts don't seem to believe in any such interaction, of either the beneficial or detrimental type...

'We do not know...'

Moving on, our second response comes from Mr Michael Gempton, who sent it via the EA Reader Services BBS. Mr Gempton doesn't seem to be responding to any particular aspect of the debate, but makes a number of interesting general comments — in particular, about the attitudes necessary for objective scientific research:

I am absolutely amazed at the extremes of opinion so vehemently expressed and with such authority, augmented by the use of findings from some specific research efforts being applied WAY outside their scope. (And I DO mean SPECIFIC — just take a look at some of their titles and/or constraining parameters.)

However, it is comforting to see some discernment beginning to be applied to the discussion, with the subject of thermal effects being appropriately partitioned and awareness of the vested interests of some powerful players in the debate tempering the impact of THEIR categorical conclusions.

At this point in time — as far as I am aware — any conclusive statements on the 'Non-thermal Biological Effects of Electromagnetic Radiation' are based on an absolute lack of definitive proof on this electric subject; with one excep-
tion (isn't there always?!) and that is, quite simply: 'We do not know'.

Whilst many people run scared at the mere thought of such an admission, it is the first essential step towards learning. Those who have taken this step automatically support the search for knowledge, through roles which range from the neutral interested party who allows investigation, to the dedicated research pioneer who champions it. Those who cannot make this admission, will only hinder progress.

Extreme views 'vital'

This is not to say that I would want to censor any opinion, at either end of the spectrum. Far from it! I personally feel that even extremist views serve a number of vital purposes.

Firstly, they give air to the little bit of a radical in us all. This allows us to take comfort in the fact that our extremist issues are being dealt with (especially with no risk to ourselves) — so we can focus on more productive pursuits.

Secondly, it is good for extreme opinion (at both ends) to be openly presented, especially when their (often) absurdity is clearly seen. Such beacons help identify the boundaries and provide reference points to those employed in honest endeavours, lest they should drift into darkness and be unfairly dismissed as quacks.

Lastly, it is often good for wild ideas to be expressed as these often lead to innovation in thought — brainstorming and lateral thinking, if you will — and since we have yet to attain satisfactory understanding on the subject at hand, regular stirring of the grey matter seems to be in order!

It is this last point that highlights the greatest difficulty and the greatest potential in supplying answers.

For starters, do we really know what AGENCY we should be investigating? "Excuse me?" you say, "Isn't that $%*@!? obvious?!"

My response is that yes, it may well be, but we have to make sure we have asked the right QUESTION — otherwise we might not be working in the right direction.

If I were asking the question I would like answered, it would be along the lines of: "What adverse effects are the result of occupying an environment which is subjected to electromagnetic radiation?" My reasoning is simple: I don't care WHAT the mechanism is, but if it can make me sick, I WANT TO KNOW!

The obvious starting point is on the direct effects of EMR on the human body — which is where I see all the breast-beating going on at the moment — so I'll quickly throw in my two cents' worth as well...

Since the human body is electrically conductive, then any alternating magnetic component of an electromagnetic field will induce currents in it. So this is an effect... But more questions need to be addressed: How does the human body respond to this? Does it cause damage? What sort of damage does it cause? Is the damage permanent or repairable? And so on. (I expect the molecular biologists, molecular physicists and molecular chemists could, and probably are, having a ball with these and a thousand other questions.)

Indirect effects?

Then there are the indirect effects. Let me illustrate by offering the following (totally unfounded) hypotheses:

1. "That cancer is caused by chemical poisoning resulting from ingestion of a product of a reaction between acid rain and the insulation material on overhead power lines."

2. "That cancer is caused as the result of an infection from the inhalation of bacteria which feed on a product of a
reaction between acid rain and the insulation material on above-ground power lines."

If either of these were true, you would still have the problem even if all power was cut off — so EMR itself would not be responsible — but the companion elements WOULD.

As the above hypotheses suggest, the TRUE cause of a problem may consist of several stages, each possibly having an obscure relationship with the other and none of which may have an obvious correlation with the observable problem. Or worse, that factors which have absolutely NOTHING to do with the problem are falsely ascribed culpability.

This latter point is where the discipline of investigation must be absolutely objective and totally rigorous in order to maintain complete integrity. If there are any flaws in this, the conclusions drawn will be compromised and probably rendered useless.

Therefore, anecdotal evidence cannot, in itself, be used to prove a thing — unless additional facts can be accumulated to give it legitimacy. It does, however, offer a supportive role in the evaluation of theories and is an invaluable source of directions to pursue.

I understand the 'Scientific Method' as BEING that discipline — one that involves a great deal of meticulous attention to detail and ordered processes with appropriate controls. You know, the kind of background YOU would want to see when adopting some one else's findings, but wouldn't want to burden yourself with when offering your own...

So where to from here? Onward and upward! Let the extremists give voice to keep us awake. Let the hypotheses be put, to stretch our imaginations. Let the evidence be examined to arrive at answers. Let the debates rage on, to keep us all honest. Let the forum continue so we can all be involved. Remember, no-one knows the answer — yet!

Thank you for those comments, Mr Gempton. I for one found them very interesting, and a welcome waft of reason and objectivity in an area that can easily become bogged down in dogma or hidden agendas. I also like your open attitude with regard to the airing of all views on this subject; I couldn’t have defined the goals of our Forum column better, in fact.

The EMC Framework

Moving on again, let's turn to a subject that we undoubtedly should have discussed before now, because it is clearly going to play a major role in determining the future of Australia’s electronics manufacturing industry. It's the Spectrum Management Authority's EMC Framework, a body of legislation which became law on January 1 this year.

I imagine that probably no-one would wish to argue with the SMA's motives in bringing in this legislation, which are entirely laudable: to try and ensure that the electrical and electronic equipment sold in Australia meets acknowledged standards for electromagnetic compatibility — i.e., low levels of electromagnetic emission, and also low susceptibility to incoming radiation. However, the problem seems to be that by imposing yet another set of bureaucratic hurdles and constraints, the EMC Framework is imposing a crippling burden on our local electronics manufacturers. Not so much on the large national and multinational manufacturers, who in most cases amortise the additional costs and overheads quite easily, but in particular on the smaller manufacturers who can’t.

In fact quite a few people in the industry have suggested that in their opinion, the EMC Framework is effectively going to kill most of our smaller electronics manufacturers, and merely consolidate the dominant position of overseas-owned multinationals. Not a cheerful prospect at all...

Anyway, that's by way of preamble to the letter I'm going to present to you now for your consideration. It comes from a reader who is the principal of a smaller local manufacturer, and is therefore written from the viewpoint of someone who is directly affected. Although he has provided me with his full name and address, as a token of good faith, he has also asked that I refer to him by the pseudonym 'Jim Fixt' — not just because of the nature of the EMC legislation's penalties, but also because of the risk that anything he writes might inadvertently implicate industry colleagues, suppliers and importers.

Here's what 'Mr Fixt' has to say:

I have been waiting for you to address the magazine in at least some of the issues raised by the EMC legislation which came into force on the 1st of January this year. You may recall that I spoke with you in December last year, shortly after I had become aware that low volume manufacturers such as ourselves had lost our exemption without notice. The situation regarding kits and therefore publishing of projects is also most unclear and directly affects your magazine (and others of course). We can't afford to bury our heads in the sand; this issue is not going to go away!

I have enclosed some clippings from the UK magazine 'Electronics World'. The editorial from the October 1996 issue is almost 100% relevant in an Australian context and I urge that you read it. There is also some other editorial from the same issue, regarding Australian EMC legislation, and a couple of letters. It is intriguing that there have been mentions of Australian EMC issues in another country's technical press, when it seems that the issues are being ignored here.

This year, in the normal course of my business, I have made a point of querying many of my industry colleagues about their knowledge of EMC, and I have to say that most of them are either completely unaware of their obligations or are just ignoring them! This is the stuff that ulcers are made of.

Mr Howard's Government claims to be reducing the amount of red tape and administrative costs for small business, but it seems that the electronics industry has not only been excluded from this promise, but indeed penalised.

I started my company in 1988. Since then I have designed hundreds of items of equipment and about 50 of those are
data loggers, digitising that's just enough. 

Before the reader says "So what?", let me point out that a big seller for me still only sells less than 100 per annum, and that only one or two of my models would reach that dizzying height.

A quick, though revealing survey of several of the EMC testing facilities indicates that testing of a single piece of equipment takes at least one day, maybe longer depending upon its complexity. The cost of this testing ranges roughly from $1500 to $3000 per day. If an item fails a test, it has to be re-submitted. Simple mathematics suggests to me that simply to be allowed to keep manufacturing my current range, assuming that an item passes first time, and assuming averages of $2000 per day to test, 1.5 days for each item, and 50 items, I'm up for around $150,000. And that's NOT a worst-case scenario!

I, and I'm quite sure, many hundreds or even thousands of Australian micro-businesses (I find the term 'small business' inappropriate) like mine cannot afford this kind of cost, which equates to six years' wages for one employee (or one year's wages for six employees).

So, basically we now have a law which gives us an ultimatum: Pay an enormous amount of money by 1999, or close the doors!

Small firms not invited

At this point I could express my opinion of the people that framed this legislation, but there are other laws which prevent me from doing so. In any case, I and my industry colleagues never received an invitation to submit any suggestions when the legislation was being framed, so perhaps I could be forgiven for believing that our interests have not been considered nor represented. Additionally, the legislation assumes that a designer/manufacturer is guilty until proven innocent — hardly democratic.

Now to some more specific stuff. Anyone can design and make a single prototype without any EMC testing or technical construction file being required. More than one and the intervention of a third party, the 'competent body', is mandatory — at great expense of both money and time.

Anything that is 'not generally available' may also bypass the need for a 'competent body' to prove its compliance. At what point does something become generally available? When it is offered for sale, when it is advertised, when the design is published, when?

Home-made radio amateur apparatus is also exempt. I recall that you debated the need for radio amateur projects some time ago, and that the general outcome was that not many hams make their own gear any more. This is borne out by the distinct lack of 'ham' projects in the magazine, or any magazine for that matter.

I think it safe to assume, and I think that you have established that amateur and professional electronics enthusiasts make up the majority of your readership and that these days, radio amateurs are mainly short-wave communicators AND electronics enthusiasts — buying, not building their communications equipment. Yet they are specifically exempted.

And what about computer enthusiasts? There are more and more projects for computers — data loggers, digitisers, virtual CRO's, virtual multimeters, BIOS testers, all sorts of I/O boards, the list goes on and on. The vast bulk of your readership is NOT exempt from EMC testing! Maybe the legislators see us all as radio amateurs? That's just ignorant and politically incorrect. I demand to be recognised as an electronics enthusiast!

Having raised the subject of computers, I have to mention a rather nasty aspect of the EMC legislation. When an item of equipment is presented for testing, it's exact construction down to the most minute detail is what is being tested. Any change — that's ANY change — necessitates re-testing!

The businesses assembling generic PC's are not exempt from EMC testing, yet I haven't seen a single generic PC with the C-tick logo or the CE logo. This would most likely be because they would have to pay enormous amounts to have all their various configurations tested. The case styles and motherboards and graphics cards and internal modems and sound cards, etc., etc., etc., change almost monthly too, and every little change requires re-testing of all configurations. This will make PC's unaffordable — the industry will collapse, the EMC testers will get rich in the meantime. Erh, that is if anybody actually obeys the letter of the EMC law.

The big PC companies (you know who they are) only offer a few configurations and seem to have opted for testing in other countries. Some bear the European 'CE' logo which is apparently acceptable to the Spectrum Management Authority (soon to be
merged into Austel). But say you buy a big-name PC and decide that a faster modem or graphics card, etc. is required. As soon as you put that card in, that PC no longer complies and has to be re-tested. This is plainly ridiculous and unenforceable.

One of the letters from the Electronics World clippings I have included raises the question of the validity of overseas EMC testing. In my possession I have a piece of digital equipment intended for video manipulation. It bears the CE logo, but causes severe interference to Channel 10 for about a 50-metre radius, and lesser but still annoying interference to the other channels and FM radio.

I thought the intention of the EMC legislation was to prevent just this sort of interference. Every little gadget that comes from Asia now bears the CE logo. Do they actually comply, or does testing there consist of sticking on the CE label?

Not so long ago you discussed the use of mobile phones and laptop computers in airplanes. Surely the CE or C-tick logo on these items guarantees their compliance? Surely the high-tech equipment on airplanes complies too — so what’s the problem, what’s the big picture here?

I think it is curious that Australia has embraced the European EMC standards, when we seem to be so much more at one with America. Their FCC regulations seem so much more workable. Warnings regarding radiated interference and received interference adorn American equipment, the solution to any problems being placed where it belongs — the user.

Let’s face it, you can’t protect people from themselves. People will always use things for purposes and in situations that they were not designed for. Even the strict Australian EMC laws won’t stop this.

I think it is reasonable to ensure that any equipment we make does not radiate RFI. I don’t think it is reasonable to have to spend large amounts of money testing small-volume, low-cost manufacturing, where the cost of testing will have a major effect on the selling price. Perhaps the legislation could be altered to exempt from EMC any production run where the cost of compliance exceeds a small percentage of the manufacturing cost.

Understanding the jargon

How do we ‘micro-businesses’ test our equipment in-house? What test equipment do we need? What levels are acceptable? What frequencies do we have to measure between? Some of the answers are available in the relevant standards documents, that is if you can understand all the jargonised mumbo-jumbo.

I think this is where EA has a responsibility to the readership. How about some practical articles on in-house EMC testing — you know, rules of thumb, perhaps some constructional articles for test equipment which will at least give us a chance to find problems before we have to spend small fortunes with ‘competent bodies’?

How about showing us how responsible you and your contributing designers are, by publishing your in-house EMC test results with each project?

I’d like to design some projects for publication, but I am concerned, as should any of your current contributors be, that a great axe is likely to fall. The penalties for ignoring EMC are very harsh and I don’t see where kits are exempted. Perhaps you can clear the air and prove that electronics enthusiasts’ kits are definitely exempt. Maybe by publishing this letter, you can influence the politicians to make some changes to the EMC legislation to make life a bit easier for us all.

I suppose I have been raving on. I realise that you may not publish all of this missive due to its length, or perhaps for other reasons, but the Australian EMC issue has been ignored and I am very concerned about my company’s continued viability, with the massive costs of both money and time that must be found before 1999. New products are also out of the question for my company, so we are slowly strangulating.

Hmmm, there’s quite a lot of food for thought there, isn’t there? My sincere thanks to ‘Mr Fixit’ for sharing his concerns with us. It certainly sounds as if the EMC Framework is likely to cause severe problems for firms like Mr Fixit’s, and could easily cause the demise of many of them before the end of the century/millenium. That doesn’t augur well for the future of Australia’s electronics industry, does it?

By the way, like other electronics magazine editors, I imagine, I approached the SMA last year and asked for clarification regarding the possible impact of the EMC Framework on our publication of project designs, and the ability of firms to sell kits for them. The answer seemed to be that because we effectively only sell information, we’re not covered by the legislation — at least for the present. Similarly since kit firms only sell a collection of components rather than a product, they too are not affected as yet...

As Mr Fixit points out, though, small manufacturing companies are very much affected. It looks as if you’ll be allowed to pursue electronics design and assembly as a hobbyist, without any hurdles. But if you want to start your own manufacturing business, be warned: it’s now a lot harder and more expensive than it was.

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  - Host Adapter
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- Super Tweeter: 25mm
- Japanese voice coil
- Impedance: 4 ohms
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- Gross weight: 4.3 kg

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MAC-320A8F 600V 20A ISOLATED TAB TRIAC
U1027 ........................................... $3.25
To suit Photograph Timer for Darkrooms (SC April 95)

TEMPERATURE TRANSUDER
AD590J CURRENT OUTPUT TEMPERATURE TRANSUDER
U20720 ........................................... $12.95
To suit Temperature Adaptor
(Electronics Today International)

VERSATILE LOW VOLTAGE ADAPTOR
This little project is just the shot for those occasions where a low-voltage regulated DC source is needed from a small package. Based on a robust but low-cost regulator IC, the adaptor uses push-on, jumper links to preset the output voltage between 3V and 15V, and depending on the heat sink you use, can deliver an output current of up to 1.5 amps. You can use it to power external peripherals from a PC, or to run a peripheral CD player from a car’s cigarette lighter socket.
EA Aug ’97

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CAT NO. CAPACITY .............. PRICE
*Internal Floppy Tape Drive 1 with 1 Travan TR-1 tape and Mounting Hardware $3.95
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MJL-21193 250V 18A 200WATT NPN TOP-3 TRANSITOR $2.50
MJL-21194 250V 18A 200WATT NPN TOP-3 TRANSITOR $2.95

2MM LED LAMPS
LEDs subject to change
Cat. No. COLOUR INTENSITY TYPE
Z10185 RED 200 MW 5MM SMD
Z10186 GREEN 200 MW 5MM SMD
Z10187 YELLOW 200 MW 5MM SMD
Z10188 ORANGE 200 MW 5MM SMD

RARE IC’s
74HC137 HIGH-SPEED CMOS 3-TO-8 LINE DECODER / DEMULTIPLEXER $2.95
Z77137 ........................................... $1.95
74HC573 HIGH-SPEED CMOS OCTAL D-TYPE TRANS LATCH $4.95
Z77573 ........................................... $1.95

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100(F) 100V PCB ELECTROLITIC CAPACITOR RB $1.25
R15536 ........................................... $1.25
150(F) (0.15(F) 630V MTK POLYCARBONATE CAPACITOR $2.00
R16140 ........................................... $2.00

AMPLIFIER TRANSISTORS
MJ-340 300V 500mA NPN TO-126 TRANSISTOR $2.00
T0420 ........................................... $2.00
MJ-350 300V 500mA PNP TO-220 TRANSISTOR $2.00
T0421 ........................................... $2.00
MJL-21193 250V 18A 200WATT NPN TOP-3 TRANSITOR $2.50
T0435 ........................................... $2.50
MJL-21194 250V 18A 200WATT NPN TOP-3 TRANSITOR $2.95
T0436 ........................................... $2.95

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This little project is just the shot for those occasions where a low-voltage regulated DC source is needed from a small package. Based on a robust but low-cost regulator IC, the adaptor uses push-on, jumper links to preset the output voltage between 3V and 15V, and depending on the heat sink you use, can deliver an output current of up to 1.5 amps. You can use it to power external peripherals from a PC, or to run a peripheral CD player from a car’s cigarette lighter socket.
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Freshware Volume 4 - J9004
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Freshware Volume 6 - J9006
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Freshware Volume 8 - J9008
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U1027 ........................................... $3.25
To suit Photograph Timer for Darkrooms (SC April 95)

BB-212 VARIAC CAPACITORS
T09020 ........................................... $9.95
BF-998 DUAL GATE MOSFET $9.95
T09029 ........................................... $9.95
To suit Low Cost RF Test Oscillator Kit (EA May 96)
BS-170 60V 300mA TO-92 V-MOSFET $1.45
T09094 ........................................... $1.45
To suit Infra-Red Stereo Audio Link (SC September 96)

FERRITES
EF-26 CORE 3C60 NO-GAP L12186 ........................................... $1.25 ea
EF-25 8-PIN HORIZONTAL GLASS / NYLON FORMER L12187 ........................................... $1.75 ea
POT CORE POLYACETAL BOBBIN FORMER 30x19 L12190 ........................................... $0.75 ea
To suit Transcutaneous Electrical Neutral Stimulation (SC August 97)

MOSFET DRIVER
IR-215S SELF-OSCILLATING HALF BRIDGE MOSFET DRIVER U10650 ........................................... $10.45
IRF-610 200V 1A N-CHANNEL TO-220 MOSFET U10815 ........................................... $2.45

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100(F) 100V PCB ELECTROLITIC CAPACITOR RB $1.25
R15536 ........................................... $1.25
150(F) (0.15(F) 630V MTK POLYCARBONATE CAPACITOR $2.00
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T0421 ........................................... $2.00
MJL-21193 250V 18A 200WATT NPN TOP-3 TRANSITOR $2.50
T0435 ........................................... $2.50
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![Way Monitor Splitter Image](image)

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For networking installation using BNC 50 ohm coax cables that are preassembled ready-to-use cables with BNC connectors at both ends.

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Length (ft)</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS7700</td>
<td>500m</td>
<td>$6.85</td>
</tr>
<tr>
<td>PS7702</td>
<td>2m</td>
<td>$6.85</td>
</tr>
<tr>
<td>PS7703</td>
<td>3m Male-Male</td>
<td>$7.95</td>
</tr>
<tr>
<td>PS7710</td>
<td>10m Male-Male</td>
<td>$9.85</td>
</tr>
<tr>
<td>PS7715</td>
<td>15m Male-Male</td>
<td>$16.95</td>
</tr>
<tr>
<td>PS7720</td>
<td>30m Male-Male</td>
<td>$41.50</td>
</tr>
<tr>
<td>PS7740</td>
<td>40m Male-Male</td>
<td>$41.50</td>
</tr>
</tbody>
</table>

**A4 Laminator**

Latest A4 size laminator, you can protect and preserve your favourite documents.

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**Multimedia Upgrad**

Cables for multimedia, video, sound and other audiovisual equipment.

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![R-OD Irving- Electronics](image)
Circuit & Design Ideas

Interesting original circuit ideas and design tips from readers. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide any further information.

Unipolar stepper motor driver

This circuit lets you control stepper motors without the hassles of computers, custom chips or heaps of Darlington transistors. It is suitable for both six and eight wire motors, with the drive limited by the switching components specified.

The circuit is based on a 4013 wired up as a Johnson counter, where the output of the final stage is inverted and fed back to the data input of the first stage. Most stepper motors contain four windings, and turning them on in the right sequence will cause the motor to run in one direction; reversing the sequence causes the motor to run in the other direction.

We can implement this direction change quite easily in this two flip-flop design, by moving each data input to the complementary output of the other flip-flop. This is achieved by two bilateral switches which switch between the Q and Q-bar outputs of each flip-flop.

The four AND gates decode the outputs of the Johnson counter into four distinct states, and these decoded outputs are connected to the output transistors driving the motor. There is a choice of either 'wave' or 'two-phase' sequencing to drive the motor. During wave driving only one winding is energised at a time, while two-phase turns on two phases at a time, producing more torque. To wave drive, simply connect D1 to Q1, D2 to Q2, etc. Connecting eight diodes between the 4081 and the driving transistors as shown will run the motor in the two-phase sequence.

My motor only needed 280mA per phase so BC639s were used. Rather than connecting the 547s to the 639s in a Darlington configuration, I wired them as emitter followers. This reduces the Vce to around 500mV as opposed to 1 volt for a Darlington pair. It may not seem much, but when the transistor is in a TO-92 package, anything you do to limit power dissipation helps. The 150Ω resistors will allow 25mA to flow into the bases of the switching transistors. If you want over 1A per phase, reduce the 150Ω down to 56Ω, and replace the BC639s with TIP31Cs. This should be good for about 1.6A, depending on the hie of your transistors. Anything over that, ditch the transistors and drive FETs from the logic.

The ballast resistors are chosen to limit the winding current to the rated value, should the supply voltage be higher than the rated voltage of the motor. The advantage of running with ballast resistors is better high speed performance.

Nick Baroni
Greensborough, Vic. $40

Eye level brake light flasher

Many modern cars have a strip of bright lights (usually LEDs) mounted at eye level at the rear, connected to the brake lights. These turn on whenever the brakes are applied, giving the driver behind better warning that you are going to stop. Sometimes even this isn’t enough, however, and so I came up with this circuit.

The circuit shown here flashes the rear light three times before staying on until the brake pedal is released.

When the brake pedal is applied, the circuit receives power, and the 555 timer IC begins to oscillate at approximately 2Hz. The 4017 decade counter is initially reset by C2 and R2, and is subsequently clocked by the output of the 555.

The 4017 outputs are ORed together via the four diodes, and the output is then fed to Q1 and Q2, wired together as a Darlington pair. The power transistor Q2 then switches the negative supply to the brake light strip. The flashing light effect is attained by ORing the Q0, Q2, Q4 and Q6 outputs of the 4017, with Q1, Q3 and Q5 left unconnected. Once Q6 goes high, the 4017 is inhibited and the brake light remains on continuously.

Installation is a breeze — the third eye-level brake light usually has a connector that will let you simply connect this circuit in series.

‘KRL’.
Toowoomba, Qld. $30
Booster for 12V motors

This circuit, although relatively simple, boosts the speed of small DC motors such as fans or mini drills by about 25%. It does this by using a Motorola MC34063A DC-DC converter IC to step the 12V supply up to 16V DC. This extra voltage will not damage most lightly loaded DC motors such as fans, and most mini drills are rated up to 18V anyway.

In operation, R1 sets the coil current limit, C2 sets the operating frequency (around 30kHz), and R2/R3 determine the output voltage (in this case, about 16.3V).

The PWM output at pin 2 of the IC is applied to the gate of Q1, an MTP 3055E power MOSFET. This in turn switches the input voltage across L1, a 70uH coil, generating the higher voltage. This voltage is then rectified by D2, a BY229 fast acting diode, and then smoothed by C3.

L2 and C4 are optional filter components to remove excessive ripple from the output, allowing the unit to power other electronic equipment with fewer problems.

My prototype has been running without problems for several months and has been tested in excess of 22W for five minutes, and 20W continuously. Although very little heat is generated by the MOSFET and a mini heat sink will suffice, D2 the BY229 rectifier needs a heatsink capable of dissipating several watts due to the large current surges involved.

Now!

Pradeep G.
Alappuzha, South India $25

FM transmitter uses varicap tuning

I made an FM transmitter recently, based on the circuit published in Electronics Australia December 1996. The main difference is that this circuit uses a varicap diode to tune the transmitter instead of the more touchy variable capacitor.

PNP transistor Q1 is connected in a self biasing configuration, with L1 serving to prevent any stray RF from overloading the input stage (L1 consists of 5 turns of 25 SWG wire wound on a small ferrite bead core). The audio output signal is applied across the varicap diode (a BB105 or similar) via a 100k resistor.

VR1 sets the DC bias on the varicap, and sets the circuit’s operating frequency. ZD1 maintains a stable 6V reference on the top of VR1, while C1 blocks the DC through the coil. The circuit is designed to cover the 88 to 108MHz FM band with the values given.

The main tuning coil is wound with four turns of 20swg ECW, space wound on a 4mm air cored former. The aerial tap is made at one turn from the bottom end of the coil. With a quarter-wave-length antenna (70cm) a reasonable range of 150-200 metres can be achieved. The circuit only draws 10mA, and so could be run on a standard 9V battery.

Stephen Carrol
Timmsvale, NSW $30

Now!

DURIN6 ELECTRONICS' 75TH ANNIVERSARY 375
BEND A COMPLETE TV VIDEO CAMERA OR A PCB LOW-LIGHT
INFRARED SENSITIVE W/3.6 MM BOARD OR A 5 MM PINHOLE LENS
SO TO EIO LED IIS TO 44 WATT INFRARED ILLUMINATOR KITS
SEE MARKETPLACE FOR DETAILS

WIN OUR 'IDEA OF THE MONTH' PRIZE!
As an added incentive for readers to contribute interesting ideas to this column, the idea we judge most interesting each month now wins its contributor an exciting prize, in addition to the usual line. The prize is a compact CCD video camera module from sponsor Althingi Sales & Services, offering 480 TV lines of horizontal resolution and 0.06 lux sensitivity, and valued at $199.00!
Construction Project:

LOW COST B&W CCD TV CAMERA

Here's an easy to build, economical black and white TV camera that is very suitable for monitoring your front door, keeping an eye on the baby or studying the nocturnal habits of your resident possum. It features an inbuilt infra-red light source for night viewing, a built-in electret microphone for picking up sound as well as image, and an RF modulator to allow convenient use of a TV receiver as the monitor.

Although there are low-cost black and white TV cameras on the market, they generally don't include features like an inbuilt RF modulator, microphone or IR (infra-red) light source for night work. The easy to build project to be described here incorporates all of these features, while at the same time costing less than most commercial cameras. It should therefore be of interest to anyone wanting a camera for surveillance or monitoring use.

It's based on one of the miniature black and white CCD camera modules, coupled with an electret microphone and preamp. For flexibility it provides separate composite video and audio outputs, as well as a modulated RF output on television channel 0 or 1. This means that its image output can be either viewed on a video monitor and heard via a monitoring amplifier, or seen and heard on a standard TV receiver.

A bank of seven IR LEDs is also built in, to provide a source of 'invisible' infra-red lighting when the camera is used at night.

A further feature is that the camera is quite compact. With an overall depth of only 50mm it can be set up as a fairly unintrusive monitor or intercom. If desired it could even be combined with an audio/video transmitter to avoid running cables through walls.

The power supply it requires is a nominal 12V DC at 150mA, which could be supplied from a 12V/200mA DC plug-pack, or from any other suitably rated battery or DC supply between 11V and 14V.

Incidentally the design of this project was carried out by the R&D Department of Dick Smith Electronics, and not surprisingly DSE will be marketing complete kits for the camera. Listed in their catalog as K-5416, the kit is priced at $149.00 and will be available through all Dick Smith Electronics stores and stockists.

The camera module

The camera module is made of a 38mm square printed circuit board, with video processing circuitry using exclusively surface mount components. In the centre of the module is a plastic lens assembly with a CCD (charge coupled device) image sensor at its base. Connections to the module include a 12V DC input and a composite video output.

The CCD sensor is a semiconductor chip measuring 6mm x 5mm, containing an array of light sensitive elements. The value of the charges on the array elements vary with the intensity of the inci-
dent light, and so the array captures the image focused onto it in pixel form. The image is scanned by shifting the charges serially through the CCD array, out to the processing circuitry where it is converted to composite video. The specifications for the camera module are shown in Table 1.

The module has its own reverse polarity protection and filtering, and so is connected directly to the camera's main power input rather than through the external protection circuitry.

As with many CCD sensors, the camera module is sensitive in the infra-red as well as in the optical range of the electromagnetic spectrum. To take advantage of this, seven infra-red LEDs have been included to allow night viewing without any visible light — albeit at reduced visibility compared with normal lighting.

The LEDs are connected in series, and emit constantly whether it is day or night. However they could be disconnected or made switchable if you wish, to reduce power consumption. The IR LEDs used have a maximum continuous current rating of 50mA, but in this circuit the current is limited to 27mA at 12V by series resistors R16 and R17. The LEDs have a typical forward voltage drop of 1.2V.

**VHF modulator**

The main purpose of including a modulator with the camera is to allow a standard television receiver to be used as the camera monitor. Televisions and VCRs that have separate audio and video input as well as the antenna input do not need the modulator.

The modulator has separate video and audio inputs, and these are used to modulate an RF oscillator and produce a signal very similar to that from a television station. This signal is tuned to VHF channel 0 if the link on pin 4 is inserted (connecting pin 4 to ground), or VHF channel 1 if the link is left out (pin 4 disconnected).

The optimum video level for the modulator is one within the limits of +2.2V and +2.7V. For maximum audio output, an input of 5V peak to peak is required. Power for the modulator is taken from the DC input via resistor R10. The modulator has a built-in zener shunt regulator which protects it from reverse polarity or voltage surges.

The video output from the camera module is shared between the main video output and the video input to the modulator. To ensure a stable picture from the modulator, a DC restoration circuit has been inserted before the video input. If the video signal were capacitively coupled to the modulator then the variations in picture intensity would cause the average video voltage to vary, possibly causing the sync pulses to vary, and ultimately causing picture distortion.

The DC restoration circuit uses Q1 to control the modulator video input current so that the sync pulse tips, which are at the negative peak of the waveform, are clamped at +2.2V. Components D2, R6 and C4 form a negative peak detector, developing a voltage on pin 3 of IC1a equal to the minimum video signal level plus 0.6V (one diode drop).

A 2.8V DC reference is derived from 4.7V zener diode ZD2 and applied to pin 2 of IC1a. If the minimum video level goes above 2.2V, then the output of IC1a increases and turns Q1 on more, pulling the video voltage down. Conversely, if the minimum video level falls below 2.2V, the bias on Q1 is reduced — allowing the video voltage to rise. The peak-to-peak amplitude of the video signal is adjusted with trimpot VR1 to be 0.5V.
The audio side

The audio section of the camera consists of an electret microphone insert and a single stage amplifier using the second half of the LM358 package. The electret microphone has an inbuilt FET buffer which requires a DC supply, provided here via R11 from the same reference voltage used by the video circuitry.

The DC voltage developed across the microphone is not stable enough to bias the amplifier, so a separate bias is provided via R12 to the non-inverting input of the op-amp. The microphone signal itself is capacitively coupled by C6. The op-amp is configured for unity DC gain and for an AC gain of up to 1000, depending on the setting of trimpot VR2.

The audio output is shared between the main audio output at SK2 and the modulator input.

Power for the DC restoration circuitry and microphone amplifier is supplied via protection and filter components D1, R1, ZD1 and C1. Diode D1 protects against reverse polarity and zener diode ZD1 clips voltage surges. Capacitor C1 reduces ripple and noise while resistor R1 enhances the filtering effect of C1 and limits current through ZD1.

Assembly

For the purposes of the description below, the copper track side of the PCB will be called the ‘bottom’ of the PCB and the other side the ‘top’.

To place the components, look at the relevant overlay diagram which shows how the components actually appear on the PCB. Read the label of the component, C2 for example from the top overlay, and then look up the description next to that label in the parts list. The parts list describes C2 as a ceramic capacitor which has a value of 0.1uF, with a working voltage of 50V and may be marked either 100nF, 0.1uF or 104 (104 means 10 followed by 4 zeros, in pF). Occasionally one of the supplied capacitors may be marked with a voltage rating greater than that shown in the parts list. This is acceptable providing it fits on the PCB. If the voltage rating is less than that shown in the parts list then advice should be sought unless the discrepancy is explained in the errata section at the end of the instructions.

In most cases the component lead spacing will match the hole spacing in the PCB and the component will be inserted fully to minimise mechanical vibration, inductance, etc. However sometimes the spacings will not match. In that case, the leads can either be given a double bend (‘cranked’) to adapt the spacing, or the component can be just partly inserted, avoiding putting pressure at the point where the lead enters the component.

For convenience, the project is best assembled in the sequence below:

(1) Insert resistors R1-15 into the top of the PCB and solder them. Resistors have their values marked on them as colour coded bands, which are given in the parts list. The last band of the colour code gives the tolerance value and is the colour band furthest from the others. Resistors can be mounted in either direction on the PCB, but it is good practice to mount them with their colour codes all in the same direction so that it is easier to read the values later.

Some of the resistors on the overlay are labeled RO. These are actually wire links, built like resistors and have a single black band in the centre.

(2) Insert diodes D1, D2 and ZD1/2 into the top of the PCB and solder them. Diodes have a band on them at one end (cathode) and must be mounted in the direction shown on the diagram. There may be more than one band, but only one end of the diode should have a band at the very edge.

(3) Insert IC1 into the top of the PCB and solder it. This IC has a case with two parallel rows of four pins, called a dual-in-line package or DIP. There is a dot or notch on the top, at the end near pin 1, and the overlay diagram shows which way around the IC has to be mounted. The pins count anticlockwise from pin 1, looking at the top of the package.

(4) Insert trimpots VR1 and VR2 into the top of the PCB and solder them. These
The camera can be connected to a TV or VCR via either the RF output socket (top), to the antenna input, or via the video and audio outputs (bottom) to the direct video and audio outputs.

**TABLE 1: Camera Module Specifications**

<table>
<thead>
<tr>
<th>Video system</th>
<th>CCIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical sensor size</td>
<td>1/3&quot; CCD (6 x 5mm)</td>
</tr>
<tr>
<td>Number of effective pixels</td>
<td>500(H) x 562(V) (290k)</td>
</tr>
<tr>
<td>Number of total pixels</td>
<td>537(H) x 597(V) (320k)</td>
</tr>
<tr>
<td>Scanning system</td>
<td>2:1 interface</td>
</tr>
<tr>
<td>Synchronisation</td>
<td>internal</td>
</tr>
<tr>
<td>Resolution</td>
<td>400 TV lines</td>
</tr>
<tr>
<td>S/N ratio</td>
<td>46dB</td>
</tr>
<tr>
<td>Min illumination</td>
<td>0.2Lux (F=2.0)</td>
</tr>
<tr>
<td>Electronic shutter</td>
<td>1/50 to 1/100,000 sec.</td>
</tr>
<tr>
<td>Horizontal sync freq</td>
<td>15.625Hz</td>
</tr>
<tr>
<td>Vertical sync freq</td>
<td>50Hz</td>
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<tr>
<td>Video output</td>
<td>1Vpp/75ohms (BNC connector)</td>
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<tr>
<td>Built-in lens</td>
<td>focal length 3.6mm (f/2.0)</td>
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<td>Storage temperature</td>
<td>-20degC to 80degC</td>
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<tr>
<td>Working temperature</td>
<td>-10degC to 60degC</td>
</tr>
<tr>
<td>Power source</td>
<td>12V DC</td>
</tr>
<tr>
<td>Power consumption</td>
<td>1.5W</td>
</tr>
<tr>
<td>Dimensions</td>
<td>38 x 38 x 24mm (H x W x D)</td>
</tr>
</tbody>
</table>

The CCD module, microphone, infra-red LEDs and their series resistors, and video output connections are all made to the copper side of the PCB.
CCD TV Camera

the solder. Place the link over both pins for operation on channel 0, or on one pin only for channel 1.

(16) Solder the free ends of the camera DC lead to the tags of DC input socket SK1, ensuring the correct polarity as shown on the top overlay diagram. Plug the other end into the 12V socket on the camera PCB.

(17) Cut both of the camera module video wires at about 25mm from the camera plug end, then strip and solder the four resulting cut ends to the video (+) and (-) solder pads on the main PCB.

(18) Drill and ream/file the four socket holes in the side of the box using the template provided. The hole for the video output socket hole so that the camera plug end, then strip and solder the four resulting cut ends to the video (+) and (-) solder pads on the main PCB.

(19) Using a pair of side cutters or pliers, break off the plastic guides around the video output socket hole so that the washer, lug and nut can all fit on the back of the socket.

(20) Place the PCB assembly centrally inside the box without the tractor supports and check hole alignment and plug fit for the camera and sockets. Then remove the assembly from the box.

(21) Cut the tractor supports as shown in the diagram. The best way to do this is to place them one at a time on the PCB near the modulator, and trim the bottom level with the bottom of the modulator. Then place them in the box, touching the bottom, and trim the top to be a close fit with the lid.

