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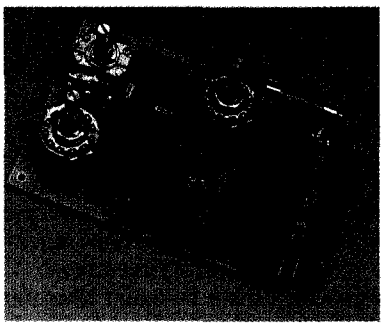
Volume 58, No.2
February 1996

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Safe lamp sequencer



One of our projects this month is a low cost lamp sequencer module, for attention-getting displays. It has been designed to run from low voltage, and is completely safe. One of the 'Discovery Series' of kit projects developed by Dick Smith Electronics, you'll find it described in the article starting on page 68.

Building our EGO tester...

Graham Cattley explains how to build, test and use his EGO sensor analyser in his article starting on page 56.

On the cover

After hearing about the growing concern about possible health risks from electromagnetic fields, Federal staff member Mal Burgess is now not quite as convinced about the benefits of having a handheld cellular phone... Tom Moffat discusses this controversy in his article starting on page 16. (Photo by Ben Granger.)

Video and Audio

Features

Projects and Technical

Columns and Comments

Departments

Professional Electronics

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LETTERS TO THE EDITOR

'Sexism' response

In the December 1995 issue of *EA* Peter King wrote a letter criticising my use of language. He cited three instances, claiming a sexist attitude on my part. The article was approximately five thousand words in length, and apparently contained three sexist faux pas. In a little over one hundred and fifty words, Mr King has done it twice.

First, he assumes that 'women' are, as a group, offended by the words 'bugger' and the IMPLIED 'dogs balls' (for which I apologise in advance!). He also implies by omission that men are not offended by the same. I know many women who frequently use much coarser language than I do, and quite a few men who never swear at all. If you were to consider that the language lowered the tone of *EA* as a whole, I would consider myself suitably chastised. However, there is nothing sexist in the inclusion of these words. To my way of thinking, it is sexist to attribute ANY particular set of standards or morals to one sex as a whole.

Secondly, the statement that this sort of language belongs in men's locker rooms is sexist in the extreme, but apparently this is OK, and not politically incorrect. As is clear from much advertising on commercial television, sexism is one area where two wrongs do make a right.

The suggestion that a technician might 'lend you his wife' is described in literary terms as 'hyperbole', which translates to a deliberate exaggeration used for effect. I used this image to STRESS the value of service manuals by comparison with something of very high value. I hate to see our language being castrated (would sterilised be less sexist here?), and I do not intend to be a party to it.

I do not claim to be perfect. I freely admit that I constantly battle with both sexist and racist attitudes, which have been very firmly implanted in my psyche over the past-something years. I am far from being politically correct, but I'm working at it. However, in this case, I simply believe that you are wrong.

David Reid,
Belmont, Vic.

Comment: In view of the criticism, we decided to give the author the right of reply. However, this subject will now be closed.

Microfax modems

In the September 1995 issue of *Electronics Australia,* a feature article on fax communications by Tom Moffat was published including information on Microfax Modems' products. Unfortunately this article contained outdated information and we therefore request *EA*'s assistance in rectifying this.

Overall the article favoured Microfax which of course we are pleased with. As mentioned in *EA,* Tom and Michael Roberts spent many hours discussing not only Microfax products but also the industry in general and where it is headed, etc.

Our dissatisfaction is with the comments made on the data side of the products, beginning with the last paragraph on page 17 which states "...Unfortunately the Microfax does not have any error correction features...". Months prior to this issue of *EA,* Microfax had in fact added the error correction feature and taken great strides in improving the data communications as a whole.

Although this one point may seem to hold little importance on its own, we have had many *EA* readers contact us to discuss Microfax products, highlighting the fact that we do not have error correction. We have had to persuade them otherwise, as most people do believe what is in print and to be told differently takes a little convincing. This does at least show that *EA* readers truely look to the magazine as a source of reliable and up to date information.

As with all computer technology, changes/improvements are made daily. We cannot expect *EA* to have guessed some of the features we now have in place. However, it would have been to everyone's advantage if the article had been checked by Microfax prior to its publication.

Kaaren Welsh, Manager,
Microfax Modems,
Avalon Beach, NSW.

Help needed

I have recently acquired a Sabtronics 5020A function generator in a state of disrepair, but have had no luck in tracking down the supplier. I would appreciate any help on sourcing a Circuit Diagram/Manual for the function generator, or the address and fax number of the importer or manufacturer.

Craig Smith,
25 Monaro Street,
Queanbeyan, NSW 2620.

Thanks for help

I am writing to thank you for your generous response to my request for service data in your journal, which you took the trouble to publish in your November issue.

I also acknowledge, with my thanks, the very helpful response of your readers Peter Webster and Warren Goninan, who took the trouble to phone me, and to send relevant data for the Trio Sig. Gen.

As the Advance Instruments Freq. Counter contains a lot of RTL logic, would you know of any publication with relevant data? Again my sincere thanks for all your help.

Jonah Bancroft,
Vermont, Vic.

Incorrect spelling

On page 117 in November issue of *Electronics Australia* an article on history on X-Rays shows complete indifferent to correct spelling. It should have been "...the Physics Institute at the University of Wurtzburg, Bayern in Germany".

(Wuertzburg, Bavaria as an alternative would have been acceptable.)

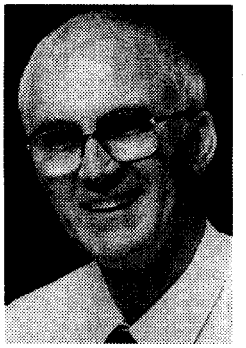
As a matter of interest, Wurtzburg always was a sleepy University town encircled by winyards until near the end of WWII. One lunchtime it was flattened by Allied Air Forces using bombs and incendiaries. Few buildings escaped destruction and one of them was, although well bruised, the Rontgen Institute.

Ilmar Belts,
Morley, WA.

Comment: Sorry, Ilmar, but we took our spelling from the press information from the German press office.

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 reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



Some GOOD news about career opportunities in electronics

One of the stark realities of this final decade of the current millenium, it seems, is a pronounced trend away from providing permanent employment, on-the-job training and 'career' opportunities, throughout our industrial, commercial and public service organisations. Instead there's more and more emphasis on casual/short term employment, and reliance on training obtained 'somewhere else'...

While this may be justified in terms of currently fashionable economic theories, I for one find it very worrying. As well as discouraging young people in particular, I believe that in the long run, it will turn out to be a disaster for both the companies concerned and for our society as a whole.

With this as background, I was delighted to be reminded the other day that one of our leading retail advertisers, Dick Smith Electronics, is still committed to providing not only permanent employment, but on-the-job training and true career opportunities. DSE's Advertising Manager David Stuart told me that his firm has recently re-launched its programme to recruit trainee managers for its retail stores.

It was cheering to learn that there has been a very positive response to the recruitment ads that DSE began running in the capital city daily newspapers, late last year. In fact David Stuart was so encouraged by the response that he decided to expand his campaign by running similar recruitment ads in Electronics Australia as well. You'll find the first of the ads in this issue, designed to appeal to our more technically inclined readership and their families.

Now it might seem at first sight that an electronics distribution and retail sales organisation like DSE would offer only a limited range of career opportunities, especially for young people with an interest in the technical side of electronics, computers and communications. However as someone who spent a number of years working at DSE myself, I can testify that it actually offers a lot more — and more varied — career opportunities than you may think. They can be very challenging and rewarding, too.

The retail sales area itself is a challenging one, of course, especially when you're helping people choose the right computer, cellular phone, test instrument or other item of hi-tech equipment. Retail sales experience is also excellent training in terms of product knowledge — it's surprising how much product knowledge an experienced and successful sales person acquires. For those who wish to move into more technical areas, it can also prepare them very well for the many opportunities that arise in firms like DSE for 'support' roles such as product selection and buying, acceptance testing and quality control, technical support and servicing.

I'd suggest, then, that for a young person with an interest in electronics who is really looking for a career, a firm like Dick Smith Electronics has a great deal to offer.

Jim Rowe

Video & Audio: The Challis Report

TECHNICS SC-LS10 CD STEREO SYSTEM

Conscious that many of his reviews have been of high-end hifi components, while nowadays many people have a preference for compact 'all in one' systems, Louis Challis has this month turned his attention and instruments on an innovative compact system just released by Panasonic under its Technics marque. The results turned out to be pleasantly surprising...

Every now and again, and especially at Trade Releases, I enjoy the opportunity of comparing notes with other reviewers and technical writers. At a recent Yamaha function late in 1995, I discussed the latest trends in packaging audio systems. The conversation drifted on to a discussion of units with multiple functions and characteristics, like the Technics SC-LS10 stereo system.

I discovered that single package multiple function hifi systems now account for more than 70% of all 'hifi' system sales in Australia. And Australia is by no means unique; we merely reflect what has become a worldwide trend. One of my compatriots commented that, on the basis of total sales, I had allocated a disproportionate amount of time to reviewing and testing individual items of high fidelity equipment.

Whilst most manufacturers tend to chase the 'median' to bottom end of the market with most units, others obviously have a somewhat different perspective. Bang & Olufsen of Denmark for example, have developed some delightfully (expensive) multi-unit modules, which typically sell for between $3000-$5000 on the Australian market. Not to be outdone, Panasonic set their R&D design teams the task of producing an equally attractive multi-unit hifi system; they decided they would compete on an equal footing with the best of the Scandinavian designs.

Panasonic released its new slim Technics SC-LS10 hifi system in late October 1995. The system embodies a multitude of new technical features, the most unusual of which is its 'Soundscape' function. This provides three different natural environmental sounds for background masking — for those people so enthused.

The first environmental sound is a composite of lapping and crashing of waves, with a seagull accompaniment. The second of the sounds is the murmur of a small rivulet, with birds chirping in the background. The last and most ear catching sound is the noise of the forest, with bird calls and crickets chirping in the background.

An innovative technical approach has been adopted for the replay of each of these sounds. Each sequence has been recorded on a 'read only' memory chip. Whilst the storage and replay methodology is innovative, I suspect that 95% of Australian purchasers will ignore this function. In Japan however, this would be an extremely positive feature, as there are relatively few birds to be heard, or rivulets to be seen, in or near most Japanese cities.

The second feature is the innovative simplification of the number of functional controls required to operate the different components within the system. There are only six primary function pushbuttons on the front panel. As each functional mode is changed, the rear illumination of each of the buttons is altered to suit the selected operating mode.

The third feature is the adoption of a power 'slide up and hinge out' loading tray for the CD player. The tray is normally recessed and concealed when playing, or when inactive. It only appears when activated, and then partially rotates and discreetly disappears when the PLAY mode is selected.

The fourth feature is the single cassette player, which is also ergonomically designed to simplify cassette loading and unloading. When activated, the cassette slides up for more convenient access. The cassette player automatically selects the appropriate equalisation and separate bias to conform to the type of tape loaded.

The fifth feature is the incorporation of a quality FM/AM digital tuner, supplemented by very sensible clock/timer functions. These provide convenient and practical record/play and sleep functions, thereby fulfilling the dual role of a quality hifi system's selectable timer and an alarm clock.

The sixth feature is the incorporation of a convenient remote control. Although employing an infra-red transmitter, this provides the ability to control all critical functions from any convenient position within that room. Many purchasers wish to control their hifi system from their bed or armchair, and I am a firm supporter of that need.

Conflicting needs

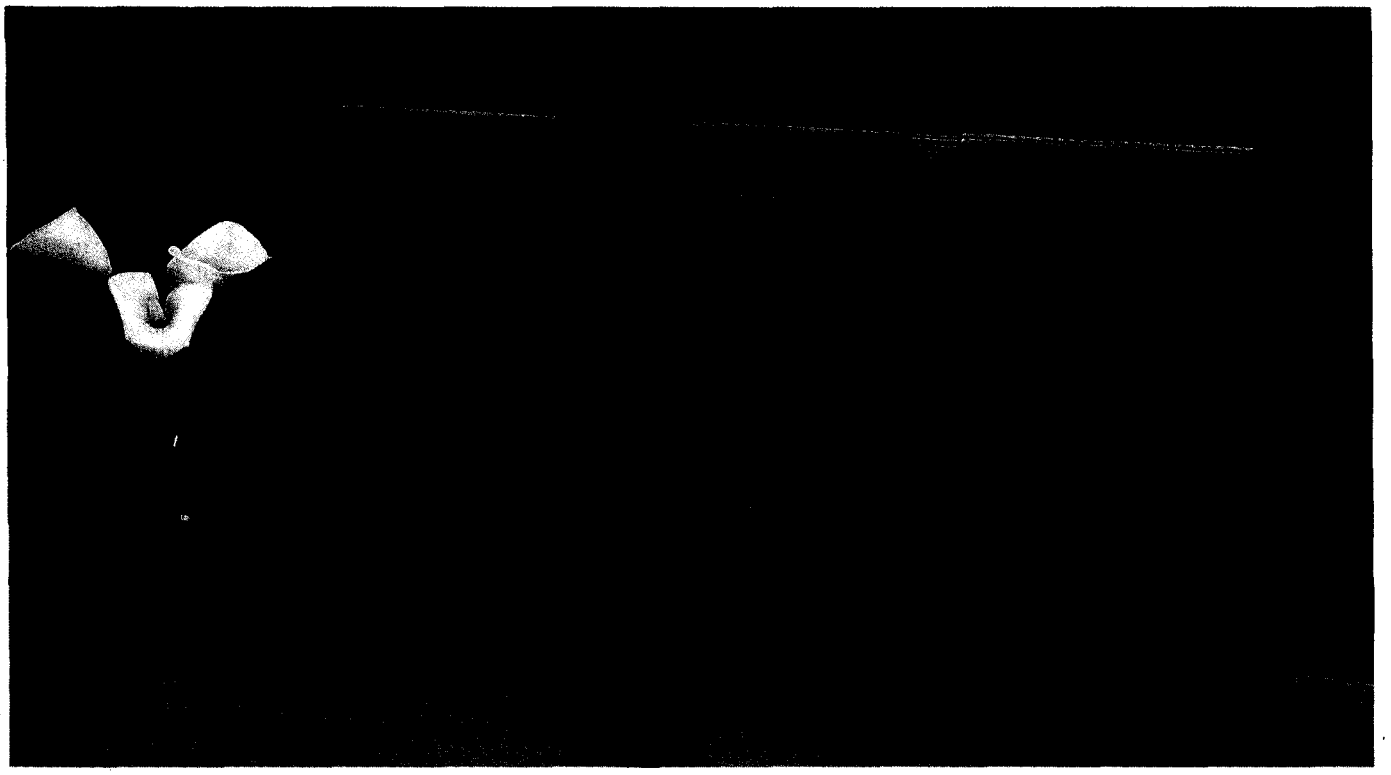
When faced with the problems of optimising the performance of a small hifi system, two conflicting requirements soon become obvious. The first is that most users prefer a smaller package, which invariably simplifies its permanent placement. The second is that the smaller the speaker enclosures become, then the harder the task for the designer to achieve a useful, or even an adequate low frequency response.