Parts List

<table>
<thead>
<tr>
<th>Resistor</th>
<th>Value</th>
<th>Colour Code</th>
<th>Four band</th>
</tr>
</thead>
<tbody>
<tr>
<td>R0</td>
<td>0 ohm link</td>
<td>Three band</td>
<td>- Blk -</td>
</tr>
<tr>
<td>R1</td>
<td>100 ohms</td>
<td>Blk Bk Bn</td>
<td>Blk Bk Bk Bk</td>
</tr>
<tr>
<td>R2</td>
<td>470 ohms</td>
<td>Yel Vio Bn</td>
<td>Yel Vio Bk Bk</td>
</tr>
<tr>
<td>R3</td>
<td>150 ohms</td>
<td>Bk Grn Bn</td>
<td>Bk Grn Bk Bk</td>
</tr>
<tr>
<td>R4,5</td>
<td>3.9k</td>
<td>Org Wht Red</td>
<td>Org Wht Bk Bn</td>
</tr>
<tr>
<td>R6,14</td>
<td>1M</td>
<td>Bk Bk Grn</td>
<td>Bk Bk Yel</td>
</tr>
<tr>
<td>R7</td>
<td>27k</td>
<td>Red Vio Org</td>
<td>Red Vio Bk Red</td>
</tr>
<tr>
<td>R8</td>
<td>15k</td>
<td>Bk Grn Org</td>
<td>Bk Grn Yel Bk</td>
</tr>
<tr>
<td>R9</td>
<td>820 ohms</td>
<td>Grey Red Bn</td>
<td>Grey Red Bk Bk</td>
</tr>
<tr>
<td>R10</td>
<td>270 ohms</td>
<td>Red Vio Bn</td>
<td>Red Vio Bk Bk</td>
</tr>
<tr>
<td>R11</td>
<td>4.7k</td>
<td>Yel Vio Red</td>
<td>Yel Vio Bk Bn</td>
</tr>
<tr>
<td>R12</td>
<td>150k</td>
<td>Bk Grn Yel</td>
<td>Bk Grn Bk Yel</td>
</tr>
<tr>
<td>R13</td>
<td>1k</td>
<td>Bk Bk Red</td>
<td>Bk Bk Bk Yel</td>
</tr>
<tr>
<td>R15</td>
<td>68k</td>
<td>Blu Gry Org</td>
<td>Blu Gry Bk Bk</td>
</tr>
<tr>
<td>R16,17</td>
<td>68 ohms</td>
<td>Blu Gry Bk</td>
<td>Blu Gry Bk Bk</td>
</tr>
<tr>
<td>VR1</td>
<td>1k</td>
<td>5mm horiz trimpot</td>
<td>-</td>
</tr>
<tr>
<td>VR2</td>
<td>5k</td>
<td>5mm horiz trimpot</td>
<td>-</td>
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Capacitors

<table>
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<tr>
<th>Value</th>
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<th>Four band</th>
</tr>
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<tbody>
<tr>
<td>C1</td>
<td>470uF 16VW RB electro</td>
<td>- Bk -</td>
</tr>
<tr>
<td>C2,4</td>
<td>0.1uF 50VW ceramic (100n, 0.1, 104)</td>
<td>- Blk -</td>
</tr>
<tr>
<td>C3</td>
<td>470uF 10VW RB electro</td>
<td>- Bk -</td>
</tr>
<tr>
<td>C5</td>
<td>100uF 16VW RB electro</td>
<td>- Bk -</td>
</tr>
<tr>
<td>C6</td>
<td>4.7nF 100VW greencap (.0047)</td>
<td>- Bk -</td>
</tr>
<tr>
<td>C7</td>
<td>2.2uF 100VW RB electro</td>
<td>- Bk -</td>
</tr>
<tr>
<td>C8</td>
<td>10uF 16VW RB electro</td>
<td>- Bk -</td>
</tr>
</tbody>
</table>

Semiconductors

<table>
<thead>
<tr>
<th>Value</th>
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<th>Four band</th>
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</thead>
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<tr>
<td>Q1</td>
<td>BC549 NPN silicon</td>
<td>- Bk -</td>
</tr>
<tr>
<td>I1</td>
<td>LM358 dual op-amp</td>
<td>- Bk -</td>
</tr>
<tr>
<td>D1</td>
<td>1N4007 1A/1KV silicon diode</td>
<td>- Bk -</td>
</tr>
<tr>
<td>D2</td>
<td>1N4148/1N814 silicon signal diode</td>
<td>- Bk -</td>
</tr>
<tr>
<td>Z1</td>
<td>1N4746 16V 1W zener diode</td>
<td>- Bk -</td>
</tr>
<tr>
<td>Z2</td>
<td>1N750 4.7V 400mW zener diode</td>
<td>- Bk -</td>
</tr>
<tr>
<td>LED1-7</td>
<td>LT4208/CQY89A IR LED</td>
<td>- Bk -</td>
</tr>
</tbody>
</table>

Testing & adjustments

If you have a multimeter available, carry out the following tests before putting the camera to use.

With 12V connected to the DC input, put the lens cap on and with VR1 and VR2 both set halfway, check the DC voltages shown in Table 2, with respect to the negative DC input terminal.

If all the measurements are within about 10% of the values shown, then your camera is probably working correctly and you can go ahead and test the camera on a TV or VCR. If one or more of the voltages are incorrect then disconnect the power immediately and make a thorough inspection of components and soldering.

The only adjustments necessary before using the camera are to set trim pots VR1 and VR2 correctly, for optimum video and audio performance. This is quite straightforward, involving in each case simply advancing the pots clockwise as far as you can before any degradation becomes obvious. If you advance VR1 too far, the picture on your TV or monitor will begin to ‘bloom’ on the brightest parts of the image, so when this happens back off a little until the image is fully clear again.

Similarly if you advance VR2 too far, the sound will become ‘edgy’ and distorted due to overload. So when this happens, back off the control a little until the distortion just disappears.

With these adjustments completed, your camera is finished and ready for use.
CMOS Circuits: The 4016/66 analog switch

This month, we look at one of the more unusual CMOS ICs. It’s the 4016 analog switch, one of the few CMOS ICs that is adept at both digital and analog signals, and its brother the 4066. They’re very handy chips indeed.

Two of the more unusual CMOS ICs have to be the 4016 and 4066 quad analog switch ICs. These ICs can handle both analog and digital signals and could really be called ‘transmission gates’. They’re designed so that when the control input is pulled high, the gate allows any signal through — i.e., closing the switch; and when the control input is pulled low, the gate is an open circuit, allowing no signal to pass.

Pretty simple, huh? In practice, they’re easy to use so long as you follow a few small guidelines.

Why two of them?

The first question you’re probably asking is why produce two ICs that do the same thing, pin for pin? Good question. The main reason has to do with how the ICs have been designed to operate when the switch closes.

The original 4016 transmission gate, even when closed had a closed-resistance of around 300 ohms, although this varies with supply voltage. 300 ohms may not sound like much, but when you need a low impedance, there are times when it just isn’t low enough.

The 4066 improved this somewhat by reducing the closed-resistance to around 75 ohms. Still not perfect, but not bad anyway. We’ll look at some circuits over the next couple of months where this closed-resistance is vitally important.

As with all CMOS ICs, you must make sure that the supply voltage doesn’t exceed 15V. Same goes for any of the input pins.

While it’s not necessary for digital signals, if you want audio or analog signals to pass through the switch without distortion, you must bias the input and output to half the supply rail. In this case, you can think of it as being needed for just about any analog circuitry. Other than that, you’re free to use the IC in almost any way you wish.

In our circuit examples, we’ll stick to using the 4066 since it really is the better chip of the two. If you have a couple of 4016 ICs in your junkbox, they’ll slot straight in — but they may not quite work as well because of their higher resistance.

Some circuits...

Hopefully from the circuits we’ll look at, you’ll be able to see the versatility of this particular chip in both analog and digital situations. Before we get going though, to save things getting a little complicated, I’ve left off the power supply pins in a number of these circuits just to make it easier to see. Just remember that pins 14 and 7 must be connected to the supply rail and ground respectively, for the IC to work.

Starting off with a few simple digital circuits, Fig.1 shows how to use the 4066 as an AND gate. Because the gate has a control input, if we use the control input at pin 13 as one of the AND inputs and either of the switch feed inputs at pins 1 or 2 as the other AND input, you should be able to see that the remaining switch feed input will be the AND output. This works because it doesn’t matter what’s going on at either of the two inputs; they both have to be high for the output to be high — the basic rule for an AND gate.

The beauty here is that so long as you use pin 13 as one input, the other input can be either pin 1 or 2. The output will simply be the other pin. This can be particularly handy when you’re laying out a PCB. You also get just as many elements in a 4066 as you do in a 4081 AND gate.

Simple inverter

The circuit in Fig.2 shows the 4066 used as an inverter. If you haven’t already seen it, there are plenty of similarities between an NPN transistor and a CMOS analog switch, particularly when it comes to digital circuitry, and this circuit is a case in point.

On the left, we have the analog switch and on the right, the transistor. There’s little difference except that the transistor’s base input has a very low resistance without the current limiting resistor whereas the CMOS gate has something like 1 x 10^7 ohms input impedance — and that’s without a resistor. The down side is that the transistor only needs 0.7V to switch on, while the CMOS gate requires at least 2/3rds of the supply rail.
A NAND gate

Because of the extremely high input impedance, the CMOS gate makes for much better 'glue logic'. In previous columns, we've looked at how you can use transistors, resistors and diodes to make logic elements if you're in a tight spot. The problem that you'll run up against is that transistors and diodes don't have very high impedances, which produces loading problems on previous and subsequent circuit elements. So much so that the whole thing can come crashing down if you join too many of these home-brew gates together...

CMOS gates don't have that problem, so it is much easier to create our glue logic using these elements instead.

The circuit in Fig.3 shows a NAND gate made by combining the circuits from Figs.1 and 2. Again, the inverter input will not load down the output of the AND gate because of the former's high input impedance. It also results in full supply-voltage-swing signals at each stage, which makes for more reliable circuits.

The only problem is that it takes two of these gates to make a NAND gate, giving you a maximum of two per IC package. They're not the most efficient way of making logic elements, but it is much better to use these if you have a couple spare in your design, rather than add in another IC package. And they are much better than using diode-transistor 'throw-together' logic.

Schmitt trigger

A little trickier is the Schmitt trigger in Fig.4. This only relies on one gate and a few resistors to produce the same result as the more common 74C14 IC version. Looking at the circuit, pin 1 is tied to a fixed voltage which can, but need not necessarily be the supply rail; the other side of the gate at pin 2 is the output. The real action happens around the control input side.

The input is coupled to the control input at pin 13 via a 4.7kΩ resistor, however this is part of a voltage divider which also connects to the control input at pin 12. In this case, the output only goes high once the input voltage rises beyond the following level:

L-to-H: input threshold voltage = Vb x (1 + (R1/R2)) conversely, the output drops low on the following level:

H-to-L: input threshold voltage = Vb x (1 - (R1/R2)) where Vb is the fixed voltage and R1 and R2 are the resistance values in ohms.

When the switch closes, the output is coupled back to the control input via the 47kΩ resistor, which mixes a portion of the fixed voltage in to push it further beyond the threshold voltage. It's not until the input drops some way below this original threshold that the output and the gate will switch low.

As you can see, this is one of the few situations where the input voltage can, and must, be higher than the supply voltage in order for this thing to work.

I really think that this circuit is in many ways much better than the Schmitt triggers you get inside a 74C14. Those gates have threshold voltages which change from chip to chip, whereas in this design they rely on the external components, which you can determine yourself.

Since every one of the parameters in these equations can be controlled externally, even down to the output voltage, the input threshold voltages which change from chip to chip, whereas in this design they rely on the external components, which you can determine yourself.
Also connected to the control input of IC1a is that of IC1b. Now it may look rather strange, but its control input is connected to its own output as well as IC1a’s control input. What you also need to remember is the 22Ω resistor to the supply rail from pin 3 and the 100kΩ resistor to ground.

Here’s how it works.

When the ON button is pressed, the control input of IC1b is pulled high via the 22Ω resistor and the ON switch S1. This allows the gate IC1b to switch on, which now also connects its own control input to the supply rail via the gate and the 22kΩ resistor connected to pin 3.

IC1b is now latched into the ON position, and the same output at pin 4 which keeps it closed also closes IC1a via its control input at pin 13. So audio now passes continuously through IC1a.

When the OFF switch is pressed, it simply grounds the control input of IC1b, which turns IC1b off, and also IC1a. The audio cannot begin to pass through until the ON button is pressed and the circuit is latched on again.

The 100kΩ resistor connected to both control inputs ensures that the circuit isn’t operated from stray hum or glitches when the OFF button has been pressed.

So here’s a case where we have the same predominantly-digital circuit element type performing digital and analog functions, in the one circuit.

**Digital mixer**

Now that we have the ability to switch an audio signal on and off digitally, there are many new areas we can open up. One of those is digital audio mixing.

The circuit in Fig.6 is a case in point. This circuit uses analog gates to mix two audio signals together in a rather unusual way. The conventional method would simply be to use two resistors to mix the signal together. In this circuit, we use a method known as ‘time-splicing’ to mix the signals together.

The way time splicing works is that one input is switched on for half the time and the other input for the other half of the time. Sounds simple in theory, but it’s a little more complicated in practice. Obviously we could simulate this by hand using a mechanical switch, which in one position would allow one signal to pass and another signal in the other position. The problem is that we only hear one at a time. It also means that we miss what’s happening on the other input when the current input is selected.

This circuit overcomes this by speeding up this switching action to the point where it is much faster than we could hear. In fact, the frequency is about 100kHz.

**Digital theory**

Digital theory says that we can reproduce all the necessary elements of a signal if we sample it at least twice as fast as the highest frequency in that sample. If we say our audio signal tops out at 20kHz, then we’d need to sample at least 40kHz. This 40kHz though is also present in the output, so it must be filtered out otherwise it would muck the audio up. But we have to do it in such a way that we don’t lose any of our wanted audio bandwidth.

By the way, this is what happens in your CD player. It can handle the 20Hz-20kHz signal from your audio CDs because it samples at 44.1kHz. The benefit your CD player has is that it uses complicated digital filters to remove the sampling frequency.

By sampling at 100kHz, we are ‘oversampling’ which makes it easier to remove the clock signal and means we don’t have to use complicated filtering.

If CDs were recorded at 88.2kHz instead of 44.1, the filtering needed would be much simplified, however you’d only get a maximum running time of 37 minutes, not the 74 we now have because of the extra samples.

Getting back to the circuit in Fig.6, two 4066 gates (IC1a and b) form an oscillator with two complimentary outputs. These are connected to two further gates, IC1c and IC1d. Depending on the phase of the clock, one input will be open and the other closed.

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(Continued on page 113)
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by ROB EVANS

As with many small projects of this nature, the voltage adaptor presented here was developed in response to a range of requests from readers, all of which had a common underlying theme. In this case there appeared to be a clear need for a small, low-cost and flexible DC power circuit that could be easily adapted to a wide range of tasks. And as there really didn’t appear to be anything currently available to satisfy that need, we set about developing a suitable circuit.

The resulting DC supply module uses just a handful of low-cost components, is very easy to put together, and offers enough flexibility to make it suitable for a wide range of jobs. As you can no doubt tell from its schematic diagram, the circuit itself doesn’t break any new ground and has been designed in a fairly basic but functional way around a common LM317 adjustable three-terminal regulator.

For those who may not be familiar with the LM317, all we really need to point out for this application is that it’s quite a hardy beast featuring both temperature and current overload shutdown, and is designed for circuits where an adjustable output voltage is needed. In our voltage adaptor, the regulator’s output voltage is set by fitting a jumper link to one of six positions on a PC-mount header strip, and its output current capability (up to around 1.5 amps) is largely determined by the size of the IC’s heatsink.

To illustrate a couple of quite different ways that the voltage adaptor can be used in practice, we have built up two prototype units to present in this article. As you can see from the associated photographs, one unit has been constructed in a very compact form with the (unheatsinked) LM317 lying flat on the PCB and flying leads used for the DC input and output connections.

This arrangement works well as a low-powered DC converter for in-car applications for example, where you need a reliable low-voltage source for a portable CD player or similar battery-powered device. It would need to be installed in a suitable case of course (there is room to spare when it’s housed inside the smallest zippy/jiffy box), and the flying input/output leads will need to be terminated in suitable
connectors, such as those shown on our prototype.

Our other voltage adaptor has been built up as an internal power adaptor for PCs, where the circuit board assembly is mounted onto an I/O slot backing plate via a small heatsink/bracket arrangement. As you can see from the shots of that unit, here the regulator chip has been fitted vertically to allow for the bracket, and the adaptor’s DC output is passed directly to a panel-mount 2.1mm socket.

Once installed in a PC, this adaptor’s DC input is derived from the computer’s own power supply via suitable ‘disk drive cable’ connectors (as shown in the shots of our unit), and can therefore supply power to an external device whenever the PC is on. This is an ideal power source for a range of PC peripherals such as powered speakers, modems, music keyboards, Zip drives, and so on — all in all, quite a handy gadget.

Quite apart from our two prototype arrangements, of course, the voltage adaptor can be used in a host of other applications where a compact DC power source is needed. Since the basic unit is both inexpensive and easy to build, there would be a strong case for having a couple of assembled adaptors on hand for when the need arises...

Circuit description

As you can see from the voltage adaptor’s schematic diagram, the circuit is quite a conventional arrangement based on the LM317 three-terminal regulator IC. The output voltage level is set by simply shorting one of the jumper links at IC1’s adjust pin, which in turn connects an appropriate resistance value (R2 to R7) to the negative line.

The LM317 itself is essentially a 1.25V regulator which passes a very small and consistent current (typically 50uA) through its reference (ADJ) pin, and returns virtually all of its internal biasing current into the load via its output pin. Thanks to these design attributes, the LM317 is ideally suited to variable supply applications where the reference pin voltage is simply ‘jacked up’ by a suitable resistor network.

In our circuit, this is done by the voltage divider formed by R1 and the resistor selected by the voltage setting jumper link. As you can see, the ‘3V’ setting connects R2, the ‘5V’ link places R3 in circuit, and so on.

Since the LM317 develops a fixed 1.25V reference between its output and adjust pins, there will be a constant current of 3.2mA flowing through R1 (1.25/390) and 3.2mA plus 50uA (from IC1’s ADJ leg) returning to ground via the chosen voltage-setting resistor. If this is say 2.4k (9V selected), there will then be a voltage drop of 7.8V across R5 (3.25mA x 2.4k) and a resulting output voltage of 9.05V (7.8V + 1.25V).

The other settings work in the same manner as you would expect, and can be calculated using the expression:

\[ V_{out} = 1.25 \times (1 + \frac{R_{set}}{390}) + \frac{R_{set} \times 50uA}{390} \]

where Rset is the selected voltage setup resistor (R2 to R7).

Other than that, there is little else to the circuit. The remaining parts include C1, which provides a degree of filtering to the raw DC input voltage, plus output bypass capacitors C2 and C3. Note that the voltage rating of C1 will really depend upon the expected input voltage in your application, but unless you plan to apply an unusually high source voltage (the LM317 itself is rated at 40V) a 25VW electrolytic should suffice. As it happens, we used a 16VW type for our PC voltage adaptor version, since the input level is known to be 12V.

Construction

The voltage adaptor is really quite straightforward to construct and as you can see in the component overlay diagram, uses a very small circuit board (PCB) which holds all of the components, including the LM317. The PCB itself measures 19 x 52mm, is coded 97va8, and uses a small section of standard header strip as the voltage selector jumper block — shown as J1 on the diagram.

Before starting construction you will need to decide on the best physical arrangement for your needs, as this will determine how LM317 is mounted. The two basic arrangements are illustrated in our prototype units, where IC1 is installed vertically and bolted to a small...
Versatile Voltage Adaptor

bracket on the PC power adaptor version, or fitted flush (that is, horizontally) on the board for the lower-powered car adaptor style.

Note that if you want IC1 mounted vertically and hard down on the board (as in our unit), you may need to enlarge its PCB mounting holes to allow for the pin skirting that seems to be on most versions of the LM317.

Start construction by installing all of the lower-profile components on the circuit board and work your way through to the larger parts, in the usual way. As we have specified close tolerance (E24 series) resistors for this project, we’d recommend that you use a multimeter to check the value of each resistor as it’s fitted, since the markings on this type are often difficult to read. Other than that, refer to the component overlay diagram for the positioning of all components, and take particular care with the orientation of electrolytics C1 and C2.

For the PC voltage adaptor version we fashioned a small heatsink/mounting bracket from a scrap of aluminium plate, and bolted this between the LM317 flange and the PC I/O slot backing plate as shown. Note that the 317’s metal flange is directly connected to its output pin and therefore needs to be electrically insulated from the mounting bracket, which will ultimately be connected to ground via the PC chassis. Use a TO-220 insulating washer and mounting bush to achieve the necessary isolation between the IC and mounting bracket, and if you suspect that a reasonable degree of cooling will be needed, add a smear of heatsink compound on either side of the washer. For a simpler approach you can use one of the new silicon-impregnated rubber insulating washers (as in our prototype), but bear in mind that these tend to offer a poorer thermal conductivity than the mica equivalent.

That’s about all there is to the basic construction process. As you can see from our PC adaptor version we’ve used a PC disk drive power connector lead to pass +12V to the unit (the +5V lead was trimmed and insulated), and a panel-mount 2.1mm socket for the output connection. Note that as the latter socket is not an insulated type, it must be wired with the positive output lead connected to the centre pin.

The car voltage adaptor version uses a conventional cigarette lighter plug as the input connector, as you can see, and an in-line 2.1mm DC plug has been used to terminate the output lead. You can fit whatever connector will suit your appliance of course, but as with all of the other plugs and sockets you will need to pay particular attention to the polarity of the connections. You may even like to fit a protection diode in series with the power input lead, if there is a risk of a reversed polarity connection.

As a last point to bear in mind, note that due to the internal design of the LM317 it will drive its output voltage to a high level if the path between the adjust pin and ground is broken. This in turn means that if the voltage selection jumper is not connected at all for some reason, a potentially damaging voltage level may appear at the voltage adaptor’s output.

As this occurs for a short time when the jumper is being moved to a different voltage selecting link, we strongly recommend that the load should not be connected to the unit during this process. ✦

PARTS LIST

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Above: The PCB artwork, shown here at its actual size.

Below: Use this component overlay diagram when constructing the adaptor. Note that IC1 is shown in its horizontal position, and will need to be mounted vertically if the bracket-heatsink arrangement is used.
From 1922...

75 YEARS OF SERVICE TO AUSTRALIA'S ELECTRONICS INDUSTRY...

...to 1997
ELECTRONICS AUSTRALIA CELEBRATES 75 YEARS OF SERVICE

ELECTRONICS AUSTRALIA CELEBRATES 75 YEARS!

As many of our long-time readers will know, EA is one of the oldest electronics magazines in the world. In fact this very month, we’re celebrating our 75th anniversary. As an introduction to the special features you’ll find on the following pages, here’s the story behind the magazine’s humble beginnings back in August 1922 — and just some of the many congratulatory messages that we’ve received.

In mid 1922, a small group of Sydney’s pioneering ‘wireless’ enthusiasts met to discuss the possibility of starting up a magazine to cater for the needs and interests of like-minded people. Those mainly involved were Mr R.C. Marsden 2JM, one of Sydney’s leading radio pioneers and keen amateurs, Miss F.Y. Wallace — Australia’s first woman electrical engineer (later Mrs C.R. Mackenzie) — and Mr A. Mitchell, a journalist on the Evening News newspaper. Mr Mitchell had also brought along printer and publisher William J. Maclardy. They met in Miss Wallace’s wireless shop in the old Royal Arcade.

Everyone was very positive, so they decided to proceed. As Miss Wallace explained 10 years later, they would attempt to supply what they felt to be a real need — a source of reliable technical information for amateurs, an official organ with which to claim recognition from the authorities (this was in the sealed-set era, of course), and also ‘a medium for interesting the public in this new and wonderful science’.

As the plans progressed they met each week in the dark and dusty basement of Mr Maclardy’s premises in Castlereagh Street, bringing their various contributions for the first issue. Miss Wallace explained later that Mr Marsden was the ‘technical man’, as they all regarded his valve circuits and other designs as being of a very high standard. Mr Mitchell became the sub-editor, while Mr Maclardy was the publisher/printer and editor.

Their first humble 12-page issue of Wireless Weekly went on sale at Miss Wallace’s shop at 8am on the morning of August 4th. They had only printed a few hundred copies, but these went very quickly. The following week they printed more to meet the demand, and within a few weeks the print run had risen to over 1000.

Clearly Wireless Weekly met a need, because it continued to flourish and grow. Within a couple of years Arthur W. Watt took over as editor, and steered the magazine through the next few anxious years as wireless publications came and went.

Before long the magazine had grown to the point where publisher William Maclardy didn’t have the capital to expand further, and had to sell it to Publicity Press of Regent Street. However he seems to have remained with it as publisher until the late 1920s, when Arthur William Watt also departed. Mr Maclardy, who had helped found Sydney’s first broadcasting station 2SB (later renamed 2BL) went on to become managing director of Broadcasters (A’ sia) Ltd, which was involved with production of sound movies.

In 1929, prominent former Melbourne radio amateur Ross A. Hull joined as Technical Editor, after a few months in the USA working with the ARRL. He stayed until 1932, when he returned to the USA to edit various ARRL publications — including the famous Amateur Handbooks.

In 1932 young John Moyle joined the staff. Along with then editor ‘Braith Hull (brother of Ross), John’s designs and articles helped make Wireless Weekly continue to grow during the 1930s. The two became joint editors when the technical side of the magazine was revamped into the monthly Radio & Hobbies in April 1939.

By December 1941 Braith Hull had left the magazine, John Moyle took leave of absence for the rest of the war as a radar instructor in the RAAF, and Neville Williams took over as acting editor and technical editor. After the war the two guided the magazine through the heady 1950s, when television arrived and hi-fi blossomed.

In April 1965 the name of the magazine was changed to the present Electronics Australia, to reflect the way radio and TV had developed into a complex and much wider industry.

And after a further 32 years, we’re still here. Back in 1932, original founder Miss Wallace wrote that for her, Wireless Weekly would always be a symbol of progress. Sadly she’s no longer with us, but we’d like to think we’re continuing this tradition — and that perhaps she might be proud of how long the little magazine she helped start has lasted.

MESSAGES OF CONGRATULATION

On hearing that we would be celebrating 75 years of publication this month, some of our many friends sent us the following messages of congratulation:

Mr Howie Vogel Region Business Manager, T&M Hewlett-Packard Australia

Hewlett-Packard Australia Limited would like to congratulate Electronics Australia on its 75th anniversary. Our association with EA has extended over the past decade, during which time we have seen the publication go from strength to strength whilst continuing to maintain its high leadership profile within the industry.

During this time Jim Rowe, the Managing Editor, has also done a number of product reviews on innovative new instruments from HP. These have been so highly regarded that Hewlett-Packard Company in the US has reproduced these as product notes — testament to the quality and high standard of articles and reviews that form the backbone of Electronics Australia. We look forward to the continuing relationship and wish EA all the best for the next 75 years.

Ms Wallace: one of our founders.

Wireless Weekly
Mr Jeff Grover Managing Director, Dick Smith Electronics

Since it began in 1922, *Electronics Australia* has encouraged generations of young Australians to explore electronics and technology. In the early days of Australian broadcasting, *Wireless Weekly* as it was then known, brought affordable radio designs to Australian families. The relationship between EA and Dick Smith Electronics goes back almost 30 years, when electronics enthusiasts would trek to Dick Smith’s only store in St Leonards, Sydney to purchase components for EA projects.

Without the continued support of *Electronics Australia*, Dick Smith Electronics would certainly not be the successful retail company it is today. On behalf of the team here at Dick Smith Electronics, I extend hearty congratulations and thanks to EA on its 75th anniversary, and look forward to continuing this special partnership in the years to come.

Mr Neville Thieie Consulting engineer, Fellow IREE (Aust), Fellow IE (Aust), Fellow AES

To have reached the age of 75 is to be quite a success, if only in the art of mere survival. To have been through-out those 75 years a teacher, inspirer and guide to the amateurs of the electronics industry, that is something to be really proud of. Professionals often profess some disdain for amateurs, but it is from their ranks, of youngsters passionate about the discipline, that it is from their ranks, of youngsters that the profession has been well served.

And the journal has maintained that interest over the many years since then, presenting valve devices under the editorship of John Moyle, transistor devices under Neville Williams and microprocessors and computers under Jim Rowe — simply and clearly to beginner and experienced electronicist alike.

Long may you flourish for another 75 years, *Electronics Australia*.

Ms Heather Harriman Executive Director, IREE (Aust)

Congratulations, *Electronics Australia*. The Institution of Radio and Electronics Engineers Australia (IREE) is proud of its friendly association with the magazine, through the days of ‘wireless’, ‘radio’, ‘electronics’, ‘computer communications’ and the more recently coined term ‘information technology’ era.

Our association has been through our members, Presidents and others being involved as employees, authors and readers. From *Wireless Weekly* in the 30s all the way through to the *Electronics Australia* of today, members have quoted and consulted copies of your publication both through our library and through private subscription.

My own involvement in electronics over the past 20 years, while I have been Executive Director of IREE Australia and earlier as a staff member of an international electronics organisation, has been with the knowledge that the profession has been well served by *Electronics Australia*.

Prof. Barry Thornton Professor of Applied Maths and Computing, The University of Technology, Sydney

Any technical publication which has served the community and kept up with developments for 75 years deserves both congratulations and thanks from its readers. I believe that any enthusiast, hobbyist or electronics professional in Australia would have read at least some of the issues of *Electronics Australia* or its predecessors over the years.

My interest was certainly stimulated each month when I managed to get *Radio and Hobbies* at the newsagent, and I learned about the principles of radio and electronics in the early days of my career which helped steer me on to the exciting developments in radar, stealth, computers and remote sensing projects in which I later became involved.

In these more recent years the proliferation of technical electronics magazines has meant that for survival, a really alert and experienced editorial team is essential. We are indeed fortunate to have this with Jim Rowe and his capable staff.

I look forward to many more years of exciting coverage and new ideas from *Electronics Australia*.

Mr Justus Veeneklas Chairman and CEO, Philips Electronics

Congratulations on reaching your 75th year of publication!

It looks as though Philips will never catch up with your years of quality service to the Australian electronics industry. We only arrived here in December 1926, when *Wireless Weekly* was already four years old, but we became an advertiser to your readers soon after.

Although you have needed two name changes, we have enjoyed keeping our original name. But we both share the excitement of innovation and the challenge to ‘Let’s make things better’.

Overleaf you’ll find the first of our special features looking back over the last 75 years...
FROM CRYSTAL SETS TO CAMCORDERs, CD'S & PC'S

The technology we now call 'electronics' has changed and expanded enormously in the last 75 years. In mid 1922, it was little more than a specialised technical activity — 'wireless' — involving a small number of engineers and experimenters. Nowadays it has grown to a vast global industry, whose products and technologies have permeated into virtually every aspect of human culture. How did it happen? The transition has taken place in an evolutionary manner, with contributions by a huge number of people — and of course some noteworthy milestones.

by JIM ROWE

It's hard to conceive just how dramatically the technology of electronics has changed in the last 75 years, since that first tentative issue of Wireless Weekly was published back in August 1922. In many ways the changes have been so great that it's very hard to understand how we arrived here, starting from there — especially since so many of the steps have been incremental, and often barely noticed even at the time.

The fact is that electronics has developed largely by way of evolution, rather than revolution. But these small incremental changes have taken place for so long, and at such an ever-accelerating rate, that comparing the situation in 1997 with that of 1922 is like try to see how homo sapiens might have developed from organisms like an amoeba.

All the same, it's an exercise that is worth the effort, if we want to try putting the achievements that have been made during the last 75 years into some kind of perspective. So let's make an attempt...

The setting

First of all, we'll try to set the scene. In August 1922, electronics consisted almost exclusively of radio equipment — or as it was then known, 'wireless'. Germany's Heinrich Hertz had demonstrated the existence of electromagnetic waves in 1887, and in 1896 Italy's Guglielmo Marconi had sent messages over a distance of 2.5km. By 1901 Marconi had transmitted messages across the Atlantic, and in 1906 Professor Reginald Fessenden of Harvard University had demonstrated broadcasting of music and speech — radio telephony.

By 1922, thermionic valves (or in America, 'tubes') were by that time well established. Edison had demonstrated in 1880 that a current could flow in a vacuum, as a result of electrons emitted by a hot filament finding their way to a nearby electrode. The idea was developed further by J.A. Fleming, who patented the diode valve in 1904, and then American Lee de Forest added a control 'grid' electrode and patented the resulting 'Audion' triode valve in 1906. This provided the first electronic device capable of reliable amplification and continuous oscillation. From that time until 1922, valve technology had undergone a period of steady improvement.

In 1912, Edwin Armstrong had come up with the concept of regeneration or positive feedback, which could be used to achieve dramatic improvements in the performance of early valve receivers. Then in 1918 he also invented and demonstrated the superheterodyne principle, which allowed much more powerful receivers again. He was granted the patent for this key technology in 1920.

In Australia, Father Archibald Shaw had set up the country's first 'wireless factory' in 1911, in the Sydney suburb of Randwick. Two years later, Ernest Fisk and others set up Amalgamated Wireless Australasia (AWA), which was to play a leading role in developing the country's industry. In 1918 Fisk and his team received the first direct wireless messages (Morse code) from Britain, in the Sydney suburb of Wahroonga, and in 1919 they gave a demonstration of music and speech broadcasting across Sydney, to the Royal Society.

In the early 1920's, amateur experimenters like the well-known Charles Maclurcan were transmitting regular unofficial broadcasts of recorded and live music, plus a little friendly patter. Their impromptu broadcasts were eagerly received by the expanding new breed of 'wireless' enthusiasts, building up their first simple crystal sets and one-valve receivers.

So by August 1922, the stage was set. Radio, which until then had been a novel and highly technical means of communicating between ships and land, and for communication between countries, was about to become a medium for...
mass entertainment and information. It was also about to become the ‘engine’ which would drive the fledgling radio manufacturing industry around the world — later to develop into today’s electronics industry.

The big adventure was just beginning, and it was an opportune time for the launch of a new magazine. But of course when William Maclardy and his friends decided to launch the first issue of Wireless Weekly, they couldn’t have realised how long that adventure was going to last...

The later 1920’s

In the following year, 1923, the first radio broadcasting stations begin operating in Australia: 2FC and 2SB (later renamed 2BL). The following year 3AR and 3LO officially open in Melbourne, and 6WF in Perth. Australia enters the radio broadcasting era, and enterprising business people begin opening not only new stations, but also building and offering for sale a plethora of receivers. A manufacturing industry begins to develop.

In the USA, 1923 also sees Lee de Forest demonstrate crude sound-on-film movies in New York, using a system based on a gas-discharge lamp developed by Theodore Case. Within a few years this and similar work would lead to a worldwide revolution in the well-established cinema industry, as ‘talkies’ replace silent films.

Also in the USA an unknown Russian emigre scientist named Vladimir Zworykin, working at Westinghouse, develops and patents an image sensor tube he calls the iconoscope. The following year (1924) he also invented the kinescope picture tube, building on the basic cathode-ray tube that had been invented by German scientist Karl Ferdinand Braun in 1897. Neither invention was given much recognition at the time, but later Zworykin would be recognised as the ‘father of modern television’.

Another relatively obscure event occurred in 1924 when Thomas J. Watson, then general manager of the Computing-Tabulating-Recording Company, changes its name to International Business, Machines — ‘IBM’. At the time its various branches made relatively low-tech machines like weighing scales, industrial time clocks and punched-card sorters, but decades later it would become the giant of the mainframe computer industry.

In 1926, Harold Wheeler of Hazeltine Labs in the USA discovers the principle of automatic gain control (AGC), which would make all future radio receivers more ‘user friendly’. In England, Scotsman John Logie Baird demonstrates crude mechanical television, while in Japan, Kenjiro Takayanagi demonstrates TV using a rotating-disk camera and a Braun-type cathode ray tube — using for the first time a system of synchronising pulses to lock the two.

The following year, 1927, Harold S. Black of Bell Laboratories in the USA discovers the principle of negative feedback and its ability to reduce the noise and distortion generated in amplifiers. Scarcely noticed at the time, this would prove to be an incredibly important discovery.

In Australia, AWA’s Beam Wireless System begins operating in April, providing reliable two-way telegraph contact between Australia and Britain via short waves (about 12MHz). Also the Rev. John Flynn’s Australian Inland Mission sets up the Flying Doctor Service, using pedal-powered radio transceivers developed by Alfred Traeger.

The year 1928 sees German pioneer Fritz Pfeumer demonstrating a crude but practical sound recorder, using magnetic tape. Developed from the Telegraphophone patented in 1899 by Danish engineer Valdemar Poulsen, it would become the seed from which the tape recording industry would later grow.

In the USA, J.W. Horton and W.A. Marrson develop the first clock whose accuracy was derived from aquartz crystal oscillator. Australia’s AWA-built Beam Wireless System expands, providing a second link to Canada.

As the initial pioneering era of ‘wireless’ draws to a close in 1929, engineers G. Holst and Benjamin Telegen of Phillips in Holland develop the pentode valve. This offers higher gain and more stable operation than either the triode or tetrode, and allows many more applications to be developed. Well-known Australian radio amateur Ross Hull returns from a trip to the USA, and joins Wireless Weekly as its Technical Editor.

The 1930’s

As a result of the Great Depression, the 1930’s start relatively quietly. In Australia, AWA buys a former car assembly plant in Ashfield, Sydney to convert into a radio assembly works. It also sets up a regular radiotelephone service between this country and Britain.
The US Federal Bureau of Standards establishes its first national crystal-based time and frequency standard, based on a crystal oscillator. Engineer Julius Lilienfeld invents and patents the idea of an amplifying device using the ‘field effect’ in a conducting crystal — the first field-effect transistor (FET), in fact, although it would be three decades before they’d be built.

The next year, 1931, sees the US Navy’s Aircraft Radio Laboratory in Washington DC set up a project to investigate the ‘detection of enemy vessels and aircraft by radio’. This was based on the work of Hyland, Taylor and Young, who noticed the way ships and aircraft could disrupt communications. Later this work would result in the development of radar.

The same year US firm General Radio Co. offers a basic cathode-ray oscilloscope for laboratory testing. With the CRT housed separately from the power supply and amplifier/timebase, it was crude and expensive but became the ancestor of today’s instruments. AWA’s new Ashfield works is officially opened by Prime Minister John Scullin.

The year 1932 sees German firm Telefunken demonstrating an all-electronic TV system at the Berlin Radio Show. In this country the Australian Broadcasting Commission (ABC) is set up, to take over national radio broadcasting. AWA sets up a full-scale valve manufacturing plant at its newly established works in Ashfield, Sydney, and Fritz Langford-Smith joins as Chief Applications Engineer. His name will later become known around the world as the editor of the famous Radiotron Designers Handbook.

Ross Hull leaves Australia and returns to the USA, joining the ARRL as Associate Editor of its publications. His brother Galbraith Hull takes over as Editor of Wireless Weekly, and young John Moyle joins the staff.

In 1933, a hand-held ‘walkie talkie’ portable transceiver is developed for use by the US Army Signal Corps. In many ways, this will become the distant ancestor of today’s cellular phones. German scientists M. Knoll and Manfred von Ardenne describe the transmission electron microscope.

Two years later, in 1935, the first television broadcasting station begins operation in Berlin, Germany. Oskar Heil of Germany builds on Lilienfeld’s work and invents the junction field-effect transistor (JFET). In the USA Edwin Armstrong announces the development of frequency modulation (FM) broadcasting, offering significantly lower noise and distortion.

In 1936, Telefunken televises the Berlin Olympic Games using iconoscope-based cameras. The British finally decide to use the EMI all-electronic TV system rather than Baird’s semi-mechanical system. In Ludwigshafen, Germany, the London Symphony Orchestra conducted by Sir Thomas Beecham is recorded on BASF magnetic tape.

Austrian inventor Paul Eisler, a refugee working in Britain, invents and patents the printed circuit; but large firms like Plessey fail to appreciate its potential. Later it will become a key technology, but for the next decade it’s ignored.

In Australia, Philips establishes a valve factory in Hendon, South Australia.

The following year, 1937, American engineering brothers Russell and Sigurd Varian demonstrate the first working klystron valve, producing continuous microwave RF output at 2.3GHz.

In 1938, also in America, R.H. Reaves develops pulse-code modulation (PCM) — another important pre-requisite for the future era of digital communications. George A. Philbrick also discovers the concept of the operational amplifier, which will later spawn (briefly) analog computers and become a foundation stone of modern linear electronics. Bell Telephone Labs also demonstrates the use of waveguides to convey microwave energy.

In Germany, the same year, E. Ruska of Siemens & Halske develops the scanning electron microscope (SEM). In Holland, Philips announces the Philips-Miller sound recording system using mechanical ‘engraving’ on a two-level plastic tape/film, with replay via a photoelectric cell. The World Radio Convention is held in Sydney. In Connecticut, former Wireless Weekly Technical Editor Ross Hull is accidentally electrocuted while demonstrating an experimental TV receiver he had built.

Of course the 1930’s had been the ‘golden years of radio’, with radio having become a primary medium for public information and entertainment, and broadcasting stations proliferating not only in Australia but also in most developed countries. By 1938, Australia was being served by 22 ‘national’ stations operated by the ABC, and 93 privately-operated ‘commercial’ stations. Over one million listener’s licences had been issued.

As the thirties draw to a close in 1939, RCA televises the New York World’s Fair. Stanford Uni engineering graduates William Hewlett and David Packard set up Hewlett-Packard and begin manufacturing test instruments in Palo Alto, California, selling their first eight RC audio oscillators to Walt Disney. World War 2 begins.

In Australia, the ABC sets up Radio Australia, its overseas broadcasting arm. In April, the technical content of Wireless Weekly becomes the monthly magazine Radio & Hobbies.

The 1940’s

Not surprisingly consumer electronics largely went into hibernation for the next five years, as most research and
manufacturing effort went into producing war materiel such as improved communications equipment, better radar systems and things like proximity fuses for bombs and shells. Of course much of this work involved developments in basic theory and production technology, which once the War ended were to result in dramatic changes to consumer electronics as well.

In many ways World War 2 acted as a kind of ‘pressure cooker’ for electronics, where the industry underwent a period of rapid forced development — yet the results didn’t appear for a while. All the same there were a few noteworthy developments in the ‘consumer’ area, that weren’t hidden by the cloak of wartime security.

In the USA, 1940 saw the country finally standardise on 525-line TV. Peter Goldmark of Columbia Broadcasting System (CBS) demonstrates colour television using a rotating filter wheel in front of a standard monochrome picture tube. In Hollywood Walt Disney releases Fantasia, the first sound film featuring three-channel stereophonic sound. In France, Marcel Wallace describes ‘panoramic reception’ — the first crude spectrum analyser.

(After the war, it becomes known that in the UK, J.T. Randall and A.H. Boot had also developed the cavity magnetron in 1940. However as it was the only device yet developed which could produce large amounts of microwave RF power for radar, this invention was kept tightly under wraps for the duration.)

The following year, 1941, commercial TV broadcasting begins in the USA, in New York City. Needless to say it was on a very limited basis. In Australia, R&H editor John Moyle takes leave of absence to serve in the Air Force as a radar instructor, and Neville Williams joins as Acting Editor for the duration of the War.

Three years later, in 1944, an engineer at the US National Bureau of Standards (NBS) demonstrates magnetic recording on a thin steel alloy tape. At Harvard University, a team of researchers led by Howard Aiken develops the first programmable digital computer using valves and electromagnetic relays. Fifty-one feet long and eight feet high, it could handle perform additions of 23-decimal-digit numbers in 300 milliseconds, and multiplications in three seconds.

The following year, 1945, the US Air Force drops atomic bombs on Hiroshima and Nagasaki, and the war ends. Huge numbers of people return from military service with training in radio, radar and other technical areas.

Also many of the developments that had been made during the war become available for peacetime use.

In the USA, audio researcher Paul Klipsch describes the use of a ‘crossover network’ to drive low- and high-frequency loudspeakers from the output of a single amplifier, for better sound reproduction.

Soon after, in 1946, London Records announces ‘full frequency range recording’ (ffrr). In the USA, a team of engineers at the University of Pennsylvania’s Moore School of Electrical Engineering led by John Mauchly and J. Presper Eckert produce ENIAC, the first fully-electronic computer.

In Portland, Oregon, engineers Howard Vollum, Jack Murdock and others found Tektronix Inc to manufacture and sell oscilloscopes. Six commercial TV stations begin broadcasting in the US.

Over in Britain, science fiction author and visionary Arthur C. Clarke proposes the use of geostationary satellites for international communications. In Tokyo, Masaru Ibuka and Akio Morita set up Tokyo Tsushin Kogyo (later to become Sony Corporation).

The next year, 1947, sees America’s General Electric announce the development of an electronic oven, using microwave heating. Printed circuit board technology begins to make an appearance. Tektronix releases its first oscilloscope, the 511, taking advantage of wartime radar technology to achieve a bandwidth of 10MHz.

In December, the first working bipolar transistor is developed by Bell Telephone Labs scientists William Shockley, John Bardeen and Walter Brattain.

In 1948, engineers Peter Goldmark, Rene Sneepvangen and William S. Bachman of CBS announce the development of the microgroove long-playing record — allowing 20 minutes of high quality recording per side. John Fluke and Art Anderson, graduates of MIT, form John Fluke Inc to produce instruments and power supplies.

As the forties draw to a close and electronics continues gathering pace, 1949 sees Professor Maurice V. Wilkes and his colleagues at Manchester University in the UK finish EDSAC, the first true stored-program digital computer. Using over 3000 valves, its memories were made up of five-foot long steel tubes filled with mercury, to function as delay lines.

The 1950’s

During 1950 the first commercial manufacturing of printed circuit boards begins. The following year in Russia, V.A. Fabrikant invents the MASER (microwave amplification by stimulated emission of radiation) principle. In the USA computer pioneers Eckert and Mauchly release their UNIVAC-1, the first commercially available stored-program machine.

In 1952, American engineer Andrew Kay develops the first digital voltmeter, and forms Non-Linear Systems Inc to manufacture and market it. Hewlett-Packard introduces its 524A, the first ‘frequency counter’, which could read up to 10MHz with a resolution of...
0.01Hz. The following year Texas Instruments demonstrates an experimental all-transistor radio receiver. 1954 is marked by researchers Charles Townes, J.P. Gordon and H.J. Zeiger announcing the first working ammonia maser, which achieves microwave amplification by stimulating emission of energy by excited molecules. Six engineers at Ampex Corporation in California also build the first video tape recorder, using 2” wide tape and transverse scanning heads.

The following year, 1955, sees Japan’s TTK release the first low cost commercial all-transistor radio, carrying the new ‘Sony’ brand name.

In 1956, as the full significance of their discovery begins to be appreciated, Bell Labs researchers Shockley, Bardeen and Brattain are awarded the Nobel Prize in Physics for their invention of the transistor.


TTK in Japan releases its first ‘pocket’ sized Sony transistor radio, although it’s not quite small enough for most shirt pockets—so the company has special shirts made for its sales people, with slightly larger pockets. In Australia, regular television broadcasting begins and the production of TV receivers moves into top gear.

The next year, 1958, Jan Hoerni of Fairchild Semiconductor develops the planar transistor. Even more significantly, in September engineer Jack S. Kilby of Texas Instruments develops the first working integrated circuit (IC), a simple one transistor phase-shift oscillator. Two of the crucial concepts are now in place for the IC era, the full blossoming of solid state technology.

Since their development in 1958, integrated circuits have evolved at an ever-increasing rate. This is a 100MHz flash A-D converter of 1991, with its top removed.

The same year Townes and Schawlow invent the laser (light amplification by stimulated emission of emission) at Bell Telephone Labs. In France, Polish scientist Stanislaus Teszner develops the Tecnetron, the first commercial germanium FET device, at Compagnie Francais Thompson-Houston. Japan’s TTK finally changes its name to Sony Corporation.

As the 1950’s draw to a close in 1959, RCA develops the Nuvisor — a tiny but very rugged ceramic valve. However it’s doomed almost before it reaches the market, because the industry is now convinced that the future is with solid state devices.

The 1960’s

As the new era begins in 1960, American firm Crystallonics develops the first practical silicon JFETs. Theodore Maiman of Hughes Aircraft Research Labs also produces the first working ruby laser. IBM releases the System/360 range of computers, which make all of its earlier models obsolete. They use hybrid IC modules, rather than the only-just developing monolithic IC chips.

Sony markets the first all-transistor TV receiver. John Moyle, Editor of Radio TV & Hobbies, dies of cancer. Neville Williams appointed Editor; young Jim Rowe joins the staff.

In 1961, the first continuously operating helium-neon gas laser is developed at Bell Laboratories by A. Javan, W.R. Bennett and D.R. Herriott. But seen as having more significance at the time is the release by Fairchild Semiconductor of the first family of commercial monolithic integrated circuits, the 900 series of resistor-transistor logic (RTL) circuits.

The following year, 1962, sees Philips announce the compact cassette audio tape format and recorders. Initially it’s viewed as a medium for dictation, but ‘hi fi’ applications soon develop. The first active communications satellites, Telstar I and Relay I, are placed into orbit over Atlantic to relay TV, radio and telephone traffic between USA and Europe. The first solid state injection laser is developed, using gallium arsenide.

In 1963, Steven Hofstein of RCA develops a MOSFET transistor suitable for ICs. Colour TV sets based on the NTSC system begin selling in the USA.

Two years later in 1965, the Intelsat I communications satellite launched by the International Satellite Telecommuniations Consortium. Digital Equipment Corporation announces its PDP-8 minicomputer (only US$20,000!), which soon becomes popular with scientists and engineers for control of experiments and processes. The minicomputer era has begun.

Robert Widlar of Fairchild leads a team which develops the 709 and 741 op-amps, and other linear chips. In Australia, this magazine is renamed as Electronics Australia.

The following year, 1966, Paul K. Weimer of RCA displays the first solid-state TV camera.

In 1968, three semiconductor engineers from Fairchild—Andrew Grove, Gordon Moore and Robert Noyce—form Intel Corporation. Sony develops and launches the first Trinitron colour TV receiver.

As the sixties close in 1969, NASA’s Apollo 11 mission lands on the moon.

The 1970’s

With the start of the seventies, the first digital calculators begin to appear. IBM introduces its System/370 computers, the first to use monolithic ICs throughout—even for the main memory. In Germany, AEG/Telefunken/Decca demonstrates their Teldec video disc recording system. Willard S. Boyle and George E. Smith of Bell Telephone Labs develop the charge-coupled device...
(CCD), initially for data storage.

In 1971, Intel unveils the first microprocessor chip: the 4004. Dov Frohman-Bentchkowsky of Intel also develops the UV-erasable EPROM. The microprocessor/microcomputer era has begun.

The following year, Philips demonstrates its LP video disc.

Three years later, in 1974, Sony demonstrates its Betamax domestic video cassette recorder (VCR), using 1/2" tape. Intel releases the 8080 microprocessor, which becomes used in many of the early 8-bit personal computers.

In 1975, Sony releases the first Betamax SL-6300 recorder. The next year, 1976, JVC follows with the VHS domestic VCR. The era of home video recording and playback has begun.

In 1977, the first 8-bit ‘appliance’ personal computers begin to appear. Tandy/Radio Shack comes out with its TRS-80, while Steve Jobs and Steve Wozniac produce their Apple II, and use it to establish their firm Apple Computer. In 1978, Intel releases the 8086/8088 16-bit microprocessor and many of the small computer makers begin planning their 16-bit models around it.

As the seventies end in 1979, Sony launches its Walkman — the first personal stereo cassette player, using miniature headphones. The era of ‘personal’ electronics products is now well established.

The 1980’s

In 1980 Sony launches the 3.5” floppy disk, destined to become a world standard for computer data storage.

The following year, 1981, sees IBM come out with its 16-bit Personal Computer (PC). This at last gives the personal computer credibility, as a personal productivity and office appliance.

One year later, in 1982, Philips and Sony release the digital Compact Disc (CD) and players. The era of digital consumer audio products has begun. Intel releases its more powerful 16-bit processor the 80286, soon to be used in the IBM ‘AT’ model PC and its clones.

In 1983, Sony releases the first video camcorder. One year later it follows up by releasing the first ‘Discman’ personal portable CD player, and the following year (1985) the first Video-8 8mm camcorder.

In 1984, Apple Computer releases its Macintosh personal computer, with a mouse-controlled graphical user interface (GUI) based on concepts developed by scientists at Xerox Corp’s Palo Alto Research Center (PARC). The next phase of ‘user friendly’ personal computers was beginning.

The following year, 1985, only three years after releasing the 286, Intel announces its successor the 386. It has 275,000 transistors on the chip. Then in 1989, it makes that chip largely obsolete again by releasing the 486, with a floating-point coprocessor included.

By now, developments in all areas of electronics are occurring at such a rate that it’s almost impossible for anyone to keep track. Digital technology is rapidly eclipsing analog electronics, in almost every area — from microwave oven timers to radio receivers.

The 1990’s

As the current decade begins, NASA launches the Hubble Space Telescope (HST) and places it in orbit. But some of the optics are misadjusted, and initial results are disappointing. IBM scientists develop the heterojunction bipolar transistor (HBT), using a small amount of germanium to effectively double the speed of silicon transistors.

Motorola announces plans for its ‘Iridium’ global satellite telephone system. Sony releases its Video8 domestic video system, using 8mm tape in a very compact cassette, and also releases its tiny TR-55 camcorder.

In 1991, Stanford Research Institute develops a flat cathode ray tube using ‘field emission’ from an array of pointed cathodes just behind the screen. Hewlett-Packard releases the first of a new lower-cost family of digital sampling oscilloscopes (DSOs) — the HP54601A. Philips/Fluke also releases the handheld Scopemeter.

Kodak announces its Photo CD system, signalling that the company realises that digital imaging will gradually encroach on the traditional film-based photo market. Apple begins shipping its Macintosh LC computer, with a 30cm colour monitor.

The following year, 1992, sees Sony releasing the MiniDisc (MD) player and Philips releasing the digital compact cassette (DCC). Neither sets the market on fire, but both demonstrate the effectiveness of compressed digital audio.

Intel develops an 8Mb (megabit) flash memory chip, while IBM and Siemens announce a 64Mb DRAM memory chip. Hewlett-Packard announces a tiny 1.3” hard disk drive storing 20MB.
In 1993, Texas Instruments develops synchronous DRAM (SDRAM) memory chips, with the potential of matching processor speeds beyond 100MHz. Intel announces its Pentium microprocessor, with 3.1 million transistors on the chip. Apple releases its 'Newton' handheld computer, with built-in handwriting recognition. Japan's Icom releases a compact hand-held receiver for the Global Positioning System (GPS).

In Australia, the CSIRO develops its 'A4', a high speed digital audio processor chip based on fast Fourier transform (FFT) processing. In December, a NASA repair mission successfully refurbishes the HST's optical systems, in orbit.

The year 1994 sees Texas Instruments demonstrating the first quantum effect IC operating at room temperature, and employing resonant tunnelling transistors. The company also demonstrates a digital micromirror image display chip, demonstrating the first quantum effect of data storage.

US speech recognition software firm Dragon Systems releases its Dragon Dictate Version 3.0, offering recognition of almost continuous speech. Apple Computer unveils its first Macintosh models using the PowerPC processor, developed in conjunction with IBM and Motorola, and also its Quicktake 100 colour still camera. Hewlett-Packard releases the HP95LX, a 'palmtop' computer offering a good deal of useful software in ROM.

Tektronix announces its Tekmeter, a compact handheld DMM/DSO for industrial electronics. In Japan, Hitachi researchers demonstrate the feasibility of a memory chip employing only a single electron per stored bit, and with the potential of storing up to 16 gigabits of data...

In 1995 Intel announces the Pentium Pro processor chip, with 5.5 million transistors and packaged with a separate Level-2 cache RAM. The first version operates at 133MHz.

Tektronix releases its THS710/720 handheld DSO's, sampling at 500MS/s and providing a bandwidth of 100MHz. Sony develops a large flat-panel LCD colour display using plasma switching. Philips and Sony announce a proposed standard for super-density video CDs — later to become DVD's.

Last year, 1996, researchers at Toshiba in Japan announced a new 'trench capacitor' DRAM memory cell with an area of less than a quarter of a square micron, and hence the potential to allow production of one-gigabit memory chips. In the USA, Sandia National Laboratory researchers built working transistors measuring only 0.1um square, while Texas Instruments also announced process technology allowing up to 125 million transistors to be squeezed onto a single chip. The groundwork was thus laid for a new generation of even denser memories and processor chips.

In California, Intel demonstrated its cable modem technology — able to provide 'downstream' data rates of up to 10Mb/s via a cable TV network. The company also released its new 166MHz Pentium chip.

Eastman Kodak also announced a new compact and low cost digital still camera, the DC20, aimed at PC users.

Finally, we arrive at this year, 1997. So far we've seen Intel release the new Pentium MMX and Pentium II processors, and demonstrate a prototype Pentium MMX chip running at 400MHz. Its largest competitor AMD has also released the K6 'challenger'. Toshiba has announced the fabrication of a CMOS image sensor chip with 1.3-million pixel resolution, while NEC has developed a working prototype of a four-gigabit DRAM chip.

DVD players have finally gone on sale in the USA, and disc manufacturers have begun to market what's expected to become a flood of movies in this format. New digital still cameras are being offered by an increasing number of manufacturers, and each new model seems to offer either higher performance, lower cost or both.

In short, electronics has come a long, long way in the last 75 years. But the pace of developments is increasing all the time — so you can expect them to continue coming, and at a faster rate.

Needless to say, we at Electronics Australia will be doing our best to keep you informed of the developments, and also helping to explain their significance.
Hey, it's Electronics Australia's 75th Anniversary.

That's amazing.
A DREAM THAT LASTED 75 YEARS...

...and is still going strong!

Seventy-five years ago this month, on August 4, 1922, Messrs W.J. Maclardy, of Castlereagh Street, Sydney launched what they claimed to be the first-ever publication to be produced in Australasia, wholly devoted to wireless. This present copy of *Electronics Australia* is a direct descendent of that first modest issue of *Wireless Weekly*.

by NEVILLE WILLIAMS

At the time that *Wireless Weekly* first appeared, regular officially-endorsed public radio broadcasting was something about which would-be listeners were still dreaming and agitating.

An article on page three of the first issue, headed: ‘OUTBACK — As It Should Be’ pictured ‘Dad Wayback’ coming inside for the evening, hanging up his hat, and switching on the wireless in time to catch the weather forecast and daily market reports. A few minutes later the whole family would gather round to enjoy a concert ‘sent out by the Amalgamated Wireless’. They would then go to bed, in the knowledge that they were no longer as isolated as once they had been.

At the time, AWA was in fact broadcasting demonstration ‘wireless concerts’ each week in Sydney and Melbourne, while other transmissions could be heard from enterprising amateur stations. But a whole year was to elapse before the Federal Government would implement formal broadcasting provisions (August 1, 1923) with the first official-broadcast station 2SB Sydney (later 2BL). Later came 3AR Melbourne, in January 1924 and 6WF Perth in June of the same year.

A clear objective

But with all that still in the future, the writer of the introductory editorial in 1922 identified the objective of the new publication with rare insight — even if rather awkward punctuation. I quote the key paragraph, exactly as published:

‘It will be the wholehearted endeav­our of this Journal to give its readers reliable news of the latest developments in the science from all parts of the world; keep the experimenter informed on all matters concerning his hobby, and help him to put his case for the relaxation of restrictions under proper control; and generally deal with the science in an understandable way, from the elementary stages to the super-technical’.

Seventy-five years on, that statement of intent is still relevant — even though, in the meantime, the science of ‘wireless’ has expanded at a speed, and to an extent, that is nothing short of mind-boggling.

The practical items in that first issue of 1922 were elementary in the extreme. There was a circuit for a one-valve regenerative radio receiver; a plug-in mounting system for honeycomb tuning coils; and constructional details for a fool-proof molybdenite signal detector.

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*The front covers of the milestone issues in our history (L to R): The very first issue of *Wireless Weekly*, in August 1922, the first issue as *Radio and Hobbies* in April 1939, and the first issue as *Electronics Australia*, in April 1965.*
This together with technical tips, news items, wireless club notes, advertisements and intriguing little snippets like the following:

‘A well known Adelaide jeweller, who is interested in wireless, puts his hobby to an interesting use. At noon each day, he checks his chronometers by radio time signals received on a set at his shop. He finds this method more reliable than the telephone system’.

By March 1923, with public broadcasting still eight months away, *Wireless Weekly* was sporting a colour cover, a new business address in Regent Street, Sydney and, more importantly, an array of titillating advertisements for an emerging band of wireless hobbyists.

With the commencement of public broadcasting, interest in wireless — or radio — grew rapidly, with receivers being variously bought and sold, built and rebuilt, in a seemingly tireless quest for any signals, more signals and louder signals.

In those days, broadcast stations using horizontal transmitting antennas tended to spray signals randomly far and wide, especially at night, and half the fun of owning a wireless set was to have listened to and logged more stations — especially distant ones — than anyone else in the street. A card with callsigns and dial settings was routine.

*Wireless Weekly* catered for all this with a comprehensive menu of programs, articles on stations, sessions and personalities, products and trade information, technical assistance and — last but certainly not least — how-to-build articles dealing with domestic receivers and accessories.

Prominent, too, was ‘The Safety Valve’, the forerunner of today’s ‘Letters to the Editor’.

A few years back, *Wild* reprinted examples of this now historic material in a publication entitled *The Best of Australia’s Wireless Weekly* in 1927. 1927 was a vintage year that saw something of a peak in the initial growth phase, involving mainly battery-powered receivers. The dozen-odd projects which were reproduced covered receivers ranging from one to 8 valves, including a reflex circuit, a neotrodyne and a superhet. To these were added a crystal set, a B-battery eliminator and a selection of audio amplifier stages.

Interest in radio broadcasting reached even greater heights in the early and mid 30’s, with more stations coming on-air and more imaginative programming. The same period saw the emergence of practical and reliable mains powered receivers, and a growing consciousness of sound quality as properly driven moving-coil loudspeakers took over from the old ‘horn’ and ‘cone’ models.

It was at this stage that *Wireless Weekly* set an industry lead with receivers for home construction like the ‘1933 Standard’ and the ‘1934 Champion’ superhet, which clearly out-classed most contemporary commercial designs. In a very real way, those receivers set the scene for the journal’s later commitment to high fidelity sound reproduction.

**Technical writers**

For some obscure reason, few of the articles in *Wireless Weekly* ever carried bylines. But one name that did become legendary in those early days was that of Ross Hull — an avid experimenter and ‘ham’, and a capable technical writer. I never met him personally, mainly because he was a decade ahead of me, but his reputation remained for years as a standard against which his successors were measured.

In the early 30’s, Ross Hull resigned from *Wireless Weekly* to take up a position with *QST*, an amateur radio magazine published by the ARRL (American Radio Relay League). Tragically, his career was cut short when he was electrocuted while working on his latest interest — an experimental TV receiver.

Ross was succeeded in the editorial chair of *Wireless Weekly* by his brother A.G. Hull, whose immediate skills were administrative and mechanical rather than electronic. But according to his lifelong friend the late Rón Bell, founder of RCS Radio, ‘Braith (Galbraith) Hull adapted quickly to his new role. He engaged as technical assistant a youth — fresh out of Scots College, Melbourne — who, over and above music and literature, had one dominating passion: radio. His name was John Murray Moyle.

Like Ross Hull before him, John already held an amateur licence and, as early as 1936, was to be found tearing around the countryside with mobile five-metre (60MHz) equipment, talking back to fellow amateurs from remote mountain outcrops around Sydney. This interest was to be taken up again 10 years later.

But, for the magazine itself, the winds of change were freshening. With radio receivers being accepted as a routine consumer appliance the traditional nexus between programs, personalities and technical matters was eroding, placing a large question mark over the basic format of *Wireless Weekly*.

Between them, ‘Braith Hull and John Moyle managed to talk their parent company into a completely new concept: *Wireless Weekly* would continue as a purely ‘program and personality’ publication, produced by non-technical journalists. Meanwhile the technical team would concentrate on a new national *monthly* magazine, devoted
mainly to radio and allied technology but with a generous helping of science and hobbies.

It sounded like a good idea and, in April 1939, the first issue of Radio & Hobbies appeared on the streets. It sold quickly, and over the next few issues gave all the indications of being a runaway success!

But then the scene changed, when Australia joined Britain in declaring war on Germany. Braith Hull left to take up other activities, and I myself became involved with R&H — first as a contributor, then as a full-time technical editor. John Moyle accepted a commission with the RAAF as a radio/radar instructor, and I suddenly found myself with the job of running the magazine with the help of a junior assistant and a shared typist.

With paper, facilities and radio components virtually frozen, it was essentially a holding operation — although the magazine was eagerly sought by service personnel, who were being introduced to radio technology for the first time in the armed forces.

A whole new team

Following the war, John Moyle and I set about assembling a technical team and organising new facilities to tackle the job ahead. Our aim was to find people with a range of skills, likely to complement the diverse interests of a whole new generation of readers.

And what unlimited scope for initiative there seemed to be, especially in view of the thousands of enthusiasts re-entering civilian life. There was a huge backlog of ordinary receivers to be built; an urge to come to grips with better quality sound reproduction; a re-opening of the amateur bands, and the promise of a mountain of surplus components through military disposals; the possibility of acquiring or building some real test equipment — and, further down the track, tape recording, a vastly improved disc recording format and television!

Far from being a daunting prospect, it was like a bunch of ‘carrots’ out front, exasperating only because one couldn’t tackle everything at once. I’m not exaggerating to say that John Moyle and I, along with newly recruited staff members, were like overgrown kids in a toyshop — incredulous that somebody was willing to pay us wages to pursue our collective hobby!

We would pore over disposals adverts and jostle with other enthusiasts every lunchtime at Price’s Radio in Angel Place. ‘Two-bob for this... a quid for that!’

We worked during the day in the office and, for the most part, went off home and kept right at it. John set up a ham shack and workshop in a ‘spare’ bedroom where, amongst other things, he spent countless hours grinding and etching crystals; I had a desperately overcrowded ‘shack’ in the backyard. Hi-fi gear dominated our respective living rooms. That was around 1947.

Amateur radio

Most of the once well-known ‘2JU’ amateur transmitters and receivers were built in John Moyle’s own bedroom/shack and checked out on air, in the late evenings. We would compare notes on the then six-metre band, with occasional interruptions from as far afield as Arch Cox in Canberra (240km) and Alan Thackeray in Young (320km). This was long before the days of VHF repeaters.

Around 1950, we began to use two metres or 2/5-metre crossband — made possible, in my case, by modifying a British made ex-disposals 1143 transceiver. Of necessity, it had been designed around components that always had been ill-suited to VHF service but, as I remember, it had been coaxed up to around 120MHz. To get it up to 144MHz was quite an assignment...

Audio and hi-fi

Interesting though these activities were, I doubt that they held the fascination of our on-going quest for ever-higher audio quality. This was against a background of argument, during meal breaks in the cafeteria, between John Moyle the recorded music exponent and Julian Russell, later an EA record reviewer but in those days, resident concert critic for our parent company.

I can recall our valiant efforts to win better sound from 78rpm records, the exercises in frequency compensation, the many lightweight — but often frail — pickups and the sad shake of the head by Fritz Langford-Smith, a guest at some of our listening sessions. As author of the famous Radiotron Designer’s Handbook and a hi-fi fan with a keen ear for distortion, he had been my immediate superior in former days with the Amalgamated Wireless

Editor John M. Moyle guided the magazine from 1945 until his untimely death in 1960. One of his relaxations was re-grinding quartz crystals.

Former assistant editor Phil Watson (L) and editor Neville Williams on the roof of the Sun newspaper building in 1948, trying out a VHF news gathering system.
Valve Company.

Then along came microgroove LP records, marked by king-size commercial gaffes that left more than a few industry executives with egg on their corporate faces. For us, LP records marked a new era, but one that involved us in still more test runs in the search for a reliable microgroove magnetic pickups — or alternatively, for a suitably hi-fi ceramic cartridge. But it all provided interesting copy for a technical magazine.

Meantime, domestic tape recorders had also made their appearance, backed up by a cloak-and-dagger tale of how they had been surreptitiously developed by the Germans, used secretly to further the Nazi War effort and discovered by chance by the rapidly advancing occupation troops.

In truth, German recording engineers had proudly demonstrated an early model tape deck to Sir Thomas Beecham in Ludwigshafen in 1936, and had used his orchestra to make the first-ever tape recording of a major concert. Far from being kept a secret, all relevant patents had been systematically filed in Switzerland, a neutral country. They had been there for anybody to study.

Tape, then stereo

The first tape recorder to reach us for inspection and comment was the ‘Magic Tape’, a basic half-track model marketed by AWA. We had more fun with it in our lab than with any other ‘new toy’ that I can remember — duly offering to prepare a lecture on the subject for the WIA (Wireless Institute of Australia).

As for stereo LP discs, one could write a very long article about the philosophical arguments that they prompted. Many established hi-fi enthusiasts didn’t want to pension off their prized mono pickup and amplifier, and they certainly couldn’t afford or accommodate a duplicate of the massive mono loudspeaker enclosure they had fought to justify in the living room.

So any plausible anti-stereo argument was worth a run if it served to postpone the evil day. Stereo was unnatural, artificial; it traded genuine quality for an illusion of spread; it could only work for someone sitting in one critical position; it was a gimmick which wouldn’t last, etc. One man who didn’t see that way was a longstanding friend, Ernest (later Dr) Benson. At the time he was a leading development engineer with AWA, who showed unusual interest when I mentioned that John and I would be auditioning a couple of advance-sample stereo records with a prototype ACOS cartridge. The latter had just arrived from the UK, and Max Cutts of Amplion had invited us to check it out.

Ernie B. duly joined us in John’s lounge room and listened intently, saying scarily a word. Finally, to our question ‘what do you think?’, he drew breath and came up with what must be the most unbiased, matter-of-fact reply that I have ever heard:

“Gentlemen, you have just written off twelve months work!”

He went on to explain that he had been quietly researching simulated stereo sound, culminating in a prototype radiogram that would hopefully have stolen a march on AWA’s competitors. In the light of what he had just heard, it would have been released just in time to be rendered obsolete!

Electronic organs

That same Ernest Benson was the man who, years before, had got me all steamed up about electronic organs. Together with EA science writer Calvin Walters, I had visited Ernie’s home and heard an organ in his lounge room that, in those days, sounded nothing short of magnificent. Then he took us downstairs to where a Hammond-like mechanism was purring away, generating waveforms for the console above.

I even went as far as having the blanks punched for a set of tone wheels, but that’s as far as it went. Anyone who addresses himself to an organ on that scale may as well forget everything else for an indeterminate period!

Further involvement in the subject had to wait until around 1960, when Stromberg-Carlson Australia collapsed following the failure of their unbranded TV receiver production. On the side, they had just begun to manufacture and market their version of a single-manual Thomas electronic organ and this, too, was doomed.

However through the good offices of Neville Oates and Bob Swan — respectively Stromberg’s organ engineer and sales executive — an arrangement was reached whereby the entire organ parts inventory would be cleared as kits and we would devise and publish a matching series of constructional articles.

In fact, we went well beyond the original Thomas/Stromberg design, adding optional 16’ and 2’ voices and reverberation. In so doing, we established something of a record in publishing about nine separate instalments, to the best of our knowledge without a single presentation error!

Home built hi-fi

But that’s fortunately not the case with home-built hi-fi equipment, notably amplifiers, tuners and loudspeaker systems. Readers in Australia and New Zealand have built them in their tens of thousands, in many cases in numbers which would have delighted companies marketing name-brand products.

Quite early in the piece, John Moyle came up with the idea of adopting the name ‘Playmaster’ for all audio-related projects which we might otherwise describe — at the time — as high fidelity. It was a brilliant idea, almost too good because in short order, it was adopted for a whole range of audio related products. The Stromberg/Playmaster organ was an an obvious example.

It would require a whole article even to scan the Playmaster projects over the years, but my mind turns automatically to the memorable last generation of all-valve amplifiers, using tetrode output valves in the ‘ultralinear’ configuration, with overall negative feedback.

The ultralinear connection, with the screens returned to tappings on the output transformer, was an ingenious way to combine the efficiency of a beam tetrode with the low output impedance of a power triode. You were halfway there even before the application of negative feedback!

Mathematicians had long since known that overall negative feedback could turn nasty at high frequencies and
cause instability — but they didn’t build amplifiers. Manufacturers knew that their output transformers were the main source of phase rotation — but they didn’t have to solve circuit problems!

It fell to people like Williamson in Wireless World, Mullard in their Outlook and us with our ‘Playmaster’ designs to bring together the maths, the transformer winding options and circuit practicalities, in devising amplifiers that would work well and behave themselves in terms of high frequency stability.

Television looms

Fortunately, that situation applied in the late 50’s and early 60’s when we had to meet reader clamour for home-built TV receivers. So much so that we changed our name from the original Radio & Hobbies to Radio, TV & Hobbies — a mouthful if there ever was one!

Our attention turned initially to junk boxes and disposals stores, crammed alike with surplus cathode ray tubes and other radar remnants, hoarded against just this eventuality. After all, they were descendants of pre-war British television — and who cared if the images were small and green, or blue? They would move and talk, wouldn’t they?

John Moyle and I became involved in a two-horse race to devise a workable receiver, using one of the available five-inch tubes — a 5BP1 or its somewhat more bulky English equivalent. The EHT supply was a problem, but someone had worked out that the need could be met with a voltage multiplier using 1000V paper capacitors and, of all things, a handful of 6H6 metal shell twin-diode valves.

Some of the 6H6’s would inevitably develop internal shorts, but who cared? There were thousands of otherwise useless 6H6s in the disposals stores, at ‘two bob’ a time!

I managed to get hold of a prototype IF strip from Bob Steane of Q-Plus, but I then had to devise my own tuner using a conventional Oak switch, incremental tuning and a box folded up from sheet brass. It wasn’t all that efficient but, given a reasonable location and antenna, it worked.

John chose to devise his own IF strip, as I remember, in collaboration with Ron Bell of RCS Radio. Phil Watson, meanwhile, was doing his best to devise suitable test gear, including a 36MHz sweep generator or ‘wobbulator’.

In due course, both John and I were rewarded with little green pictures that moved and talked — and it’s debatable whether any single project ever gave us greater satisfaction. You could even reduce the walking/talking picture to postage stamp size, much to the intrigue of visitors!

Attempts to enlarge the picture weren’t always quite so successful, particularly when the circuitry was reworked for one or other of the larger tubes that could be picked up in those days. Apart from their awkwardness and the sheer hazard of handling them, few of those early tubes were designed to have their total screen area brightly illuminated. Unable to drain away, the electrostatic charges inside and outside the glass would tear and distort the picture into grotesque shapes.

But then, just when we had had our fill of green pictures, the Manufacturers’ Special Products (MSP) branch of AWA came up with a full kit of deflection components for their companion 17” (43cm) tube. My overcrowded shack in the backyard then saw the birthpangs of what was the first modern TV receiver to be described in this country for home construction: The 1957 TV Receiver. It was finished and working before it even saw the inside of our lab.

Larger-screen models followed in successive years, but the urge to ‘roll your own’ was gradually overtaken by the attraction of the factory-built product, off the shelf, at a cut price on time payment.

Moreover a new challenge had appeared on the horizon — the transistor — which was clearly going to change the whole scene.

The solid state era

Back in the 50’s and 60’s, when transistors started to arrive, there was no special exemption for the magazine and its staff. We were very much at the technical cross-roads. Conditioned by decades of valve circuitry, and with a commitment to many thousands of like-minded readers, we had to absorb and interpret the new solid state concepts, without appearing to be over-anxious to abandon the old.

Looking back, I can well remember the release of germanium signal diodes such as STC’s ubiquitous GD3 and the Philips/Mullard ‘OA-’ series.

I also remember a call from the late Graham Hall of Ducon, to say that he was sending over some sample silicon power diodes “that will supersede those bulky, inefficient valve rectifiers that you’ve been using in your receivers and amplifiers”. This they certainly did!

The first transistors to reach our lab were odd point-contact and junction germanium types, of little immediate use for RF service but sufficient to permit a certain amount of basic ‘fiddling’.

Our first ‘conversation piece’ was a breadboard style receiver involving as I recall four of those early transistors, plus prototype audio driver and output transformers from RCS. It was simply a non-regenerative detector, followed by an amplifier stage driving two transis-
tors in class AB push-pull.

Gain and selectivity were limited but, on the signals that it could receive, it produced useful output from a sensitive loudspeaker, while operating at 6V from four ordinary torch cells. The promise for battery powered equipment — portable and automotive — was obvious.