There are of course many different ways in which this problem can be addressed. The most common approach over the last two decades has been to adopt a speaker design which makes liberal use of electronic boost. This generally compensates for the functional and dimensional limitations of an undersize speaker enclosure.

I have observed before that Technics have devoted an inordinate amount of research time and much more attention to the development of innovative speaker systems than most other Japanese manufacturers. Their SB-R100 flat panel speaker system, which was developed in the early '80s, was virtually 'a legend in its own lifetime'. Over the range 100Hz to 20kHz, the SB-R100 provided the flattest response of any speaker system that I have ever measured.

Whilst the technology developed and adopted for the SB-R100s may now be considered *passe*, that hasn't stopped Technics' R&D people from researching newer and more innovative loudspeaker system designs.

On the basis of their external appearance, if one ignored the curved fascia, you could be forgiven for thinking that the SC-LS10 speakers were just another example of a plain and ordinary speaker system. But as it transpires, if you were to examine them more closely, you would discover



that Technics have adopted a somewhat revolutionary design philosophy. That philosophy bears no resemblance to the innovative techniques originally developed to such a high standard in the SB-R100s, and the Technics' large panel speaker system (which I reviewed in *ETI* in June 1985).

The SC-LS10 system design principle is based on a newly developed active air coupling woofer system. This system uses a Kelton-type dual cavity construction cabinet, in which the outer cavity houses a 160mm diameter passive radiator, and the inner cavity incorporates a semi-conventional 65mm diameter cone type drive unit.

The manufacturer's literature claims that this system is linked to the amplifier by active feedback. It is possible that Technics have developed a two wire system that could achieve that aim, but I was unable to identify either where, or how, that active feedback was implemented.

The fundamental principle of the Kelton cabinet design is that it harnesses the air pressure between the passive radiator and the main driver to achieve a resonant boost in the critical low frequency range, thereby providing the improved output response without expending additional output power or energy. In principle, this should result in an extended cutoff frequency at the lower end of the spectrum. It should also simultaneously minimise the loudspeaker's second and third order harmonic distortion components.

Technics claim that the enhancement of the bass response is astounding, especially when the size of each enclosure is considered. Their literature also forcefully claims that the feedback between the active driver unit and the amplifier further reduces the low frequency distortion.

The neatly styled speakers are described as being a three-way active air coupling woofer system with 16cm passive radiator, 12cm cone type driver unit, 6.5cm cone mid-range driver, and a 25mm dome type tweeter. The crossover frequencies have been selected as 250Hz and 5kHz.

Neat appearance

The frontal appearance of the LS10 CD stereo system is neat and impressive. The designers have adopted a gently curved front panel format.

The most frequently used controls are placed in three separate groups. On the left hand side of the main panel are four large and clearly labelled rectangular pushbuttons. The lowest of these is the POWER ON/STANDBY switch. Above it is the CONTROL OPEN/CLOSE switch (which elevates or lowers the upper section of the front panel, to provide access to 10 additional illuminated switches). The uppermost switches activate the SOUNDSCAPE and EFFECT functions.

Four matching large and clearly labelled rectangular pushbuttons on the right hand side of the system activate the TAPE OPEN/CLOSE, the CD OPEN/CLOSE, VOLUME+ and VOLUME- respectively.

The selection of the TAPE OPEN or the CD OPEN switches have been carefully considered to achieve maximum visual impact. If you press TAPE OPEN, the lower section of the front escutcheon is electro-mechanically activated to provide clear and convenient access for loading or unloading. The compact cassette is then conveniently dropped into a well, which has been automatically elevated during the process.

Pressing the CD OPEN/CLOSE button initiates a similar type of function. The only difference is that the uppermost section of the system's front panel slides up, whilst the CD tray simultaneously hinges outward.

If you press the CD OPEN/CLOSE whilst the tape well is open, or the cassette OPEN/CLOSE whilst the CD transport deck is projected outwards, the controls automatically close the component that was open. This provides access to the other unit. I discovered that this function is neat, convenient and most impressive.

The lower hinged section of the front panel incorporates a neat multi-function plasma display. Below the display are six large rectangular pushbuttons, again multi-functional and illuminated from the rear. The specific illumination legends vary depending on whether you have selected tape, CD or tuner. If you push the tape button, the word PLAY appears and the three lower controls provide FAST/REWIND, STOP and FAST/FORWARD. If you press CD, the CD PLAY symbol arrow is illuminated on that button, whilst the three lower buttons are now illuminated with REWIND (one track or multiple), STOP and FAST/FORWARD (one track or multiple).

If you select TUNER, the word BAND is illuminated, and by pressing the TUNER button the LW (144-288kHz band), MW (522-1611kHz band) and FM (87.5-108MHz band) are each activated sequentially.

When the tuner has been activated, the functions of the three lower switches

become SHIFT DOWN, MODE (with second ranking options of MANUAL or PRESET tuning) and SHIFT UP.

The central plasma display module uses clear white, and relatively large numerals or letters for the functions selected of TAPE, CD or (NO DISC), LW, MW or FM — each with its frequency. The pre-selected channel is indicated by 1-12 numerals, for the 12 separate pre-set frequencies available in each band.

At the extreme right hand end of the plasma display, a quasi-analog display indicates the nominal volume setting. This only roughly indicates the 20dB increments of the output attenuator setting. The internal digital attenuator covers an impressive 82dB range in 2dB steps. When the level is changed, the display momentarily indicates the new attenuator setting in dB relative to maximum output. That range should prove to be more than adequate for normal use.

The advantage of a digital attenuator of this type with a system that comes with its own speakers is that the output settings can be accurately matched to the speaker's input requirements, to minimise (if not avoid), the potential for excessive drive, and premature loudspeaker damage.

There are 10 supplementary illuminated switches, accessed via the CONTROL OPEN/CLOSE button. The first on the left is labelled SOUND MENU, and provides access to WIDE, HEAVY, NIGHT and NORMAL frequency contours. The second is the V. BASS button (for added bass boost). The third is the clock timer, which provides a PRESET through the use of the three lowest buttons at the base of the SELECTOR/OPERATION panel. The two outer buttons provide appropriate increases or decreases, whilst the central button provides access to the time in hours or minutes, and should also be used for holding and setting the time set.

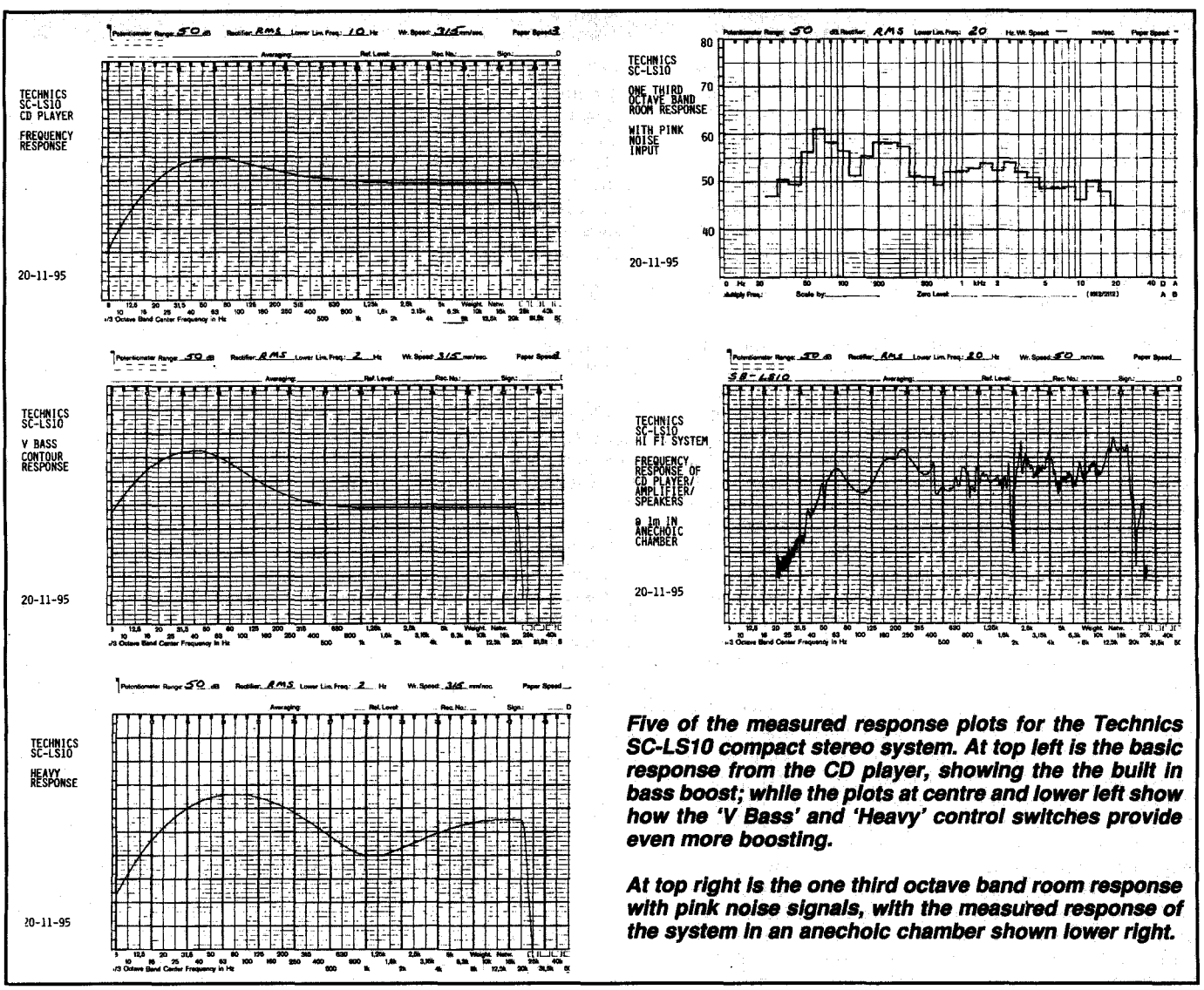
The fourth button is the RECORD/PLAY button, through which you can program the CD stereo system to switch ON or OFF. That button has other uses, including setting the time for recording onto the cassette player, and a signal from the radio tuner at a predetermined time, or for a predetermined period each day.

The RECORD/PLAY button sequence also allows you to select CD player, cassette player, or one of the three radio tuner channels to be activated, thereby duplicating the normal functions of an alarm clock.

The fifth switch is the memory button, which is used to store up to 12 preset channels for each of the three tuner bands. The sixth button is the Dolby noise reduction button. This activates the Dolby 'B' function when recording or replaying a compact cassette.

The seventh button sets the tape direction. With it you select side 'A' or side 'B' of a compact cassette without removing it from the cassette well.

The eighth button is the EDIT button. This is selected when recording from a CD onto a cassette. When selected, this calculates where the tracks shall be split up for



Five of the measured response plots for the Technics SC-LS10 compact stereo system. At top left is the basic response from the CD player, showing the the built in bass boost; while the plots at centre and lower left show how the 'V Bass' and 'Heavy' control switches provide even more boosting.

At top right is the one third octave band room response with pink noise signals, with the measured response of the system in an anechoic chamber shown lower right.

automated recording on to sides 'A' and 'B' of the cassette, respectively.

The ninth button is the AUXILIARY button, which connects the two auxiliary inputs on the rear panel of the CD stereo system to the amplifier input. Finally the tenth button is the RECORD button, which is selected as the final step to initiate an automated recording process from a CD directly to a compact cassette — which must of course be already pre-loaded.

The rear panel of the CD stereo system incorporates a 75Ω coaxial socket for the FM antenna. It also has a miniature socket for an AM band loop antenna (provided), and a supplementary aerial terminal for an external AM band conventional MW antenna.

Auxiliary inputs may be provided from the two clearly labelled coaxial RCA sockets for left and right channels. The two speaker enclosures are connected by means of a pair of neat colour coded, spring loaded locking speaker terminals. These are labelled as being suitable for speakers with 4-16Ω minimum impedance. Speaker leads are provided, but although colour coded, they are not impressive.

A 2m long mains lead is provided. This has a standard two pin mains plug (i.e., no earth pin) at one end, and a two pin miniature socket at the other, which is inserted into a matching captive plug on the rear of the system.