Progress in transistor design was thereafter mirrored in a number of simple constructional projects, culminating in a full-scale transistorised portable receiver, the "Transporta-7" described in February 1959. This comprised a vinyl covered wooden cabinet and an inner metal bracket which supported the loudspeaker and two circuit boards, one carrying the tuner section and the other an audio amplifier with class-AB output stage. It performed very well and I used it for some years as a casual portable, much as one does with present-day transistor receivers. The one-time experimenters' dream had become a reality: acceptable quality with economy of battery drain.

But old habits die hard. The issue carrying the design was ready for distribution when the company publisher suddenly realised that the poster had been overlooked — the one normally supplied for display by newsagents. Would editor John Moyle please scribble out the few eye-catching words necessary to occupy the space? He duly obliged and a few days later the poster was on display all around Australia, proclaiming: A 7-VABLE TRANSISTOR RECEIVER.

Tragedy intervenes

Sadly, editor John Moyle was not to share in the technological explosion that characterised the solid-state era.

As an active radio amateur, a former president of the WIA (Wireless Institute of Australia) NSW Division, and a federal councillor of the same body, he had been nominated to represent the interests of Australian amateurs at the 1959/60 ITU (International Telecommunications Union) conference at Geneva.

Before leaving, he had not been a well man. But characteristically, he decided to fulfil the assignment first and worry about his health later. On the way back from Geneva, he planned to follow up matters arising from an earlier factfinding tour in 1956, and to spend some time with veteran American publisher Hugo Gernsback, with whom we had had a long and cordial relationship.

But as the conference drew to a close, John had to seek medical help. A Swiss doctor diagnosed cancer and advised him to fly straight home, while he was still able to do so. He died in March 1960, leaving the future of the magazine in the hands of the team which he had done so much to consolidate and inspire. His obituary was published in the April 1960 issue under the heading 'Engineer, Writer and Musician'.

A couple of months later, I had my own share of trauma, although minor by comparison. While working on a project in my backyard 'shack', I hurried out into the damp, wintry night, slipped on a wet concrete step and ended up with a broken femur. Next morning, my wife had to ring Phil Watson with the news that I would be in traction at Parramatta hospital for an indeterminate number of weeks, and that he'd have to be the new instant editor.

So while, for the next four months, I wrote and edited what articles I could, propped up on pillows, it fell to Phil to make the on-the-spot editorial decisions.

Transistors take over

By 1960, with both germanium and silicon transistors, plus related devices, pouring off the production lines, their ruggedness, small size, operating economy and low cost offered undeniable attractions across the whole range of electronic equipment. Equally, their compatibility with printed circuit boards or 'PCBs' fitted in with industry moves towards mechanised assembly and soldering.

In relatively short order, most new consumer equipment was 'transistorised', along with test equipment and a variety of electronic gadgetry that would not have been practical in the valve era. The changeover took a little longer in the case of hi-fi power amplifiers, TV receivers and transmitting equipment, which had to await the development of reliable high power and/or high frequency devices.

As it turned out, the magazine's move into solid-state technology was spearheaded by a young engineer who joined the staff only a couple of months before the death of John Moyle. While the rest of us were still of necessity technically 'bilingual', with a foot in each camp(!), it fell to Jim Rowe and our then-new draftsman Bob Flynn to sort out the early confusion of terms and symbols, and to come up with adequately illustrated articles and handbooks.

A new title

My own chief role, in those days, was to 'steer the ship' and a change in course seemed to be indicated.

Back in 1939, the & Hobbies was judged to be a necessary and appropriate part of the title. But with electronics playing an ever increasing role in science and technology, space devoted to non-electronic topics was clearly not serving the best interests of either readers or advertisers. So the decision was taken that, henceforth, the magazine would concentrate on technology, science, hobbies and activities that had some tangible connection with electronics.

EA's first frequency counter project, described in 1970. It used gas-discharge tubes for readout and a mixture of RTL, DTL and ECL integrated circuits.
In fact, the editorial content had been moving in that direction for some time and even Calvin Walters, our popular and free-ranging science writer through the formative years, began so to bias his choice of subjects.

To match the change in course, a new name Electronics Australia — abbreviated to EA — seemed to be desirable and a memo to that effect was duly despatched to the management of our parent company.

I shall never forget the incredulity with which it was greeted by the company’s then editorial manager Lou Leck, who knew a great deal about producing newspapers and popular magazines — but to whom ‘electronics’ was an obscure buzz-word used mainly by space-age weirdos.

It was only with the greatest misgivings that he finally accepted my assurance that it was also commonly used and understood by all of our existing readers and advertisers. It might even attract others who were being put off by the down-market connotation of & Hobbies. He, in turn, convinced the Board and, in April 1965, R.TV & H disappeared and EA took its place.

The name change certainly proved timely, because the availability of solid state devices encouraged the construction of a whole array of new electronic gadgetry, as well as a new range of updated test equipment, receivers and amplifiers.

No longer was the cost and complexity dictated by the number of valve functions that the constructor could afford, accommodate or provide power for. With transistors, and more especially ICs, circuit functions could be expanded or added for the price of a few small components and a minor increase in the area of a PC board.

Since 1970, virtually all of our projects have been based on constantly evolving solid state technology, ranging from relatively simple gadgets to the ambitious Playmaster Pro Series Three Power Amplifier (February-March 1994) and its companion Pro Series Four Preamp (December 1996/January 1997).

The revolution is complete. Valves and valve type components exist mainly for replacement purposes, for nostalgia and for those hifi fans who insist that valves sound sweeter than transistors...

Import duties cut

In 1972, a Federal Government initiative totally changed the complexion of the electronics industry. Faced with the need to accept more imports to balance export earnings, the Whitlam Labor government drastically reduced tariffs, including those on electronic components and equipment.

The decision signalled a flood of imported components which were at least as good and generally cheaper than those produced locally. The same was true of built-up equipment, notably domestic, portable and car radio receivers, small to medium-size TV sets, audio-hifi components test equipment, communications equipment, etc. The impact on the local industry was devastating, with many factories forced to close.

For hobbyists, the effects were quite complex. Through enterprising parts dealers, they gained ready access to new high-tech components, often keenly priced. But against that, the supply of such components has often been selective and erratic. Again, the cost incentive to build one’s own has been eroded by the availability of affordable built-up equipment at all levels. (How many amateurs, these days, use home constructed ‘rigs’?)

Even where the urge to acquire experience has prevailed, familiarity with built-up equipment has heightened expectation that the home-built unit should ‘look the part’ — hence the demand for high tech designs, with professional looking panels, cabinets and PC boards.

There is obviously a place for ambitious, professional looking projects — and there have been any number of them over the last few years — but I can never quite forget the pleasurable experiences I, and others, have re-lived, while generating simple articles for the magazine re-creating a more selective crystal set, or a humble little regenerative short-waver!

The digital era

The 70’s also saw yet another revolution in the emergence, at a consumer level, of digital technology. It came first in the context of computers and later in roles which had traditionally been filled by analog equipment.

While the digital concept is at least as old as the abacus, the first fully electronic calculating machine (computer) is generally reckoned to have been ENIAC, commissioned in 1945 at the University of Pennsylvania.

My own first encounter with electronic computers, analog and digital, was at the Commonwealth Aircraft Laboratories in Melbourne — my most vivid recollection being a room full of racks crammed with thousands of twin-triode valves, all glowing warmly and presumably awaiting their turn to lose emission.

Solid-state technology subsequently reduced those early monsters from room size to furniture size but, while they rated a mention in feature articles, they still seemed far removed from the technical activities of EA readers.

The first step towards closing the gap came when our then parent com-
pany, John Fairfax & Sons, invested in a couple of Digital Equipment PDP-8 minicomputers which amongst other things, became the focus of a staff familiarisation program.

As technical editor of EA at the time, Jim Rowe sacrificed quite a few lunch hours for the chance to gain ‘hands on’ experience — and was duly bitten by the computer ‘bug’. But, having in mind the current cost of even those ‘mini’ computers, and the specialised roles for which they seemed best suited, we quite seriously debated whether the magazine itself would ever need or be actually able to own one. As for individual readers, it seemed an even more remote possibility...

So, initially, we were resigned to publishing articles to explain the rudiments of logic theory and its representation in electronic circuitry. The highlight of this phase was a Logic Demonstrator (April/May ’67), a project which filled a teaching role very well, but had no other function. After sitting around in our lab for some time, admired but never used, it was finally donated to a youth training group.

Then came our first actual build-it-yourself computer, introduced in August 1974 — a project that actually tied as a world first with one published in the American magazine Radio Electronics. With due parental pride, Jim Rowe insisted on calling it the ‘EDUC-8’, signifying an educational, 8-bit computer. Unfortunately, not everyone noticed — or conceded — the play on words and Jim has had to live, ever since, with sly references to his ‘E-DUCK-AITE’!

I might add that designing the EDUC-8 project took Jim almost 12 months of work (all in his own time), and probably placed his marriage under some strain...

Even in 1974, however, the everyday role of computers was still a matter for speculation. An emerging group of computer ‘nuts’ was insisting that one day, we would be using them for routine lab and office jobs — but the fact remains that the issue in which ‘EDUC-8’ first appeared did not carry a single advert for computer equipment aimed at John Citizen.

I doubt that many foresaw the enormous impact which the then new and costly LSI (large scale integration) chips would have, when coupled with Asian and/or automated production methods.

The release of IBM’s PC and the considerable assortment of more pretentious models which continue to be offered at highly competitive prices, not only provide an enticement to get involved, but also a strong disincentive for individuals or parts suppliers to do so at the build-one-yourself level. Not surprisingly, therefore, technical interest in the subject now centres on the choice of equipment and the options by which it can be used to best advantage.

As for the magazine itself, every word in it has, for years, been readied for printing by computerised typesetting and desktop publishing equipment. Virtually all of the articles have been written and/or sub-edited on computer-based word processors, some in the EA office, others owned privately by staff members and contributors.

So much for the early reservations which Jim Rowe and I shared, about the availability and affordability of basic computers.

‘The best laid plans...’

Facing the 80’s and my own pending retirement, everything looked shipshape for the future. We had a functional, though not pretentious, office/laboratory complex within a few hundred metres of Sydney Central railway station. Assistant editor Phil Watson was due to retire also, but while his position could be taken over by Greg Swain, Phil would still be on call on a casual basis. Jim Rowe was firmly entrenched as editor with Leo Simpson looking after product reviews, plus a laboratory team by now as much at home with solid-state and digital technology as their predecessors had been with valves and analog.

It was then that entrepreneur Dick Smith rocked the boat, by making Jim Rowe one of those offers that, as per the cliche, ‘he could not refuse’. In consequence, the editorial team had to be restructured, with Leo Simpson moving to technical editor (ultimately editor) and my own period of service extended by a couple of years.

It proved a challenging and busy period, with the personal computer market virtually exploding and with pushbutton digital technology invading the video, audio and receiver equipment market. Levers, mechanical switches, meters, dials and tuning condensers gave place to ‘logic’ controls, not only in commercial equipment but in projects as well.

The current era

That’s about the way it looked when I officially retired in July 1983. Since then, of course, things have moved on. In 1987 Leo Simpson and Greg Swain left to start and run their own magazine — nowadays one of EA’s main competitors. About the same time Jim Rowe came back, to take over the running of EA and with a new editorial team ensure that it continues into the future, with our traditional mission of helping readers keep abreast of electronics and its continuous stream of developments.

No doubt the magazine will have to continue changing and evolving, as technology changes both its subject matter and (very likely) the way it best delivers this information to the readers. But having survived all of the changes that have taken place in the last 75 years, I’m confident that it will continue to prosper. ♥

About the author

The late Neville Williams joined the magazine, then Radio & Hobbies, in December 1941 — as Technical Editor. He held that position until April 1960, also serving as Acting Editor during the war and also later during the illness of then Editor John Moyle. After Mr Moyle’s death he was appointed Editor and served in this position until April 1971. He then became Editor-in-Chief and continued to guide the destiny of the magazine until his retirement in July 1983. His total length of full-time service with the magazine was thus almost 42 years — more than any other individual.

Even after his retirement, Mr Williams remained very active and was still a regular contributor, with columns and articles coming from him in a steady stream until his death in November 1996, at the age of 81.

This article has been adapted from a two-part series Neville originally wrote for our August 1987 and January 1988 issues. We decided to use it in this issue both as a tribute to his 55 years of service to the magazine, and because we believe it gives an excellent overview of the way the magazine and its staff have had to develop and adapt as electronics itself has developed over the last 75 years.
From glowing 'tubes' to solid state 'chips'

For the first 40-odd years of its development, the electronics industry was based on thermionic valves or 'vacuum tubes'. Then on June 30, 1948, Bell Laboratories announced the invention of the transistor. The announcement was hardly noticed by the newspapers, and even the scientific community doubted they could be made to work as a practical device. But over the last five decades the transistor and the integrated circuit 'chip' developed from it have together revolutionised the industry.

The basic invention of the transistor in many ways inaugurated and continues to define the 'electronic' age. From its invention at AT&T Bell Labs in New York on December 23, 1947, the transistor began to replace the vacuum tube or 'valve'. It has provided a tiny, reliable and relatively inexpensive substitute for the relays formerly used in electromechanical telephone exchanges.

More importantly, the transistor and its offshoot the IC have ushered in the 'solid-state revolution', spawning today's worldwide semiconductor electronics industry and making possible dramatic changes in communications, computing, entertainment, medicine, space exploration and a host of other fields.

Perhaps the most far-reaching impact, however, has been in communications. Modern communications networks would not be possible, in fact, without the transistor and IC. As key components in telephones, computers of all sizes, PABX's, communications satellites, microwave relay systems, and undersea and terrestrial cable systems, these devices underlie every aspect of worldwide communications.

How it happened

The transistor was not a 'bolt from the blue' type of invention. It was discovered at Bell Labs by physicists John Bardeen, Walter Brattain and William Shockley — who were engaged in a project deliberately aimed at finding a solid state replacement for the valve.

Ten years before, William Shockley and Alan Holden, both physicists at Bell Labs, had tried to make a solid state amplifier using carbon contacts brought together through pressure exerted by a quartz crystal. They thought an amplified output would be produced by a change in the resistance of the carbon as a signal was applied to the crystal. It wasn't.

Shockley then speculated that if he were to oxidise a metal wire screen, sur-
rounding it with a semiconducting oxide, he could limit conduction through the oxide from one side of the screen to another. But again tests were not successful.

Another staff member of Bell Labs, Russell Ohl, used silicon crystal diodes (developed during World War II for radar and microwave systems) to amplify signals. But Ohl’s amplifier depended on a negative resistance effect and turned out to be too unstable.

After the war, Shockley returned to Bell Labs, and after studying Ohl’s device, proposed a field-effect structure with silicon and germanium deposited on insulators. It was tried, but no field effect was observed.

John Bardeen then suggested that the lack of field effect could be explained by charges being trapped on the semiconductor’s surface. The experimental leader of the group, Walter Brattain, then began conducting experiments based on Bardeen’s theory.

On November 21, 1947, they had their first success. They observed a field effect in an electrolyte in which they had immersed an N-type germanium slice, with a metal point contact on its surface. It was only capable of operating at up to a few hertz, but it was the beginning.

By December 4th, Brattain had successfully repeated the experiments with silicon as the semiconductor. On December 15th they showed that the point contact would reverse the flow of current, and the following day they achieved power amplification.

By December 23, 1947, the team had developed what they thought would be a practical device and held a demonstration in which the transistor (then un-named) demonstrated a power gain of 18. The next day, Christmas Eve, the device was made to oscillate, and they had the device that Bell Labs had asked for.

They had discovered, however, that it was not a field effect device after all; instead, the control electrode was injecting the extra carriers, which were flowing into the point contact (collector) and adding to the output current.

It was the experiment of December 23, 1947, for which Bardeen, Brattain and Shockley were awarded the Nobel Prize in 1956.

Shockley continued to refine his theories and by the time the original point-contact transistor patent was applied for on June 17, 1948, he had a working model of the junction transistor. A patent for this improved device was applied for the same month.

The transistor owes its name to John Pierce, who was executive director of research communications sciences at Bell Labs in 1948. In a discussion with Brattain, he mentioned that since the point-contact device was the electrical dual of the valve and the most important function of a valve was transconductance, the dual for the new device would be transresistance. They had the idea of calling it a ‘transfer resistor’, then final-
ly settled on the name ‘transistor’.

### Into production

About this time, plans were under way to start production on the point-contact device. While it became relatively simple to make one transistor, it was quite another problem to make them in quantity. For no visible reason, transistors made in the same way stubbornly refused to behave in the same fashion. Western Electric, then the manufacturing division of the Bell System, was given the job of finding the answers.

Part of the problem was the incredibly small dimensions involved in transistor manufacture. Transistor action occurs in areas so infinitesimally small, you can fit thousands of them into the thickness of a sheet of paper. Other dimensions are equally fearsome.

But the real name of the ghost in this story was contamination. The purity of the germanium used for transistors had to be several orders of magnitude higher than anything then available. The slightest trace of any unwanted impurity would make a transistor either behave erratically or kill it altogether.

At times, the transistor ‘death rate’ due to impurities was so high that harried engineers invented a mysterious (and facetious) element called ‘deathnium’ to explain their difficulties. This ominous, and completely fictitious element will never be found on any chemist’s periodic table of elements, but the wry humour it expresses helped Western Electric through some trying times.

To further complicate the problem, germanium used for transistors had to be cut from single crystals of the element, and nobody had ever grown any before. This meant that, along with new methods for refining raw germanium, methods for growing perfect single crystals had to be developed.

In an example of necessity being mother to invention, Bell Laboratories came up with zone refining, an ingenious means of refining germanium and other semiconductor materials to a degree of purity never before obtained by man or nature.

Simultaneously, Bell Labs chemists were hard at work turning the ancient art of crystal growing into an exact science. Following hard on their heels, Western Electric engineers quickly transmuted their experimental lab work into efficient factory production methods. How well they succeeded is vividly demonstrated by the enormous silicon crystals they routinely grow nowadays, compared with the puny three and four ounce dwarfs of nearly five decades ago.

When silicon entered the transistor picture in 1953, it seemed the whole arduous process of learning how to do the apparently impossible would have to start all over again. The advantages of silicon had long been known: it is as abundant as the sands of the earth, can operate at higher temperatures, and has better electrical characteristics than germanium. What wasn’t known was how to work with this intractable element.

Silicon has a melting point of 1417°C Celsius (compared to only 937°C for germanium) and reacts with any material used to contain it at that temperature. Impossible as it seemed, some means of melting and refining silicon without actually touching it had to be devised.

Once again, the Bell Labs-Western Electric team put their heads together and came up with a solution. The answer was a variation of zone refining called float zone growing, in which high-power radio waves are used to melt a thin section of silicon rod and move both it and its impurities down the rod. The same kind of surface tension that lets you fill a water glass to just beyond its brim without sloshing, keeps the molten zone from spilling out of the rod.

For all the endless series of problems that beset Western Electric engineers in those days, there were some compensating advantages to being first. One of these was that the patents which resulted from the numerous inventions have been an asset in negotiating cross licensing agreements with other companies in the industry.

Realising the potential impact of this technological breakthrough, in April 1952, Western Electric held the world’s first transistor manufacturing symposium for its transistor patent licensees. For five very crowded days, representatives of nine foreign and 25 American companies heard WE engineers reveal the details of what they had learned.

The April symposium led to the publication a few months later of a definitive two-volume work on transistor technology. Between getting out this
massive work and getting the transistor into manufacture, many Western Electric engineers became almost strangers to their families.

Today the 1952 symposium is remembered not only for the impetus it gave to worldwide transistor technology, but also for a memorable bit of prophecy.

Western Electric management knew the transistor would never really get anywhere unless it could eventually be made cheaply. The enormous potential was there and immediately recognizable, but would the mighty midget ever become economically feasible?

On the last day of the symposium, after four days of discussion that sometimes seemed to make the problems of manufacturing the transistor economically and technologically insurmountable, the question of cost finally came up. One attendee, dazzled and bewildered by the technological demands of making the strange new device, asked the question that had been looming large in everyone's minds — "How much will the darned things cost?"

There was a hushed, almost embarrassed silence. Then Don Wilkes, Western Electric's general manager, boomed out loud and clear, "Twenty-nine cents!"

Wilkes' faith has long since been vindicated. At the time he spoke, transistors were running at between five and 10 dollars each, and a good month's production was measured in the hundreds. Today, transistors can be purchased for well under 29 cents, and annual production numbers in the United States alone run into many 1000’s of million.

The first IC

The next milestone in the solid state revolution came almost 40 years ago, with the development of the first integrated circuit at Texas Instruments.

TI engineer Jack S. Kilby demonstrated the first working IC on September 12, 1958. Since Kilby's early invention ICs have become ever smaller in size, ever greater in capability and reliability and ever lower in relative cost, allowing development of systems once confined to science fiction.

Today, due in part to the invention of the IC and complementing developments, the electronics industry has grown from US$25 billion in 1960 to nearly US$1000 billion. To accommodate the market's changing needs, the latest ICs have reached densities in the gigabit range and require geometries of 0.2-micron and below.

**Kilby's invention**

After the transistor became the industry replacement for the vacuum tube, the world searched for a method to connect complex configurations of components inexpensively. Kilby's invention offered a solution to this problem.

Kilby wrote in an article for *IEEE Transactions On Electron Devices* in 1976, ‘The first electronic equipments were composed of a few dozen components and could be readily assembled by hand-soldering techniques. Each component was manufactured separately by a process optimized for the purpose. As electronic equipment became more complex, shortcomings in this procedure began to appear. The cost of the equipment increased more rapidly than component count, and equipment reliability suffered a corresponding decrease'.

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sation and had a small contract from RCA to develop the Micro-Module concept — an approach entailing creation of discrete components of uniform size and shape, with built-in wiring. The Micro-Modules could then be snapped together to form circuits, eliminating the need for wiring the connections.

Kilby disliked the Micro-Module approach, because it didn't address the problem of large quantities of individual components in elaborate circuits. As a result, he looked for an alternative.

Rather than reworking conventional concepts of design, Kilby re-examined the problem.

He later said "I began to feel that the only thing that a semiconductor house could make in a cost-effective way was a semiconductor. Further thought led me to the conclusion that semiconductors were all that was really required — that resistors and capacitors (passive devices), in particular, could be made from the same material as the active devices (transistors)."

"I also realised that, since all of the components could be made of a single material, they could also be made in situ, and interconnected to form a complete circuit. I then quickly sketched a proposed design for a flip-flop using these components. Resistors were provided by bulk effect in the silicon, and capacitors by P-N junctions."

The breakthrough

Encouraged by the results of a preliminary test, Kilby set out to build an integrated circuit. Using a sliver of germanium mounted on a glass slide, he built a phase-shift oscillator.

On September 12, 1958, he connected a power source to his device and applied a 10-volt power supply. A sine wave flickered across the screen of a nearby oscilloscope. The age of the integrated circuit had begun, in a Texas Instruments laboratory in Dallas.

Kilby's breakthrough was followed by TI's introduction of the first integrated-circuit computer in 1961. The design team headed by Kilby created this computer for the US Air Force.

The computer, which was 6.3 cubic inches in volume, weighed 10 ounces and had fewer than 600 parts, proving that integrated circuits were practical and that they had the potential for making a broader impact. Built conventionally, the same device weighed 480 ounces, and had a volume of 1000 cubic inches and consisted of 8500 individual components.

Despite the promise that this new device held for making smaller, more reliable, lighter and less expensive electronic products, it was met initially with lukewarm interest. Designers did not feel comfortable with the idea that their 'components' were too small to see or work with. Long accustomed to hands-on design work in which components could be plugged in and pulled out freely, engineers were unsure how to work with this new invention too small to take apart.

TI's President Patrick Haggerty was convinced of the significance of integrated circuits. Persuading the rest of the industry would require the appropriate demonstration vehicle. With this thought in mind, he challenged Kilby to assemble a team to create a calculator, that would be both powerful and yet small enough to fit in a shirt pocket.

In 1967, TI demonstrated a hand-held calculator capable of executing the basic four functions provided by adding machines many times its size.

The ability to perform multiple calculations quickly, easily and at nominal cost was a popular one. More importantly, the possibilities of the integrated circuit were becoming more apparent.

The next 30 years would see the integrated circuit accepted not only by the electronics industry, but by the world. Today, thanks to Jack Kilby, TI and others who worked on integrated circuit development, every electronic product imaginable is benefiting from the integrated circuit.

Electronics has certainly come a long way since that fateful Christmas Eve in 1947, when Shockley, Bardeen and Brattain first produced a working transistor.

(Adapted from material supplied by Lucent Technologies/Bell Labs and Texas Instruments Semiconductors. The photographs are by courtesy of Lucent Technologies/Bell Labs and Texas Instruments Australia.)

Above: a montage suggesting the progression from the valves of 1948 to today's complex and powerful IC chips. Below: an example of a state-of-the-art IC, the Texas Instruments TMS320C65 high speed digital signal processor.
You’ve got to be switched on in the electronics industry. And the most switched on thing to do this year is to attend the Hong Kong Electronics Fair in October. Over 1,000 exhibitors from all over the world will display their latest products at the Hong Kong Convention & Exhibition Centre. And this year, the extension of the Fair to the new wing gives you more space to shop.

From hi-tech systems to simple gadgets, you will find everything you need at the Fair. Major exhibits include audio-visual equipment, home appliances, electronic gadgets, electronic toys & gifts, computer & multimedia, telecommunication equipment, security systems, electronic & electrical accessories and trade services.

You can even extend your shopping list to take in the new electronicAsia 97, a components and electronic equipment fair organised by the Hong Kong Trade Development Council and Messe München International to be held alongside the Electronics Fair.

Apart from shopping, the Asian Electronics Forum to be held concurrently with the fairs will also provide plenty of insights into the trends and challenges of the industry.

The Hong Kong Electronics Fair is where the action is. Be here to get plugged into the latest development in the industry.

Fill in the coupon and fax it to us or attach your business card to it and send it by mail. We will fill you in with the details.
THE PHENOMENAL GROWTH OF COMPUTERS

Undoubtedly one of the most significant events that took place in the electronics industry over the last 75 years was the development of digital computers. No other class of machine has contributed so much to the growth of human knowledge, or to systems which help us cope with the enormous mountain of information which our society has accumulated.

by JIM ROWE

The first electronic digital computers may have appeared in the mid 1940's, but like most other inventions they were anything but a 'bolt from the blue' which sprang fully developed from the mind of a single genius. Many of the key ideas involved had been grasped by people in much earlier eras, who had been unable to build upon them—because science and technology had not as yet reached a stage where the tools or components were available to allow them to do so.

The events of the pre-computer era do indeed demonstrate that like seeds, crucial ideas can only 'take root' and grow when the time and conditions are right. Having an innovative idea too early can be almost as unproductive—and probably much more frustrating—than having it too late!

Building foundations

All through history, people had been fascinated by the idea of a machine able to carry out calculations or do similar things 'all by itself'. The ancient Greeks are said to have had an 'astronomical computer', with dials driven by gear wheels to show the position of the planets on any given day.

That incredible genius Leonardo da Vinci apparently invented a mechanical calculating machine around 1500, although it's not certain that it was ever built. In 1653 the French mathematician and philosopher Blaise Pascal built a similar adding and subtracting machine, the 'Pascaline'. It was based on gear
wheels and ratchets, and apparently made Pascal famous throughout Europe.

Twenty years later, the famous German philosopher Gottfried Leibnitz developed the mechanical calculator even further, producing one which could multiply and divide as well as adding and subtracting. For a mechanical device it worked surprisingly well — so much so that apart from relatively minor improvements, the basic design for this type of mechanical calculator remained almost unchanged for around 250 years. Accountants and book-keepers were still using very similar units well into the 1930’s!

Sometime early in the 17th century there also appeared another idea that was ultimately to be of crucial importance in the development of today’s electronic computers: the idea of a binary number system, based on 2 rather than 10. This is generally credited to either Sir Francis Bacon, or the Scottish mathematician John Napier (the inventor of logarithms).

The idea of actually programming a machine to do a job automatically and repetitively was probably first brought to fruition in 1801, by the Frenchman Joseph Jacquard. Controlled by holes punched in a series of thin wooden cards, linked by cords to form a crude ‘punched paper tape’, Jacquard’s weaving looms could automatically produce fabrics with almost any desired patterns.

Probably the next milestone in pre-computer history came in the 1820s, when British mathematician Charles Babbage developed what he called his ‘Difference Engine’. This was a machine designed to work out automatically any type of astronomical, nautical or similar reference tables which are based upon a fixed mathematical relationship or ‘law’.

Due to financial troubles, Babbage never fully perfected this machine, but before his death in 1871 he designed an improved ‘Analytical Engine’ which was in many ways a mechanical version of modern computers. It had a ‘mill’, or processor, and a ‘store’ or data memory. Babbage planned to control its operation using Jacquard’s system of punched cards, and had even worked out a way to make it able to ‘jump’ back and forth in the ‘program’ by winding the cards forward or back!

Incidentally, Babbage received quite a lot of help from the woman who is generally credited with being the first computer programmer: Lady Ada Lovelace, Lord Byron’s daughter.

A brilliant mathematical thinker,
Lady Lovelace not only helped Babbage perfect the design of the Analytical Engine, but it was apparently she who discovered important programming ideas like the use of a single set of instructions for repetitive operations. So we really must credit her as the inventor of the program loop and subroutine.

In 1890, raw information for the 11th Census of the United States was processed by mechanical punched-card tabulating machines invented by Herman Hollerith. As a result, the Census information was processed in less than a third of the time taken for the previous 1880 Census, with a dramatic reduction in human effort — even though the population had grown by 25%, and many more questions had been asked.

Back in 1854, an obscure and largely self-taught mathematician called George Boole had demonstrated that mathematics was basically a highly developed and ‘symbolic’ form of logical reasoning. In his historic book *An Investigation of the Laws of Thought*, he also developed the basic elements of symbolic logic — a set of conceptual ‘building bricks’ which could be used to construct logical and mathematical functions.

But it wasn’t until 1937 that someone was actually able to build upon Boole’s work. In that year, American electronics engineer Claude Shannon published a now famous paper, showing how Boole’s principles could be used to design electrical switching circuits.

A couple of years later, Shannon went on to show how virtually any kind of information or ‘data’ could be encoded in the form of binary codes (1’s and 0’s) — so that it could be reliably stored, processed, or transmitted from one place to another using electrical or electronic circuits.

So thanks to Babbage, Lovelace, Hollerith, Boole and Shannon, all of the main parts of the computer puzzle were finally in place — along with the technology to achieve its practical realisation. From then on, the developments came thick and fast.

**The computer age**

In the early 1940s, a group of scientists and mathematicians in England developed a series of special-purpose computers to crack the secret message codes being used by the Germans during the war. Working at Bletchley Park in Hertfordshire, they first produced machines using relays, then more refined models using thermionic valves or ‘vacuum tubes’. Although these ‘Colossus’ computers were designed specifically for code cracking, they were strictly speaking the world’s first fully electronic computers.

Then in 1944, at Harvard University in the USA, the first general-purpose programmable digital computer was produced using both vacuum tubes and relays. Called ‘Mark I’, it was developed by a team of researchers led by Howard Aiken.

Two years later another team of engineers at the University of Pennsylvania, led by John Mauchly and J. Presper Eckert, produced the first fully electronic computer. Apparently this was inspired by an earlier design produced by John Atanasoff, at Iowa State University.

**UNIVAC-1**, Eckert and Mauchly’s first commercially available stored-program computer which appeared in 1951.
Dubbed 'ENIAC' (which stood for 'Electronic Numerical Integrator and Computer'), the Eckert-Mauchly computer was a monster weighing around 30 tons and covering about 150 square metres of floor space. It also contained about 18,000 vacuum tubes, and used 150 kilowatts of power.

ENIAC operated about 1000 times faster than Aiken's Mark I, and was used for all sorts of scientific and engineering calculations. However it was still not a true stored-program machine. Like Aiken's machine it was programmed by 'hard wiring'.

**Stored programs**

In 1945, Eckert and Mauchly had been joined by John Von Neumann, a Hungarian mathematician. After building ENIAC the team then came up with the idea of storing the computer's program in its own memory, along with the data. The notion of the modern stored-program computer was born.

Surprisingly, however, it was not the Eckert-Mauchly-Von Neumann team which produced the first working model of a stored-program computer. This was achieved in England in 1949, by a team at Cambridge University led by Maurice Wilkes. But Wilkes had actually studied with Eckert, Mauchly and Von Neumann in the USA, and happened to complete his 'EDSAC' machine some months before his tutors finished their own 'BINAC'.

In 1951 Eckert and Mauchly produced the first commercially available stored-program computer, UNIVAC-1. By this stage they were working for Remington Rand, later to merge with Sperry. A UNIVAC-1 was used to process the votes for the 1952 US presidential elections, allowing President Eisenhower to be proclaimed the winner only 45 minutes after voting finished.

Things really started moving after that, because the transistor had been invented at Bell Labs in late 1947 by Shockley, Bardeen and Brattain. By 1950 the new devices had been developed to the point where they represented a practical alternative to the thousands of vacuum tubes used in the first generation of computers. This opened the way for smaller, faster and more reliable computers — which also didn't need their own power substation!

In the early 1960s the next generation of large 'mainframe' computers appeared, with fully solid state circuitry based on discrete transistors. IBM produced the 7000 series, while Control Data produced the 160-A which had been designed by Seymour Cray.

But of course in 1958 the monolithic integrated circuit or 'IC' had been developed by Jack Kilby, at Texas Instruments. This made it possible to compress at first tens, then hundreds and finally thousands of transistors and their associated components into tiny chips of silicon, which could be housed in packages no larger than the first transistors. The IC was to trigger the next round of computer developments, by allowing both a further dramatic increase in the computing power and reliability of the machines, and at the same time a dramatic reduction in their relative size and power consumption.

In early 1964, on its own 50th Anniversary, IBM released the six models of its new System/360 range of mainframes. These used hybrid IC modules rather than the still-develop-
ing monolithic chips, but provided a new standard of performance which immediately made all of its previous models — and those of most of its competitors — obsolete.

The British firm ICT released its 1900 series of small mainframe machines in early 1968. These used the recently developed TTL (transistor-transistor logic) ICs.

Mainframe computers were entering their ‘third generation’. Development of the new range was said to have cost IBM over US$500 million, a far cry from the US$600,000 expended by Eckert and Mauchly in producing ENIAC.

Minicomputers

Even the development of transistors had made it possible, by the early 1960’s, for designers to squeeze a basic computer into a box the size of a small refrigerator. The era of minicomputers was about to dawn.

In 1965, the Digital Equipment Corporation (DEC) of Maynard, Massachusetts announced what was to become the first commercially successful minicomputer: the PDP-8. (The ‘PDP’ stood for ‘Programmed Data Processor’.) The basic machine sold in the USA for under $20,000 — far less than existing mainframe machines, and regarded as a breakthrough at the time.

Based on 12-bit binary words, the PDP-8 contained a modest magnetic core memory of only 4096 words and a machine-language instruction set so limited that programmers could remember it all in their heads. Initially it used only a Teletype ASR-33 teleprinter for input and output, with inbuilt paper tape reader and punch for ‘loading’ and ‘saving’ programs.

I was lucky enough to be able to ‘play’ with one of the first PDP-8 machines to reach Australia, thanks to the good nature of John Cockram, then EDP manager at John Fairfax and Sons. I was able to spend many lunchtimes feeding in and running the first programs I ever wrote — and also many evenings poring over print-outs, trying to find their bugs!

I remember vividly that before you could even load a program into the memory after switching on the power, you had to key in a short ‘bootstrap loader’ routine, via the front-panel switches. This was to remind the machine how to load in the real programs, through the ASR-33 teletype’s tape reader...

The PDP-8 was extremely crude by modern standards, with far less computing power than the smallest modern desktop PC. But in the late 1960s, it and the other minicomputers which soon appeared were responsible for a dramatic expansion of the impact of computers in areas such as science and engineering.

For the first time, there were computers which were not huge and incredibly...
expensive monsters, costing so much to run that they could only be made available to a select body of 'high priests'. The minicomputer at last made it possible for ordinary scientists and engineers to get access to computers — not just for calculations, but also for monitoring and controlling lab experiments and industrial processes.

The first PDP-8 used discrete transistors, but DEC came out with an IC version in 1967. They also came out in 1970 with the larger and considerably more powerful PDP-11, which expanded the applications of minicomputers even further. Other firms soon produced similar small 'instrumentation' computers, such as the model 2116A from test equipment maker Hewlett-Packard. The age of automation began to dawn.

The microprocessor

The real breakthrough which led to the development of today's personal computers or 'PCs' came in 1973, when the Intel Corporation in California's 'Silicon Valley' developed the microprocessor. IC technology had finally reached a point where just about all of the parts for the processor section of a computer could be squeezed into a single tiny chip of silicon, a few millimetres square.

At first, these microprocessor chips sold for hundreds of dollars. But within about four years, manufacturing techniques and yields had improved dramatically, and the cost plummeted to less than $25. Not only this, but IC technology also made it possible to provide the memory section of a computer with a mere handful of RAM and ROM chips, whose prices began falling in the same fashion.

It now became possible to make a practical general-purpose microcomputer that was even more powerful than the first minicomputers, and little larger than a desk model typewriter — for less than $1000. In a little less than 12 years, computers had become more than 10 times smaller and over 50 times cheaper, for the same amount of computing power.

The age of the personal computer had arrived. At first they were like smaller versions of the first minicomputers, intended mainly for use by scientists, engineers — and electronics hobbyists keen to try their hand at computing.

But then in 1977 the first true 'appliance' personal computers appeared, designed especially for use in the home, school and office by people who had never used a computer before.

Probably the first of these to become really successful was the TRS-80 model 1, developed in the USA by the Tandy/Radio Shack Corporation and sold by them very widely throughout the Western world. Another very successful model in the first generation of machines was the Apple, the first of which was produced by a pair of young enthusiasts in a garage in Los Altos, California. Steve Jobs and Stephen Wozniac went on to found today's

Apple Computer's Macintosh personal computer, released in 1984, which pioneered the application of an easy to use 'graphical user interface' or GUI.
Apple Computer Corporation.

By the end of 1981, combined sales of the Tandy TRS-80 model 1 and the Apple were well over one million — many times more than the number of all computers, of any size, in use before 1978!

And along with this growth in sales of ‘hardware’, there was a corresponding growth in the ‘software’ market. A whole new industry had sprung up, producing pre-written software programs to run on the new machines.

In late 1981, an event happened which was to trigger the most recent almost explosive growth in personal computers. Deeply involved in mainframe computers since the 1940’s, the huge IBM Corporation finally entered the market with its own ‘PC’, based on the Intel 8088 16-bit processor.

The arrival of the IBM PC gave the personal computer much greater credibility as a personal productivity tool and office appliance. It also set new records for sales: over 200,000 units were sold in the first 15 months.

Following the huge success of the IBM PC, many other companies entered the market, many producing machines designed to be software compatible with the IBM machine — so they could use all of the programs written for it. Asian manufacturers in particular were quick to produce these ‘clones’, which generally sold for much less than the original IBM machine.

Needless to say IBM came out with enhanced models of its own PC, which grew into the PC-XT and PC/AT.

Apple Corporation also came out with more powerful models, following the original 8-bit machine. The most notable of these was the ‘Macintosh’ — source of what is now the second largest family of personal machines.

Of course mainframe and mini computers have not faded away with the enormous growth of personal computers. The larger machines have also taken advantage of the same advances in technology, undergoing almost continuous improvement in terms of both speed and computing ability.

The latest machines are many thousands of times faster and more powerful than those first clumsy machines of the late 1940’s, and in comparative terms much less expensive.

Computers have certainly come a long way — and apart from the events which laid the pre-computer groundwork, it has all happened in the last 50 years. The next 50 years should be even more interesting, judging by the way computer technology continues to accelerate. Already it’s predicted that within five years, personal computers will have processors running at 1GHz, with hundreds of megabytes of RAM memory and tens of gigabytes of disk storage.
The author's prototype is housed in a low-profile plastic instrument case, but an alternative would be a metal rack-mount box. The switch allows easy audio bypassing if desired.

Actually diminishes instead — with each peak being alternately replaced by an adjacent dip. This principle is the basis of frequency shifting.

In fact, frequency shifting as a method of acoustic feedback reduction is well established, having been used since the 1960s. Typically 6dB more usable gain before feedback is obtained in practice, as well as a much more stable situation with no ringing on speech in near feedback conditions. As well, the improvement is independent of varying the microphone position and whether a room is empty or full of people.

There is no set-up procedure or skill required to use a frequency shifter, and the full benefit can be obtained no matter what other methods of feedback reduction are in place.

Extensive testing has shown that a 5Hz up-shift is at the threshold of perceptibility on speech, and recorded music sounds quite normal when reproduced through the prototype. Similar units have been successfully used with the high powered monitor systems used for stage performances of live bands.

The design presented here produces a 5Hz shift across the 20Hz to 20kHz range and beyond, with very low noise levels and THD (total harmonic distortion) below 0.1%. It uses modern, readily available ICs and requires only minimal adjustments to be fully aligned and ready to use.

While this Audio Frequency Shifter (AFS) is not unique, the designer is unaware of any similar unit being commercially available in this country. 'Shifters' are sold in the UK, and also in the USA and possibly other countries, but Australian PA owners have been strangely reluctant to try them. Or perhaps they've never heard of them, and hence there is no demand and no products on sale!

Fig.2: The shifter works by splitting the incoming audio into components with a 90-degree phase difference. These are fed to four-quadrant analog multipliers, along with the signals from a 5Hz oscillator, with a similar phase difference. The two multiplier outputs are then added, leaving a single output 5Hz higher in frequency than the incoming audio.
AFS design outline

In the AFS the input signal is fed into two complementary phase-shift networks called the 'outphaser', whose outputs are 90° phase shifted with respect to each other over a 20Hz to 20kHz range, whilst maintaining a flat amplitude response. Then two analog multiplier ICs are used to multiply the two audio signals with a fixed 5Hz oscillator and a 90°-shifted version of the same 5Hz signal. The two multiplier IC outputs are then summed to produce the desired output (see Fig.2).

For example, when an input signal at 1000Hz is multiplied by the 5Hz signal in U5 the resulting output consists of two sidebands, the sum and difference signals at 1005Hz and 995Hz. Similarly the other multiplier U6 produces the same two frequencies; but because the two 995Hz signals are 180° out of phase, and the 1005Hz signals are in phase, the former cancel in the summing stage leaving only the 1005Hz signal. An exactly similar argument applies for any audio frequency fed into the AFS, so the nett result is that all audio frequencies emerge shifted 5Hz higher.

Note that reversing the multiplier inputs of either the audio or low frequency signals will produce a 5Hz downward shift, as would changing the summing stage into a subtracting one.

Circuit details

Referring now to the circuit diagram, the input buffer (U4b) is a simple differential stage which can be used for either balanced or unbalanced inputs and has a gain of 2.2 times. The overall gain is later restored to unity in the output stage — a noise reduction measure.

The outphaser employs two TL074 quad Bi-FET op-amps U1 and U2, with all eight op-amp sections connected as unity gain all-pass filters in two chains of four stages. An all-pass filter rotates the phase of an input through 0 to 180° over its operating frequency range, whilst leaving the amplitude unchanged (see notes 1 and 2).

Each stage in the two chains has been carefully chosen with staggered poles or frequencies where the phase shift is exactly 90°. The total phase shift through each chain exceeds 720° at supersonic frequencies, however in the range from 20Hz to 20kHz the important 90° difference is maintained to within a 2° error margin.

Note that for proper operation of this circuit it is essential that 1% tolerance components are used, including poly-
Soldering technology


A thorough and comprehensive reference to modern soldering and the associated technologies used for both electronic and microelectronic packaging and assembly. Author Dr Jennie Hwang is a recognised world authority in this area, and a consultant to the US military, major OEMs and SMT manufacturers. She has previously written Solder Paste in Electronics Packaging and BGA & Fine Pitch Peripheral Interconnection, both well respected references in the field, and has been both president and a board member of the US Surface Mount Technology Association.

There are some 20 chapters in this work, covering virtually every aspect of modern soldering, packaging and assembly — from environmental considerations right through to detailed metallurgical microstructure analysis techniques. Most of us in the industry probably wouldn’t have dreamed there were now so many aspects of soldering, surface-mount and packaging technology, and how much detailed knowledge is now required for efficient and professional manufacturing!

Dr Hwang takes us through it all in a highly organised and methodical fashion, and seems to cover just about every conceivable aspect of soldering, IC packaging and electronic assembly. She gives a huge amount of reference data along the way, including many informative and interesting shots taken via an SEM (scanning electron microscope).

For those who need to keep up to date in this area, it’s probably an essential reference. The review copy came from McGraw-Hill Australia, of PO Box 239, Roseville 2069. (J.R.)

Digital IC reference


This excellent book suffers from one basic problem: the pages are so narrow, it’s almost impossible to keep the book open at the page you want to read. That said, in all other respects it achieves what its title says, describing and giving applications for over 185 of the 74 series and the 4000 series of digital ICs. It has some 600 diagrams and 15 chapters and should prove useful to anyone working with digital ICs.

The first three chapters explain the basics of digital ICs, including TTL and CMOS principles, and today’s main sub-families of the 74 series (LS and HC). Chapters 4 and 5 cover CMOS principles and CMOS ICs, while the next chapter deals with logic circuitry including logical symbols and mathematics, along with data for some of the ICs.

Later chapters progress through bilateral switch ICs, waveform generator circuitry, clocked flip-flop and counter circuits, special counter-dividers, data latches, registers, comparators and code converters. Chapter 14 then covers specialised ICs such as multiplexers, demultiplexers, addressable latches, decoders, full adders, bus transceivers, priority encoders and rate multipliers.

The final chapter presents a miscellaneous collection of digital circuits.

There are pin diagrams for ICs throughout the book and typical applications with circuit diagrams. The writing style is friendly and informative.

The book should prove useful to both beginners and professionals, and because it is up to date, it covers today’s ICs, such as the 74HC40193 and even the CMOS 555 timer.

The review copy came from Butterworth Heinemann, PO Box 251, Port Melbourne 3207. (P.P.)

Microwave repair


This is the fourth edition of Homer Davidson’s book on servicing microwave ovens, testifying to its popularity. So far it has apparently sold over 40,000 copies, putting it into the ‘best seller’ category among technical books.

Homer Davidson is of course a prolific US technical author, with many articles and books to his name, and this one certainly provides a lot of down-to-earth practical information on microwave oven servicing. It’s quite comprehensive, and in this fourth edition he has both updated and expanded a lot of the material.

Although it’s primarily written for the US market, and all of the models discussed are those sold in that market, I believe much of the material presented would still be of great value to the reader over here. It’s all clearly written, with plenty of illustrations, and the techniques presented should in many cases be equally applicable to local brands and models (some of which will be very similar, of course).

Whether you’re a service tech who needs to repair microwaves faster, or an amateur who only wants to repair your own, it’s likely to be of considerable value. Just make sure you read the warnings about safety!

The review copy came from McGraw-Hill Australia, of PO Box 236, Roseville 2069. (J.R.)

There is no crowding inside the prototype case. A rectangle of unetched PCB laminate, connected to earth, is mounted underneath the main PCB to provide a measure of shielding.

The multiplier stage uses two Analog devices 74HC40193 ICs, while the next chapter deals with logic circuitry including logical symbols and mathematics, along with data for some of the ICs.

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The book should prove useful to both beginners and professionals, and because it is up to date, it covers today’s ICs, such as the 74HC40193 and even the CMOS 555 timer.

The review copy came from Butterworth Heinemann, PO Box 251, Port Melbourne 3207. (P.P.)
Here’s a new low cost design for a unit which can be of great assistance in controlling acoustic feedback (‘howl-round’) in public address and other sound reinforcement systems. It operates by shifting the audio spectrum by 5Hz, and features very low noise and distortion over a full 20Hz to 20kHz bandwidth.

by PHIL ALLISON

Anyone who has ever used or heard a PA (public address) system in an auditorium will be familiar with the phenomenon of acoustic feedback or ‘howl-round’, whenever the gain control is set at too high a level. Typically an ear-shattering screech comes from the speakers until the operator reduces the system gain; even then ringing at various frequencies can often be heard whenever the person addressing the gathering speaks into the microphone.

Acoustic feedback occurs when the sound finding its way back to the microphone position from the loudspeakers is equal or more in level to that coming from the voice of the person at the microphone. The ‘system gain’ is then said to exceed unity and positive feedback creates full power oscillation at a resonant frequency of the entire room and PA system.

A variety of remedies for acoustic feedback exist, including the use of directional (i.e., cardioid) microphones and the careful placement of loudspeakers to minimise the sound level arriving back at the microphone. Also a graphic equaliser can be placed in the audio chain, to smooth out the overall response. These methods are effective to varying degrees, but much less so in rooms with noticeable echoes, where reverberation becomes the major cause of feedback problems. The non-directional nature of reverberation means that sound will approach even a cardioid microphone on its front axis and largely negate any placement scheme.

Readers should be aware that the vast majority of rooms and auditoriums have significant amounts of reverberation. Only heavily acoustically treated rooms like recording studios or open air situations are reverberation free.

Why shift frequency?

Now there is an important but little known fact about the acoustics of rooms and auditoriums. If a frequency response sweep of a room is done VERY slowly, it is found to have a fine structure of minor resonances, superimposed on the usual much broader major ones. This fine structure consists of sharp peaks and dips about the average level, each one separated by only a few hertz, right up and down the audio spectrum (see Fig.1).

![Fig.1: In detail, the frequency response of a typical room has a series of sharp peaks and troughs, separated by only a few hertz.](image)

These narrow band resonances are caused by standing waves set up between the walls and other parallel surfaces of a room. They seriously exacerbate acoustic feedback problems when a PA system is used and can limit the available gain before feedback occurs in even the best systems by 10dB.

However, the really interesting fact is that the frequency spacing of these resonances is a constant number of hertz, characteristic of the room and its reverberation time. Generally for most auditoriums the spacing of adjacent peaks is about 10Hz, or 5Hz between adjacent peaks and dips.

If the whole audio spectrum of the signal from the microphone could be shifted by about 5Hz, then the effect of these peaks would be eliminated. A sound going around the microphone-speaker-room loop is no longer reinforced each time at a (minor) resonant frequency, but
an underdamped needle. Budget priced VU’s should be the most suitable.

To align the AFS use an input frequency of 380Hz and a level of between 1 - 3V RMS. Adjust P1 and then P2 for minimum modulation, then repeat the above until no further improvement is possible; the modulation should now have all but disappeared.

If the input frequency is now swept up and down the audio band, there should be several areas where the modulation reappears and others where it disappears again (see note 3). The modulation percentage should not exceed 2% anywhere in the audio range, provided that sufficiently accurate components have been used in the outphaser. This small level of amplitude modulation at 10Hz has proved to be completely inaudible.

The Audio Frequency Shifter PCB module is now ready to install in your case. If you are using a plastic box then cut a piece of light gauge aluminium sheet or copper clad PCB material and place it under the AFS board with suitable spacers, connecting it to signal ground. Also connect the transformer’s frame to mains ground by linking the IEC socket ground pin to the rear mounting panel (see photos).

If you opt for a rack-style case, then I recommend earthing the metalwork but leaving the PCB ground floating. Ceramic capacitors of 10nF or larger may be connected from input ground to the metal panel adjacent to the input connector, as an anti-RF interference measure.

**Using the AFS**

The AFS is designed to operate at standard line level of about 1V RMS. Connect in the signal chain before the main amplifier stage. If a graphic equaliser is in use, it may be connected either before or after the AFS.

When everything is set up I suggest you adjust the system as usual with the AFS in bypass mode. Then switch it into circuit and increase the gain setting until a slight warbling sound starts. Adjust the gain downwards about 2dB below this level and leave it. The PA system should now be both louder and much more stable than before, with no ringing and better intelligibility.

**BEWARE**, however: switching the unit back to bypass mode now will probably result in an immediate loud howling from the speakers!

**Possible modifications**

1. If desired the input gain may be altered to suit particular applications where the signal level may be higher or lower than the 1V level specified. The ratio \( R1:R3 \) and \( R2:R4 \) sets the input gain and \( R57:R59 \) the output gain. The overload margin and noise levels will be affected and a suitable ‘trade off’ should be found.

2. In the case of very large auditoriums the optimum frequency shift is less than 5Hz. To lower the oscillator frequency, increase the values of \( R44 \) and \( R45 \) by the same amount and also increase the combination of \( P1 \) and \( R54 \) by that same percentage. A frequency shift of 2Hz will suit even the largest venues.

3. A multi-channel unit may be constructed by installing the required number of PCBs and mains transformer with a higher rating. Allow 150mA AC of secondary rating for each channel.

**References**


Mini construction project:

THE MINISTROBE: USING THE NEW WHITE LED

Late last year Nichia Chemical Industries Ltd announced the release of a new semiconductor device, the white LED. Dick Smith Electronics has recently started to stock white LEDs, and so we thought we'd base this project around one of these interesting devices.

by GRAHAM CATTLEY

Not that long ago, LEDs came in four standard colours: red, green, yellow and orange. Blue LEDs have recently appeared on the scene, and these have raised a lot of interest in people wanting to make white LEDs.

By combining red, green and blue LED chips inside the one package, a 'white' LED could be created. You can find these LEDs around, but they do tend to draw more current, and require a careful balance in the current to each of the LED chips to produce a white light.

New developments in blue LED design have resulted in a new super-bright blue LED, by using a gallium-nitride semiconductor crystal instead of the usual crystal used in blue LEDs, silicon-carbide. This bright blue LED has opened up a new way to produce white light from a LED, by covering the LED's emissive surface with an yttrium-aluminium-garnet phosphor layer. The phosphor layer absorbs most of the blue light, and re-emits it as yellow light. This light mixes with the blue light that passes through the layer to produce a bright white light.

A white LED

So what are these new white LEDs like? Well, Dick Smith Electronics kindly sent us a sample LED to try out. DSE is currently selling the 5mm white LED as catalog number Z-4002 for $7.95 each.

From the outside, the LED looks just like any other LED, with a 5mm diameter water-clear body and 20mm leads. On closer inspection, however, there are some subtle differences in construction between this and a normal LED. Firstly, if you look down the body of the LED, you can see the yellowish phosphor coating covering the blue LED crystal. This coating appears a dull yellow in low levels of normal light, and when it is bombarded with the blue light from the crystal it will fluoresce and give off a bright yellow light.

The second difference is that there are two connections made to the crystal's surface — one for the anode, and one for the cathode. These are made with thin gold wire, and join the crystal's surface to each of the leads.

This is different from normal LED construction where only the anode is connected in this way, with the cathode connection made directly through the bond of the crystal to the 'cup' formed at the top of the cathode lead.

All of the white LED's electrical characteristics are printed in an eight-page data sheet supplied by DSE with the LED, but some of the more important
The multiplier stage uses two Analog Devices AD633 'four quadrant' multipliers ('four quadrant' means it operates with both polarities of both inputs). These eight-pin DIL ICs (U5, U6) are complete circuit blocks in themselves, requiring no external components or fussy adjustments. They have been laser trimmed during manufacture to eliminate offsets and offer low distortion and noise levels. The multiplier 'X' inputs are used here for the two audio signals from the outphaser, while the 'Y' inputs receive the two 5Hz oscillator outputs.

The AD633 operating equation is:

\[ V_{\text{out}} = \frac{(V_x \cdot V_y)}{10} \]

This equation means that the output voltage is the product of the instantaneous values of the two input voltages, having regard for polarity, divided by a scale factor of 10. The IC's small signal bandwidth is specified as 1MHz, with a slew rate of 20V per microsecond, so an audio signal presents no problems.

Having the 1:10 scale factor means that to achieve operation with overall unity gain, one of the signals must have an amplitude of 10 volts. This is the case with the 5Hz oscillator, whose output level at the multiplier inputs is very close to 10V peak.

The oscillator circuit will be familiar to some readers as a revamp of the Miniosc design (EA December 1996). Operating now from +/-15V supplies and using another TL074, the output frequency and also level are fixed, the latter by using back to back 6.2 volt Zener diodes.

As before, the combining stage U3b operates to substantially cancel third harmonic distortion caused by the use of the zeners. This feeds a low-pass filter network formed by R51 and C12, to further reduce harmonics to about 0.1%. It then drives U4d, connected as single stage all-pass filter, which is adjusted to produce exactly 90° phase shift at the frequency of the 5Hz oscillator by use of trimpot P1. The input and output signals of the all-pass filter are used to drive the 'Y' inputs of the two multiplier ICs.

The outputs of the multiplier ICs are summed by U4c, with trimpot P2 used to compensate for any small mismatch in levels occurring up to this point, due mainly to resistor tolerances. The gain here is 0.45, to compensate for the 2.2 times gain at the input.

Finally the output buffer U4a is connected in a pseudo-balanced configuration, with ground compensation on R66 to drive balanced input circuits. Switch S1 acts to bypass the whole circuit by connecting the output buffer directly to the input buffer.

### Power supply

The power supply is straightforward using a centre tapped 30V AC, 150mA transformer with a bridge rectifier and IC regulators to produce +/-15 volts supplies for all the ICs. The total circuit drain is about 40mA, so TO-92 style 100mA regulators easily suffice. The circuit is largely immune to supply rip-

**Table 1: White LED Specs**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward voltage:</td>
<td>3.6 - 4.0V</td>
</tr>
<tr>
<td>Max forward current:</td>
<td>30mA</td>
</tr>
<tr>
<td>Peak forward current:</td>
<td>100mA (1:10 mark/space)</td>
</tr>
</tbody>
</table>
A simple plastic instrument case houses the prototype, but readers may prefer to use a rack-style metal cabinet with 'Cannon' type connectors, for that professional audio look. Or alternatively you could install the PCB and transformer inside an existing PA amplifier case, where there is sufficient room.

Construction

The PCB should be carefully checked for bridges between tracks and missing holes before you begin loading components. Holes for PC pins and the two trimpots may need to be enlarged, and the four mounting holes drilled to size.

Using the overlay diagram start by loading the resistors — after first double checking the values with your digital multimeter, as 1% four band resistors are sometimes ambiguous.

I recommend the use of IC sockets, provided they are the 'dual wipe' variety or else have machined pins. After these have been fitted then the capacitors, power supply components, links and PC pins may be installed.

When you have finished, double check for correct orientation of the diodes, capacitors and IC sockets and again check for solder bridges all over the board, using your ohm-meter where any doubt exists. At this stage I suggest you wash the PCB with methylated spirits, to remove all solder flux and then dry with a hot air gun on low power.

Cleaning the board like this will help reveal any remaining whiskers of solder and sub-standard joints.

Commissioning

Since the board is self contained, it may easily be tested before installing in your case. Simply connect the switch S1 as shown, the transformer and your bench audio generator (or Miniosc) and a CRO if one is available. Do not install the DIL ICs for the moment, but apply power and measure the two supply rails; verify that they are close to +/-15 volts.

If all is OK, switch off the power and install the ICs.

After restoring power a signal should appear on the CRO screen probably with some 10Hz amplitude modulation visible. If this is not the case, check the +/- 15 volt rails again. If they are OK then use an analogue multimeter or CRO to check that the 5Hz oscillator is working with 8 volts rms on all output pins. The other op-amp and multiplier IC outputs should be at zero volts DC (+/- 20 mV). To stop the 5Hz oscillator simply short together the positive ends of the two zener diodes.

When the unit is operating normally the input and output levels are virtually the same in either position of switch S1, and any slight 10Hz amplitude modulation can now be adjusted to minimum by use of trimpots 1 and 2. If no CRO is available, then a moving-coil VU meter or AC voltmeter may be used to detect the amplitude modulation — provided it has

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THE MINISTROBE USING THE NEW WHITE LED

As you can see, there are a lot of unused holes in the basic circuit; these are used if you want to add some of the component modifications described in this article.
The circuit LED's bright white light, its high efficiency and fast response time. Electric motors, car engines, electric mixers, almost anything that moves or rotates at these sorts of speeds (or multiples thereof) can be seen as though they are stock still, by simply adjusting the knob on the front panel.

As described, the MiniStrobe can effectively 'stop the motion' of almost anything running from 400 to 4000rpm. As you can see, this gives a 1:10 mark spacing ratio, with an upper pulse frequency of 100Hz. Now this doesn't sound much when compared with 4000rpm, but if you think about it 400rpm translates to 66.6Hz — so our 100Hz maximum will let us view machinery running at a theoretical maximum of 6000rpm, more than enough to use on most domestic equipment.

The MiniStrobe is built on a 26 x 60mm PC board, and is designed to fit inside the smallest of jiffy boxes along with a 9V battery.

Needles to say, as soon as we received the LED from Dick Smith, we connected it up to a power supply via a suitable dropper resistor, and turned it on. Sure enough, the LED emitted a bright white light with perhaps a slight bluish tinge.

Running at 20mA, the LED produces 600mCd (quite bright) and a forward voltage drop of 3.2 - 4V. Table 2 shows the appropriate value dropper resistor to use for a number of different supply voltages.

### The MiniStrobe

Well, a white LED is all very well, but what use can it be put to? After a bit of thought, we came up with the MiniStrobe. It takes advantage of the LED's bright white light, its high efficiency and fast response time.

As described, the MiniStrobe can effectively 'stop the motion' of almost anything running from 400 to 4000rpm. Electric motors, car engines, electric mixers, almost anything that moves or rotates at these sorts of speeds (or multiples thereof) can be seen as though they are stock still, by simply adjusting the knob on the front panel.

A Wide/Narrow switch lets you alter the width of the output pulse to prevent blurring at higher speeds.

### The circuit

The purpose of this circuit (Fig. 1) is simple: flash a LED at a variable rate, set by the speed control on the front panel. Essentially it's fairly straightforward, but by looking through the specs a way of achieving a higher output light level can be found.

Although the LED is rated at a maximum forward current of 30mA, it can be run at up to 100mA (and give correspondingly higher light output) if we follow a few simple rules: the LED must not run at this current for more than 10ms, and it must be left off for at least 90ms afterwards to cool down.

As can you see, this gives a 1:10 mark space ratio, with an upper pulse frequency of 100Hz. Now this doesn't sound much when compared with 4000rpm, but if you think about it 400rpm translates to 66.6Hz — so our 100Hz maximum will let us view machinery running at a theoretical maximum of 6000rpm, more than enough to use on most domestic equipment.

The circuit is based around two 555 timer ICs, one set to provide a fixed length pulse to the LED when triggered, and the other to trigger it at a variable rate set by the user. U1 performs this second function, as it is set up in astable mode and delivers a needle-thin (30us) pulse on its output pin 3 at anything from 6.66Hz to 66.66Hz, depending on the setting of VR1.

R1 is a stopper resistor that limits the top speed of the astable so that we don't exceed our 1:10 mark/space ratio. These output pulses trigger U2, a monostable that is configured to produce one of two different pulse widths. With SW2 open, C3 charges through a total of 110k, giving an output pulse width of 1.8ms. If SW2 is closed, C3 charges through only 10k, and a much shorter 156us pulse is produced.

The pulse output from U2 switches on Q1, which in turn drives the LED via R5 a 56-ohm dropper resistor. This limits the current through the LED to around 100mA and provides a nice bright display.

### Construction

The MiniStrobe is built on a 26 x 60mm PC board, and is designed to fit inside the smallest of jiffy boxes along with a 9V battery.

Start construction by mounting the eight PC pins around the edge of the board. The four resistors and three

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**Diagram:**

Fig.1: U1 runs in astable mode, generating narrow pulses at a rate determined by VR1. U2 is a monostable that produces a 1.8ms or 156us pulse (depending on the position of SW2), every time it is triggered by U1. The output is buffered by Q1 which can handle loads up to 800mA.

**Table 1:**

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<tr>
<td>Peak forward current:</td>
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<tr>
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<td>Luminous intensity:</td>
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<tr>
<td>Colour temperature:</td>
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<td>Viewing angle:</td>
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**Notes:**

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THE MINISTROBE USING THE NEW WHITE LED

As you can see, there are a lot of unused holes in the basic circuit; these are used if you want to add some of the modifications shown below.

capacitors are next, followed by Q1 and the two ICs. Use the overlay diagram as a guide when installing these components, as you’ll notice that a lot of holes are unused (for now) and it is easy to put a component in the wrong place.

Connect VR1 and SW2 to their respective PC pins using short lengths of hook-up wire, and then solder in a 9V battery clip with SW1 connected in series with the positive lead. LED1 should be connected to a pair of 50mm leads, keeping the actual LED leads long (around 10mm) and fitting a couple of pieces of heat shrink over the joints to prevent them from shorting together. (A handy rule of thumb when installing LEDs is to remember that when looking into the LED, the cathode leg is larger than the anode.)

Drill a 5mm hole in one end of the jiffy box to accommodate the LED, and three holes in the lid for the pot and two switch-
es. Trim the pot shaft to 10mm or so and then you can put the whole thing together. The battery sits on edge on the right-hand side of the box, while the PC board can be held in place on the left with a small piece of foam packing material.

Optional mods
As mentioned earlier, there are some unused holes on the PC board, and these allow you to expand the MiniStrobe (MaxiStrobe?) in a number of different ways. The first (and most dramatic) modification is to add extra LEDs to provide more light output from the strobe.

There is provision on the board for an extra seven LEDs (and associated drop-ber resistors). These can, of course be more white LEDs if you wish, but you could also take the less expensive approach and install some of the cheaper high intensity red LEDs. These LEDs can produce up to 3000mCd, and can create quite an impact, particularly in a darkened room.

If you decide to add some extra LEDs, the MiniStrobe will probably have to be run off a 9 - 12V power supply, as the poor old 9 volt battery probably won’t be able to keep up with the extra load. Fig.2a shows how the extra LEDs are wired in.

The second optional modification is to replace SW2 with a 100k potentiometer, to give a variable pulse width. In the original configuration of Fig.1, R2 is switched in and out of the circuit to give two different pulse widths. By removing R2 and replacing SW2 with a 100k pot (as shown in Fig.2b), a variable width pulse (at the same frequency) can be achieved.

Fig.2c shows how to add a BNC output to the MiniStrobe to enable you to accurately determine the rotational speed of an object, by letting you adjust the MiniStrobe to give you a stable view, and then connect it to a frequency counter to get an accurate reading. To convert the counter’s output (in hertz) to rpm, simply multiply the reading by 60.

If you want to calibrate the MiniStrobe, Fig.2d shows how a 50k mini trim pot can be installed instead of R1 to allow you to set the top end of the range. If you install the project in a bigger box, you can then use a larger knob on VR1 and mark off a new scale to match. The strobe’s frequency drifts slightly with supply voltage, so in this case you would be best off running the unit off a regulated power supply.

Safety warning
One final note: The human mind tends to base its perception of the outside world on what it sees, rather than what it knows or hears. As a result, it is very easy to forget that a piece of high speed machinery is running when you are looking at it under a strobe — after all, it looks still...

DON’T be tempted to reach out and touch any part of a moving object viewed under these conditions, as you can cause serious injury to yourself and others. When testing this project with a 24V electric motor running at 5000rpm I still reached over to touch the small paper flag that I’d attached to the motor’s shaft, to be met with an embarrassingly loud (and painful) buzz. So be warned!

New blue LED
As well as the new white LED, Dick Smith Electronics are now supplying a new high-intensity blue LED that uses the new gallium-nitride (GaN) semiconductor crystal which produces a very bright blue light output when energised. The LED is encased in a water-clear resin, and has a viewing angle of +/-30. The LED has a luminous intensity of 500mCd when running at 3.6V at 30mA. Dick Smith stores and dealers are stocking the blue LED as catalog number Z-4007, for $6.95.
The antenna and around the earpiece lie. Where your ear actually presses against the phone. Our product consists of a quality leather case custom made for most popular phones with a lead shield sewn into the antenna base/loading coil area and right across the earpiece area. When you put the case over your phone you fashion the cloth protected extremely malleable lead shield around the antenna base. You can test the effectiveness with a meter type microwave leakage detector. The difference from unprotected to protected is amazing, yet the signal strength meter on your phone display will show the same levels of signal as an unprotected phone.

Cancer from Mobile Phones: Why Take the Risk? There has been much talk lately about the electromagnetic radiation effects of mobile phones on your head. It seems that some university teams have established a link between 900MHz mobile phone frequency and cancer in laboratory rats. Whether this alleged link is applicable to humans is yet to be established. Anecdotal evidence, however, seems to indicate that these new mobile phones give many people up to severe headaches, disorientation, etc. Jaycar has been searching the world over for 6 months now to find a suitable RF (Faraday) shield to protect the head from radiation yet not compromise the performance of the phone itself.

At last we have come up with a product that does this. The area of greatest radiation concern is around the base of the antenna and around the earpiece, where your ear actually presses against the phone. Our product consists of a quality leather case custom made for most popular phones with a lead shield sewn into the antenna base/loading coil area and right across the earpiece area. When you put the case over your phone you fashion the cloth protected extremely malleable lead shield around the antenna base. You can test the effectiveness with a meter type microwave leakage detector. The difference from unprotected to protected is amazing, yet the signal strength meter on your phone display will show the same levels of signal as an unprotected phone.

The Jaycar PHONE GUARD protector costs no more than a standard replacement leather case and gives you the comfort of reducing the direct radiation into your head which could be extremely harmful.

This superbly designed case also includes a ROTATABLE BELT CLIP, which easily allows you to turn your phone to the horizontal position, allowing you to sit down comfortably.

NEW POWER SUPPLIES

NEW VOLTCORE 2 AMP REGULATED

NEW VOLTCORE 2 AMP UNREGULATED

NEW MOTOROLA MICRO TAC LI-ION BATTERY

Lithium ion batteries give you much better talk time and are environmentally friendly. This battery has a current capacity of 1.35 amp. When used with a 8400/8700 Motorola you get 120 hours standby & 540 mins talktime, and with a Microtac you get 40 hour standby and 180 mins talktime - and no memory effect. And at Jaycar pay no more. These sell for between $189 & $250 at our opposition.

NEW OLD STORE - ASPEY 132 Olympic Rd, Castle Hill • OPENING MID AUGUST

NEW OLD STORE - ASPEY 132 Olympic Rd, Castle Hill • OPENING MID AUGUST

NEW OLD STORE - ASPEY 132 Olympic Rd, Castle Hill • OPENING MID AUGUST
EXTREMELY LARGE LCD DIGITAL CLOCK WITH CALENDAR AND TEMPERATURE

This must be the largest LCD clock we have ever seen! Ideal for warehouses, factories, offices and home etc. Includes: Temperature readout in C or F. Calendar with day, date and month display. +12 or 24 hour time. Huge 162 x 94 LCD display with actual time digits 55mm high. Total size 210(w) x 230(h) x 35(d)mm. Charcoal in colour.

Operates from 2 x AA batteries. Cat. XC-0230

NEW PINING FOR VINYL?

Now is your chance to make the ultimate phone turntable. Yet another scoop purchase. Jaycar has done it again with a genuine stock purchase of a German PAP3100 turntable. Electronic turntable motor. This turntable has been designed for the ultimate home entertainment market! It can be driven by AC110/220V or DC5V (switchable). With a built-in 33rpm or 45rpm motor. The speed of the turntable can be changed by +/- 30 rpm by a variable potentiometer. It also has a switchable a.c. or d.c. power source. The turntable can be controlled in motor speed by a variable potentiometer. It also has a switchable a.c. or d.c. power source. The turntable can be controlled by an electronic controller circuitry! These are due to a couple of local turntable enthusiasts. It is an easy-to-set up market product! The turntable is now back in vogue the price of $49.95 each in 2001.

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C & K SLIDER SWITCH, 1-2, 10 plus 50c ea | NICAD/NI-MH CHARGER

Plugs into your cigarette lighter. Charges 1-4pcs. AAA, AA, C, D and 1pc. 9V. See 97 Cat. page 77 for full details.

INDUCTANCE DMM

Includes: Capacitance
Temperature +Transistor test
Continuity +Ohm test

BULK USERS - CONTACT OUR WHOLESALE DEPARTMENT FOR SPECIAL PRICING (02) 9743 5222
 allegiance rear Dolby speakers. 5.5" woofer and 1" dome tweeter. See August 1996 advert for full details. Limited quantity available. Not available at dealers. Cat. CS-2430

Retail Price $299 Pr Was $169 Pr Sellout Price $99 Pair

LOW COST EXTENSION SPEAKERS 4" speakers, handle 60 watts. Cat. AS-3150 Was $6.95 Pr Now Only $4.95 Pr
$10 Wonders
by OWEN BISHOP

5 - An exit door timer
Adding a simple security system to your home needn't be difficult or expensive, as this month's $10 Wonder shows. Using a couple of CMOS ICs, it's an alarm which can be coupled with last month's Programmable Alert to give a cheap and simple alarm system that can cover a single door or window, or even the whole house.

The weakest part of any security system is the Exit Door, the door by which you leave your home when you go out. Other doors, and windows too, may be securely bolted and chained from the inside, so that only brute force can open them. But you can't use bolts on the exit door — you have to rely on a lock.

Everyone knows that the latch-type lock can be opened from the outside using a piece of stiff plastic, and so it is essential for this door to have a mortise deadlock, preferably with five levers.

Keys can be copied, however, or you might forget to lock the door when you leave, so it is a good idea to have some kind of alarm system to back up the physical side of security. The problem is how to get out of the house without setting off the alarm and, later, how to get back in again. The solution is this month’s $10 Wonder project.

The circuit includes two timers, which allow you about 20 seconds to leave the house and shut the exit door behind you, without triggering the alarm. When you return, you again have 20 seconds in which to go to the hidden control box and reset the system. To keep the cost within our $10 budget, we use the relatively low-precision technique of timing by charging capacitors.

The sensor for this circuit is a switch mounted on the door. When the door is closed, this switch is closed, so we refer to it as a normally-closed (NC) switch. The simplest form is an inexpensive microswitch mounted on the door-frame, and arranged so that its plunger or lever is held depressed when the door is closed. Most microswitches have change-over contacts, so use the pair that are closed when the plunger is pressed.

The reason for using a normally-closed switch is that the system cannot be inactivated by someone cutting the wires between the door-switch and the control box. Cutting the wires has the same effect as opening the door!

Reed switch
A neater but more expensive type of door switch is a magnetic reed switch. The switch consists of two lengths of springy metal ('reeds') sealed in a tube (Fig.2). This is mounted on the door-frame; some types suitable for a wooden frame are designed for fitting into a recess bored in the frame. The other part of the switch consists of a permanent magnet. This is mounted on, or recessed into the door.

When the door is closed the magnet comes close to the reed switch. Its field magnetises the reeds, causing them to be attracted to each other so that they make contact and close the switch. When the magnet is removed (door opened a few millimetres) they lose their magnetism and spring apart.

This circuit can be used with most of the audible warning devices (sirens, screamers, piezo-alarms) available ready made, provided they are rated to operate on 9V. Many operate over the range 6V-15V and so are entirely suitable. You may also use this circuit to drive last month's $10 Wonder, the Programmable Alert.

How it works
The part of the circuit labelled 'wires
to door’ in Fig.1 consists of a pair of wires (light duty figure-8 wire is suitable) running from the control box to the door switch. At the control box, one wire is connected to R1, the other to the 0V rail. Incidentally, if you have several doors to protect, you could have a loop connecting their door switches in series. Then if any one of these is opened, the alarm is triggered.

The loop could also include devices such as passive infra-red detectors and smoke alarms, for many of these have normally closed switches which can be wired into the system.

All the logic gates used in this circuit are of the NAND type — that is, their output is low (0V) only when both their inputs are high (9V); otherwise the output is high. The input to pin 9 of the NAND gate (IC2c) is normally low and, as we shall see later, pin 8 is normally high, so its output is normally high.

The next pair of gates are connected as a set-reset bistable or flip-flop. When the bistable is in its usual reset state, the output at pin 4 (IC2b) is low and capacitor C1 is discharged. This rates as a low input to IC2a, which has a high output, so that its output remains high whether or not the door is open or shut. The bistable cannot be set and the alarm can’t sound. The alarm is enabled again at the end of the low pulse.

LED1 indicates the state of the charge on C2. Normally this is high (9V) and LED1 is out. When you close S2, the low pulse begins immediately and LED1 comes on, when C2 has discharged to 4.5V. By this time, you should be out of the house because the low pulse is due to end any second.

The pulse generator takes 30 seconds or so to recover its state after S2 is opened. When you return to the house LED1 will be on, reminding you to open S2. Do not close it again until 20 seconds or more after LED1 has gone out.

**Construction**

To minimise the wiring we have made use of the copper tracks for several inter-gate and inter-IC connections. For this reason, several of the strips below and between the ICs are not cut. Note that the ICs are NOT mounted level with each other, and that you can use solder blobs to join some of the IC pins in pairs, saving on installing some of the links.

Ideally the circuit should be housed in a plastic box on which S2, S3 and the LEDs are mounted. When you check the circuit after completion, bear in mind that electrolytic capacitors often vary by as much as 50% from their nominal value. If you find that timing periods are too short or too long, replace the capacitor with another one of the same nominal value or use a larger or smaller resistor to compensate.