Test results

The objective performance tests of the CD stereo system revealed that most of the manufacturer's claims are readily achieved. The amplifier provides 2 x 15 watt output, both channels driven into a 4Ω load, with less than 0.5% distortion.

I discovered that the amplifier's output response has been deliberately contoured at the lower end of the audible spectrum. The frequency response is continuously boosted up by +4.5dB at 63Hz, and the output response lies within the range 0dB to +4.5dB from 16Hz to 22kHz.

As you will observe on the attached level recordings, the amplifier's low frequency response exhibits a gentle rise between 20Hz and 500Hz, with a flattened peak which falls between 50Hz and 80Hz.

A gentle peak of that magnitude, in what is described as being the 'normal' mode, is not a matter for concern. The circuit designers have adopted that approach as being the most expedient means of compensating for the inherent drooping characteristics of the matching loudspeaker system.

Although I had difficulty in comprehending the design philosophy, the amplifier also incorporates two separate and additive means of modifying the bass response. The 'heavy' mode replicates some of the more pertinent characteristics of a conventional loudness control. As the level recording show, it increases both the bass and treble response of the output circuit.

When the heavy mode is activated, the bass boost is increased from 4.5dB to 13dB between 50Hz and 100Hz, whilst an 8dB treble boost is provided at frequencies above 12.5kHz. The 'V BASS' switch provides an additional 12dB boost in output at 40Hz. These supplementary bass boost switches provide a convenient means of tailoring the low frequency replay characteristics of the system to suit various tastes in reproduction quality.

The amplifier's harmonic distortion components at power output levels under 15 watts are particularly low, with peak harmonic distortion levels being less than 0.1% once the power output level drops below 14 watts into a resistive load. Whilst the 15 watts per side power output appears to be modest, it is adequate to ensure peak sound pressure levels in excess of 90dB at a distance of 2m from the face of the speakers in a typical living room.

The CD player uses the renowned Technics MASH single-bit digital to analog conversion (DAC). Whilst this provides a very flat response, it is then modified by the amplifier's pre-contoured output frequency response. The CD player's output is within +4.5dB to -0dB from 20Hz to 22kHz. Its conversion linearity is excellent all the way down to -60dB, is 0.2dB low at -70dB and is 0.4dB low at -80dB as well as at -90dB.

The combined CD player and amplifier distortion figures are equally impressive at high signal levels. When the amplifier's distortion figures are taken into account, then there is no significant trace of audible distortion until the CD test signal's output drops below -65dB.

Our evaluation of the compact cassette player was less straightforward than for the CD player. I discovered that the choice of tapes for both RECORD to REPLAY evaluations, or when evaluating the REPLAY characteristics of the deck, play an important role in the nature of the results.

I measured the REPLAY response of the cassette player with two conventional reference tapes, Type II and IV. With the Type II reference tape, the REPLAY response was within +/-4dB from 20Hz to 10kHz.

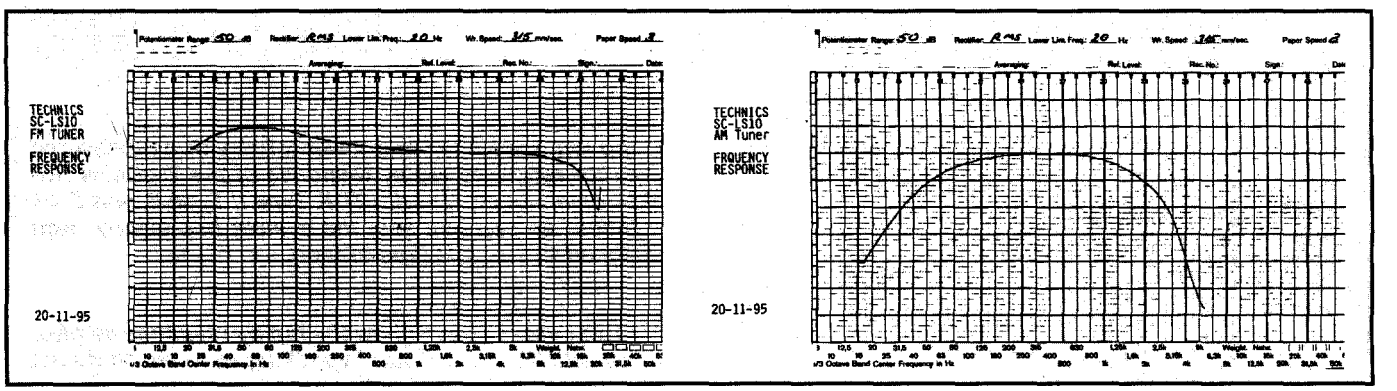
The drooping response at 10kHz is undoubtedly the result of slight differences in azimuth alignments for this particular cassette player, as opposed to the azimuth alignment of the recorder on which the reference replay tape was produced.

With a Type IV reference tape, the REPLAY response was within +/-3dB from 22Hz to 13kHz, recorded at -20VU level.

Both of the above reference tapes exhibit an unusual +5dB peak in the low frequency range as a result of the integral bass boost circuitry preceding the amplifier's output stage.

Whilst the compact cassette player performance is determined to a large degree by the adoption of a bi-directional RECORD/REPLAY mechanism, that proved to be less significant than the equalisation and bias settings of the deck. As I discovered, the deck's RECORD/REPLAY performance is determined by which tapes you actually use.

First I used a conventional selection of type I, type II and type IV tapes, and was not overly impressed by the frequency response. But when I re-tested with TDK AR-X90, SA-X90 and MA-XG90, the mea-



At left is the measured response of the system in FM tuner mode, including the built in bass boost. At right is the equivalent response in AM tuner mode; as you can see, it's mainly suitable for listening to the news...

sured frequency response was substantially better. With the type I (TDKAR-X90) tape, the response was +/-3dB from 22Hz to 16kHz. With the type II (TDK SA-X90) tape, the response was within +/-3dB from 20Hz to 16kHz, whilst with the Type IV (TDK MA-XG90) tape, the response was again within +/-3dB from 22Hz to 16kHz.

With conventional tapes complying with the IEC requirements for the high frequency response, each exhibits a significantly greater droop, and does not conform to the performance standards that one would expect from such an expensive system.

The next most important element in this system is its FM tuner. This displays an outstanding performance, with a frequency response extending from 20Hz to 16kHz +4dB/-3dB. The FM tuner exhibits both excellent sensitivity with a 2uV sensitivity, and better than 75dB signal to noise ratio. The alternate channel selectivity is better than 65dB — so the objective performance characteristics of the FM tuner were almost faultless.

In contrast, though, the AM tuner has a very narrow bandwidth: only 50Hz to 2.1kHz +0dB/-6dB. The extended low frequency response of the AM tuner is clearly a function of the amplifier's bass boost equalisation characteristics. This tuner also has only moderate sensitivity; our measurements indicated it to be in the order of approximately 500uV/m. With such a narrow bandwidth, the AM tuner is best suited for listening to the news, and only infrequently to background music.

Listening tests

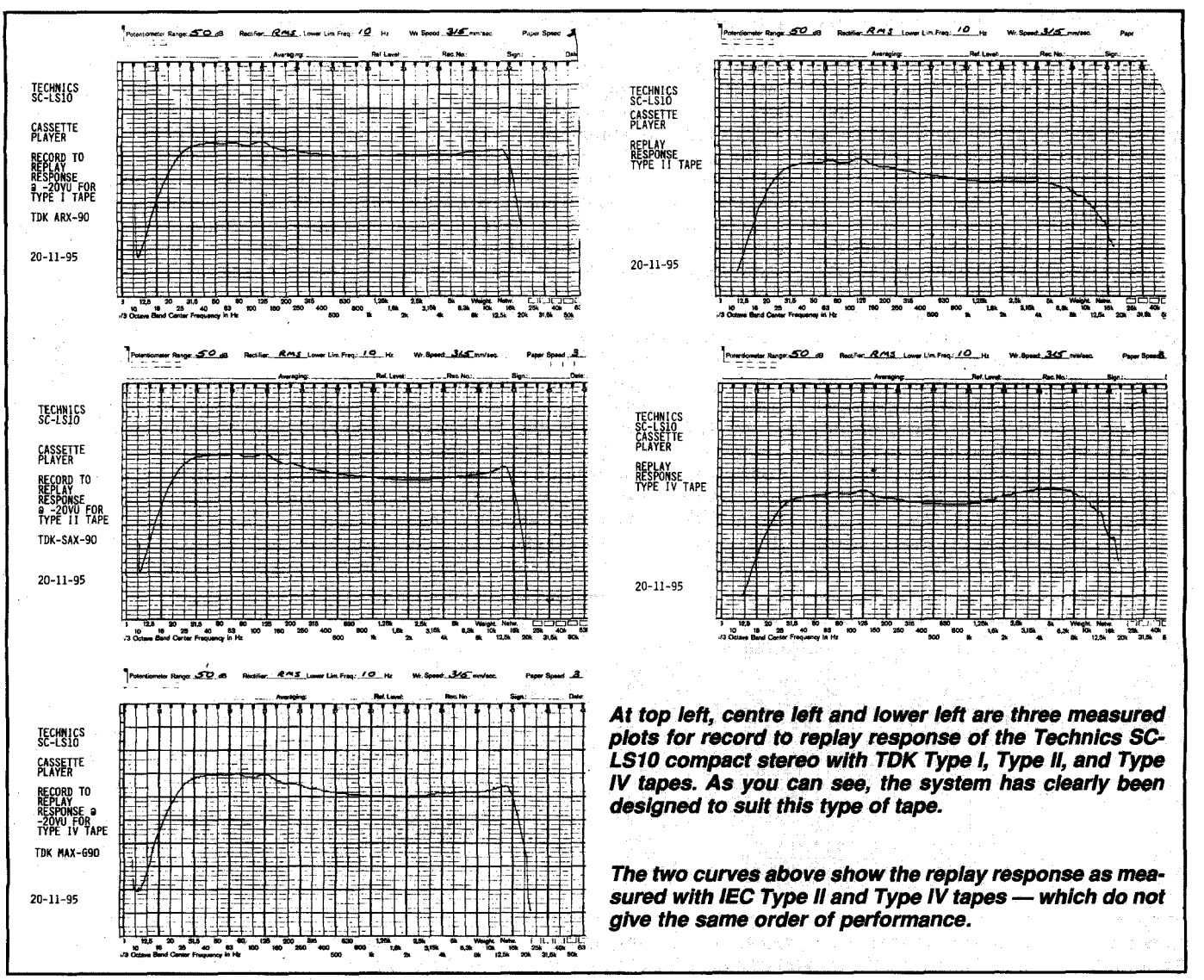
I took the two boxes in which the Technics LS10 CD stereo system had been delivered home, and set the system up in my living room. I spent approximately 10-15 minutes in unpacking the system and setting it up with all connections including speakers, AM loop antenna, simple wire FM antenna, and of course power. I then spent another 10 minutes playing around with the speaker positions to provide an appropriate spectral bandwidth with a pink noise signal on a CD test disc.

Then I sat down in my armchair, and soon discovered, by means of the delightful remote control, that I could rapidly and conveniently control all primary functions from that position or any other in that room.

The first thing I did was to load the 'Sheffield/Coustic Test & Demo' disc (Sheffield 10040-2-T). Track 18 contains five minutes of pink noise (which is about five times as long and five times as convenient as the pink noise track on any other test disc). With that track playing, I adjusted the position of both speakers by ear, to provide the flattest response with minimal low frequency tonality.

The pink noise room response sounded relatively smooth. I was however aware of the presence of some significant peaks at the bottom end of the spectrum, and some apparent dips higher up in the spectrum.

I subsequently measured the pink noise room response, and found that the



At top left, centre left and lower left are three measured plots for record to replay response of the Technics SC-LS10 compact stereo with TDK Type I, Type II, and Type IV tapes. As you can see, the system has clearly been designed to suit this type of tape.

The two curves above show the replay response as measured with IEC Type II and Type IV tapes — which do not give the same order of performance.

response was within +/-8dB from 20Hz to 20kHz. With the handbook beside me and another 15 minutes of effort, I was able to tune in the appropriate number of AM and FM stations, and equally importantly set the clock.

I kept the Sheffield/Coustic Test & Demo disc in the CD player, and gave the system its first serious audition. The music was live, vibrant, and although not true to life, it was clearly impressive, and I started to develop an affinity for this unit.

Track 1, the Sonic Demonstration, convinced me that with the appropriate quality of software loaded in the CD player, a salesman would have little difficulty in convincing an intending purchaser that this was the unit to buy.

The second disc I selected for assessing the sound quality was 'Spirit', a new Sony Masterworks Disc (Sony SK62005). This disc features the Australian Chamber Orchestra in various sinfonias and violin concertos. I soon discovered that this is a particularly good CD for evaluating a sound system and its speakers.

The second track is Mozart's Violin Concerto No 3 in G Major, performed exceptionally well by the ACO. I discovered that the SL10 system performs admirably on classical music of this genre. Whilst I played each of the other tracks on the disc, the Mozart and the Mendelssohn Sinfonia No 10 in B minor were the most memorable pieces, and produced an outstanding reproduction on the LS10 system.

I progressed to a third disc featuring the renowned pianist Yefim Bronfman, playing Prokofiev's 'Piano Sonatas' (No.1 in F minor, No.4 in C minor and No.6 in A Major). As it happened I had just attended an orchestral concert at the Sydney Opera House, where Yefim Bronfman had been the soloist, playing Beethoven's Sixth Concerto.

His performance of the Prokofiev piano sonatas was marginally better on the disc, and the disc was well recorded and particularly well reproduced. But the subjective impressions were simply not the same.

I progressed to a range of more contemporary music, and discovered (not surprisingly) that the SC-LS10 system performs somewhat better on pop music than it does on classical.

When faced with vibrant drum, tympani and related staccato content, the quality of the reproduction is out of all proportion to the size of the unit, or more pointedly the volume of the speakers. The system's practical limit is achieved at 0db of the volume control setting, and at maximum output distortion does become a problem on some discs, with some pre-recorded tapes, or on some FM radio broadcasts.

Summary

My overall impression of the SL10 system is that it is well designed and provides superb functionality, notwithstanding its small dimensions.

It develops adequate sound output over the critical audible frequency range, with minimal distortion except when played 'flat out'. The combination of 'user friendly' features and related functional gimmicks (by way of opening panels, tilting CD decks, and elevated cassette well) will both impress you and your friends and visitors.

Whilst I can readily commend this system on the basis of its performance, appearance and functionality, I am concerned that the fluctuating relationship between the Yen and Australian dollar may have skewed the selling price. When compared against a higher priced Bang and Olufsen system, and most mini and midi systems which I have reviewed, the SC-LS10 system's performance places it at almost the top of the class.

The dimensions of the Cassette CD Receiver section of the SC-LS10 system are 300 x 314 x 197mm (W x H x D), while the speakers measure 200 x 314 x 170mm (W x H x D). They weigh in at 5.5kg and 2 x 3.2kg respectively. The quoted RRP for the total system is $2499.

Further information on the Technics SC-LS10 system should be available from any Panasonic dealer, or direct from Panasonic Australia at 1 Garigal Road, Belrose 2085; phone (02) 986 7400 or 13 2600, or fax (02) 986 7575. ❖

What's New in VIDEO and AUDIO

Personal stereo has 'virtual' bass

Panasonic's new 'Shockwave' personal headphone stereo offers a special feature, called the Virtual Motion Sound System. This involves special bass circuitry which sends a music signal to the headphones where it is converted into a pulsating/vibrating effect, so low bass sounds are felt as a physical vibration by the wearer of the headphones.

The Shockwave RQ-SW20 is designed for rugged outdoor use. It features a sturdy body with a solid internal mechanism and rugged external design. The body and headphones are both water resistant.

The cassette compartment has a novel twist lock mechanism for opening and closing. This ensures that it is sealed effectively and tapes are protected from strong vibrations and shock (for smooth tape operation). All four edges are protected by a rubber covering which absorbs shocks if the unit is dropped or banged.

The RQ-SW20 also has a digital synthesiser tuner with 20 station preset, auto reverse playback, XBS (eXtra Bass System), metal tape selector, detachable belt clip and anti-rolling mechanism. The RRP is $219.

New hifi phones from Beyer

The new Beyer DT531 headphones are open design, circumaural headphones which feature computer designed diaphragms for what's claimed to be extraordinary sonic transparency. Neodymium 'rare earth' magnets deliver high efficiency and superior transient response, while an improved adjustable headband and replaceable ear cushion, together with the lightweight construction (only 245 grams excluding the cable), assures pleasurable listening for long periods of time.

The DT531 exhibit a frequency response of 10Hz to 30kHz, and will deliver a nominal SPL of 95dB (IEC 268-7). They are supplied complete with a two metre coiled cable fitted with a gold vapourised combination plug to mate with most common headphone sockets provide on high quality equipment and television receivers. The RRP is $329.

Sony launches digital camcorders

Sony Australia has launched the first Digital Handycam Camcorders in Australia, with two new models which employ Sony's know-how in digital technology and experience in the manufacturer of 8mm camcorders.

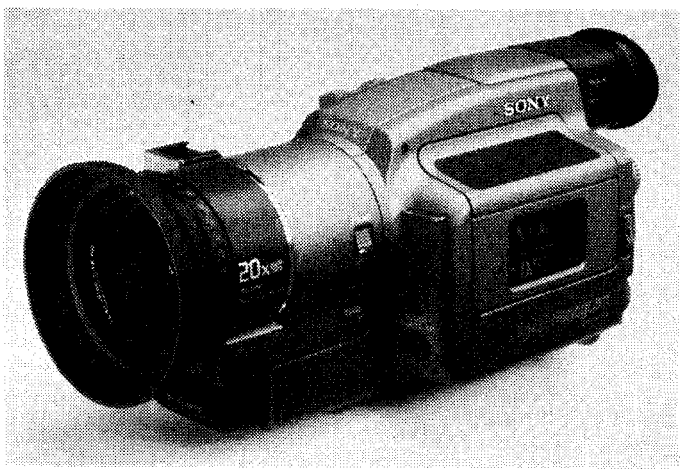
The DCR-VX1000E and DCR-VX700E are based on the Standard Definition (SD) format of the consumer use digital VCR specifications, agreed upon by the HD Digital VCR Conference held in 1994.

The new machines offer superior picture quality, with a horizontal resolution of 500 lines. This is achieved by using the digital component recording system, which separately records a wide band range, equivalent to six times the colour area of analog video in the PAL system.

One of the main benefits offered by the DCR-VX1000E and DCR-VX700E is the ability to copy Camcorder recordings to another digital video with no discernible loss in picture and sound quality.

The DCR-VX1000E and DCR-VX700E both feature the super optical steady shot system to counter vibration due to shaking without affecting picture quality. In addition, the Camcorders have a photo-mode shooting function, which suppresses picture blur caused by movements in between frames for clear, still frame recording. Both models provide a 12-bit PCM digital recording for dynamic stereo sound and also feature a newly developed audio DSP system, which contributes to clear digital sound and superior wind noise reduction.

The DCR-VX1000E features the three charged coupled device camera system, similar to those used in professional video cameras, to record pictures with the highest picture quality available in consumer use camcorders. The DV output jack, for direct connection of video and audio via one single cable, enables dubbing and editing of images with minimum picture quality degradation.



The viewfinder and lens on the DCR-VX1000E are aligned in the same manner as a conventional SLR camera, ensuring ease-of-use. The magnesium alloy body and square hood has been based on the successful design of Sony's professional video cameras.

For more information circle 271 on the reader service coupon or contact Amber Technology, 5 Skyline Place, Frenchs Forest 2086; phone (02) 9975 1211.

THX speakers from Kenwood

The Kenwood Electronics 'X1' series of THX theatre speakers comprises the LS-X1F THX three way, five speaker system that is designed for front (left, centre or right) sound, the LS-X1S THX surround three way, six speaker system designed for surround rear (left and right surround sound), and the SW-X1 THX subwoofer. Although the speakers are primarily designed to go with Kenwood's THX amplifiers, they can be used in any home cinema and surround sound environment that demands high quality home theatre sound reproduction.

THX approved speakers are designed to meet the high standards laid out by the licence holders of THX, Lucas Film Ltd. Firstly, the front left, front centre and front right loudspeakers must have directivity controlled for added clarity and to permit listeners to hear the harmonics of musical instruments correctly. THX therefore recommends that the dispersion pattern of the front speakers be deliberately shaped into an elliptical format in order to reduce reflections from the floor and ceiling.

Towards this end, Kenwood's LS-X1F drivers are arranged on axis with the two 130mm woofers at top and bottom with the dual mid-range units and dome tweeter on centre.

The resultant dispersion curve complies with an elliptical dispersion pattern. Again meeting the THX specification to be able to handle 100 watts, the LS-X1Fs are designed for amplifiers capable of 150 watts.

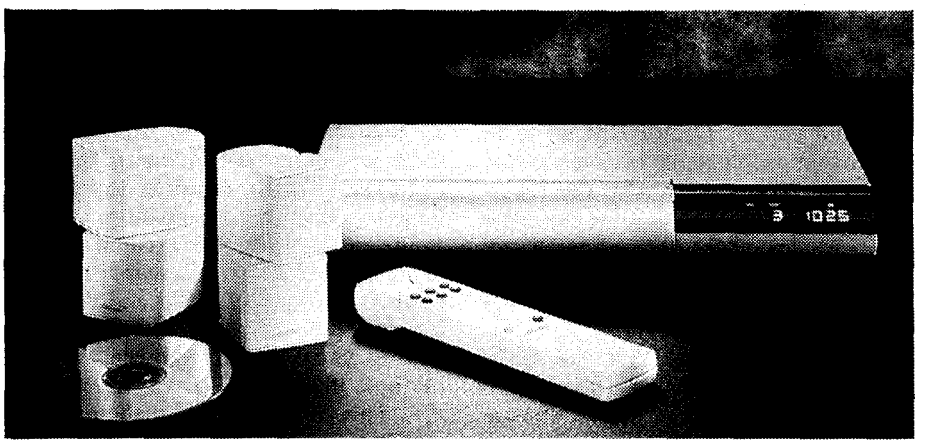
The LS-X1S surround speakers are an asymetrical design, producing a dipole radiation pattern for forward and rearward sound. Since bass frequencies are not directional, the 'bass' drivers face inward towards the audience while the mid and high frequency units face front and back. Able to be used with amplifiers up to 150 watts, the LX-X1S are also available in black matt or white finish.

The SW-X1 THX subwoofer is designed to handle bass notes in the range from 20Hz through to 500Hz and supports a bass reflex design employing a massive 12' injection moulded polypropylene cone woofer. Net weight of the SW-X1 is 26kg, and it has solid construction to produce 'earth moving' bass reproduction without cabinet resonances. The SW-C1 is designed to be partnered with amplifiers around 100 watts.

Covered by a 12 months parts and labour warranty, Kenwood's THX home theatre speakers are available at selected Kenwood dealers.

The LS-X1F THX front/centre speakers have an RRP of $2997 for a set of three (or $999 each); the LX-X1S surround speakers an RRP of $1499 and the SW-X1 THX subwoofer $1499. ❖

Next generation Bose 'Lifestyle' system



Bose Australia has just launched its new generation Lifestyle 20 system which incorporates speakers which are half the size of the original Bose Cube speakers, along with an even smaller music centre — despite added features.

To develop the new 'Jewel Cube' speakers, the research engineering team at Bose apparently had to rethink and redesign every element of a speaker driver. After three years of development under the code name 'cricket' — representing the design goal to create a big sound from something very small — they achieved rich and powerful sound from extremely small enclosures (in combination with a bass module).

An extremely powerful motor structure — the voice coil and magnet — had to be produced to meet the performance desired. Bose used a magnet made of neodymium iron boron, which provides 10 times the magnetic energy of a traditional strontium ferrite magnet. This powerful magnet is only about the size of a 10 cent piece, but together with the 25mm voice coil, it provides the performance required.

In order to get the required acoustic output from the tiny speaker, the enclosure is ported. Such a small enclosure demands a very long port of about 100mm. A traditional straight port would not fit inside the speaker, so taking a cue from nature, the speaker port is wrapped around itself into a nautilus shell shape. This nautilus port generates the cube's sound output at lower frequencies.

Around the size of a light globe box, measuring just under 60mm high, 60mm wide and just over 80mm deep. Bose claims the individual Jewel Cube is the tiniest speaker of this calibre produced to date.

The speakers are an integral part of the Lifestyle 20 CD system and each speaker array consists of two attached Direct/Reflecting Jewel Cub speakers, which can be rotated as much as 180° to achieve the desired balance of reflected and direct sound. Lifestyle 20 is a 'two zone' system, which means a CD can be channelled into one room while the radio plays in another.

Bose have also taken the Lifestyle range one step further with what is claimed as the world's smallest six disc home CD changer. The changer is in the form of a CD cartridge which can be easily removed from the music centre for quick loading.

In keeping with the Lifestyle range, the music centre is a contemporary, polished aluminium case with an even easier to see front display panel. It includes a built in AM/FM tuner and system controls, and is about the size of a laptop computer.

As with all Lifestyle systems, it offers an RF remote control, which will operate the system from anywhere in the house. Total system power is 200 watts: 50 watts per cube speaker and 100 watts for the bass module.

The Jewel speakers are only available as part of the new Lifestyle 20 music system, which retails for around $4750. For more information about Bose stockists call toll free on 1800 023 367. ❖

CANCER AND E-M FIELDS: ANY TRUTH IN IT?

A controversy is raging all over the world, over whether electrical energy emissions from power lines, electronic devices, and the earth itself might cause cancer or other human diseases. Tom Moffat has spent several weeks sorting through the evidence for and against. Here's his report:

by TOM MOFFAT

Controversy? Whooh! You better believe it. Just last night I went to bed after a long day of wading through a mountain of information about electric fields and cancer. I turned on the radio for a few minutes' relaxation, and tuned around for something light to listen to. Where I ended up was KGO in San Francisco, and it wasn't light at all.

There was a talkback show in full swing, hosted by a guy calling himself 'Doctor Bill'. Apparently he was a scientist of some kind, a wealth of information on many subjects. Just as I landed on KGO, the discussion turned to power lines and cancer. Doctor Bill let it be known that people doing research in this area were "fraud artists who call themselves scientists". People (like me) who write articles about this research are "dumb-cluck reporters", as are the editors (like Jim Rowe) who allow such drivel to be printed.

Dr Bill announced that the EMF scare was just like the 'asbestos fraud', perpetrated by eco-freak radical greenie ratbags from groups such as Greenpeace, the Sierra Club, and the Wilderness Society. Such venomous outpourings from the likes of Dr Bill make one wonder just who is rattling his cage. With the scene thus set, let's get into it (cluck-cluck).

The EMF (electro-magnetic fields) debate is polarised along the same lines as many other issues in society. In general those who 'believe' are the conservationists, people who protest about forests being chopped down and go to whale rescues. They are usually cautious about their health, perhaps embracing vegetarianism. A sweeping generalisation would be to call them 'left wing'.