Locate the box some distance from the Exit Door, preferably hidden in a cupboard, so that an intruder can’t find it and switch off the system. The box should be big enough to hold a battery power supply. Quiescent power consumption is about 7.5mA, the main users of current being the LEDs.

We have used relatively large-value resistors in series with the LEDs to conserve current. If you feel that you can manage without their guidance, omit them and resistors R7 and R8, and the circuit could then be powered by a 9V PP3 battery.

For long periods of operation use a 9VDC plugpack, but keep the wiring hidden if possible. The 2N3053 transistor is rated at 700mA, which is more than enough for most types of buzzers, sirens and the like, but you could substitute a similar power transistor if you like.

**PARTS LIST**

<table>
<thead>
<tr>
<th>Resistors</th>
<th>(all 5% 1/2 Watt)</th>
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<tr>
<td>R1, R2, R5</td>
<td>10k</td>
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<td>R3</td>
<td>100k</td>
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<td>R4</td>
<td>470</td>
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<td>R5</td>
<td>150k</td>
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<td>R7, R8</td>
<td>2.2k</td>
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<tr>
<td>C2</td>
<td>470uF axial 16WV electrolytic</td>
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<tr>
<td>D1</td>
<td>1N4148 signal diode</td>
</tr>
<tr>
<td>IC1, IC2</td>
<td>CMOS 4011 quad NAND gate</td>
</tr>
<tr>
<td>LED1, LED2</td>
<td>5mm red LEDs</td>
</tr>
<tr>
<td>Q1</td>
<td>2N3053 NPN transistor or equivalent</td>
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<th>Miscellaneous</th>
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<tr>
<td>S1, S2</td>
<td>Door switch (see text)</td>
</tr>
<tr>
<td>S3</td>
<td>Push-to-make pushbutton</td>
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Audible warning device, 9V operating (see text); 2.5mm matrix stripboard 98mm x 34mm (37 holes x 13 strips); 6 x 1mm terminal pins; 2 x 14-pin IC sockets.
Project ideas, classroom demonstrations and AmiPro

A discussion on the basic principles of troubleshooting opens the column this month, followed with reader letters covering wordprocessors, valve amplifier design and using a TV set as a computer monitor. We also look at passive infra-red security lights, shattering glass with a high frequency and how to tell if someone is passing through a gate located half a kilometre away.

In the June issue I was brave (some might say silly) enough to admit to jumping to wrong conclusions during a recent appliance troubleshooting session. In hindsight, by telling all, I might be giving readers the impression that I have little or no experience at fault-finding. When coupled with other admissions I occasionally make, some of you might wonder whether I have any technical expertise at all!

I like to admit to my mistakes, as I believe most people prefer this, rather than reading a pompous rundown on how good one is. It’s much more interesting to read about failures, as if, for no other reason, it makes you feel better about your own limitations. But it does tend to give an impression that perhaps Peter Phillips is a technical idiot.

I’m prompted to say this because of our first letter, which although perfectly reasonable, is perhaps based on the writer’s impression of my skills (or lack of them). Here’s the letter, followed of course by my defence.

**TV servicing**

I read your preamble on Page 88 of EA, June 1997 and was surprised at the method you decided on to locate the problem in your CTV (colour television set).

Why you decided that the horizontal line output stage was faulty, without any preliminary checks of the bridge rectifier, regulator, or over-voltage/current section, or deflection yoke is beyond me. Removing the line output transistor without substituting a load (i.e., 60W or 100W/240V bulb) across the collector to emitter is ludicrous and is asking for a power supply fault at the very least!

Why remove the vertical section of the CTV? I have never repaired a CTV yet that had the vertical oscillator or its output as the cause of blowing a fuse.

Which ‘textbook’ did you consult before undertaking this repair? Your “In all cases I had taken a textbook approach to troubleshooting...” is thoroughly inaccurate in the case of CTV repairs! Consultation with EA’s own serviceman (a qualified CTV technician) before describing this method of troubleshooting might save a customer a lot of money and the technician a lot of work trying to figure out why a TV is dead after one of your readers attempt your ‘rip it out and turn it on’ method, in the belief it’s the accepted norm in the trade! (Tony Jones, A.T.E.T.I.A, Tasmanian Division, by email.)

When describing my fault-finding method Tony, I purposely kept it brief. I wanted merely to point out the actual problem, not really how I found it. I was trying to show readers that sometimes a fault is not really a fault, but an error, in this case on my behalf by not remembering such a basic thing as the type of fuse I should be using.

I gather from your letter that you think I should be consulting with experts. While it’s been some years since I did a lot of TV servicing, it’s quite possible I have taught some of your colleagues. I taught TV servicing for over five years in NSW TAFE, before moving into a different part of the TAFE system where I taught computers, microprocessors and so on. Prior to teaching, I ran my own TV servicing business.

As you might remember, a TV servicing course takes 18 months to two years, and covers every part of a TV set in detail. The theory is augmented by practical sessions that usually require students to find faults in the part of the receiver covered in the associated theory session. The teacher therefore has to know what he’s talking about, as students will quickly complain if the teacher is incompetent.

In the field, things are very different compared to a TAFE laboratory. There’s rarely time to theorise, and most technicians use methods gleaned from experience. I remember a part-time TV teacher (technician in the day, teacher at night) showing students how a knock with a screwdriver can help find an intermittent fault. A useful technique, but outside the syllabus.

So let’s look at the Peter Phillips’ method of finding faults, which is based on a lot of teaching and practical experience. (And perhaps a few more readers will remember me teaching a fault-finding course in industry as a private consultant.) I know, bragging again — but perhaps it’s time to point out a few aspects of my very varied background.

The first thing is to locate the area of the fault by regarding the appliance as a system. There are four types of systems: linear, divergent, convergent and feedback. Most appliances are a combination of all four, so you really have systems within systems. A TV set is a very complex ‘system’, so it helps to locate the area first, then view that area as a system. And that is the method I used to faultfind the set I mentioned.

But there are other practical rules to follow as well. The first is one I learned in the field: do the easy things first, like check the fuse, connections etc. The usual sensory checks (sight, sound, smell etc) also come into it. Then there’s the fault history of the particular appliance, and faults for that model. Most technicians have access to data that lists known faults for a particular model, now available on floppy disk or CD-ROM from some technical organisations.

Now let’s look at the set in question; a Philips KS631. It’s a very unusual set and it’s likely I own the only one of its kind. It is a modified version of a European model and was used as the basis for the Australian version, which looks very similar on the outside. Inside, the set has a mother board and lots of plug-in modules. The local version has...
everything on one board, and also differs in some parts of the circuit, particularly the power supply.

This is why it was easy for me to check if the vertical deflection board was faulty. All I had to do was unplug it. As for checking the power supply, of course I suspected it. However, in this set the power supply is relatively simple, and there were no indications of any sort to make it worth unsoldering diodes etc., to further check it. Furthermore, the horizontal output stage produces most of the supply voltages for the set.

You mention connecting a load across the collector and emitter of the LOP (line output) transistor. This technique might apply to more modern sets, but my set dates back to 1985 (or so). With the LOP transformer disconnected, there’s no current through the LOP transformer and no voltages developed for the rest of the set.

And why did I reckon the LOP transistor or transformer might be the culprit? Given the circuit diagram, the history of the fault, visual checks etc., these components seemed the most likely. They both do the most amount of work in the receiver, and given the age of the set, and that it was a development model, it was a very reasonable assumption.

I could go on Tony, but I certainly followed a textbook approach in attempting to isolate the fault to a particular section. My methods of doing this were based on the set in question, and might not apply to all sets. I also followed the practical rules. And as you must admit, I also found the fault.

As for readers following my method, as you will know from your own experience, quite a lot of faults are owner induced. I remember a guy hiring me to readjust his brand new set after he had attempted to ‘improve’ it by fiddling with every available adjustment on the back panel. Another customer of mine tried to improve his set by adjusting the slugs in the tuner, the IF strip (an old set) and wherever he could find something that turned.

If a reader, or anyone for that matter is silly enough to think they can fix a TV set after reading a five-minute dissertation in a magazine, then they deserve to pay for the service call. But as I’ve said before in this column, I doubt that our readers think that reading EA is a substitute for formal training and practical experience. It never has been, and will never be so. We are a technical magazine and mainly for technical people. If we have to couch everything we write in the belief that someone might do something silly, we would be of no interest to our intended audience.

### TV as a monitor

In May I included a letter from a reader seeking information about making a conventional TV set into a computer monitor. The following letter gives a Web address for further information on doing this:

Referring to Roger Duke’s letter in May, if he has Internet access, there is a fair amount of information on converting a TV set into a computer monitor at http://www.hut.fi/~then/electronics/pc_video.html.

A subsection on this Web page on PC Video topics is titled ‘Computer and TV’ and has a number of links to suggestions and solutions to this problem, including software and circuits. The home page http://www.hut.fi/~then/ has a number of links which lead to all kinds of electronics and programming information.

Thanks, EA, for helping me foster a general interest in technology since I was 10 years old. Keep up the good work. (Dominic Peterson, Queensland University of Technology.)

And thank you, Roger, both for you kind comments and for this information. The Web is certainly a useful source of information.

### Valve amp design

And here’s another response to an enquiry in May, this time about a book on designing valve power amplifiers.

Regarding valve power amplifier design, I recommend the book described below. I have found it gives an excellent coverage of the field as it is today, and is based on commonly available devices. The description is from the London Power Web site at: http://www.wwdc.com/~power/index.html.


The book offers a simplified method for designing tube power amplifiers for audio use. The traditional graphic approaches have been synthesised into a few simple equations that allow the direct use of tabled tube data. Vacuum tube operation is clearly explained, as are class A, class B, cathode bias and fixed bias operation. Push-pull and single-ended designs are included, as are numerous front-end circuits. Differential, concertina, paraphase and transformer drivers and splitters are presented, with new light shed on a few ‘long lost’ methods. Specific circuit adjustments are offered for linearising audio amplifiers, and for maximising power output for musical instrument use.

The book includes complete designs that incorporate off-the-shelf transformers and currently available vacuum tubes. Designs include amplifiers with a power output from 15 watts to over 400 watts. Output transformerless designs are presented and up-to-date hybrid...
tubes/solid state circuits are explored. A complete design method is offered to accommodate any output power level. Also included are power supply designs, an appendix that covers tube data for commonly used types, a list of new ultra-wide-bandwidth audio output transformers from Plitron Mfg, as well as their matching power transformers. Appendix C provides information on the newly expanded line of Hammond transformers for tube use. (Bill Bolton, Sydney, NSW)

So valve amplifiers are no longer a thing of the past! Thanks Bill, for sending this information, it’s bound to interest quite a few readers seeking the ‘valve sound’.

Security light problem

The next letter seeks advice on disabling the permanent-on function included in most PIR operated security lights.

‘Can somebody help me with a Nitewatch Series NW-12 Sensorlite infrared passive security light? This light has a facility to switch it on perma­nently by switching the supply off and on within two seconds. All very well if you don’t live in the country, where at the first lightning strike there’s usually a short power interruption, causing the light to come on and stay on.

This is not too bad if you are at home, but if you happen to be away for some time, you are obliged to worry a neighbour to switch the mains off for more than two seconds.

I have not been able to get any information such as application notes on the IC used in the light so I cannot disable this facility. The numbering of the IC does not tie in with the generic system, so I assume it’s a special IC. (Tony Paine, Springton, SA)

As you say Tony, this function is apparently achieved with an IC, and without the data, you have no way of knowing how to disable it. I assume you’ve tried the manufacturer or the agent for the light fitting. Or perhaps it’s an imported item. I can’t help you, but perhaps a reader has figured out a way to overcome this problem.

Word 6.0 problems

I had expected more letters in support of Word 6.0 after my introduction in the May column. But the only letter I’ve received about this is one agreeing with me:

In the May 97 edition of EA you men­tioned problems with Word 6.0. Would your problems have anything to do with master documents? Or large documents in general? I have problems using Word with large documents (more than 10 pages), especially where more than one section is involved. I can never seem to get the sections to have the page number just the way I want. I would be interested to hear how AmiPro fares in this regard. Is there a review of AmiPro you could point me to? (Fabio Barone, Griffith, NSW)

The problems I’ve had with Word 6.0 are not necessarily to do with the size of the document, as the document in ques­tion ran to over 200 pages. Instead I think it’s more to do with the rather clumsy way everything is done in this program. I have always disliked programs that try and do the thinking for you, as rarely does its solution suit your needs. For this reason, and because it takes too long to get a document together with Word, I prefer AmiPro.

I earn a large part of my living with AmiPro, and have used it to produce camera-ready copy for five textbooks and a large range of documents of all types. I’ve also used it for a range of two-colour documents, as a database linked to its mailmerge facility and so on.

When I did freelance software reviews for Your Computer, I reviewed version 3.0 of this program, sometime in 1991, I think in the March edition. The most recent version is 3.1, which fixes some of the bugs in version 3.0.

But perhaps you might be interested in a short history of this amazing program. I first saw it demonstrated at a press conference in the late 80′s. At the time, all word processors for IBM compatibles were DOS-based, and importing graphics was difficult and cumbersome. So imagine my interest when for the first time on an IBM PC, I saw integrated text and graphics on the screen just as it would print out on paper.

The program includes a simple but versatile vector-based drawing program, rather like DrawPerfect. After seeing AmiPro in operation I immediately pur­chased a copy and used it to produce a number of simple books for sale to TAFE students. I later produced a range of illustrated documents for various clients at a time when these documents were otherwise put together using conven­tional ‘cut and paste’ techniques.

AmiPro was originally developed by the Samna Corporation, and was based on modules the company had developed for industrial clients, including the company’s Ami wordprocessor. Lotus bought Samna in 1994 (or so) for $60 million and rewrote it to version 3.0 and subsequently 3.1. Lotus is now owned by IBM, and AmiPro is now WordPro, part of the Lotus Smartsuite. Unfortunately, although WordPro has more bells and whistles, it is slower and not as reliable as AmiPro.

Like all programs, AmiPro has the occasional bug, but although I’ve used it for nearly 10 years, I have never lost a document and have found version 3.1 pretty reliable, even under Windows 95. I believe I could not earn a similar income using Word 6.0, as although it has similar facilities, it takes nearly twice as long to put a document togeth­er. I have never understood why AmiPro is not the standard, as it’s truly an indus­trial strength wordprocessor.

Shattering glass

The next letter comes from a reader interested in using a high frequency to shatter glass.

‘I’m writing to ask you or your readers advice on a topic that, to the best of my knowledge, has never been covered in EA. I am a retired science teacher, and I still enjoy entertaining little ones at primary schools with scientific tricks. A Van de Graff generator and its ‘hair raising’ effect is always a hit.

But I would like to include in my itin­erary (with the older ones) a demonstra­tion of shattering glass with a high fre­quency. I remember seeing this many years ago, but I forget how it was done. About ten years ago I tried using a 10W valve amplifier (an EA design), but all I succeeded in doing was burning out the output transformer.

Last year I built the EA 50W per channel stereo amplifier, so I wonder if I could use it with an appropriate tweeter. Is there a problem I’m not aware of to do this, or do I need more power? I was intending to use small thin-walled pill bottles, placed about 30cm from the tweeter. Or if these are not available, I thought of using 2mm sheet glass cut to a 10cm square. Is there a way of rough­ly calculating the resonance of such a sheet? I have no reference in any of my books. Thanks for a very interesting col­umn each month. (L. Beswick, Newnham, Launceston)

Thanks for the kind comments, Mr Beswick. Readers might remember you
as the contributor of perhaps one of our most popular What?? questions, the star project idea that could interest anyone as the contributor of perhaps one of our window. Whether this has ever tuned to one frequency.

high for an audio amplifier. A need a larger sheet. I also suggest you use a piezo tweeter, as these are more efficient than a conventional speaker. An alarm siren might do, providing it can work with a range of frequencies. That is, it's not tuned to one frequency.

We've all heard of a soprano hitting a high C (around 1040Hz), and shattering a window. Whether this has ever actually happened I don't know, but I'm sure it's possible. Perhaps a reader who has done experiments in this area might let us know.

Remote gate alarm

The following letter describes a project idea that could interest anyone who wants to know if someone has passed through a gate. The problem is the gate is about half a kilometre away...

I live on a block of land on a main road in Queensland. I'm always worried about security, especially at night, as my neighbours live some 300 metres away. The front gate is about 500 metres from the house, and I have a shed full of equipment between the house and the gate. It's not practical to lock the gate at night and unlock it every morning, so I'd like to suggest a project that might overcome the problem.

My idea is to have a beam set across the gate, powered by a battery that is charged with a solar panel. When the beam is broken, a transmitter would send a signal to the house and sound a doorbell or an alarm. For security reasons, the beam must be invisible and the circuit boards small enough to put inside the gate posts (pipes). A movement detector is no good, as it would detect every passing wallaby and roo.

(Martin Clark, Townsville, Qld)

We published a project in February 1994 that could help you Martin, and an updated version of this project is in the July 97 edition. The project is called a laser beam communicator, but it can double as a perimeter detector. The idea is to use an infrared laser beam across the gate. When the beam is broken, a relay operates.

The next thing you need is a solar battery charger, and one was described in the November and December 94 issues. Both of these projects come from Oatley Electronics, who can probably help you further. The final part is a transmitter that can send a signal over a distance of 500 metres. If you have line of sight between the gate and the house, the laser communicator can be used, both as a speech transmitter, or simply to send an on-off signal to the alarm in the house.

Otherwise you'll need a radio signal. Unfortunately most of the UHF systems we've described can only operate to a maximum of 100 metres. However, a commercial system for controlling a model aircraft might do. In any case, I suggest you contact Oatley Electronics on (02) 9584 3563 for further details. They might have something suitable.

75 years old

In case you haven't noticed, EA is now 75 years old, making it one of the oldest magazines in Australia. My association as a writer for EA goes back a mere 18 years, and with this column for almost nine years. I see it as a privilege to be not only the recipient of so many reader letters, but to be associated with one of the most venerable institutions of the electronics industry. So congratulations EA, and my thanks to all readers for your letters. It's you who make the magazine a viable proposition, and that's something that we, the writers, must never forget.

What??

Once again I need to appeal to you all for more What?? questions, because we're running low. You can email, fax, post or download to our BBS any question you think might appeal to other readers. We can only offer you the moment of fame you will get as being the presenter of the question, and of course my gratitude.

The question this month comes from John Raymond, and concerns a capacitor and lost energy. We've had similar questions before, but not quite like this one:

As shown in Fig.1, a specially made variable capacitor has an insulated fixed plate (left) and a movable grounded plate (right) which can be moved by turning the handle on the feed screw. Now:

1. With the plates well apart, we measure a capacitance of one farad (big plates!)
2. Charge the plates to 1000V and remove the charge source. Assume no leakage or series resistance, so the capacitor remains charged at 1000V. As charge = CV, the charge is 1F x 1kV = 1000 coulombs. The stored energy is 1/2CV^2 = 0.5 x 1F x 1000V^2 = 500,000 joules.
3. Turn the handle very slowly to bring the plates closer together, until the capacitance is two farads. The charge must be conserved at 1000 coulombs, so as C = 2F, V must now be 500V. But: the stored energy is 1/2CV^2 = 0.5 x 2F x 500^2 = 250,000 joules.

So, where has the lost 250,000 joules of energy gone? It can't be lost in heat (we are assuming no resistance losses), and it can't be lost in EM radiation as we changed the capacitance slowly. It can't be lost by antenna radiation as the charge is DC. As well, energy can't be destroyed. Over to you!

Answer to July's What?

According to Professor Sumner Miller: Strangely enough — the density of the medium does not enter the discussion. In a sea of mercury, waves of a certain wavelength would travel with the same speed as sea-water waves. Isn't Nature fantastic? ✧

EA's Reader Service BBS

As part of our service to readers, Electronics Australia operates a Reader Information Service Bulletin Board System (BBS), which makes available a wide range of useful information for convenient access and rapid downloading. You can also leave contributions to some of our columns. The BBS is ANSI compatible and is currently operational for virtually 24 hours a day, seven days a week, on (02) 9353 0627. Use any speed up to 28.8kb/s.
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both signals will appear in the output at equal amplitude. However, what if we vary the duty cycle? If we do that, then we vary the balance. One input will be on more than the other in a given clock period. Remember that since we’re sampling at 100kHz, we always get enough of the signal to reproduce it correctly.

In varying the balance, we can produce a cross-fade, allowing us to vary the mix from one channel only, through to a balanced mix through to the other channel only. And all using just one IC.

This is one case where if we’d used two transistors instead to create the oscillator, we would have used more current as well as making the whole design much bigger than it really needed to be.

There are no loading problems that often occur with simple resistive mixers, since only one input is ever connected to the circuit at any one time. They just swap over a lot — that’s all!

The cross-fade function here is used in many situations and is a great way to spruce up your own home movies.

Well, that’s all for this month. Next time, we’ll continue with more circuits using this handy little IC. See you then.
Voice of America’s New Sao Tome Relay

The opening of a new Voice of America relay base on the island of Sao Tome created world-wide interest for shortwave listeners, as for many this was a new country to be received and verified. Like many listeners, my reports on the reception of Sao Tome were sent to the Voice of America in Washington and when the first verification was received it made my total verified countries up to 301.

Recently a North American listener heard Sao Tome on medium wave on 1530kHz and this resulted in a very detailed account of this isolated broadcasting station in the Gulf of Guinea, off the coast of West Africa. Sao Tome is a small island of volcanic origin and measures about 30 miles from north to south and 20 miles in width. The VOA relay station is located just south of the town of Sao Tome on the main island. The medium wave antenna is a two tower array. The station operates seven transmitters. One on medium wave, four on shortwave of 100kW, a modified transmitter for use on the tropical band, and a further medium wave station on 945kHz which the VOA have provided. The latter has a power of 20kW and broadcasts locally-produced Portuguese programmes for Radio Nacional De Sao Tome E Principe.

As well as the medium wave towers there are 14 curtain shortwave antennas to cover the shortwave bands as well as special aerial for the tropical band frequency. The power for these seven transmitters is supplied by VOA’s diesel generating plant, which produces close to 5MW (megawatts) — so the station uses more power than the rest of the island of Sao Tome.

As this is a relay station there are no programmes produced on Sao Tome; all programmes are received on a digital satellite link which originates from the VOA studios in Washington. The station’s local address is: The Voice of America, Sao Tome Relay Station, PO Box 522, Sao Tome in Principe, West Africa. However listeners should direct their reports to the VOA’s Washington address as the chance of a verification from Sao Tome is remote — there are no staff on the station prepared to issue verifications.

This information is only available because Chief Engineer, Charles L. Lewis was supervising the transmitter plant recently and he took the time out to answer in detail a report from a listener in the United States.

All India expands

The history of broadcasting in India goes back to the early days when amateur type stations began to operate on medium wave in 1926. By 1936 these medium wave stations had been established in Calcutta, Bombay, Madras, Delhi, Lahore and Peshawar under the present name of ‘All India Radio’. In this phase of Indian radio there was only restricted coverage, except at night when most stations covered a greater portion of the country; but there were difficulties in networking programmes and it was not until the event of shortwave broadcasting that a more suitable service was introduced.

The wartime influence of All India Radio was appreciated by the British Government and the BBC, which had difficulty in reaching India, began to use their transmitters on shortwave to cover the Asian area of Australia.

According to DX Post of India, the first cluster of India’s high powered shortwave transmitters sprang up around New Delhi during the 1950s. Aligarh became the site of 250kW shortwave transmitters almost a quarter century ago. Later on Madras and Bombay received their 100kW shortwave transmitters to launch a nation wide commercial service named Vividh Bharti.

India also went hi-tech, making use of the indigenous satellites, when she installed her first super-powered shortwave transmitter outside the Delhi-Aligarh belt in Bangalore. Four 500kW shortwave transmitters were ordered in 1989, the first was delivered in 1989 and test transmissions began in November. The signal was directed towards West Asia, but according to reception reports received it picked up loud and clear as far away as New York.

The 500kW Bangalore based shortwave transmitter is currently India’s best ambassador in Europe and North America.

The schedule for listeners in Australia and New Zealand in English is: 1000-1100UTC on 13,700kHz, 15,050 and 17,387kHz; and 2045-2230 on 7150kHz, 9910 and 11,715kHz.

AROUND THE WORLD

CZECH REPUBLIC: Prague broadcasts to Australia and Asia 0900-0930 on 17,485kHz; to South Africa 2000-2027 on 11,600kHz and 2130-2157UTC on 9495kHz.

INDIA: AIR, Delhi’s latest schedule shows: 1000-1100 on 15,050kHz, 13,700 and 17,387kHz; 2045-2230 on 7150kHz, 9910 and 11,715kHz.

IRELAND: West Coast Radio broadcasts on Thursday 1900-2000 on 15,625kHz and Saturdays from 1500-1600 on 6175kHz.

ISRAEL: IBA broadcasts in English 0400-0415 on 7465kHz, 9435 and 17,545kHz; 1400-1430 on 12,080kHz and 15,630kHz; 1545-1600 on 12,080 and 15,650kHz; and 1900-1925 on 7465kHz, 9435, 11,605 and 15,640kHz.

KOREA: Radio Korea’s latest English schedule shows: 0200-0300 on 7275kHz, 11,725, 11,810 and 15,575kHz; 0800-0900 on 9570 and 13,670kHz; 1030-1100 on 11,715kHz; 1900-2000 on 5975 and 7275kHz; 2100-2130 on 3970kHz and 2100-2200UTC on 6480kHz. This is only part of the schedule.

MALTA: Voice of Malta, PO Box 143, Valetta, has been testing 1800-1900 on 5890 and 9765kHz. The station requested reports on this test.

NEW ZEALAND: RNZI’s new schedule shows 1650-1950 on 6145kHz.

This item was contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time and 12 hours behind New Zealand Standard Time.
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**141T / 8535A**
Frequency Range: 10 MHz to 18 GHz with internal mixer

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This universal type portable oscilloscope is capable of 5-channel, 12-inch display employing a 15-cm rectangular type cathode ray tube with red internal phosphor. The COS6100M is sturdy, easy to operate, and extremely reliable - an ideal instrument for diversified types of research & development of electronic equipment.

**Main Features**

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**141T / 8504**
500 MHz General Purpose Oscilloscope

The 7904 is a wide real time bandwidth general purpose oscilloscope.

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TEKTRONIX 7904

500 MHz General Purpose Oscilloscope

The 7904 is a wide real time bandwidth general purpose oscilloscope.

**Main Features**

- 500 MHz at 10 mV/div
- 500ps/div fastest calibrated sweep rate
- 15 cm/sec Enhanced Writing Speed
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Early Radio Test Equipment — 1

Test equipment has been around for as long as radio itself, and was once just as rudimentary. Let's have a look at what was available to a radio mechanic in days gone by, to help track down faults.

The most ubiquitous of all early test instruments would have surely been the 'multimeter', used to measure volts, ohms and current. Like many of the radios of the 1920s and 1930s, a lot of these devices were home built. Most of the early meters had only DC voltage and current capability, but AC ranges followed in the later 1930s with the availability of copper/copper-oxide rectifiers.

Many of the early simple instruments comprised a 0-1mA moving-coil meter movement, with factory shunts to provide additional 0-10mA and either 0-50 or 0-100mA current ranges, and with suitable series ‘multiplier’ resistors to give usually four voltage ranges of typically 0-10V, 0-50V, 0-100V and either 0-500 or 0-1000V. These were considered adequate for most service work.

Construction

Most often these meters were built in a rather large case measuring approximately 10" x 8" x 2" (250 x 200 x 50mm) and sometimes used rows of banana sockets to give access to the various ranges. The test prods were simply plugged into the appropriately labelled sockets. At least one rotary switch was needed to switch between voltage and current, and sometimes between ‘High’ and ‘Low’ resistance ranges.

Sometimes, a two-pole 10 or 11 position switch was available for a fully switched instrument, to allow the use of a single pair of sockets for the test leads. But these switches were expensive, and not always very reliable. Quite often, the circuit diagrams of such meters were rather crudely drawn and very hard to follow.

Resistance ranges

The tricky bit was the resistance ranges. Given a scale of 100 graduations for full scale deflection (FSD), the minimum practical reading of a 0-1mA meter is therefore 10uA, which when used with a 1.5-volt torch battery enabled a maximum resistance reading of merely 150,000 ohms. The high ohms range needed at least a 9V grid bias battery, which would have only extended the range to 900,000 ohms. A higher voltage battery (22.5 volts for instance) gave a corresponding higher ohms range — in theory.

The trouble is, as anyone who has used an analog or 'old fashioned' multimeter knows, the resistance ranges are very cramped at the high resistance end of the scale. The reason is quite simple. For these ranges the meter is reading current, from a fixed voltage source through the unknown resistance. Mathematically, it is a reciprocal function (which incidentally has nothing to do with 'you scratch my back and I’ll scratch yours!') and not a linear function as are the voltage and current ranges.

However, if the home constructor could fathom out the theory, a lower resistance range could be included by using an appropriate shunt to effectively turn the meter to a 0-10mA or 0-100mA. This allowed a correspondingly higher current to flow through the circuit with a corresponding lower resistance scale.

Voltage ranges

These are simply an application of
Ohms law once again. The meter this time is reading current from an unknown voltage source, but through a fixed and known resistance. On this occasion, the scale reading is linear.

A 0-1mA multimeter was said to be a ‘1000 ohms per volt’ because that was the value of the total series resistance to read full scale from a voltage source of 1 volt. The series resistance is derived quite simply by dividing the required maximum range by the FSD of the meter. So a 0-10V range required a 10,000 ohm multiplier, and so on.

Strictly speaking, the internal resistance of the meter itself should be subtracted from this figure, but most 1mA meters had a resistance of only 100 ohms. So for ranges of 10V and above that represented less than 1% of the total resistance, and could safely be ignored.

**Current ranges**

A shunt resistor in parallel with the meter is required to achieve higher current ranges, and to work out the current value the internal resistance of the meter must in this case be known. The formula for a given shunt is the internal resistance divided by (n-1), where ‘n’ is the factor by which the original meter scale is to be multiplied.

Hence, the shunt for a 0-100mA range would be equal to the meter’s internal resistance, often in the order of 100 ohms, divided by 99 — or a little over one ohm.

The higher current scales meant parallel shunts of a fraction of an ohm, and these were often purchased with the meter movement as supplied by the manufacturers.

So there we have it! A typical circuit for a switched version is shown in Fig.2. Fig.1, originally in *Radio and Hobbies* for July 1939, illustrates the difficulty of following the diagram of the switching.

**AC ranges**

For the home constructor AC ranges were added by the simple addition of a rectifier as described, an extra switch, and an additional dial scale that reflected the slight nonlinearity of the output from the Cu/CuO rectifier. These scales were once again provided by the manufacturer.

**How accurate?**

The limiting factor for the ohms range was the accuracy of the meter and the calibration of the scale. As long as the battery was not flat, and the meter was ‘zeroed’ in the usual manner, that part of the scale from about 1/5 of FSD upward could be sufficiently accurate for service work. The higher end of the scale may as well not have been there, and the higher ranges must be used, in much the same manner as an analog instrument of today. At the very highest end of the scale, a fraction of a division could easily be responsible for a 10 or 20% error!

The limiting factor for the current range was the value of the shunts, and once again, the accuracy of the dial scale. As both these items were often factory produced, they were regarded as quite accurate.

The voltage range, however, is a different kettle of fish. The accuracy here is purely determined by the accuracy of
the series multipliers. Resistors of 20% tolerance were regarded as satisfactory for ordinary home construction projects. 10% types were available, at extra cost, but 1% and 2% types were definitely stretching the friendship. Once again, the series shunts were sometimes supplied by the manufacturers, but at a price. Basically, you got what you paid for.

**Loading effect**

In certain applications the 1000 ohms per volt multimeter was notorious for its poor accuracy on the voltage ranges, but not because it used wide tolerance multiplier resistors. It all had to do with the shunting effect of the meter upon the voltage being measured. The following explanation might help.

Consider trying to measure the screen voltage of a normal pentode wired as a voltage amplifier. Typically, the value of the screen dropping resistor was 1.0 megohm, resulting in a screen voltage of about 50 volts when the screen current was 0.2mA. If the meter's 100V scale is used to measure the voltage, this effectively connects a 100kΩ resistor from the screen to earth, forming a voltage divider with the existing 1MΩ screen resistor. If the HT voltage is 250 volts, this means that 0.27mA will flow through the chain, and the screen voltage might well be so low that it may not draw any current at all. The meter will therefore now read about 27 volts!

If say, the meter's 0-1000V range is used, then 1MΩ is placed in series with the 1MΩ screen resistor — resulting in 0.125mA flowing down the chain. If the screen still draws 0.2mA, the additional 0.125mA means that 0.375mA would flow through the 1MΩ screen resistor, resulting in a voltage drop of 375 volts from a 250 volt source. This is of course an absurdity. The screen will draw some current, a voltage drop will occur across the screen resistor, and the voltage reading will be somewhere between 27 and 50 volts — but closer to 50.

Of course trying to read 50 volts on a 0-1000 volt scale has its own scale accuracy problems!

When reading battery, normal HT or cathode voltages, and screen voltages on RF, mixer, and oscillator plate stages, such inaccuracies were markedly reduced because the higher value meter shunts were placed across much lower impedance (resistance) sources. A cathode resistor, or the internal impedance of the voltage source, such as batteries, or even a normal 250 volt power supply, are much much lower than the impedance (resistance) of the multimeter being placed across it.

**Fig.2:** This somewhat clearer circuit drawing of a more sophisticated instrument appeared in *Radio & Hobbies* for January 1958.

**Fig.3:** One of the set analysers referred to in the text. Unfortunately it is beyond restoration, but is an interesting static museum item.
Fig. 4: A circuit of a typical 'set analyser' of the 1930s, designed for home construction. Anyone game?

Work arounds

So how did the servicemen cope, back in the vintage radio days? There were one or two tricks that manufacturers adopted, which helped. Firstly, they specified the voltage to be measured on a specified range of the multimeter, thereby allowing the serviceman to compare apples with apples.

A second way they helped was by using a 'voltage divider', a large resistor with adjustable taps and a total resistance of between 15,000 and 25,000Ω, connected between HT and earth and used to derive the various intermediate voltages. This meant that there was a constant current drain across the HT of between 17 and 10mA, in addition to what was being drawn by the oscillator plate or RF screen or whatever.

If, say, the audio amp screen was to be set at 50 volts, a meter resistance of 100kΩ across that portion of the voltage divider (say 3 - 4kΩ) is going to introduced fairly insignificant loading.

Another trick was to set the mixer screen and IF amplifier screen voltages at the same level, and derive that voltage from a single screen dropping resistor. Quite often the value of this resistor was in the vicinity of 20 or 30kΩ, which again means that the shunting effect was minimal when using the higher scale of the instrument.

The 'Circuit Tester'

An extension of the multimeter was a curious device, popular in the USA in the early 30's and called a 'circuit tester' or a 'set analyser'. This device, it seems, was designed to measure voltages and currents without having to remove the chassis from the cabinet.

The idea was that a valve was removed from its socket and plugged into the appropriate socket of the set analyser. A cable with one or another adaptor was then plugged into the vacant socket on the chassis.

By judicious manipulation of a series of pushbuttons for current ranges, and switches for voltage ranges, and either more complicated switching or a series of 'wander plugs' to connect to the respective base pins, the entire operating conditions of the valve under test could be measured.

Not only that, there was often an external source of grid bias. This feature was incorporated to vary grid voltage and measure the anode current variation, thereby enabling the mutual conductance of the valve to be measured.

This method of testing valves was by far and away more superior and reliable than the equally ubiquitous and unreliable 'emission tester'.

The emission types of valve tester were standard fare for vintage servicemen in Australia, whereas the set analysers were not. Perhaps being imported and designed for the comparatively few valve types used by US radio manufacturers of the early 30's limited their appeal somewhat in this country, where European valves were as common as the US types.

The set analyser became obsolete by the late 1930's, due in no small measure to the introduction of more and more valve types. One survivor is illustrated in Fig.3. Unfortunately, the maker's plate is missing, and examination underneath shows that it has been tampered with and modified, so that restoration is nigh impossible. It does, however, give a good idea of what one looked like. A typical circuit for such a device is shown in Fig.4.

In future articles we'll look at valve testers, audio and RF oscillators and other test gear.
Do you remember last month's Madhouse column about the TV station staff reunion? At functions like that you are supposed to REMEMBER things — faces from the past, how it was to work at that particular place. And I started doing just that, remembering how it was to work at that TV station. And then I realized just how much things have changed.

In my days with Hobart's Channel Six, known as TVT6 back in the early 1980s, there was a weekly ritual. Thursday was payday, and every Thursday a large proportion of the staff would pick up their paycheques at lunch time and then head off to the Black Buffalo Hotel.

We would then settle in for a very pleasant extended lunch break, for at least two hours, during which we would consume enormous steak dinners washed down with plenty of beer. Later in the afternoon we'd make our way back to work, contented and happy that we'd chosen such a fine place to work. There was no problem facing the bosses when we returned; they were usually at lunch with us...

**Everyday event**

But that was nothing compared with my employer in the early seventies: Channel Nine in Melbourne. Here the lunchtime performance occurred every day, at the Bridge Hotel. It was the accepted practice for everyone who could, to clear out at 12:00 and stay at the Bridge until 2:00. The only requirement was that management had to know where you were. And every effort was made to keep the pay phone at the Bridge clear for incoming calls, so if you were needed you could be summoned quickly. There were no cellphones in those days, thankfully.

It was during my GTV9 days that I first learned the meaning of 'takeover' and 'retrenchment'. Once there was a major management upheaval, with the old bosses out and new bosses in. And the new bosses were going to make the business 'more efficient'. So the entire staff was called into the audience seating area in Studio 9, the place where 'Hey Hey It's Saturday' comes from to this very day.

The new boss then addressed us, but not with the usual "no changes, no staff reductions" spiel that is so common today. Instead he laid it on the line: one third of the staff would be without jobs as of that afternoon. While we were in Studio 9, notices were being distributed to the desks of people chosen to go. Those who received notices were to clear their desks and leave immediately after the meeting.

That was the first purge I ever experienced, and the first purge I survived. I was older, and experienced, and thus of more than average value to the company. The younger, less experienced people suffered most. One videotape operator got the sack while on his honeymoon.

Nowadays there is no such thing as a permanent, safe job. Every employee must spend some time looking over his shoulder. It is probably true that every manager has a mandate to reduce staff if at all possible, and if an opportunity presents itself, the manager is remiss if he/she does not act.