In the other corner we have the developers, those who chop down forests — but for sound economic reasons. They are sometimes disparagingly referred to as 'rednecks'. They are high up in the pecking order of society, they tend to run things. They are the 'right wing', and *they* don't believe in the EMF scare.

So the debate is polarised as much on political grounds as on scientific grounds. The actual words are being spoken by scientists on both sides, and it's quite possible there are large dollops of bulldust coming from both groups. But it seems that most of the scientists' work is being conducted in good faith; the problem is that reliable results just aren't forthcoming.

Why so bitter?

What drives the debate, and why is it so bitter? Well, on the believer side there are many forces. One is the fact of life that to get a scientific paper published, you must have positive results. In the early stages, if a research project came up with a result showing 'no correlation' between EMF's and disease, it was 'no news' and not worth publication. But if a study showed a possible link, then it was 'news' and it got a run. This doesn't imply dishonesty on the part of the researchers; it's just the way things work.

The yes side is turning out to be a boon for lawyers, and the 'victims' they represent. There have been some highly publicised lawsuits based on perceived injury by EMF's. In one case a Florida man claimed that emissions from a cellular telephone had caused his wife to die of brain cancer. Just this one incident knocked the cellular phone industry on its ear, and got the lawyers drooling. We'll look at the cellular phone issue later...

There are also suspicions that the power industry itself is promoting a fear of EMF's from power lines. Reason: one way to protect people from dangerous power lines is to put the lines underground. This means lots of jobs, much of them on government money, as line crews tear down overhead power lines and rebuild them underground.

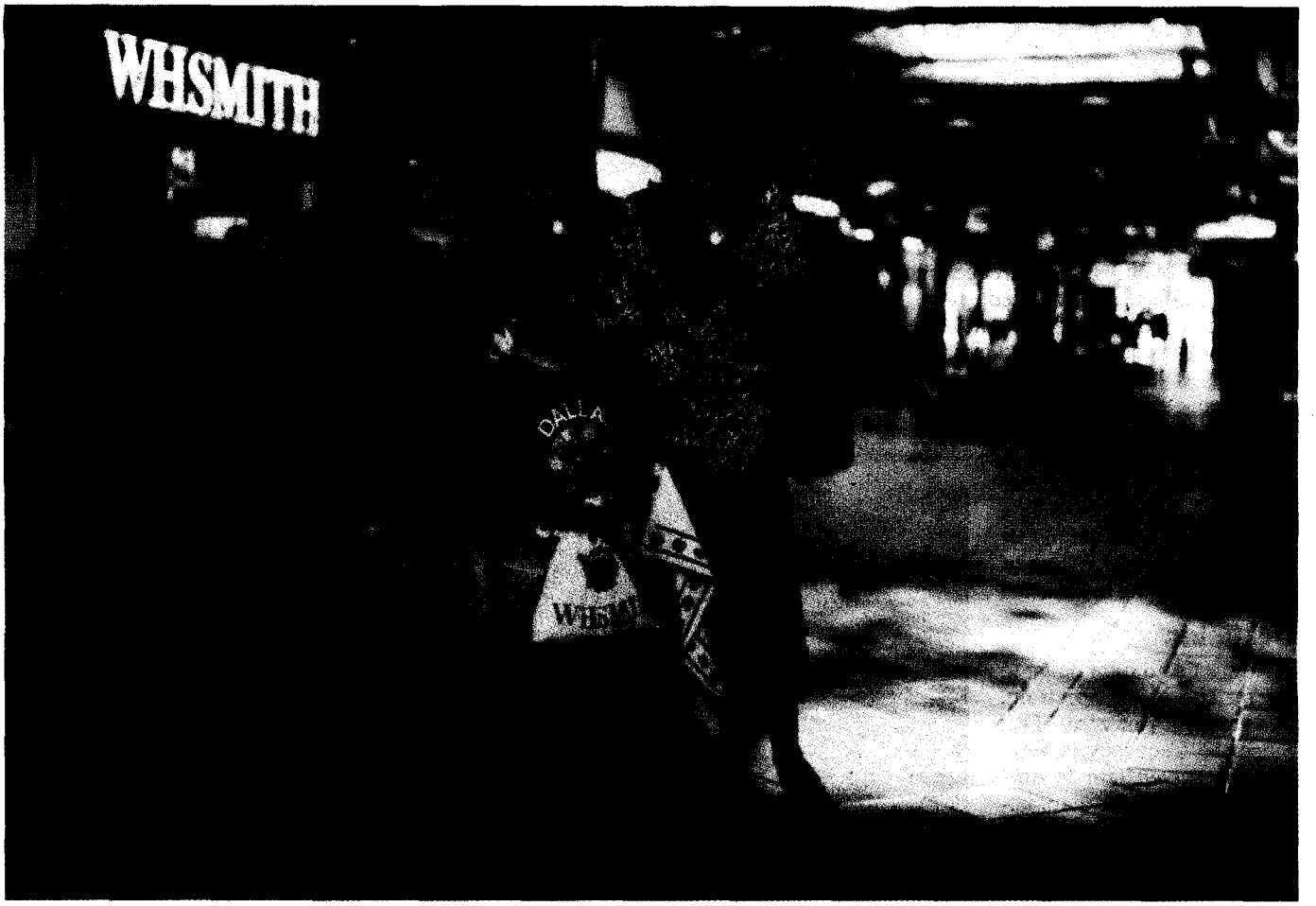
Those who debunk EMF's sometimes fear that the government may set standards for maximum EMF emissions, meaning more expensive house wiring schemes and more critical designs for things such as electric blankets, shavers, and hair driers.

Even the humble vacuum cleaner emits what some people consider dangerous amounts of electrical energy. Manufacturers of these products don't want to be forced to redesign them because of what many see as 'silly' government regulations.

Both sides are adamant they are right, but there's no way to know for sure at this stage. The problem is that researchers might run one set of tests, with results pointing a strong finger at the health risks of EMF's. Then they run the tests again, just to verify the results, and suddenly there is no connection between EMF's and health risks. The real point of this whole kurfuffle is that nobody knows, at this stage, why results are so inconsistent.

In just one week while this was being written, *Science* magazine reported a study showing genetic changes in immature human blood cells caused by exposure to low-level EMF's — a two to three-fold increase in expressed RNA. But when Pacific Northwest Laboratories attempted exactly the same experiment, they got 'no observable effect'.

Then from *New Scientist* came a story saying a leaked report from the US National Council on Radiation Protection contradicted repeated denials from scientists that power lines and electric appliances can cause disease in people. Instead, *New Scientist* reported 'a powerful body of impressive evidence' that even very low exposure to electromagnetic radiation has subtle and long-lasting effects. These influence sleep patterns, Parkinson's disease, and Alzheimer's.



Cellular phones: they're very convenient, but is there a long term risk of brain cancer?

The perceived dangers

Let's ignore the political side of things now and try to make some sense of this business. Much concrete evidence is lacking, but we can use our knowledge of electronics and physics to eliminate a lot of the variables. We will start with the concept of frequency within the electromagnetic spectrum.

First we need to differentiate between 'radiation' and 'field'. Radiation occurs when part of the energy applied to an electric circuit leaves that circuit and takes off into space. A circuit designed especially to enhance radiation is called an 'antenna'. Radiations thus launched continue to travel away from the circuit, even when the current that caused them is stopped. This is why CW or any other kind of radio works.

A field, on the other hand, extends outward from a circuit, but it doesn't actually leave the circuit and travel anywhere. And when the current through the circuit is stopped, the field ceases to exist.

It would be fair to say, then, that a field causes radiation, to a certain extent. A circuit becomes an antenna and radiates the maximum proportion of the applied energy when it is resonant, and resonance depends on its length. The simplest antenna is a half-wavelength long. As the frequency decreases with respect to its length, a circuit becomes less and less an antenna and more and more a transmission line. In the ultimate case a transmission line would conduct all its energy along itself and radiate nothing.

We usually think of electromagnetic radiations as waves, but they can also be thought of as particles called photons. The energy content of photons increases as the frequency increases, and a point is eventually reached where the photons have enough kick to break apart chemical bonds, a process called ionisation. If the frequency is high enough to bring this about, we have what is called 'ionising radiation'. Ionising radiation occurs at the frequency of the shorter wavelengths of ultraviolet light, and into the X-ray region.

In living tissue, the area most affected by ionising radiation is the genetic material of cells, DNA. If the DNA is badly damaged the cells die, and the organism can die too — this is 'death from radiation sickness' of the type that follows nuclear war or accidents. But if the DNA is less damaged the cells can continue to live, although in a changed form. And if the cells in question are reproductive cells, the changes pass down through the generations — a process called *mutation*. Reproduction of the mutated cells generally results in cancer.

We know for a fact that ionising radiation in the form of X-rays and gamma rays can definitely cause cancer. There is no dispute here. And we also know that ionising radiation of a slightly lower frequency — ultraviolet light from the sun — can also cause cancer of the skin. There is no dispute here, either. So we will take the dangers of ionising radiations as proven, and eliminate them from further argument.

Non-ionising radiation does not split chemical bonds, but it still has a strong effect — heating. This is believed to be caused by an alternating electric field making molecules move about in sympathy, and that's really all that heat is — the movement of molecules. The faster

Cancer and E-M Fields: Any Truth In It?

the movement, the more heat, so it follows that the higher the applied frequency, the more heating occurs. The amplitude of the movement is also important, so the stronger the emission, the stronger the heating.

This effect is demonstrated in a microwave oven, where a frequency of around 2.5GHz is applied with a power of several hundred watts. Meat cooks from the inside, heated by its own jumping molecules. And it's not just biological substances; a microwave oven can boil a cup of water too. So we can take it as proven that EMF's do cause heating — although there's a lot of debate about the matter of degree, and the effects of the heat on living organisms.

DC fields

Now let's go right down to the far end of the spectrum, to a frequency of zero - DC. Since the frequency is zero, then its wavelength is infinite, and any circuit automatically becomes a perfect transmission line that conducts all and radiates nothing. So there is only a field, and no radiation. And since the field is static, not changing, there is no excitement of nearby molecules and thus no heating.

A DC field is sometimes referred to as a 'static' field. As with any other fields there are two components, the electric field and the magnetic field. A DC static field is what we call 'static electricity'. No one has ever claimed that a DC static field can cause harm to living organisms. We sometimes experience static fields as a tingling sensation when standing near a very high voltage source, or as hair standing on end.

Scooting your feet across a carpet can sometimes generate a static field upon your own body. This manifests itself as a spark that lashes out as you touch a metal doorknob — painful but not dangerous. On a larger scale is lightning, which certainly can cause serious health problems, such as instant death. But here the problem is conduction of electricity — current flowing — rather than a static field. We have the potential to flow.

So the electric part of DC fields can be eliminated from the health issue. This leaves the magnetic part of a DC field, caused when current is actually flowing through a conductor.

We are subjected to magnetic DC fields from the moment we are born, in the form of the earth's magnetism. This is in the order of 30 to 70uT (microTesla). Just to get this in perspective, a sensitive compass needle will move in a field as low as 10uT. A fridge magnet can produce up to 10,000uT, or 10mT (milliTesla) at 10mm from its surface. Probably the strongest magnetic field a human can experience comes from a medical diagnostic tool called a magnetic resonance imager (MRI), which can subject the body to up to 2000mT, although for a short period.

Computer monitors: many of us now spend most of our day in close proximity to one. Are the current safe levels for external field intensity low enough?

In the work place, people who work in industries which produce metals and chemicals by electricity can be continuously subjected to fields of up to 30mT. A couple of Tasmanian operations come to mind — Comalco at Bell Bay, and the cell room in the Electrolytic Zinc Company at Hobart.

General scientific opinion is that no harm is caused to humans by prolonged exposure to DC magnetic fields. Short-term exposure is considered harmless at levels up to 2000mT (the MRI scanner). Beyond that it is theoretically possible for magnetic fields to affect the electrical activity of the heart, and there is also concern about what might happen to someone wearing a cardiac pacemaker.

So, for all practical purposes, we can eliminate static (DC) fields from the list of potential dangers to the general public. Let's move on then to ELF — extremely low frequencies — those used by power lines, 50 or 60 Hz.

AC power concerns

'A McGill (Montreal) University professor believes that EMF's may have been a factor in an observed up-to-seven fold increase in leukemia among children whose mothers used sewing machines during pregnancy.' So goes a story in *Microwave News*, a magazine devoted to exposing the perceived hazards of electromagnetic fields. The magazine's publisher, Dr Louis Slesin, has got his teeth into these issues like a terrier and he just won't let go. Dr Slesin is a thorn in the side of the non-believers, including such august bodies as the American Physical Society.

Leading the skeptics is Dr David Hafemeister of the California Polytechnic State University. He has prepared a background paper on 'Power Line Fields and Public Health'. This report carefully picks apart the many issues that have been raised about power lines and human health. And in particular it gets stuck into the media, for 'sensationalising' stories about power lines, with such headlines as 'Is My Electric Blanket Killing Me'.

Some strong 'yes' evidence served up by Dr Slesin concerns some studies done in Sweden. One study showed an increase in cancer and leukemia, in men exposed to ELF fields in the work place. Another indicated three times the normal rate of leukemia in children who lived near major power transmission lines.

These studies are debunked in the Hafemeister report, mostly on the grounds of suspect experimental methods and some fairly technical statistical techniques which we won't attempt to explain here. There is also suspicion that increased cancers might be caused by factors other than the ELF's themselves — for instance, it is usually the lower socioeconomic classes who live near power lines; overhead wires are consid-

ered visual pollution in ritzier areas. And it is known that cancer is more common among the 'lower classes'...

Let's look at power lines from an electronics point of view. Because of the low frequency, a power line is not usually considered a good radiator. However there are some circuits designed especially to radiate on these frequencies, such as the transmitters that communicate with submarines under water. Radiation from power lines, then, can be discounted. It's the fields that cause concern.

Power lines themselves are usually constructed as parallel wires. These can be seen as transmission lines which conduct lots of power very efficiently, but radiate very little. The field between the wires would be quite intense, but mostly contained between the wires. A power company employee, working up a 'hot' transmission tower, might be subjected to quite a high field if he was located between the wires. So far no studies of this possibility have come to light.

Down at ground level, a really big transmission line of 115 to 765kV can produce a field of 10uT. A suburban distribution line of 12kV might produce 0.2 to 1.0uT.

One thing I've never seen discussed in the literature is the effect of SWET (single-wire-earth-return) power lines. The classic version of the SWET line consists of one wire strung along from the top of one pole to the top of the next. The other side of the circuit is grounded. Every now and then there will be a pole transformer to feed power to consumers. One side of the transformer will be grounded, and there will be a big insulator on top protecting the connection to the overhead line.

This arrangement can be seen as an *unbalanced* transmission line, and by their very nature unbalanced lines do a poor job of keeping the fields confined to their immediate vicinity. Since the ground is part of the circuit, someone standing directly below a SWET line would be right smack in the middle of the most intense part of the magnetic field.

SWET lines are slowly being phased out, although they are still common in rural areas. Here in Port Townsend in the USA, where I am living at the moment, most street power lines appear to be a modified version of the SWET, in which the ground side is carried by an elevated wire spaced several metres below the 'hot' wire. The pole transformers still have unbalanced primaries, and the ground wire appears to be connected to every 'messenger wire' that supports the weight of power lines going into houses. It all looks like an unbalanced mish-mash, and I'd suspect there are abundant magnetic fields spread far and wide.

Still, power lines don't hold a candle to the magnetic fields that exist within the average home. Some electrical appliances, particularly those with motors, can produce 100uT a few centimetres away. This is 10 times the field directly below the biggest power line.

The strength of the field follows the familiar inverse-square law, which states that field strength drops away as the square of the distance; that is, if a device produces a particular field at 10cm, then it will produce 1/4 that field at 20cm. And conversely, at 5cm it will produce four times what it would at 10cm.

Modern digital cellular phones are a miracle of high technology. But could the pulsed nature of their output make them even more of a health risk than the analog variety?

Here rises the concern about things like electric blankets. The human body is separated from the circuit by only a couple of millimetres, the thickness of some wire insulation and a bit of wool fabric. In addition the circuit is in the form of a coil instead of a parallel transmission line, so in theory its field should be very prominent. Opposing this, though, is the fact that the electric blanket circuit has a lot of resistance, placed there intentionally to convert the electricity to heat.

Possibly more sinister is the AC-powered electric shaver. Here we have a device with a motor, and a thing called a 'field winding' to make it go round and round. So there's a strong ELF field present, and the distance from the human body is virtually zero as the shaver scoots along the face. And since it's working on the head, the shaver is quite close to the brain. It's easy to see why devices like this cause concern, although at this stage no real hazard appears to be proven.

It is believed that pulsing a field on and off makes it much more likely to have deleterious effects on human health. Interestingly, only one disease is associated with pulsed fields — lung cancer. Pulsed fields might come about from something like an AC/DC motor which has brushes and a commutator. The make-and-break action, accompanied by sparking, would certainly cause strong variations in the field strength.

This suggests that a man should never shave his chest with an old-style electric shaver — not really likely. But the importance of pulsing may give readers the heebie-jeebies, when we get to digital cellular telephones.

Another source of pulsed fields is the television set, or video display monitors in general. Here we have fields being pulsed by two frequencies at once, the picture frame rate which is the power line frequency, and the horizontal line rate of around 15kHz. The 15kHz energy is transformed up to enormous voltages to run the display tube, so there's a lot of nasties flying around. The most dangerous area is believed to be at the back of the set near the deflection yoke. And there's always that old worry about the front of the picture tube emitting X-rays, under bombardment of the electron beam.

Things are starting to look suspicious now, but there is still a lack of strong, reproducible evidence of a link between ELF's and cancer. Still, concern about a link has spawned a policy of 'prudent avoidance' from the 'yes' faction. This is a bit like wearing braces, even when you're pretty sure your belt is going to keep your pants from falling down. It doesn't cost a lot, and it does decrease the likelihood of disaster.

Not surprisingly, much of prudent avoidance has to do with television monitors. For instance: Don't work less

Cancer and E-M Fields: Any Truth In It?

than arm's length from your computer screen. Better yet, use a laptop with an LCD screen which doesn't emit all those fields. When you stretch back in your chair and rest, don't lean your head against the back of the computer monitor on the desk behind you. And keep children at least two metres away from the TV set.

As for motors, don't stand next to the dishwasher while it's running. Make sure that things like air conditioners and electric clocks are at least a metre from your bed.

Avoid electric shavers, and handheld hair driers unless the motor is at the far end of a long hose. As for electric blankets, try to get one of the new low-field designs.

Prudent avoidance also extends to bigger issues, such as relocating power lines underground. This in particular has raised the ire of Dr Hafemeister: "Spending considerable funding to mitigate ELF under the guidance of 'prudent avoidance' would make sense if the ELF risk was documented and some measure of cost-effectiveness could be determined.

This is not the case for the alleged adverse effects from ELF/EMF. Since prudent avoidance does not place a limit on mitigation costs, it allows fear to propel society's institutions to spend more than $1 billion per year."

So much for power line frequencies. Results = worrying, but unproven.

RF, radio transmitters

Our next stop up the spectrum is MF and HF, where radiation takes over in importance from fields. Here heating is possible, even likely. Yet in the literature there has been little mention of this part of the spectrum, possibly because few members of the public are affected by it.

However some people are right in the firing line. I have a friend who once worked as a broadcast engineer at the site of two large ABC radio AM transmitters. He not only worked there, he lived there. Because of the proximity he would have been continuously subjected to quite substantial fields. He seems healthy enough now, but is that just good luck?

For many years in Hobart, one of the commercial AM stations had its transmitter very close to some houses on Mt Nelson. How did that affect the residents? No data available. Maybe not enough voters to worry about.

Are cellphones a risk?

This brings us to cellular phones, the issue that sparked this article in the first place. The idea came about following an approach from a reader, who said he had heard of a secret US government report done back in the Nixon era which proved once and for all that radio transmitters operating in the 100-1000MHz range were capable of causing cancer. I went on an enormous digging mission in the USA, which is how I unearthed Dr Slesin and Dr Hafemeister. But no sign of the secret report.

At cellular radio frequencies the predominant energy is radiation, as compared with fields. Antennas are very small, so lots of radiation comes from a concentrated source. And the transmitters are operated only a few centimetres from the brain.

All these factors added together have generated a lot of concern among cellphone users. But you ain't seen nothin' yet. Due to the low powers involved, analog phones are probably fairly benign. But the new digital phones emit energy in PULSES.

The most common digital cellphone system is called GSM. Here speech is digitised, stored, and then transmitted in bursts (pulses) every 4.165 milliseconds. Consider a transmitter rated at one watt continuous power. With pulsed transmission and a duty cycle of perhaps 100 to 1, the same transmitter could develop 100 watts of peak power. So with a digital cellphone, we now have a transmitter operating on a very high frequency with a very efficient antenna, radiating 100 watts of peak power just a couple of centimetres from the user's brain.

These phones are already causing problems overseas. The frequency represented by pulses every 4.164ms is 216.6Hz, clearly within the audible range. And operating a GSM phone near a home stereo system produces a strong 216.6Hz hum through the speakers.

Some car manufacturers are suggesting that digital cellphones should only be used in cars with external antennas; otherwise the phone may block or trigger the airbag or other important systems. There are also reports of very unpleasant noises being picked up by hearing aids, and there's also fear that GSM phones may interfere with cardiac pacemakers.

Here in the USA, cellphone base sta-

tions are popping up everywhere, and in some places there is strong opposition to them ('not in *my* back yard'). People have heard rumours, most likely based on the technical facts presented herein, and their concerns may well be justified. But, like everything else in this EMF-cancer business, nothing is proven. There are only suspicions.

Microwaves

Almost every proposal to install a microwave dish in a residential area seems to bring protests. A big official looking dish just reeks of danger in many people's eyes. One memorable case occurred at Richmond outside Hobart, when the University of Tasmania acquired a large microwave dish to use as a radiotelescope. The locals were certain they would be 'fried', if the thing pointed anywhere near them. It took a lot of talking to convince them the installation was unable to transmit, and would be used only for receiving.

The frequency of microwaves is known to produce efficient heating, but danger from microwaves depends primarily on two things: the power involved, and the directivity of the antenna. A very directional antenna is always used in practical microwave systems to allow communication from one place to another without spreading energy anywhere else. In a communications-type microwave link, power is something like 1/10 of a watt. Yet because of antenna gain such a system can throw a clear signal at least 60km.

In my own days working in microwave stations, there was never any fear of being near the transmitters. The only precaution necessary was to avoid looking down a waveguide, or into an antenna when a transmitter was running. It was felt that the heat thus generated could injure the retina. Nowadays many microwave stations are adorned with 'DANGER! MICROWAVE RADIATION' signs. Maybe it's a case of prudent avoidance.

Radar, on the other hand, uses enormous transmitter power, helped along by a very directional antenna. One radar site I worked at could deliver 25 million watts of peak power. Whenever the thing was running, red warning lights were flashing everywhere and staff at the station were encouraged to stay inside. It was felt that being hit by the radar's beam would cause massive internal heating, probably leading to death.

There was once a story going around about personnel at a small Air Force radar station who used to spend Friday afternoons standing near an operating radar antenna, so its beam was about waist-high on them. The idea was to cause heating in the testicles, resulting in temporary sterilisation and eliminating the chance of any unwanted pregnancies over the weekend. Looking back on it, one wonders how many of them later discovered the sterilisation was permanent, or how many had kids with birth defects.

You'd think, with modern knowledge, that intentionally bombarding the sexual organs with microwaves would no longer be contemplated. But from *Time* magazine of October 23, 1995, comes this story: 'Women suffering from abnormally long and heavy periods (known as menorrhagia) may soon be treated by having their uteri zapped with microwaves.

In a study of 23 women, 83% who underwent this novel regimen were relieved of their symptoms within six months. It works by destroying the patient's overly thick uterine lining.' It makes you wonder what else is destroyed — DNA in reproductive cells?

Summarising

In this article we have carefully tried to avoid any definite yes-no judgments about cancer worries and other dangers. We have presented some arguments from both sides, linked to facts well known to anyone familiar with radio and electronics. Most of the evidence is in, but nothing is certain. We can, however, guess at some likelihoods:

DC (static) frequencies — virtually no danger.

Power line frequencies — probably little danger, except when pulsed.

RF, as in AM broadcasting — no evidence, but warrants study.

Analog cellphones — probably little to worry about.

Digital cellphones — pulsed nature worrying, but nothing proven.

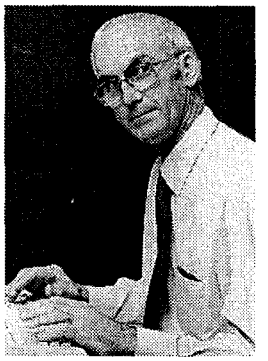
Microwaves — high power certainly dangerous, low power questionable.

Studies of these matters go on, particularly in the cellphone area. In fact the big cellular companies are funding much of the research themselves. The first lawsuit that started the whole brain cancer scare has put the wind up them.

It would certainly be better to find out if the phones are dangerous in advance of distributing millions of them to the public. The alternative could be one of the biggest legal tangles since the O.J. Simpson trial. ❖

FORUM

Conducted by Jim Rowe



Austel and the Telecomms Act: doubt and confusion still reign...

Remember the discussions we had in the October and November issues, about the Telecommunications Act and Austel's interpretation of it, and their ramifications for DIY construction projects? We have some further responses on the same topic this month, plus a suggestion that the SMA's new EMC Framework could end up causing even more headaches for magazines like *EA* and our readers, at some time in the future.

I might have tried to put the lid on our look at Australia's draconian *Telecommunications Act* and Austel's interpretation of it, in the November column, but it's clearly a topic that isn't prepared to go away just yet. I suspect that's because it really *is* a lot more complex than meets the eye — despite what many people will try and assure you.

One problem seems to be that because the Act itself is in principle so all embracing, so much depends on its day-to-day interpretation by the people at Austel. And in practice some of this day-to-day interpretation seems to result in 'rulings' that are almost the opposite of what you'd expect from reading the Act itself — a situation with the potential to confuse just about anybody and everybody.

Anyway, with those brief comments as preamble, let's look at some of the letters and other messages that have come in, responding to the October and November columns. After reading them, I think you'll agree that there's still a lot of doubt and confusion in evidence.

Here's one that was posted on our computer BBS by Mr Alan Campbell, of Woomera in South Australia. Mr Campbell commented about a few different topics, but here are his comments on this topic:

Now, I'll not deny that the laws, as they stand, are open to interpretation. However, as an Austel licensed General Premises Cabler, I promptly reached for my books to clear up a few points...

First, Technical Standard (TS) 001, which covers the safety requirements of telecommunications devices. Paragraph 5.3 covers the use of Line Isolation Devices (LID's). To be specific:

'For indirectly connected equipment (i.e., equipment separated from the network by a line isolation device), compliance with this Standard may be achieved by using a line isolation device in association with customer equipment such that all requirements of AS/NZS 3260 are met.'