So behaviour as mentioned above, like having a leisurely lunch in the boozzer, is an invitation for trouble. Of course there is the 'business lunch', company sanctioned and fully tax-deductible, but I'd say about 99% of *Electronics Australia* readers are not really eligible for business lunches. (*Nor are EA's own editors and staff, for that matter — Ed.)*

**'Keep dancing!'**

There is a saying here in the USA: If you want to keep your job you have to keep dancing as fast as you can. If somebody dances faster than you, or cheaper, or longer, you're out the door. There is no longer much sense of loyalty, either of employee to company, or company to employee. It's all a matter of economics.

Here in Port Townsend where I currently live in the USA, there are very many people talented in numerous fields, all of whom must support themselves somehow. It's a small town, with limited jobs. As well, in the USA there is a limit as to how long one can remain on the dole. So that means there is always someone knocking on your employer's door, wanting to do your job, usually for less money than you.

I faced exactly this situation a few months ago. I was working for an Internet Service Provider, a good part of the time as a telephone tech support representative. Your mission is to help new users get connected to the Internet. They are sent full instructions when they sign up — but if they just bought their new Packard Bell computer at K-Mart that very week, they are not particularly computer literate. So the tech support representative must walk them through the instructions, step by step.

**Moral support**

Once you've done this a few times, it's fairly routine. You are really giving moral support, not tech support. So you don't need a techno-wizz to do the job, just someone with a soothing manner. The technical expertise is already built into the instructions you're walking the customer through.

Soon the management realized they only had to pay $8 an hour for someone who could properly do the tech support job. They didn't need to pay twice that for a Tom Moffat, so guess who went bye-bye. But my skill stayed behind; I had written the instructions in the first place.

Another factor keeps coming in here, as well as pay. In today's business climate you are expected to work hard, to dance fast and to dance long. Whoever is best at this wins, whoever falls behind loses. This is the Silicon Valley Credo, and the Microsoft Way.

Well, my friends, I am here to say...
right here and now that I don’t do that any more. There is more to life than working hard. This lazy attitude of mine probably contributed to the loss of my last job — I balked when I was told that henceforth I was on a 50-hour week for 40 hours’ pay. And it will make it harder for me to get another job, at least in the current climate. Well, then, so be it...

I see exactly the same pressures building up in Australia. I have been following the Forum column in EA with considerable interest, and I see two issues emerging. You readers are sick and tired of selling your considerable technical skills for a pittance. And many of you are developing a ‘lazy’ streak just like mine. By that I mean, you are realizing there is a lot more to a good life than just a good career.

Squeezing more...

In Forum I keep seeing ‘hard work’ pop up, which one New Zealand correspondent equated to ‘hard life’. You are so right, my friend. Let me quote some other random snippets from correspondence I have received. From a schoolteacher in Melbourne: “Life goes on. School is well and truly in session and they appear to be squeezing more out of us than ever. Something to do with economics, I suspect.”

From a Sydney woman: “I have been extremely extremely busy. For the last two weeks I have been working long hours and I have had things on nearly every night. I feel like I have hardly had any time to relax... I am feeling so worn out... in fact I feel sick... If I didn’t have so much to do I would probably go home.”

But, as evidenced by Forum, what hurts most is the lack of recognition for a lifetime’s experience. This letter came to me from an electronics tech in Sydney: “What really got to me was taking a low-paying job with [deleted] (at 52 years old, and all they would offer was a TO2 grade) and then seeing a street cleaner’s job advertised with Randwick council that offered just as much as I was getting!

“It burned me pretty badly, as I have put a lot of effort into my career as an electronics tech. I’ve kept up as best I could with modern technology in all its expanding fields...”

I know the how this guy feels. Had I kept my job in technical support, after more than 35 years in electronics, I would have been making the same money as the lady who checks out my groceries at the supermarket — or my own son, who with zero years’ experience is now a trainee theatrical stage hand. All these jobs pay eight bucks an hour.

The positive side

Enough whingeing. There is a positive side to all this. I think the solution may be — you just don’t get an ‘employee’ any more. ‘Self employed’ used to be a euphemism for ‘unemployed’, but now maybe it’s a synonym for ‘smart’.

In my own case, since I’ve left my ‘real job’, my life has improved considerably. I traded one job for four jobs. I’m still doing computer tech support, but now it’s in people’s offices and homes, rather than over the phone. I meet some extremely technically challenged computers — Elwha (Madhouse, March 1997) was only the start. And it’s fun!

I’m also back at Port Townsend High School and the Community Auditorium, doing sound and lighting and television production, for twice the money I got doing Internet telephone tech support. I’m playing music in two bands, and of course I’m now in my eighteenth year of writing for Federal Publishing. Most importantly, I’m doing WHAT I DAMN WELL ENJOY!

Interesting book

I’ve recently been reading an interesting book called Cybercorp, by James Martin. That’s right, virtual companies that only exist as packets of data flitting about on the Internet. It’s kind of a complicated concept, but the Cybercorp model seems to be a collection of people, working away at their computers, anywhere in the world, toward a common commercial goal. None of them actually ‘work’ for the company, they are contractors.

The Cybercorp itself grows and shrinks with the workload. I visualize it as kind of a dynamic memory heap in a computer, that grows and shrinks with the demands placed upon it. Every worker in the Cybercorp realizes there is no such thing as permanence, but every temporary job lost will be quickly replaced by another one. As James Martin puts it, “the Cybercorp should be designed for continuous change, not periodic Hiroshimas”. Thus downsizing, and upsizing, are just the Cybercorp organism living and breathing.

So it’s goodbye to job security as we know it. Is this such a bad thing? Probably not, once you get used to it. I’ve spent a good part of my life self-employed (all right, UNEmployed), but I’ve never starved, and so far I’ve never had to tap the government for assistance. With several part-time jobs going at once, if one slacks off another seems to expand to fill the hole.

For instance yesterday, I spent the day happily fighting with a totally screwed-up computer. Today no computer calls, so I’m spending the day writing a Madhouse column. Tomorrow and for the following two days I’m doing a big sound job at the high school. If I add up all the income generated this week, it ain’t bad at all.

There’s one big difference between what I’m doing and James Martin’s Cybercorp. I gather that all Cybercorp work is to be done in front of a computer, in isolation from other human persons. I couldn’t take that; I need company. The way it works now, I meet some new life form every time I meet a new computer. When I’m working at the auditorium, by definition I am working with a crowd. In the band, I am performing before a crowd. Humanity everywhere!

The only time I am in isolation is when I’m writing this stuff; there’s just me and my laptop. But you have to have some privacy sometimes, and it’s not truly private — because I’m pouring out these thoughts, and you’re reading them. Aren’t you? Please? ✪
August 1947

Engineer listens for sky signals:
American engineer Grote Reber has built a large dish antenna in the backyard of his home in Wheaton. The huge dish faces the southern sky and can be tilted at any angle of declination along the north-south meridian. The radio waves captured by the dish are directed to the mouth of a drum containing a radio amplifier. This converted electromagnetic energy is heard as it swishes over his super-sensitive receiver, and he uses a chart recorder to prepare 16-hour daily reports of radio activity transmitted from the Sun and other bodies.

The listening post not only serves him as a hobby, as when he trains his device at Mars and other stellar bodies to probe them for human intelligence, but is also the means through which he is conducting experiments on the measurement of electromagnetic energy at radio wavelengths arriving from the sky. Reber says he receives ultra-high frequency radio waves when he focuses on the Milky Way, the Sun and Mars. He began his astro-physical experiments 10 years ago.

August 1972

Flat computer display: A flat panel display has been announced by Burroughs to replace the CRT in computer terminals. The 14.5 x 9.4 x 2.2 inch picture-frame style display weighs only 7.5 pounds, making it easily transportable in an office.

Designated the TD700 Self-Scan Terminal, the system is claimed to be the first commercially viable product to use the gas discharge matrix technique. Individual gas-filled cells in a honeycomb configuration are selectively ionised and illuminated to display the various characters. The character size is 0.2 x 0.28 inches high and is built on a 7 x 5 dot matrix.

One reason the system is now feasible is that Burroughs has eliminated about 90% of the addressing electronics which was necessary with earlier design attempts.

Video phones poised for take-off: After years of experimental work and predictions that video telephone service is 'just around the corner', telephone manufacturers finally have video phone hardware in use commercially.

Bell Telephone's PicturePhone service, initiated in Pittsburgh in 1970, is gradually becoming available in other US cities as central telephone offices are modified for video service. PABX switching services for up to 10 video phones are standard equipment, but custom switching has been installed for larger numbers of stations.

Initial customers for video phone systems are expected to be medium-to-large companies.

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**EA CROSSWORD**

**ACROSS**
1. Popular Microsoft GUL (7)
2. Buzz in a crowd (7)
3. Name of a bell (7)
4. Name of a spacecraft investigating other planets (7)
5. Susceptibility changes at this temperature. (4)
6. Defect (5)
7. Name of exclusion principle. (5)
8. Person skilled in small wires (7)

**SOLUTION TO JULY 1997:**

**DOWN**
1. Part of a circle. (6)
2. Group of elements. (3-6)
3. Break a fruit (4)
4. Just one more. (5)
5. Rating of the Southern Cross. (4)
6. Non-linear lines of wave propagation (4)
7. Means of showing phase difference (6)
8. Reducing duty limits on equipment (8)
9. Opposite to 3 down. (5)
10. Store in much data. (1, 4, 2)
11. Basic property of Earth. (9)
12. Copy information (8)
13. Image, etc. (8)
14. Non-stereophonic. (8)
15. First surname of discoverers of radioisotopes. (8)
16. A transmission block (6)
17. Local failure; flaw. (5)
18. Name of opera by Verdi. (4)
19. Musical instrument digital interface. (7, 7)
INTEL’S NEW PENTIUM II PROCESSORS, IN THEIR SINGLE EDGE CONTACT PACKAGE: 233, 266 & 300MHz VERSIONS, COMBINING THE ADVANCED TECHNOLOGIES OF THE PENTIUM PRO WITH THE MULTIMEDIA POTENTIAL OF THE 57 EXTRA MMX INSTRUCTIONS, PLUS DUAL INDEPENDENT BUSES...
ELECTRONICS Australia, August 1997

VIDEO PROJECTOR PRODUCES 5000 LUMENS

Digital Projection Inc., a subsidiary of UK firm Digital Projection Limited, has unveiled a new video projector capable of producing extremely bright images — claimed in excess of 5000 ANSI lumens. The new projector is based on Texas Instruments’ Digital Micromirror Device (DMD) technology.

“Our POWER 5dv uses the same chassis as the POWER 4dv”, said Mike Levi, president of Digital Projection’s North American operations, “but is driven by an even more powerful Xenon arc lamp combined with advanced thermal management and optical systems, to increase light output by nearly 50%.”

Digital Projection’s POWER 5dr features non-pixelated, film-like images, factory pre-converged light valves, a claimed luminance uniformity greater than 90%, and stable colour reproduction throughout the lamp life. It’s designed for use in demanding large-screen applications in leisure and entertainment, business, education, simulation, command and control, staging and rental markets.

Source compatibility includes PAL, SECAM, NTSC, VGA, SVGA, XGA, and MAC graphics formats up to 1024 x 768 resolution. A choice of interchangeable lenses provide optical solutions for the most demanding arena, stadium, large-venue or rear screen applications. The illumination system is designed around a powerful and compact, extended-life Xenon arc lamp, proprietary to Digital Projection.

The Digital Projection 5dv and 4dv are claimed to represent the highest-level execution of Texas Instruments’ three-chip Digital Micromirror Device (DMD), with light output and performance eclipsing CRT, LCD and light valve projection alternatives. (Business Wire)

WINNER OF 68HC05 DEVELOPMENT SYSTEM

The winner of the Oztechnics 68HC05 competition announced in our May 1997 issue was Mr Stephen Wilson, of Camp Hill in Queensland. Mr Wilson has been sent his Oztechnics...
68HC05 Development System, and we congratulate him for his initiative. We'd also like to thank the many other readers who sent in entries for this competition, for their interest and support.

PHILIPS EXPANDS NIJMEGEN WAFER FAB

To support volume production of its new fifth-generation RF wideband transistors, Philips is investing a further US$15 million in the company's state-of-the-art discrete products wafer fab at Nijmegen, Holland. This represents yet another step in Philips' plans to make the Nijmegen facility, already the largest semiconductor plant in Europe, the world's leading source of discrete RF products and modules.

MICROCHIP SENSOR REGISTERS FINGERPRINTS

SGS-Thomson Microelectronics has demonstrated the first working prototype of a microchip that can directly register the pattern of a human fingertip, detecting variations in the electrical currents running along the ridges and valleys of the skin. The prototype was demonstrated at the CardTech-SecurTech Conference in Orlando, Florida.

The patented electronic fingerprint imaging sensor differs substantially from existing technologies. Through direct physical contact, the sensor array 'grabs' a fingerprint pattern without using an optical or mechanical adaptor such as a scanner or camera. When the finger is placed onto the chip's silicon surface, the capacitive sensors register the fingerprint pattern by interacting with electric field variations produced by the skin's ridges and valleys. The chip then creates an electrical representation of a fingerprint. The new technology is claimed to offer superior greyscale image quality and a direct route to the digital information used in the personal identification process.

"This offers a new dimension in the arena of biometrics, which is emerging as a key technology for security and identification," according to Alan Kramer, Director of the Innovative Systems Design Group of SGS-Thomson's Central R&D Division. "Some of the security applications for this electronic fingerprint imaging sensor include PC access, electronic security for internet transactions, physical identification for access to automobiles and buildings, and Personal Identification Number (PIN) replacement, as well as applications in the smartcard, appliance and portable electronics fields."

Compared with alternate personal identification methods such as infrared and retinal scans, the electronic fingerprint technology provides heightened security, ease of use and cost benefits. The compact one-chip solution is smaller and lower in power consumption than optical methods, consuming less than 1mW at 5V. It also generates higher image quality than most other identification methods, including technologies based on heat.

Since the chip's pixels are on a pitch of more than 25um, it can be easily integrated into standard CMOS technology used to produce today's microprocessors and other common chips.

The live fingerprint imager is based on a feedback capacitive sensing scheme. Two metal-2 plates are placed adjacent to the skin area and separated from the skin surface by the passivation oxide.

As a result of a general expansion of the discrete products fab, one of five separate wafer fabs on the Nijmegen site, its total production area of 3000 square metres is now fully operational, with all critical wafer handling areas meeting Class-100 clean room conditions. Existing products manufactured in this facility include general-purpose broadband transistors, video modules, CATV modules, cellphone RF power modules and transistors, and modules for cellular basestations. Both MOS and bipolar technologies are currently used in the manufacture of these products, several of which require processing to sub-micron geometries.

The additional US$15 million will be spent equipping the wafer fab with the specialist equipment required in the double-polysilicon process that is used to produce Philips Semiconductors' new range of fifth-generation RF wideband transistors.

WINNER OF THE FLUKE 18 METER

The winner of our Fluke 18 Automotive Meter Competition, as announced in our May 1997 issue, was Mr Graeme Burrow of Colonel Light Gardens in South Australia. Mr Burrow has received the Fluke 18 Meter, valued at $219, and kindly donated by Dick Smith Electronics.

We congratulate Mr Burrow on winning the meter, and would also like to thank all of the many readers who sent entries for this competition, for their interest.

The skin surface can be thought of as a third plate opposed to the metal-2 ones and separated by a dielectric layer with variable thickness, composed of air.

From a lumped-model point of view, this structure forms two series-connected capacitors. The metal-2 plates are separately connected to the input and output of a high-gain inverter, thus forming a charge integrator.

Since the distance between the skin and sensor identifies the presence of ridges and valleys, an array of cells is used to sample the fingerprint pattern. The array is addressed in raster mode by means of horizontal and vertical scanners. The chip also contains timing control and voltage references.

The current prototype is able to capture a fingerprint image at 390dpi, enough to provide high-reliability fingerprint matching based on image processing algorithms. Future prototypes are expected to increase resolution to as much as 750dpi.
NEWS HIGHLIGHTS

CSC AUSTRALIA WINS SAT COMMS CONTRACT

CSC Australia has won a multi-million dollar export order to develop software for a mobile satellite communications network that will operate in Europe. The export contract will provide work for 20 software engineers working out of CSC Australia’s Adelaide office during the next 12 months.

CSC Australia signed the contract with NEC Australia, which will provide ground station equipment and services, and mobile terminals to telecommunications carrier Nuova Telespazio SpA. in Italy. Owned by the Italian Government, Nuova Telespazio manages all Italian satellite activities within the IRI-STET Group.

Nuova Telespazio’s M-SAT Mobile Telephone System will provide voice, fax, data and short message services using the European Mobile Satellite payload of the ItalSat F2 satellite.

Under the $4 million contract, CSC Australia has provided an initial set of software and computer hardware similar to that developed for the Australian Department of Defence’s Interim Defence Mobile Communications Network (DMCN).

BELL LABS SETS F-O LASER RECORD

Bell Labs scientists, working with colleagues at Opto Power Corporation in Tucson, Ariz., have demonstrated record-setting output powers from optical-fibre lasers. The fibre lasers, each pumped by a single semiconductor laser and with the output coupled directly into a single-mode fibre, produced from 8W to 21W of power.

The research team has built a cascaded Raman fibre laser with an output power of 8.5W at 1472 nanometres; the laser could be used to boost communications signals in long-haul communications systems. Conventional lasers used for this purpose typically produce only 0.1 of a watt. They’ve also built fibre lasers, with ytterbium-doped fibre cavities defined by two-fibre Bragg gratings, that yield 16.4W of power at 1065nm and 20.4W at 1101nm, into a single-mode fibre. The lasers’ output power levels are about 80 and 300% higher than other single-mode fibre lasers operating at 1065 and 1100nm, respectively.

The fibre lasers were pumped by a single high-power laser diode array with more than 40W of optical power at 915nm. In these high-power fibre lasers, light from a semiconductor laser is guided within the outer layer, or cladding, of a specially developed fibre with a single-mode core containing the rare-earth element ytterbium. The light is absorbed by the ytterbium, which changes its wavelength and makes it possible to ‘pump’ optical amplifiers that boost communications signals. They make it possible for the signals to travel longer distances and are powerful enough to be used as a single source for distribution of the signals, through a router, to many users. (Business Wire)

HEWLETT HONOURED BY ROYAL SOCIETY

William R. Hewlett, co-founder and director emeritus of Hewlett-Packard Company, has accepted the 1997 Benjamin Franklin Medal awarded by the Royal Society for the encouragement of Arts, Manufactures and Commerce (RSA).

The Benjamin Franklin Medal was instituted in 1956 to mark the 250th anniversary of the birth of Franklin, and the 200th anniversary of his election to membership of the RSA. The Medal is awarded annually, alternately to citizens of the United Kingdom and of the United States who have forwarded the cause of Anglo-American understanding and cooperation, particularly in the fields of arts, manufactures and commerce.

Mr Hewlett received the 1997 Medal combination of high specific energy and long cycle life. The LPB has an expected specific energy of 200 watt-hours per kilogram and a cycle life comparable to the expected lead-acid cycle life of greater than 600.

For electric vehicles to compete effectively with conventional internal combustion engines, the battery must allow vehicles to reach a range of 150 miles or more. Currently, lead-acid batteries produce approximately 35Wh/kg, which allows electric vehicles to travel less than 100 miles per charge.

LPB technology has been developed under USABC since 1993. 3M has been a leading force in this effort and was awarded two contracts previously. (Business Wire)
IBM RELEASES
8.4GB 3" HARD DISK

IBM has announced a record-breaking 8.4-gigabyte hard disk drive for high performance desktop personal computers, called the Deskstar 8. The world's first desktop PC drive using IBM's MRX (Magnetoresistive Extended) head technology, the 3" drive sets a new world record for data density: 1.74 billion bits per square inch.

Deskstar 8 also features Ultra Direct Memory Access/33 (DMA/33) technology, delivering high transfer rate performance. The drive spins at 5400rpm, has an ATA-3 interface, uses four platters and incorporates a 512KB data buffer. It offers 9.5ms average seek time, 5.6ms average latency, 5.8MB/s minimum sustained transfer rate and 76.2 - 127.4MB/s media data rate.

DIGITAL TO USE
AMD'S K6 PROCESSOR

AMD has announced that Digital Equipment Corporation will use the AMD K6 MMX enhanced processor in its Venturis desktop computer family. The new K6 processor-based Venturis FX-2 systems will run at clock speeds from 166MHz to 233MHz and are predicted to be among the best value desktop systems in the industry for commercial computing environments. The US selling prices are expected to start at US$1250. The new systems include the Intel 430TX PCI chip set, three DIMM sockets, 64-bit SDRAM interface, a 256KB pipeline-burst secondary cache and system memory expandable to 256MB. Pre-installed software includes Microsoft Windows 95 or Windows NT 4.0 operating systems, and Digital's ClientWORKS systems management and control software.

TOSHIBA & CHARTERED TEAM FOR EMBEDDED DRAMS

Toshiba Corporation of Japan and Chartered Semiconductor Manufacturing of Singapore have entered into a five-year partnership agreement that calls for technology and manufacturing cooperation on embedded DRAMs, a burgeoning semiconductor business segment based on leading-edge system on silicon technology.

Under the terms of the agreement, Toshiba will license its embedded DRAM technology to Chartered, beginning first with 0.35um and migrating to 0.25um. After process qualification, Chartered will manufacture embedded DRAM products for Toshiba and other customers.

The first embedded DRAM products produced under the partnership are expected to emerge in the market in 1998. The 0.35um and 0.25um embedded DRAMs will be manufactured in Chartered's new Fab3, which will serve the company's diverse customer base.

These embedded DRAMs will employ trench-capacitor technology, currently used in Toshiba's 16MB and 64MB DRAMs. Embedded DRAMs integrate traditional DRAMs with digital logic on the same chip, using a common process. Such integration offers lower package count and reduced power dissipation.

NAVAL AMATEUR RADIO SOCIETY

The Australian Naval Amateur Radio Society (ANARS) is inviting enquiries from all radio amateurs and shortwave listeners who have a professional naval or marine background. ANARS offers the opportunity to enjoy amateur radio activities in company with 'kindred souls of the sea'.

Society members conduct weekly nets on Mondays at 0930 UTC in CW on 3532kHz, and on Wednesdays at 0930 in SSB mode on 3620kHz. They also conduct daily SSB nets at 0400 on 7075kHz and at 0430 on 14,175kHz. The Society also promotes various awards and publishes regular issues of QUA, the official journal of the Society.

For further information contact the secretary of ANARS at 13 Brothers Road, Dundas 2117, phone (02) 9638 3569, email to fayen@sydney.-dialix.oz.au or simply join one of the nets.
Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY...

Telecom protection device

The CLP200M is a new protection device from SGS-Thomson Microelectronics that provides transient overvoltage and overcurrent protection for telecom lines. It is specifically designed for use in analog and ISDN line cards, PABX systems and other telecom equipment for protection against lightning surges and other dangerous transients.

It is a dual bidirectional device with a peak pulse current rating of 100A for a 10/1000us surge and provides assured protection against lightning surges up to 4kV, and longer duration surges caused by mains coupling or mains contact.

Other key features include a maximum voltage at switch-on of 290V, a minimum current at switch-off of 150mA and a failure status output pin that provides a signal whenever the CLP200M is shorting the line to ground. This signal can be used to drive a warning LED or as an input to a fault counter circuit.

For further information circle 272 on the reader service coupon or contact SGS-Thomson Microelectronics, Suite 3, Level 7, 43 Bridge Street Hurstville 2220; phone (02) 9580 3811.

Chipset for satellite broadcasts

Analog Devices has announced SATCOM2, a highly integrated chipset that combines all the functions needed to capture and process high quality audio/video signals in direct broadcast satellite (DBS) equipment. The AD6461 analog signal processor accepts 480MHz intermediate frequencies from commercially available L-band tuners and demodulates QPSK components. A pair of onboard 'tunable bandwidth' filters optimise bit error rate and reduce noise and distortion.

Filtered analog signals are passed to the AD6462, where they are digitised, error corrected and formatted as an MPEG-2 transport data stream. The resulting signal output format conforms with the open transmission and coding protocol specified by the Digital Video Broadcast (DVB-S) launch group.

For further information circle 280 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755. Web site: http://www.analog.com.

Virtual Dolby surround sound IC

Medianix Semiconductor has announced that its MED25006 single-chip, digital Virtual Dolby surround processor has been certified by Dolby Laboratories and that volume production of the chip has started. The IC uses 24-bit DSP technology to implement a 3D surround sound algorithm that creates the effect of front and rear speaker pairs using only two speakers. A subwoofer audio output is also supported. Applications include consumer audio products that cannot accommodate more than two speakers, such as desktop computers, televisions and arcade games.

Virtual Dolby surround technology was unveiled by Dolby Laboratories in January 1997, and Medianix Semiconductor demonstrated its single-chip implementation of the audio algorithms on the same day. The chip also supports Dolby Pro Logic decoding for original four-channel plus subwoofer surround sound systems; Dolby 3 stereo output, with left, right and centre channels; and mono to stereo synthesis. The chip also contains 'sweet-spot' adjustment to compensate for placement of speakers relative to the listener.

For further information circle 272 on the reader service coupon or contact Medianix Semiconductor Inc, 100 View Street, Suite 101, Mountain View, California 94041; phone + 415 960 7081, fax +415 960 0478.

ADC has 230MHz bandwidth

The AD9070 from Analog Devices is a new 10-bit sampling analog to digital converter (ADC) with a usable bandwidth of 230MHz, a 100MS/s sampling rate, and a power dissipation of 600mW (typical). Applications include point-to-point and satellite communications, direct IF sampling in communications systems, high definition television, spectrum analysers, radar, medical imaging, digital oscilloscopes and transient recorders. The ADC operates from a -5V supply and needs an external encode clock to operate. It has an out-of-range indicator and comes in a 28-pin plastic SOIC package.

For further information circle 279 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755. Web site: http://www.analog.com.
3.3V SRAM modules

White Microelectronics now has available 3.3V commercial grade 4Mb and 16Mb SRAM MCMs with JEDEC standard 68-lead PLCC packaging. The devices are designed for 3.3V processors and meet the requirements of typical networking systems, ISDN, ATM, VME boards, fax/modem cards and other applications requiring high density SRAM for surface mount boards.

The 4Mb SRAM, WPS128K32V-XPJC, is organised as 128K x 32 and has access times of 15ns to 25ns. The 16Mb SRAM, WS512K32BV-XCJC, is organized as 512K x 32 and is user configurable as 1M x 16 or 2M x 8. Access times are 15ns to 20ns. The modules are based on BiCMOS technology.

For further information circle 278 on the reader service coupon or contact Philip Farahmand, White Microelectronics, 4246 East Wood Street, Phoenix, AZ 85040; phone (602) 437 1520. Internet http://www.whitemicro.com.

SOT223 temp sensor

A 1000 ohm platinum temperature sensor in a standard SOT223 plastic package has been released by Heraeus Sensor-Nite. The device is designed specifically for measuring and compensating for the temperature of a printed circuit board. The cooling fin of the package optimises thermal contact to the circuit board and the device measures with an accuracy of +/- 0.5% over a temperature range from 50 to 150°C.

For further information circle 277 on the reader service coupon or contact Heraeus Sensor-Nite GmbH, Reinhard-Heraeus-Ring 23, D-63801 Kleinostheim; phone +49 6181 355 211.

CCD signal processor IC

Analog Devices has introduced the first members of a new imaging product family that performs decoding and signal processing in a single IC. The 10-bit AD9805 and 12-bit AD9807 CCD (charge-coupled device) signal processors combine a three channel correlated double sampler, programmable-gain amplifiers, digital gain and offset correction. Applications include desktop scanners, electronic camera backs and 35mm film scanners.

The devices convert the output from CCD and contact image sensor (CIS) modules to digital data. They need no external support circuitry, operate from a +5V supply and come in a 64-pin plastic quad flatpack (PQFP) surface-mount package.

For further information circle 276 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755.
Battery disconnect
switching IC

An integrated battery disconnect switch that can be used with NiCad, NiMH, and lithium ion cells has been released by Temic Semiconductors. The new Si4720CY is claimed to be the industry’s first such device to integrate P-channel power MOSFETs and level shift circuitry in the same package. This combination provides the reverse blocking capability needed for power supply designs which use multiple battery types, or for those that need isolation from the power bus during charging, both of which are typical of portable computers and portable instruments.

Because the MOSFETs work as high-side switches, the IC is said to eliminate the need for 12 or more discrete components such as watches, smoke detectors and home medical appliances.

The device operates down to +100mV with an external 100mV reference. Other features include low power (2.3mW at 200kHz), 3uA power down, synchronous serial interface, and AC common mode rejection.

For further information circle 274 on the reader service coupon or contact Braemac Pty Ltd, 1/59-61 Burrows Road, Alexandria 2015; phone (02) 9550 6600.

12-bit ADC with
instrumentation input

Burr-Brown’s new ADS7817 is a 12-bit, 4mW, 200kHz sampling analog to digital converter with instrumentation amplifier input. It features a high impedance, full differential, bipolar input range with 80dB common-mode rejection, making it suitable for motor control and industrial process control applications. Other applications include battery operated systems such as watches, smoke detectors and home medical appliances.

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130 ELECTRONICS Australia, August 1997
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Hewlett-Packard describes its new LogicDart as an 'advanced logic probe'. After trying one out for a short time, we can certainly agree. It combines a traditional logic probe with a 3-1/2 digit DVM/ohm meter, a 33MHz frequency counter and a three-channel 100MS/s logic timing analyser — all in a handy handheld package only slightly larger than a compact DMM!

by JIM ROWE

Not all that long ago, logic probes were little more than a couple of comparators in a probe body, driving red and green LEDs. Many of us built one ourselves, and the simplest versions did little more than indicate a logic 'high' or 'low', generally for one particular logic family (say TTL, or CMOS).

The more elaborate models would indicate the high-impedance 'tristate' condition as well, and if you were ambitious they might also have a latch or one-shot to register the passing of a pulse. That was about as elaborate as most logic probes got — simple and unpretentious, but still very handy for basic troubleshooting in digital circuits.

I still have a couple of these traditional logic probes in the drawer under my bench. But after trying out HP's new LogicDart they're never going to seem the same again...

Of course, the only real shortcoming of those traditional probes is that they're only logic probes. If you want to check a board's supply rails properly, you still need a DMM; it's the same if you want to check track continuity or the value of a pullup or timing resistor. And if you want to verify that the various clock signals are right, you still need to fire up the scope or the frequency counter. As for wanting to compare the relative timing of a couple of signals against the relevant clock — that's when you'll probably need a logic analyser.

Wouldn't it be great if somebody was able to come up with a single instrument capable of doing all of these jobs? They have, and it is; because that's just what HP has achieved with the LogicDart (HP E2310A).

When you first turn the LogicDart on after replacing the batteries, an 'about' display appears and describes the instrument as 'your personal digital troubleshooter'. To my mind that's a pretty apt description.

In fact it's a very impressive little beast. In a compact but rugged case only slightly larger than a typical DMM, HP's engineers have managed to squeeze the functions of a 3-1/2 digit digital voltmeter, an ohmmeter, a continuity/diode tester, a digital frequency counter, and a three-channel logic timing analyser with waveform storage and sampling up to 100MS/s. Oh, I almost forgot — there's also a built-in digital clock and calendar, and last but not least, a logic probe!

For DC voltage measurement the LogicDart operates over the range from -35V to +35V, with a rated accuracy of +/-0.5% of reading + 2 counts) and a resolution of 10mV. For resistance measurement it measures from 0.01kΩ (10Ω) to 120kΩ, with essentially three digits of resolution and an accuracy ranging from +/-1.5% of reading + 1 count) at the low end, to +/-7.9% of reading + 1 count) above 12kΩ. The continuity LED and optional beeper operate below around 140Ω.

For frequency measurement, it operates over the range from 1Hz to 33MHz, with only one digit of readout below 10Hz, two between 10Hz and 99Hz, and three from 100Hz to 33MHz. The rated accuracy is +/-0.1% of reading + 1 count).

As a logic probe, it has the usual high (1) and low (0) logic level LEDs, which are both off in the tri-state mode and in this case also flash alternately at a fixed rate if the LogicDart detects a pulse train or other dynamic waveform. The high and low logic thresholds can be set up to correspond to TTL (3.3V CMOS), 5V CMOS, or ECL. The beeper can also be enabled if you wish, to provide two different audio tones for high and low (giving an alternating two-tone beep for a pulse train). Glimches of 15ns or greater duration can be detected.

Extending these functions as a logic analyser, the LogicDart can make use of two further input channels in addition to the main 'Channel 1' input used for the functions just described. It therefore becomes a three-channel logic timing analyser, sampling at up to 100MS/s and taking records of 2048 samples per channel. There's a choice of edge, pattern or edge/pattern combination triggering, and the effective timebase range can be set between 10ns/div to 20s/div.

In this mode there are two cursors which can be manipulated for relative timing measurements, quite apart from the LogicDart's own ability to make an automatic frequency measurement. As with many modern DSOs and logic analysers there's also one of those magic 'autoscale' buttons, where the
instrument automatically sets itself to give you at least a ‘ballpark’ display of whatever signal is present.

As an analyser you can operate the LogicDart in either single or continuous sampling mode. You can also save and recall waveforms, and compare a new waveform with one previously saved. And — wait for it — you can even print out measurements and waveforms on a small portable thermal printer, an optional accessory. The two are coupled via an infra-red link rather than a cable.

**Micro controlled**

Needless to say these impressive LogicDart goodies are under the control of a microprocessor, as with most modern test instruments. Despite this it all runs on either three AA alkaline cells, or a plug-pack power supply (included) delivering 12V DC. Typically it will operate for about 15 - 20 hours from a set of batteries.

The case measures 198 x 89 x 38mm, and weighs only 400g. At the top of the case front is a rectangular LCD screen measuring 66 x 37mm, and with an active area of about 61 x 33mm. This is used for most of the LogicDart’s information display, apart from the three LEDs at the bottom used for the logic probe and continuity indication.

The LCD display appears to be fully bit-mapped, and of about 128 x 64 pixels; it’s configured to show both graphical and alphanumeric information, in various combinations according to the mode you’re in at the time. Although the waveform displays given are nominally only of the ‘logic analyser’ type, they do provide some indication of intermediate levels — and hence a useful guide to waveform integrity.

The five buttons visible immediately below the display in a horizontal row are software-defined function keys, with their functions always clearly defined along the lowest area of the display. Below these again are the LogicDart’s 17 other control buttons, arranged as you can see in a fairly intuitive series of groupings. The main on/off button is at top left, in a row with the three mode select buttons; then there’s an array of nine buttons used for things like cursor control, timebase range select, shift select and waveform saving/recall. Down at the bottom are the buttons used for acquisition control, and finally the ‘System’ button used to set the LogicDart’s clock/calendar, logic thresholds, display language (there’s a choice of six), beep options and so on.

If you haven’t noticed from the picture there’s also a ‘Help’ button, which produces brief but handy displays of information on mode options and the functions of the various keys. This makes the LogicDart’s user manual largely redundant after you’ve looked through it initially.

I should also mention at this point that the LogicDart comes with various accessories, as well as the manual and AC adaptor. There’s a zip-up soft carrying bag plus three probe leads with a set of ‘attachments’ including two ‘browser’ probe bodies with fine sharp points, six miniature ‘grabber’ clips, three adaptor tips, and some ground leads and extender pins.

**Trying one out**

Thanks to our good friends at H-P Australia’s TMO division, we were able to get our hands on one of the first LogicDarts into the country, and I was able to try it out for a while. I tried to give it quite a workout, by using it to check signals in a number of different boards (including the final prototype of my PC-driven Arb & Function Generator).

Frankly, I was most impressed. The LogicDart really does seem to include pretty well all of the functions you need for a lot of day-to-day troubleshooting in digital circuitry, all rolled into one handy and easy to drive little instrument. Instead of having to reach for and/or turn on a variety of other instruments, to check out various possibilities, most of the time you merely need to press a few buttons on the LogicDart...

My best summary of the instrument is that it’s essentially the ‘digital-domain multimeter’ many of us have needed for years, but probably didn’t ask for because we didn’t think it could be done. HP’s designers have my vote, not just for seeing the need, but also for working out how to deliver the solution — and at the price they’ve achieved it.

By the way regular readers won’t be surprised to learn that while I had the LogicDart, I carefully opened it up to have a look around inside that compact case. And the interior turned out to be just as impressive as its external functions. The LogicDart is very nicely made, and clearly designed for both efficient automated assembly and convenient later servicing if needed.

So that’s about it. For anyone who does design and/or troubleshooting of digital circuitry, you really only have to try out the LogicDart to want one. Your only problem is likely to be stopping your colleagues from borrowing it all the time!

**HP E2310A LogicDart**

An advanced logic probe or ‘personal digital troubleshooter’. Combines a logic probe, 3-1/2 digit DC voltmeter/ohm meter, diode/continuity tester, 33MHz frequency counter and three channel 100MS/s logic timing analyser in a compact case, with microprocessor control.

**Good points:** Provides just about all of the test functions needed for efficient troubleshooting in the digital domain, in a handy and easy to use form.

**Bad points:** If there are any, we couldn’t find ‘em. It might need a secure point to attach a chain, to prevent it ‘wandering’.

**Australian Price:** $1130 plus sales tax if applicable. The optional HP 82240B portable thermal printer is $205.00 plus sales tax.

**Available:** By calling HP Australia’s Call Centre on 1800 629485.
NEW PRODUCTS

1GHz scopes for communications

Tektronix has announced the TDS 700C and TDS 500C family of InstaVu digital storage oscilloscopes (DSOs). The new models are said to be optimised with a new and unique communications signal analyser package and other enhancements that allow designs to be verified with a wide variety of industry standards. They allow direct connection of optical and electrical communication signals and the extended triggering modes are claimed to enable better efficiency when capturing communication signals.

The instruments are available in four and two channel models and have a real-time sampling rate up to four gigasamples per second, a waveform capture rate up to 400,000 acquisitions per second, an 8MB record length, and a 1GHz bandwidth. There are five models in the series, three with colour displays and two with monochrome displays. Prices start at US$14,592 (TDS 700C) and US$10,705 (TDS 520C).

For further information circle 242 on the reader service coupon or contact Tektronix, Test and Measurement Products, 80 Waterloo Road, North Ryde 2113; phone (02) 9888 0100.

IR remote control via a radio link

The Powerlink system lets you control infrared remote controlled audio visual equipment anywhere in the home. The system includes a relay unit, a base unit, two power supply units and instructions. The relay unit is placed in the room where control is needed, and the base unit in the room with the equipment being controlled.