What this means is:

1. You CAN listen to a talkback show on radio, since the radio station has such a LID in its telephone reception circuits (assuming the radio station has an Austel approved PABX).

2. Since a modem contains a LID, you do NOT need an Austel permit for your PC.

3. A standard telephone also contains a transformer, so I rather doubt the use of a tone generator would be breaking the law. In fact, if such were the case, I would need a Personal Licence, being an (organic) originator of audio tones, which are interpreted as 'Speech'...

4. Last, concerning the recording of a telephone conversation. Well, that's covered in TS002, paragraph 5.9.3. Basically you can do it, as long as you send a warning tone down the line (and yes, even this can be exempted) of 1400Hz +/-15%, duration 425 +/-75ms bursts. This tone is to let the other person know they are being recorded.

To conclude this section, I agree that the actual Act is very vague. However, when taken in conjunction with the relevant Technical Standards, they're fairly sensible. Agreed, you can't put out designs for modems, as someone may install the LID incorrectly. However, if you were to attach a warning that a LID is required, you SHOULD be able to publish your 'Off-Hook' warning circuit. (Mind you, you may want a solicitor to check that!)

Well, there you are. Thanks for those comments, Mr Campbell; I guess your main thrust is that although the Act does seem 'vague' and all-embracing, Austel's Technical Standards make things clearer and rescue the situation.

I'm not sure if I can agree with you on that one, though. However before making any more comments, I'd like to present another response along similar lines.

This second response came as a letter from Mr Neil McCrae, a Melbourne based consultant to the broadcasting industry, who wrote:

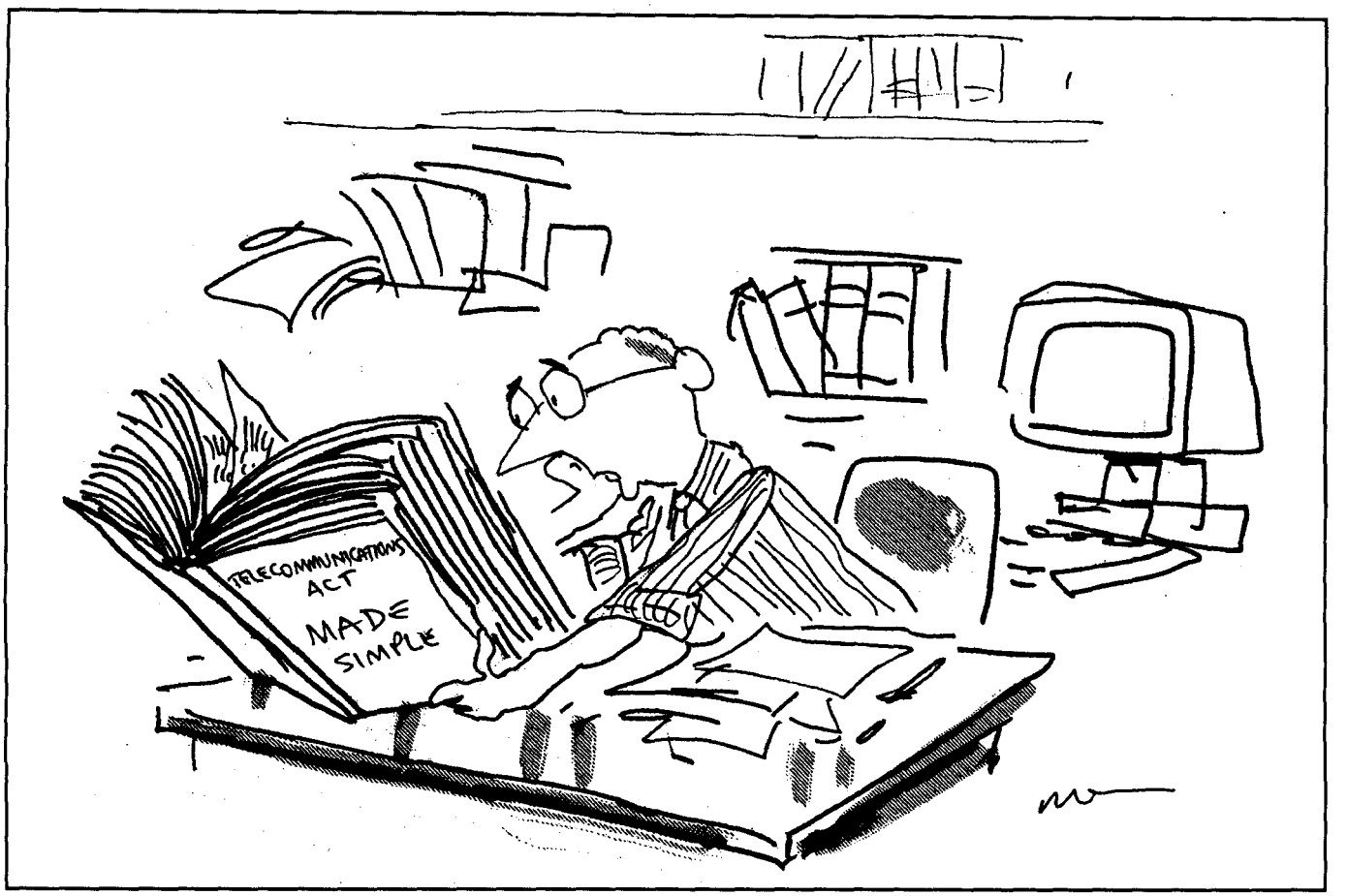
This is in response to your invitation to comment on your October 1995 Forum article regarding your 'Off Hook Alarm' project.

Frankly I am surprised that it should take so long for Electronics Australia to discover the legal position regarding devices connected to the telecommunications network. The situation is not new as a result of the introduction of the Telecommunications Act and the establishment of AUSTEL.

It has never been legal to connect devices to the network unless they had a permit as a result of being tested against specific standards issued by Telecom or (now) AUSTEL.

Over the years of reading EA and other magazines I have been disturbed to see numerous projects intended to be connected to the telecommunications network in complete disregard for Telecom Bylaws or the requirements of the Act.

About 20 years ago it became mandatory for a radio station to interpose a Line Isolation Unit (LIU) between each point of connection of the station equipment and the Network. The LIU, which had to be a Permitted Device, provided a limitation on the



maximum voltage that could be applied to the network or from the network to the station equipment.

More importantly, it provided a very high level of isolation between the station and the network so that hazardous voltages could not be transferred to or from the network. The LIU essentially became the network boundary so that the station equipment was deemed to be outside the network.

Hence your comment about a person using a Walkman while listening to a talkback program is not valid.

I make these comments about the use of LIU's by radio stations, having served on an AUSTEL technical working party with the task of drafting LIU technical specifications.

There is a widespread misapprehension that the Public Switched Telephone Network operates at 'only a few volts' and therefore poses no risk of electric shock. I note your reference to a 'tiny nine volt battery' and 'negligible current between the device and the line'.

The point that must be understood is that at times of electrical storms or when a high voltage power line near a telecommunications cable develops a fault, extremely high and dangerous voltages can be induced into the network. Voltages in excess of 3-5kV are not uncommon and so one of the very important tasks for AUSTEL is to see that the public is adequately protected against these hazardous voltages.

This is why, for example, 600-ohm line transformers are designed and tested to very high voltages between primary and secondary. The Altronics type M1000 with AUSTEL approval number CCL A93/LTD/0140 will withstand a 4kV proof test.

Have a look at a modern telephone and note the absence of metal parts that can be contacted by the user and also note the very high creepage and clearances that are maintained between the user of the phone and the internal circuitry.

Now have a look at your Off Hook Alarm. If the cable to the line was connected to a 4000 volt power supply would you feel confident that you could touch the metal parts of the unit without the risk of receiving a shock?

The requirements of the Telecommunications Act may seem draconian as you have said, but it must be remembered that AUSTEL has a duty to not only ensure the interoperability of equipment connected to the network but also ensure that there is no risk of injury to persons working on the network or using the network.

I would urge you to apply to Standards Australia for copies of relevant AUSTEL technical standards and also AS/NZS 3260: 1993 - Approval and Test Specification - Safety of Information Technology Equipment Including Electrical Business Equipment.

Clause 6 together with Appendix 1 should be of particular interest to you for the design of future projects.

Thanks for those comments too, Mr McCrae. I've left in your points about the need to ensure that the user of communications equipment is protected from injury due to high voltages fed to it from the PSTN, even though this has been discussed before, because it's important enough to justify repeating.

I notice that both Mr Campbell and yourself stress that the PSTN is *not* effectively extended by a radio station broadcasting a 'talk back' program, because radio stations all have a LIU/LID — and that the network effectively ends at this device. But the point I was making in the October issue is that regardless of what Austel's Technical

Standards might seem to say in this regard, the fact remains that the Act itself says that the Network includes anything connected to it via 'guided or unguided electromagnetic energy' (Section 5).

Not so clear cut...

Actually the day-to-day situation regarding LIUs doesn't even seem to be as clear cut as suggested by Mr McCrae and Mr Campbell. Although Austel *does* seem to regard the PSTN as effectively ending at the LIU as far as radio stations are concerned, they don't seem to see things the same way with LIUs in other situations.

For example there's an LIU built into all 'permitted' modems, yet I've heard many tales from firms who have been told by Austel that computers, monitors, printers and other equipment — connected to the PSTN only via a modem — should still be tested for approval as 'permitted' attachments.

In fact I've seen quite a few personal computers carrying a 'Permitted Attachment' label with the specific permit number. One of my own computers — the first one I bought, an old IBM XT — has such a label, quoting number C82/7/901A.

Why would IBM and the computer manufacturers concerned have gone through all of the costly testing and other rigmarole necessary to get this 'Permitted Attachment' approval, if it wasn't really necessary because the Network (and hence Austel's jurisdiction) does in fact end at the LIU inside the modem?

Frankly, I've heard so many conflicting opinions regarding LIUs, and whether or not they do form a 'Network boundary' for the PSTN, that now I'm inclined to believe that either (a) no one really knows the answer, including all of Austel's bureaucrats and boffins; or (b) Austel itself does know, but for some reason deliberately keeps everyone confused.

By the way, and despite what Mr Campbell suggests, a similar situation seems to exist in the case of devices that are coupled to the Network acoustically — like acoustic modems and DTMF diallers. Although many of Austel's regulations and Technical Standards seem to suggest that the Network ends at the telephone, and telephones certainly have to pass a plethora of tests as if they *do* act as a 'Network boundary', acoustic modems and diallers still seem to need testing and approval as a Permitted Attachment. This is despite the fact that they aren't even 'coupled to the Network via guided or unguided electromagnetic energy' — just by *sound* waves!

In fact when I bought a fax machine a couple of years ago, it came with a small acoustic-coupled DTMF dialler. I noticed at the time that the dialler carried its own Austel Permit number (A89/12/0082). Again I doubt if the fax manufacturer/importer would have gone through all of the costly testing and approval rigmarole if they didn't really have to do this.

So what *can* we deduce about LIUs or LIDs — *do* they provide a true PSTN 'Network boundary', as people like Mr Campbell and Mr McCrae suggest? Or does the Network really extend out through them, to encompass everything remotely 'coupled' to it via 'guided or unguided electromagnetic energy', as the Act implies? Frankly I'm blessed if I know; the answer seems to be "yes", "no", "maybe" or "yes and no", depending upon who you ask, and when!

How serious?

Let's move on, though. Another letter that turned up in response to the October and November columns touches on a different aspect of the topic, but one that's quite relevant. It's the aspect of protecting users and equipment from dangerous voltages generated in the PSTN itself — which was raised again by Mr McCrae, you'll recall, as a justification for many of Austel's testing requirements. However this correspondent casts some doubt on just how serious Austel really is, in carrying out this protective role.

The letter came from Mr Ted Baker, of Bathurst in NSW, who if my memory serves me right was the founder of test instrument firm Elmeasco (now part of Nilsen Instruments), and ran it for many years. Here's what Mr Baker wrote:

I have copies of correspondence with Austel dated from December 1992 to August 1993. Although the subject matter differs a bit from that in your Forum, I thought the following may serve to indicate the magnitude of this bureaucratic monster. Unless this institution has changed, I believe you will also discover that things are much worse than you imagined.

My interest was in Austel approval of items such as fax machines, portable phones etc. Unlike the modern, normal telephone these devices have little or no built-in protection against transient voltage peaks on the power and telephone lines, and consequently they are knocked out by even modest voltage surges.

So far I have had three experiences of the above and in all cases the quote for repair was more than the cost of a complete new unit, and needless to say the insurance company is not at all happy. My inquiries revealed the answer was to install a protection device, in fact the company in Sydney who supplied my current fax offered (at extra cost) an unlimited guarantee on the fax if I purchased the protection device which they stocked and which I understand was Austel approved.

Now you may think this was the end of my problems, but no. I discovered this protection device had a basic design problem which rendered it useless in the event of even a modest voltage surge.

The telephone line is protected by a small gaseous discharge component mounted on a small board. The earth lead from this component is by way of a standard small track on the board which promptly burns out in the event of a modest voltage surge. And worse: the unit's fault indicating lights still show things are normal when this happens! (I simply bridged this track with a heavy lead).

My points to Austel were:

1. That the above protection device should NOT have Austel approval.

2. That Austel should put pressure on manufacturers to install some protection against voltage surges in faxes and portable phones etc.

3. That the wording on the Austel sticker, which they apparently supply when an item is approved, would lead most people to believe Austel has checked all aspects of the device and therefore recommends the purchase of that unit. This wording needs to be clarified/modified.