The relay unit senses the output of the equipment’s IR remote control and relays the code as a radio signal. The original code is converted back to infrared by the base unit. The effective range of the system is claimed to be typically 50 metres. Additional base and relay units are available to expand the system. Extension infrared emitters are also available to give increased flexibility for positioning the base unit. The RRP of the Powerlink system is £59.99, additional base or relay unit is £29.99 and the extension IR emitter is £10. International delivery is available.

For further information circle 244 on the reader service form or contact Nationwide Antenna Systems, 17 Campbell St., Bowen Hills 4006; phone (07) 3252 2947.

SMD infrared rework tool

The Solder Light from PDR is a focussed infrared hand-held SMD rework tool, claimed to allow safe and easy removal of all SMD components. The process incorporates gentle pre-heating of the board to be reworked, with the Solder Light IR emitter providing the extra heat energy to the component being removed. This causes the solder joint to reflow, allowing the component to be removed.

The system allows SMDs with connection points under the body of the component to be safely removed, as the heat to reflow the solder does not have to be driven through the device. Instead, reflow occurs at the junction of the two sources of heat energy. The balanced application of heat energy also allows rework of components with heat sensitive parts, including SMD connectors which can melt with conventional techniques.

The controlled heat profile is said to be safe and repeatable, preventing damage to the reworked component, surrounding devices or the PCB. It also avoids the situation where a hot gas tool can blow away light components positioned close to a heavy component being reworked.

For further information circle 247 on the reader service coupon or contact Computronics Corporation, 6 Sarich Way, Technology Park, Bentley 6102; phone (08) 9470 1177.
Virtual DSO, spectrum analyser and DMM

The Pico ADC 200 is a high speed virtual instrument for use with a PC. Together with PicoScope Software, it allows a computer to be used as a 50MS/s dual channel digital storage oscilloscope (DSO), a spectrum analyser or multimeter. The external trigger connector also doubles up as a simple signal generator.

The device plugs into the parallel port of the PC and is controlled via Windows (3.x or 95). It allows a signal to be viewed as a waveform, while simultaneously showing frequency components of the waveform (like a spectrum analyser) and AC voltage and frequency values.

The ADC 200 can also be used as a high speed data acquisition/data logging device. Drivers written in C, Pascal and Windows (Visual Basic, Delphi and Excel) are supplied with the instrument. It comes in two versions: the ADC 200-50 capable to 50MS/s samples and spectrum analysis to 25MHz, and a lower cost unit with 20MS/s and spectrum analysis to 10MHz. Both units are supplied with cables, power supply and manuals.

For further information circle 243 on the reader service coupon or contact Emona Instruments, PO Box 15, Camperdown 2050; phone (02) 9519 3933.

Radio operated controller

Imark Communications has developed a radio controlled relay switching system which operates in conjunction with normal mobile and/or portable radios that are fitted with a DTMF encoder. The controller comprises a KG208 mobile radio, a power supply, an Imark D104 four-way DTMF decoder and an interposing relay module, and is housed in a weather resistant enclosure. The system can be supplied to operate on any RF frequency between 66 and 520MHz.

Up to four DTMF decoders can be installed to control four different functions. The decoders can be link-selected to provide N/O or N/C contacts and the outputs can be isolated for servicing. Applications include controlling lights; security gates and doors; irrigation systems; equipment in plants, factories, or at mine sites.

For further information circle 241 on the reader service coupon or contact Imark Communications P/L, Unit 2, 75 Mark Street, North Melbourne 3051; phone (03) 9329 5433.
Microprocessors and Peripherals

Faster 80C51 MCUs take less power

Philips has introduced a new range of 80C51 and derivative microcontrollers (MCUs) said to feature a 50% increase in speed and up to 75% reductions in power consumption compared to existing 80C51 devices. The devices have a 2.7V to 5.5V operating voltage range, and are suitable for battery-powered applications such as pagers, PCMCIA cards and mobile phones.

The redesigned 80C51 core has allowed an increase in the maximum clock frequency from 24MHz to 33MHz, and makes the chips fully static in operation. As a result, the system clock can be stopped to reduce standby power consumption without losing the contents of registers or affecting the state of the microcontroller.

The first members of the redesigned 80C51 family are now available in masked ROM form. Philips' entire family of 80C51 microcontrollers will migrate to the new core design by the end of 1997.

For further information circle 201 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 9805 4479. Internet at http://www.semiconductors.philips.com.

Embedded VXI controller uses Pentium Pro

National Instruments has announced the VXIpc-860 embedded VXI controller, said to be the first with a 200MHz Pentium Pro processor. It is 35% faster than the company's 200MHz Pentium VXIpc-850, and compatible with Windows NT/95/3.1. It is also VXI plug-n-play compliant, and compatible with the company's LabVIEW and LabWindows/CVI application software, test executive software, and NI-VXI/VISA bus interface software.

Like all of the VXIpc-800 series, the controller features a modular, PCI-based local bus design with an interchangeable daughterboard to upgrade to new microprocessors. It has the MITE, MANTIS, and TNT4882C custom ASICs, and can achieve a VXI data transfer rate better than 30Mb/s.

Also included are 16MB of DRAM (upgradeable to 128MB) and a 1.3GB (or larger) internal, enhanced IDE hard disk. The front panel has connectors for a super VGA monitor, a GPIB interface, serial and parallel ports, SCSI-2, and 10-Base-T Ethernet. Also on the front panel are two PCMCIA slots (one Type II and one Type III), a single full-size expansion slot that accepts either a PCI or an ISA plug-in board, VXI clock and trigger signals, and an internal floppy drive.

For further information circle 207 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 9879 5166. Website at http://www.natinst.com/.

Eurocard PC with PAL/NSTC Video

The PC-EYE is an embeddable PC card with built-in video capture. It allows composite video or S-video format PAL/NSTC sources to be processed for live video display on Windows-based systems. It is built around the EC586 high performance PC sub-system, and the EC586TV mezzanine module.

Images can be acquired from camera, VCR, or other PAL/NSTC sources and displayed to screen on a resizable window within a Windows-based system. Live video functions can be added to suit client applications.

The EC586 is a Pentium PC on a single 100 x 160mm Eurocard and has all the features and functions normally found in a complete PC. It can often be used as a stand-alone single board computer and has both PC/104 and IEEE1000 interfaces for expansion with industry standard modules.

For further information circle 208 on the reader service coupon or contact DGE Systems Pty Ltd, 103 Broadmeadow Road Broadmeadow, 2292; phone 1800 818 736.

16K and 32K Serial EEPROMs

Atmel Corporation has announced the availability of the AT24C128 and AT24C256, a pair of ultra-high density, two-wire serial EEPROM devices specifically developed for the cellular phone market. The devices are organized as 16,384 (16K) and 32,768 (32K) x 8-bits respectively. In cellular phones, these devices are used to store frequently dialled numbers, last number called and other memory-based functions.
Additional applications include high end TV chassis, pagers, set-top boxes, digital cameras, and other portable consumer applications.

The devices are available in 1.8V, 2.7V and 5V versions, and support clock frequencies up to 1MHz. They are currently being offered in 8-pin JEDEC PDIP and 8-pin EIAJ SOIC packages and are plug-in replacements for previous generation lower density Atmel devices. The new devices are also being offered in the new chip array BGA package.

For further information circle 210 on the reader service coupon or contact Atmel Corporation, 2325 Orchard Parkway, San Jose, CA 95131; phone (408) 441 0311, Web site at http://www.atmel.com.

USB-based micros

Motorola has announced the first of a family of universal serial bus (USB) 8-bit microcontrollers, the 68HC(7)05JB2 and 68HC05JB2 which are aimed at low-speed USB computer mouse applications.

The 68HC(7)05JB2 has an on-chip memory of 2048 bytes of user ROM (or EPROM) and 128 bytes of user RAM. It also has 16-bit input capture/output compare timers, 10 bidirectional I/O pins, a low voltage reset (LVR) circuit, a 3.3V +/- 10% DC voltage for the USB pull-up resistor, and hardware mask and flag for external interrupts. It provides fully static operation with no minimum clock speed, multifunction timer, power saving STOP and WAIT modes, illegal address reset and an 8 x 8 unsigned multiply instruction.

Mask options for the 68HC05JB2 include external interrupt pins, edge triggered or edge and level triggered; port A and port B pulldown and pull-up resistors connected or disconnected; port A PAO-PA3 external interrupt capability enabled or disabled.

For further information circle 209 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 9887 0711.
PLC review:

THE SPLAT SL88
MICROCONTROLLER

Programmable logic controllers can be put to use in a vast range of applications, from home security to home automation; from running lights, to running a bottle factory. The SL88 from Victorian firm Microconsultants is aimed more at hobbyists and people needing to control small machinery at a low cost — and what’s more, it’s designed and built in Australia.

by GRAHAM CATTLEY

If you have ever tangled with a programmable logic controller (PLC), you’ll know that at best they tend to be frustrating, lumbering beasts that take months of experience to program effectively. You’ll also know that most of them use a rather antiquated programming system known as a ‘ladder diagram’. These diagrams attempt to represent the program structure as though the PLC were made up from a series of interconnected relays.

This is perhaps because early PLCs were a series of interconnected relays. Great racks of them, in fact. Any major changes to an existing program were done with an angle grinder, a box of new relays, and several miles of wire.

Needless to say, the microprocessor revolution changed all this, and you can now see an entire factory controlled by a small box on the wall. Unfortunately, many modern PLC systems inherited the programming techniques of their prehistoric ancestors, mainly for backward compatibility. Another feature that’s been preserved is the price: today you’re likely to be up for $1000 or so, even for a bare-bones system.

The SL88

The SPLat SL88 is a simple, straightforward microcontroller made in Australia by Microconsultants, an Australian company which realised that what the world really needed was a simple, off-the-peg microcontroller unit that could be used by anyone needing to control a small to medium system.

The SL88 differs from most other PLCs systems in three important areas: simplicity, ease of use, and price. The SL88 costs around $150.00, consists of a single high quality PC board measuring just 88 x 95mm (the size of a floppy disk), and yet provides the following features:

- Eight inputs;
- Eight outputs;
- Four timers timing over the range of 100ms to 0.9 hours;
- Another four timers timing from 10ms to 5 seconds;
- 24 data memories;
- 500 program steps;
- an RS-232C interface for downloading programs from a PC, and
- LED indicators on all inputs and outputs.

A built-in regulated supply running off 24V DC (or 18V AC) powers the controller, and all off-board connections are made by screw terminals. Each output is rated at 400mA, with the controller able to support a total output current of 1A.

As you can see from the photo, there is relatively little on the board, with almost all the work done by the large 68HC705 microcontroller IC in the centre. The PC mounted DB9 socket allows you to plug the controller into a standard COM port on your PC for programming the controller’s internal EEPROM, while the 17 LEDs indicate the status of the inputs and outputs, as well as power.

SPLat/PC software

The SPLat SL88 package consists of the SPLat SL88 board and a single floppy disk containing the SPLat/PC software and support files. That’s it — no thousand page manuals or user guides to digest. The whole basis of the SPLat system is that you can get the thing up and running in a matter of minutes.

The SPLat/PC software supplied is designed to perform two main tasks: first, to let you write your program and download it into the SL88; and second, to perform an emulation of the microcontroller so that you can test your program in situ.

This latter function is perhaps the most interesting and enjoyable part of
working with the SPLat/PC system, in that you can make real time changes to your code and see the results immediately. There’s no need to go through the cumbersome edit-save-compile-down­
load-run routine every time you want to make any changes.

The SPLat/PC program consists of a number of different windows, each displaying a different aspect of the micro­
controller’s operation. One of the most interesting of these is the input/output window, which shows a block of eight DIP switches and a row of eight LEDs. The switches are effectively connected to the controller’s eight inputs, and can be turned on or off by clicking on them with the mouse. The output from your program is displayed on the row of LEDs, which change colour when they turn on.

All this happens in real time, so you can get a pretty good idea of how your pro­
gram will behave in the real world. Other windows show the status of the stack (a temporary storage system), a listing of the values of any used variables, and the status of the eight built-in timers.

SPLat/PC appears to be well written, with much attention to detail, and a sen­sible layout. A couple of the nicer touches include the ability to view stack values in hex, boolean, or decimal nota­tion, and automatic scaling of timer values to compensate for running the pro­
gram in the emulator.

The actual programming language is a sort of cross between BASIC and assem­bler, with reverse-Polish stack based arithmetic operations. All very well, you say, but what good is all this if you’ve never been able to program the VCR, let alone a PLC — besides, wasn’t I raving on at the start of the article about how difficult PLCs are to program?

Well, yes I was, but there is one aspect of SPLat/PC that I haven’t men­tioned yet — the help and tutorial file. This file is marvelous. Displayed in Windows Help file format, it walks you through the whole system in a graduated series of experiments that can be performed quickly and easily.

Even if you can’t drive a programmable calculator, you’ll have no problem working through each of the demonstrations, each of which introduce a dif­ferent aspect of programming PLCs. It is aimed very much at people who haven’t programmed before, and with the advantage of running each of the pro­
grams on the emulator, single-stepping and changing inputs on the fly are easy and simple to do.

If you have a real SL88 plugged into the serial port, its outputs will mirror what’s happening on the screen — very handy for testing in a real system, and very encouraging for new users who can see that their program actually does something.

The tutorial covers more that just programming, however. It goes into control systems and concepts, and in later stages it covers state machines and state diagrams.

So, if you are looking at a simple way to control a sprinkler system, stage lighting or even a large model railway, consider using the SL88 programmable logic controller; it’s cheap, simple, easy to program and Australian made. What more could you ask? *
Microsoft pumps $1B into cable company

Impatient with what he sees as the low speed with which television and computer technologies are being integrated, Bill Gates has announced that Microsoft is investing US$1 billion in Comcast, the fourth largest US cable television company — with 4.3 million subscribers. Microsoft will own 11.9% of Comcast. Most importantly, the deal will put Microsoft in position to force Internet integration into the television industry, which has been reluctant to succumb to the wild and wacky world of the Internet.

Gates said that he and Comcast president Brian Roberts will work closely together regarding the direction of Comcast. Microsoft treasurer Greg Maffei will serve as an observer on Comcast’s board of directors.

Driving the deal is Microsoft’s belief that its current dominant position in the personal computer software industry has created a unique, but time-limited window of opportunity to control the future direction of the Internet into the consumer market through television.

“This move is geared towards Microsoft casting itself as a massive information company for the next century”, said Stephen Auditore, president of Zona Research, a television industry market research firm. “By investing in Comcast, they are essentially going to get themselves something of a captive delivery mechanism for content.”

The first to benefit from the Comcast investment will be WebTV, the San Francisco company that is marketing set-top boxes which allow TV viewers to surf the Internet. WebTV’s progress in the market has been hurt by the slow pace at which telephone and television companies are updating their equipment to handle Internet traffic.

Comcast will use much of the $1 billion from Microsoft to accelerate the construction of fibre-optic cable to expand high-speed Internet access. Comcast is currently testing modems that would hook people’s computers to the Internet via cable.

Gates said Microsoft will have a ready market for a version of the WebTV box it is currently developing to hook into the Comcast cable system. The WebTV software eventually may be put inside new set-top boxes that cable operators buy for customers, potentially putting channels for cable TV alongside Internet access. Microsoft is also developing software to enable personal computers to be easily hooked up to cable lines for Internet access.

S3, Faroudja to make super video chips

Would you like to have HDTV-quality video images on your computer screen? A new alliance between chipmaker S3 in Santa Clara and the television engineering firm Faroudja Laboratories in Sunnyvale is aimed at developing a set of chips that will provide PC displays with unmatched video display capabilities.

The two firms said they hope to have a prototype circuit board ready by the end of this year. The circuits to be designed will eliminate the distortions that typically occur when moving images from material developed for television broadcasting are played back on PC screens.

S3 is a US$460 million manufacturer of multimedia accelerator chips which are used, among others, by nine of the world’s top ten PC manufacturers. Faroudja Labs is one of the world’s leading television engineering firms, with numerous inventions found in a majority of TV sets on the market today — including Sony’s Trinitron sets. In the late 1980s, Faroudja developed high-definition TV technology that worked with existing NTSC transmission standards.

IDT launches its 200MHz MMX processor

It works just like a 200MHz MMX processor from Intel, but the new IDT-C6 microprocessor launched by Integrated Device Technology (IDT)
And Cyrix makes four...

Cyrix, the Texas chipmaker, has become the fourth company to offer PC manufacturers a family of medium to high-end MMX-capable microprocessors to run Windows-based operating systems and applications. The company’s new 6x86MX processors run at 166MHz, 200MHz and 233MHz, and cost about half of what market leader Intel charges for similar products. Earlier Advanced Micro Devices and upstart Integrated Device Technology launched Pentium II-class processors.

At US$320, the Cyrix 233MHz processor compares with $469 that AMD charges for its comparable K6, while Intel has put a $583 price tag on Pentium II chips in this class. Industry analysts said Intel’s price structure has only one way to go in the face of the new competition — and that is down, way down. “I think Intel will bomb their prices”, said analyst Jim Poyner.

Intel’s next round of scheduled price reductions wasn’t until August. But analysts were expecting that Intel’s system of regularly scheduled price cuts would be an early victim of the unprecedented competitive situation Intel is facing in the processor market, which it virtually had to itself until two months ago.

Cyrix said one of its first customers for the new line is CyberMax Computer, which will be marketing a line of Cyrix-based PCs ranging from US$1900 to $2300. Comparable Intel-based systems cost around $3000.

Chip veteran to head SIA

George Scalise, a long-time semiconductor industry veteran and architect of the first US-Japanese chip trade agreement in 1986, has been elected to become the new president of the Silicon Valley-based Semiconductor Industry Association. Scalise, who is 63 and was vice president at Apple Computer, succeeds Thomas Armstrong who left the association in March.

Scalise joined Apple last spring to help the company’s then freshly-appointed CEO Gil Amelio turn around the struggling computer maker. Scalise followed Amelio from National Semiconductor. He spent a large part of his career at Advanced Micro Devices in Sunnyvale and Fairchild Semiconductor.

CMOS processors in new IBM mainframes

Mainframe computers are far from dead. To prove the point, IBM has released the fourth generation of its top-of-the-line 390 Series mainframes, machines that offer more bang for the buck plus vastly improved data security and user friendliness.

The new System 390 mainframes run on CMOS-based microprocessors, as opposed to the traditional custom circuit boards. Their low power consumption has eliminated complex and costly water cooling systems, allowing IBM to deliver machines that cost much less than the previous generation 390s, yet offer similar performance.

IBM said it expects a large portion of its current mainframe customer base to upgrade to the new machines, which are far less costly to operate and maintain. The company also expects the machines to do well in the market for corporate network servers and Internet access systems.

Barrett becomes Intel president

Craig Barrett, fondly referred to within his company as ‘Mr Intel Inside’, has been promoted to the position of president — replacing Andy Grove, who has become chairman. Grove retains his title of chief executive officer.

The new line-up more closely reflect the roles both men have been playing. Grove manages Intel’s overall operations and interfaces with the outside world, while Barrett, as chief operating officer, has been making sure Intel’s internal operation continue to run incredibly smoothly and profitably.

Many inside and outside of Intel credit Barrett for much of Intel’s success. “Craig Barrett has got to be one of the most powerful unknown people in the industry”, said Linley Gwenap, editor of Microprocessor Report newsletter.

Sun breaks ban on encryption exports

Sun Microsystems has begun to market an advanced computer data encryption technology to customers worldwide, in defiance of US government policies that prohibit American companies from selling such software to overseas customers. Sun said it will be able to sell the software legally, because it was developed by the company’s Russian-based subsidiary, Elvis. There are currently no laws against US companies selling encryption products that were developed outside the United States.

Sun said its encryption software is far more sophisticated than anything US companies are currently allowed to export.

Executives at RSA Data Security, the Silicon Valley company that pioneered the public-key type of encryption technology in the 1970s, said the Sun move could mean the beginning of the end for the US ban on encryption export controls. “This is a significant part of the wall coming down. That sound you’re hearing is the dying gasp of a Cold War dinosaur”, said RSA president John Bidzos.

Industry officials have been negotiating with the federal government for more than a decade for relaxation of encryption export controls, in the face of the availability of such products in overseas markets from local developers. To date, the US government has maintained it will only allow for encryption exports if the products incorporate code that national security and federal law enforcement agencies would be able to crack.

At Sun, executives tried to downplay the notion that their company was out to force the inevitable. “I want to emphasize that we had no intention of politicizing this. This development has come out of market demand. Our customers require this security, and we are giving it to them”, said Humphrey Polanen, general manager of Sun’s security and electronic commerce group.
Computer News and New Products

Cordless keyboard with touchpad

The VersaPoint from Interlink Electronics is a cordless keyboard with a touchpad pointing device.

Computer for hostile environments

Lucas Control Systems has introduced the Deeco ST-x 130 486 Pentium-based computer for rack-mounted applications. It is designed for use in hostile environments such as extreme factory temperatures and conditions of high humidity, shock and vibration.

The computer is claimed to be 100% compatible with IBM PC/AT software, and is available in SX to DX4 (100MHz) versions. An optional Pentium Overdrive processor is also available. All versions have two 72-pin SIMM sockets for up to 64MB of DRAM. It has a 213mm Sharp colour LCD display (640 x 480 pixels) with optional SealTouch infrared (IR) touch controller, which eliminates the need for a keyboard. A standard keyboard or mouse can also be used.

The computer includes three full-size and one half-size ISA card slots, shock-mounted internal hard drives, and a 3.5" 1.44MB floppy disk drive. Local bus Ethernet and a 1.5MB semiconductor disk are available as options. It comes with one RS-232C serial port, one parallel port and a keyboard port, and has an internal 32-bit VESA local bus.

For further information contact Lucas Control Systems Products, Wendlingen, Germany; phone +49 7024 971 214, fax +49 7024 971 240.

266MHz Pentium II PC

Hewlett-Packard has announced a new HP Vectra VL PC powered by Pentium II 233MHz and 266MHz processors. Prices will be announced soon. The computer features a 'tool-less' desktop chassis, claimed to make it easier to service, maintain and expand. For example, a CD-ROM or other 5.25" front shelf device slides into the chassis without screws or rails, and the back-shelf expansion is held with one screw secured without tools.

The computer can also can function vertically or horizontally and has a modular internal design that allows the motherboard and backplane to slide out of the chassis, without removing add-on cards or disrupting other components. It will include a 24X CD-ROM (on selected models), two USB (universal serial bus) ports and up to 4GB of IDE hard-drive capacity.

For further information phone the HP Customer Information Centre on 131347. Their web page is at http://www.hp.com.
Low cost HP
600dpi laser printer

Hewlett-Packard has introduced the HP LaserJet 6L printer as a replacement for the company’s 5L printer, with an expected street price of $799 (including sales tax). Print speed is six pages per minute, a 50% increase over its predecessor, and the duty cycle is increased from 4000 to 6000 pages per month. It also has ‘instant on’ fuser technology to eliminate warm-up time.

The printer has 600 x 600dpi resolution, resolution enhancement for graphics and text, and comes with a choice of 26 TrueType scalable typefaces. It has 100-page input and output trays, a single sheet feeder and a straight-through paper path said to ensure wrinkle free printing of envelopes, labels, special stock and transparencies.

Updated software
for schematics

lmex Design International has released WinDraft Schematic Capture version 2.0. The program has several new features, such as a parts palette of up to 20 frequently used parts and the ability to import BMP graphic files. TrueType fonts have been added throughout, including title block, pin numbers, references, values, and hierarchical sheet symbols. Editing functions, toolbars and dialog boxes have been revised, and design size is now displayed on the tool bar.

Other new features include automatic cyclical backup, print preview, faster screen refresh, design statistics and on-screen pin count indicator. The unlimited pin capacity version is $868, and the 650 pin version is $442.40. Free shareware versions of this program and its companion Winboard PCB layout program can be obtained from http://www.lmex.com, http://www.midcoast.com.au/bus/me or by downloading ‘wdshare.exe’ and ‘wbshare.exe’ respectively on the anonymous FTP service. These versions are complete, fully functional programs with a 100 pin/pad limitation and can be used to view any size design.

For further information circle 163 on the reader service coupon or contact ME Technologies, PO Box 50, Dyers Crossing 2429; phone (065) 50 2200. Internet http://www.midcoast.com.au/bus/me.

Phone/fax modem runs at 50kb/s

The new Sportster Flash fax modem with personal voice mail from US Robotics combines voice mail, speaker phone and fax facilities. It is ‘x2 56K’ technology ready (for speeds of more than 50kb/s over normal telephone lines), and is Flash ROM upgradeable to future standards.

The modem digitally records incoming voice messages for multiple voice mailboxes, and can signal an alphanumeric pager when fax or phone messages arrive, for retrieval from a remote location. It also automatically detects an incoming fax call and has a full duplex speaker phone. Because it supports international data communication standards, the modem is compatible with the 33.6kb/s V.34 standard, and is also compatible with modems down to 300b/s. The RRP is $229.

For further information circle 160 on the reader service coupon or contact US Robotics Pty Ltd, 473-479 Victoria Street, West Melbourne, 3003; phone (03) 9482 6557.

Australian Computers & Peripherals from JED... Call for data sheets.

JED Microprocessors Pty. Ltd
Office 7, 5/7 Chandler Road, Boronia, Vic., 3155. Phone: (03) 9 762 3588 Fax: (03) 9 762 5499

The printer comes with 1MB of memory, effectively doubled with HP’s Memory Enhancement technology (MEt), and can be expanded to 9MB. Copy, fax, file and read capabilities can be added with the optional LaserJet Companion printer accessory.

For further information phone the HP Customer Information Centre on 131347. Their web page is at http://www.hp.com.

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For further information circle 160 on the reader service coupon or contact US Robotics Pty Ltd, 473-479 Victoria Street, West Melbourne, 3003; phone (03) 9482 6557.
Handbook on PC data acquisition

Iotech has published a 128-page Signal Conditioning and PC-Based Data Acquisition Handbook, claimed to be a definitive guide to signal conditioning techniques used in today's test and measurement applications. It is said to be a comprehensive reference tool that helps readers design accurate data acquisition applications, avoid common pitfalls, and understand the requirements needed for proper transducer use.

The handbook serves both as a primer for the beginner and as a quick reference guide for the experienced engineer. For further information circle 164 on the reader service coupon or contact Scientific Devices Australia, PO Box 163, Oakleigh M.D.C. 3166; phone (03) 9579 3622.

ISDN tester for primary rate interface

Wandel & Goltermann has released its new IBT-20 universal tester for the ISDN primary rate interface (PRI). The instrument is said to include all the test functions needed to bring into service and maintain ISDN lines and ISDN equipment such as PBXs. It includes a tracer for TE and NT operation, and error rates (BERT) can be measured and services tested in both modes.

Other features include monitoring capabilities, X.25 test functions (B or D channel), a Windows PC detailed decoder for examining traces and captured data, and access to all results for printing logs.

For further information circle 166 on the reader service coupon or contact Wandel & Goltermann, 42 Clarendon Street, South Melbourne 3205; phone (03) 9690 6700.

SUNSHINE DEVICE PROGRAMMERS

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<th>Description</th>
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Box 163, Oakleigh M.D.C. 3166; phone (03) 9579 3622.

CONGRATULATIONS TO ELECTRONICS AUSTRALIA ON ITS 75TH ANNIVERSARY.

GRIFFITH UNIVERSITY
INDUSTRIAL AFFILIATES PROGRAM
5TH ANNIVERSARY - JUNE 1997

From 1993 - 1997, 150 students have provided valuable solutions and working prototypes to 70 Queensland electronic industries.

The Industrial Affiliates Program, an Australian first, makes final year students available to organisations for three months. Students get involved in industry projects at the conceptual stage through to the completion of prototypes.

Industry projects are now being accepted for the next program.

Make sure you are part of this valuable program by accessing highly trained microelectronic engineering students and the extensive electronic resources of Griffith University.

To tap into these resources, please contact Carol-joy Patrick on telephone (07) 3875 5007, facsimile (07) 3875 6726 or email: c.patrick@sct.gu.edu.au

GRIFFITH UNIVERSITY
LEADING THROUGH INNOVATION
The IBM Patent Server
http://patent.womplex.ibm.com/

The US patent server is an interactive search site containing over two million patents. This site contains information regarding US Patent & Trademark Office (USPTO) patents, and is designed to make searches of US patent information over the last 26 years. The server lets you search for patents by patent number or by performing a text search for each patent.

Once you have a list of patents that match your search results, you can view an abstract of each patent by simply clicking on it. If it looks interesting, you can then view an image of the actual patent submission, scanned in from the original.

There is provision to order the full text and any image of a patent in hardcopy, and this can either be faxed or mailed to you. If you find an especially interesting patent, you can vote for it and it may appear on their Gallery Page, along with patent #4858627 for a Smoker's Hat, or patent #5606804 for a Microwave clothes dryer and method with hazard detection...

VAF Research

If you’re in the market for a set of Australian-built hifi loudspeakers, just enjoy window-shopping for speakers, or are interested in the design philosophy and background history of a respected local loudspeaker designer, VAF's Research's new web site may be worth a look.

It offers high resolution images, technical details and prices for VAF’s entire range of loudspeaker products, including those available in kit form, plus reprints and quotes from media reviews of several models. Not surprisingly, the site also offers internet facilities for ordering and finding out more about VAF speakers, plus a Technical Information page on hifi loudspeakers.

A rather interesting page of information is the history of VAF Research, covered in some detail by founder, designer and now Managing Director Philip Vafiadis. Here Philip recounts his early aspirations as a genuine speaker enthusiast and designer, and takes the story through to the present day with his thoughts on the future of VAF products.

Fluke Corporation
http://www.fluke.com/

As you probably know, Fluke produce a wide range of electronic test equipment, from simple handheld digital multimeters through to high end calibrators. Their web page gives details of all the products in their range, along with basic specifications for their more popular test equipment.

If you dig far enough, you’ll find a series of application notes on how to use Fluke equipment to perform a multitude of tasks. These notes range from component testing to power measurements, and they all seem to be quite clearly written with a healthy sprinkling of diagrams along the way.

There also seems to be a huge section of the site devoted to computer network analysis, containing chat rooms and other support services, but you’ll have to register with Fluke if you want to take advantage of it.

Have you come across any good sites that you think other readers would be interested in? If so, feel free to let us know — our email address is electaus@magna.com.au, so why not drop us a line?
EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also, some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

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KEY TO CODING

A  Kits and modules  E  IC chips and semiconductors
B  Tools  F  Test and measuring instruments
C  PC boards and supplies  G  Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

Electronics Australia Reader Services

SUBSCRIPTIONS: All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Company, P.O. Box 199, Alexandria NSW 2015; phone (02) 9353 9992.

BACK ISSUES: Available only until stocks are exhausted. Price $7.50 which includes postage within Australia only. OVERSEAS READERS SHOULD ADD A FURTHER $2.50 FOR EVERY BACK ISSUE REQUIRED.

PHOTOCOPIES: When back issues are exhausted, photocopies of articles can be supplied. Price $7.50 per project or $15 where a project spreads over several issues.

PCB PATTERNS: High contrast, actual size transparencies for PCBs and front panels are available. Price is $5 for boards up to 100 sq. cm, $10 for larger boards. Please specify negatives or positives.

PROJECT QUERIES: Advice on projects is limited to correspondence only and to projects less than five years old. Price $7.50. Please note that we cannot undertake special research or advise on project modifications. Members of our technical staff are not available to discuss technical problems by telephone.

OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.

READER SERVICES BULLETIN BOARD: (02) 9353 0627; ANS1. 24 hour access; any rate to 28.8kbt/s.

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ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria NSW 2015; phone (02) 9353 0620.

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146  ELECTRONICS Australia, August 1997
**Power Supply**

Make a 13.8V 10A (20A peak) DC power supply from recycled components. Includes transformer (350VA), mains lead, 100μF electrolytic capacitor, heatsink, new PCB with all onboard components and power handling stages, wire or connectors. Bargain price: $80

**DC Motor**

New, Australian (Prestate) 12V DC golf buggy motor. High torque. 75mm dia, 150mm long, 30mm shaft with dia 7mm, weight 2kgs. Ref: 10A: $36. 20A DC MOTOR SPEED CONTROL Ref SC June '97, slightly modified, PC and on-board components (with 2 power MOSFETs!), plus the flyback diode and controller needed across the motor: $18

**Magnifiers / Loupes**

Jewellers eyepiece: $2. Twin lens loop: 50mm x 75mm, $12. 110mm $15. A set of 4: $30.

**12V SLA Battery Chargers**

Intelligent 13.8V / 650mA "plugpack" gel battery charger. Has isolation transformer, electronic switching regulator, dual LED indicator: $9.80

**Fiberoptic Vision Tubes**

Slightly diminished high resolution US made night vision tubes. Have 25/40mm dia, fibre-optic coupled image, direct output windows. Give good image in low light, need infrared illumination in dark places. Our 880nm illuminator is ideal. Use for low light video, preamp, etc. Comes with an EHT power supply kit that operates from 9V DC. 25mm version is $80. 40mm version is $105. Each with more blemishes, but suitable for very sensitive IR testers: 25mm $35, 40mm $45 (includes EHT supply unit)

**Helium Neon Laser**

Large 2x3mm He-Ne laser head plus a compact potted US made laser power supply. The head plugs into the socket, and two wires are connected to 240V mains. Needs 3-6V/5mA DC to enable. Bargain: $100

**MOVING MESSAGE DISPLAY**

Compact high res 9" screen B/W video and audio monitor. Has two way audio, built in mic, audio amp, speaker and "talk" pushbutton. Add a preamp and mic for remote audio monitoring (our 32mm audio amp is ideal). Has two camera inputs and manual or auto switching (a8 speed) between each camera, and audio and video outputs to connect to a VCR etc. Needs 12V DC 1A (our switched mode supply is ideal). Monitor and 8-way mini input connector only: $125

**Switch Mode Power Supply**

Compact (50 x 360 x 380mm), in a perfect metal case, 240W output in 12V DC/2A and 5VDC/5A out: $17

**12V VCR**

IR remote controlled 12V VCR with record and playback (no tuner): $299

**CCD Camera**

Tiny (35x25x27mm) CCD camera, 0.1 lux, IR responsive (works in total dark with IR illumination), connects to any standard video input (eg VCR) or via a modulator to aerial input: $120

**Kits for CCD Camera Security**

New interface kit for TIME LAPSE RECORDING, plus link relay output! Can be directly connected to a VCR or via a learning remote control: $25 for PC and all onboard components, used PIRs, controller: $120

**32mm 10 LED IR ILLUMINATOR**

New IR (880nm) LEDs have an output about equal to our old 42 LED IR illuminator: $18.

**32mm Audio Preamplifier**

An $8 kit that produces a line level signal from an external microphone, connect the output to:

- **UHF VIDEO TRANSMITTER** ($30 or $20 when bought with the camera. For a complete Audio/Video link: $85)

- **32mm Audio Amplifier**: An LM380 based $9 audio power amplifier which can directly drive a speaker. Use the 32mm preamplifier. **WHAT IS 32mm?** All boards are 32mm dia, so you can house these kits in a plastic 32mm joiner: cheap plumbing part.

**PC PockeT sampler Kit**

Ref EA Aug '96. Data logger/sampler, connects to PC parallel port, samples over a 0-2V or 0-20V range at one/hour to one/hour, 12 bit. Monitor battery charging, make a 5kHz scope etc! Kit includes on-board components, PCB, plastic box and software (3.5" disk): ($30)

**Woofer Stomper Kit**

Works on dogs and most animals, ref SC Feb '96. PP and all on-board components, transformer, electret mic & horn plazio tweeter: (K77) $43 extra tweeters (4s): $7 as approved 12V/20A transistor. ($14)

**UHF Remote Trigger**

Channel Rx and Tx: (K77) $40

**Used ICs**

Guaranteed, previously socketed ICs, never soldered to. Data not supplied. 14681PS - real time clock: $4, $1.30 or $2. $1.30 or $2. $60, $80, $100 (versions $80. Tubes with 9V battery: $35, 25mm $35, 9V $30, 12V $60, 10mW $30, EHT supply $20).

**FAX Polling**

Back by popular demand. Poll (02) 9570 7910 for our list of items. Updated every month.

**Mini TV Station**

Make your own mini TV station with this metal cased, commercial transceiver with telescopic antenna. Dimensions 123 x 70 x 200mm, weighs 1.3kg, in operation. Includes power switch, indicator LED, RCA audio and video connectors, twin RCA-RO input, 32mm AUDIO PREAMPLIFIER with electret microphone ($8), and a CD camera completes the station. Transmitter: $30. When paired, with a 3CCD camera $20. Regulated 10.4V 500mA plugback to suit: $10

**Audio - Video Monitor**

Compact high res 9" screen B/W audio and video monitor. Has two way audio, built in mic, audio amp, speaker and "talk" pushbutton. Add a preamp and mic for remote audio monitoring (our 32mm audio amp is ideal). Has two camera inputs and manual or auto switching (a8 speed) between each camera, and audio and video outputs to connect to a VCR etc. Needs 12V DC 1A (our switched mode supply is ideal). Monitor and 8-way mini input connector only: $125

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**Motor and Pump**

New, compact plastic pump with a 240V AC 50Hz 0.8 1W 2600 RPM induction motor. Very quiet, made in USA. Operates from 5kHz to 25mm dia, outlet 20mm dia. Other end of motor has 20mm long 4mm dia. shaft. Motor can be removed for rewinding for a lower AC voltage. We calculated 5.5 turns per volt: $19

**Super Bright Blue LEDs**

BY FAR THE BRIGHTEST BLUE EVER OFFERED, super bright at 400mcd: $1.50 ea or $10 for $5 mcd at SUPER PRICES

100 red: $10 for $4
300 mcd green: $1.10 ea or for $7 (make white light by mixing the output of red green and blue)
30 yellow: $1.10 ea or for $7
30 yellow (small torch) also available in 3mcd: $10 for $9
Super bright flashing LEDs: $1.50 ea or for $10 for

**Battery Box**

Twin AA battery holder and batteries for 60e with any LED purchase; flash a high int LED for a month! $1.50 per meter. $6 per meter.

**CAR ALARM KIT**

With the LOT

This kit can be armed/disarmed by a hidden switch, or by a UHF REMOTE CONTROL which works operating a CENTRAL LOCKING KIT. The CAR ALARM includes a PCB, all onboard components and ultrasonic transducers. It features ultrasonic motion detection, provision for bonnet-boot protection, panic switches not supplied, vibration detector and a flashing high intensity LED. Four LEDs make for easy diagnostics and setting up:

- **CENTRAL LOCKING**: four door commercial kit that includes 2 master and 2 slave actuators, wiring loom, control unit, necessary hardware and instructions: $35
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