Regarding 3 above, Austel advises that their only responsibility is to check the unit as to its suitability and safety etc., for connection to a telephone line. They do not do the testing themselves but contract this work out to other companies!

There is a ridiculous situation which could arise whereby a device could receive Austel approval and operate very poorly or not at all, as in the case of the aforementioned 'protection' device.

I did not get any satisfactory responses from Austel. The feeling was they either could not, or would not

understand what I thought were logical points.

In the finish I received a telephone call from a junior engineer at Austel who asked me to relate my problems, which I did. His response was: "Yes I understand your points very clearly, but unfortunately I can't do anything about it".

After this I gave up.

Hmmm — thanks for those comments too, Mr Baker. While I can't go into detail about the specific devices you've had trouble with, your story does seem to cast doubt on just how serious Austel really is, in preventing damage to either the Network itself or user equipment connected to it.

It sounds as if the protective devices concerned may fall into the category of 'bridging equipment', and that Austel may deem them 'OK' providing they meet its requirements for minimum line shunting and insulation between the 'works' and the case exterior. If I understand your letter, they're effectively not concerned with the question of whether or not the devices actually provide any measure of reliable equipment protection, against high voltages from the PSTN.

By the way, have you tried Trade Practices? Perhaps they'd be interested in this one, even if Austel regard it as 'not our problem'...

More trouble looming?

Finally, this month, I'd like to present for your interest a message that came by fax from Mr Terry Morley, of East Victoria Park in WA. Mr Morley is apparently a designer and manufacturer of electronic equipment, and he's concerned at the possible ramifications of the new EMC Framework that has been launched by the Spectrum Management Authority (SMA):

In your October edition you published an advertisement for the Spectrum Management Authority. The advert advises all manufacturers, importers and wholesalers of new regulations governing electromagnetic interference.

I have obtained the information booklet published by the SMA, and have some grave concerns about the extent of the regulations.

The regulations cover all electrical, electronic and electromechanical equipment. Most of the projects described by your magazine will be affected, so I think it is in your best interest to investigate for yourself the implications of this new legislation.

For myself, a small manufacturer of low volume electronic equipment, it is yet another log thrown in the path of getting a product to market.

The new regulations are as wide ranging and prohibitive as the Austel regulations governing connection to the Public Telephone Network.

For Electronics Australia the ramifications for kit suppliers for your projects may be even more devastating. For instance, a switchmode power supply or microprocessor-controlled project kit (that's 50% of all kits these days) will need to be submitted for testing and approval to a registered NATA Testing Laboratory. Presumably Electronics Australia would leave this to the likes of Altronics, Dick Smith etc. OK — so assuming approval is forthcoming, the kit can go to market. However it doesn't stop there. The kit supplier will need to prove that all kits are assembled to their approval and are exact replicas of the original submitted for testing. This obviously can't happen!

My first thoughts were that linear circuits and low speed digital circuits would not be included in any EMC (electromagnetic compatibility) legislation, but this appears not to be the case. Motors cause EMI; so does a linear audio amplifier driven into clipping, or one with crossover distortion; plasma balls; stepper motors and drive circuits; any PC driven equipment; train controllers; drill speed controllers; dimmers; test equipment, etc, etc.

I am not against the necessity of reducing EMI; in fact I'm all for it. However the legislation appears to be so wide ranging that many businesses, products and individuals that are not significant contributors to the EMI problem will suffer at the hands of yet another bureaucratic attempt to correct a problem which they have neglected for the past 30 years.

Thanks for those comments, Mr Morley, and you may well turn out to be right that in the long run, some aspects of the new EMC Framework legislation could prove as much of a worry as the Telecommunications Act. It's not exactly a cheering thought, is it? Particularly in view of the way Austel and the SMA are going to be merged into a single entity, next year...

On the other hand, from what I heard at the SMA launch of its EMC Framework, I believe some of the concerns expressed in your fax may be unfounded. Some of the same concerns occurred to me at the launch, and I was able to get clarification from the SMA's Radiocommunications Standards Manager Ian McAlister — who was quite reassuring.

It seems that for the present at least, the new EMC regulations will apply only to complete manufactured products, and those manufactured and marketed in significant volumes from January 1, 1996. I'm assured that they're not aimed at individuals, manufacturers of very low volume products, kit marketers or home constructors. So magazine projects and kits for them will not be affected, and this may also be the case with a low-volume manufacturer like yourself.

I know this sounds like another case of 'draconian legislation tempered with realistic day-to-day interpretation', and perhaps this will turn out to be the case in the long run. It's possible that in the future, someone in the SMA could decide to widen the 'net' to include low volume manufacturers and kits — but this could be very difficult, as you suggest. It would probably be impossible, if they tried to extend it to cover individuals.

I suspect that the SMA realises this, too. They seem to have decided to direct their limited resources towards those areas of the EMC problem where they *will* be able to have a significant impact, rather than into areas where it'll be almost impossible to achieve much.

For example one of the prime causes of EMI in our modern urban society is fluorescent lighting; yet it would be almost impossible for the SMA to do anything about the zillions of fluorescent lamps already installed in all of our office buildings and homes. So for the present at least, the new legislation will apply only to *new* products and equipment. Any action on what our American friends would call 'the heritage problem' will have to wait...

But that's about all we have space for, this month. I hope you'll join me here in the Forum next time. I don't think there's any law against it, as yet! ❖

COMDEX 1995: SHOW OF SHOWS

Each year, the world's largest computer show seems to grow even larger. The 1995 version was no exception, with almost a quarter of a million visitors trudging around an array of enormous display halls distributed around Las Vegas. Here's a report on some of the high-tech wonders and marketing spectacles they found — if they had the required level of energy and persistence, that is.

by MARK HARRIS

Yogi Berra, the legendary manager of the New York Yankees baseball team, is best remembered for a number of self-contradicting or tautological phrases that have become part of the American culture — such as: "Nobody goes there anymore. It's too crowded" and "It's *deja vu* all over again".

As it happens, both of these sayings apply to the Comdex show in Las Vegas, where just about everyone goes through the annual ritual of vowing never to return, because of the madness of the event. But they always *do* return...

The 1995 edition of the gargantuan computer trade show attracted a record 230,000 people during the five-day race against time and physical exhaustion. Both limit people's ability to view all of the exhibits, from 2200 companies spread out over 1.3 million square feet of space (equal to 29 football fields), in half a dozen convention centres around Las Vegas.

Despite the presence of a high-income crowd that effectively doubles the population of Las Vegas, the city's casinos are not all that thrilled about Comdex. Most participants in the annual high tech nerd-fest have a reputation for spending much of their free time scarfing free chicken wings and jumbo shrimp at evening receptions, rather than blowing the proceeds from their stock options on poker tables and slot machines.

Still, Comdex represents a huge economic boost for Las Vegas. The Las Vegas Convention and Visitors Authority calculates that the show deposits US$320 million into the local economy, through convention fees, lodging, meals, shopping and transportation. If Comdex were a corporation, the show would rank in 48th place on the list of the 150 largest public companies in Silicon Valley.

Bill's next vision

Comdex wouldn't be the same without a keynote address from Microsoft chairman Bill Gates. After the success of his Vision 2005 speech the previous year, Gates returned to Vegas with a new and highly entertaining multimedia presentation that outlined Microsoft's vision of the future. A future in which intelligent, animated characters help users of the company's business applications link their work to the Internet.

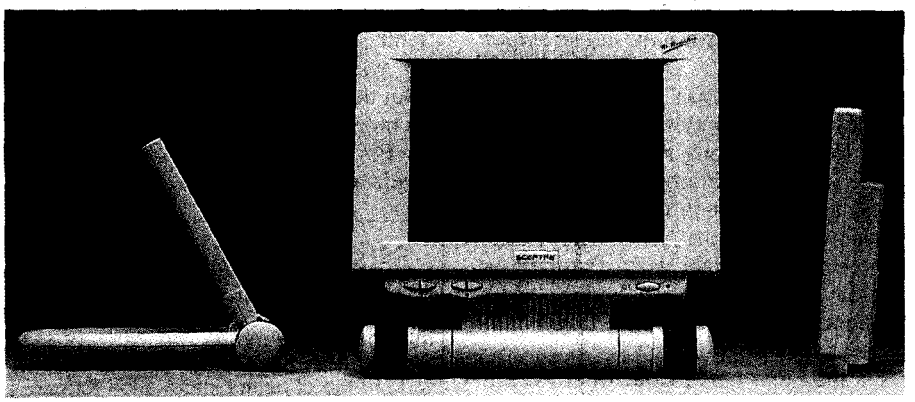
Gates told the crowd of about 7500 people that while business applications account for about 60% of all software sales, there is plenty of room to make the programs more 'intelligent' and to improve their ability to facilitate communication. "The ultimate goal is to empower people", Gates said. "Small business people will be able to connect to the online world on an equal basis to the bigger guys."

Gates presented a movie about a fictional battle to save a landmark resort. The movie highlighted features that could be added over the next five years to the company's 'Office' suite of software applications.

Most notably Microsoft will be incorporating animated characters such as a snoozing typewriter and a talking dog, which helps guide users through tasks such as coordinating schedules, taking meeting notes and searching out sites on the Internet.

The characters were similar to those used in Microsoft's 'Bob' home software package, which has been a commercial flop since Microsoft launched it at Comdex 1994. But Microsoft executives say their company is committed to what they call a "social user interface" to make computers easier to use.

In the movie, characters used a single integrated application to perform Internet searches and create links, working with colleagues in remote locations through video conferencing and the simultaneous transfer of voice and data.



Flat panels are starting to become a big item at Comdex, although it remains a market waiting for price improvements to attract the masses. Californian firm Sceptre Technologies showed this 1" thick, 11.3" diagonal TFT colour active matrix display that offers flicker and static-free viewing with a resolution of 800 x 600 VGA. But the US$1500 price tag attracts few consumers...

Gimmicks get attention

A show that is this big puts a lot of pressure on companies to rise above the noise and attract more than an average share of the attention. Creativity is the operative word when it comes to Comdex — and deep pockets. A reception in a nice hotel ballroom with food and drinks is a sure-fire recipe for a quiet evening. At Comdex, you've got to do things in a big, no-expense-is-too-great kind of way.

Just consider 'The Panda Project', a start-up personal computer company in Boca Raton, Florida, which pulled out

Following on the heels of a similar move by Hewlett-Packard, Pacific Image Electronics introduced an integrated 300 x 600dpi colour scanner, plain paper fax and copier system. According to the company the ScanMedia's US$895 price tag is less than half that which consumers would have to shell out if they bought each of the three functions in dedicated machines.

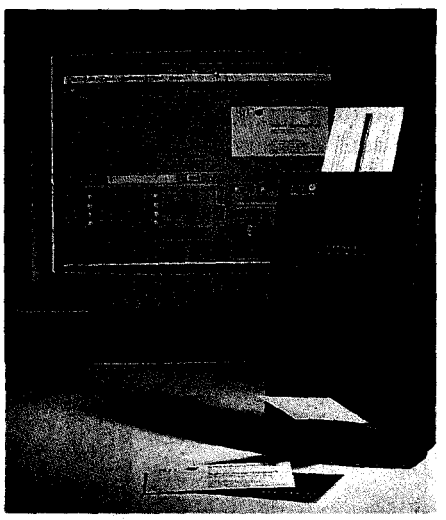
all the stops to get the undivided attention of at least a few Comdex attendees. The company used a shuttle bus to pick up 100 key customers, Wall Street analysts and journalists for a short ride to the Las Vegas airport. The group then climbed aboard a chartered jet for a 45-minute flight to Palm Springs, where they were whisked by limousines to the Elizabeth Taylor mansion. Liz herself wasn't home, but the travellers were treated to a fancy dinner and a performance by comedian-turned-super-movie star Dana Carvey.

Hollywood stars were everywhere at the show, including many members of the casts of the various *Star Trek* generations. Rocker Lyle Lovett, best known as the singer no longer married to Julia Roberts, played at a party put on by Fujitsu Microelectronics of San Jose. The Temptations, the classic Motown group famous for 'My Girl', got top billing at the annual Micrografx Chili Cook-Off which drew 6000 hungry fans.

One of the hottest party tickets once again was that for the 7th Level party, this time at the new trendy 'Beach' disco which charged $150,000 for half a night's rent. As usual, the members of 7th Level executive staff, including former members of the Pink FLoyd and Dooby Brothers got on stages with a handful of their friends for a world-class rock jam.

Not to be out-done, Witch Desk — a start-up software company in San Jose — somehow came up with $500,000 to hire Fleetwood Mac and rent a hall to host the 13,000 people it invited.

Even the NBC television network, which has big multimedia ambitions, got into the act with a 'VIVA LAS COMDEX' party, including the NBC Nightly News broadcast in which anchor Tom Brokaw did the broadcast from a booth in front of the Las Vegas Convention Center.



Seiko Instruments took a big gamble by jumping into a market dominated by companies that have either gone out of business or soon will be: businesscard readers. But Seiko thinks it has found the key to success, in improved software for character recognition.

On a more modest scale, Seattle software developer MidiSoft was one of several exhibitors offering free foot massages.

And of course Comdex's adult entertainment counterpart, called AdultDex 95 caused the usual controversy. NMP Interactive, a publisher of adult CD-ROMs based in Venice, California, unveiled a service called 'Interotica Live'. At NMP's office in Venice, 50 booths are staffed by women waiting for calls through the Internet from men, who can send text messages asking the women to unrobe in front of a video camera. The cyberspace Peeping Toms, however, will pay a steep price for the service: NMP is charging $5 a minute, payable by credit card.

Software Publishing tried something no other company has probably done, or would consider doing: use audience members to give the presentations of its new 'ASAP', a revolutionary personal presentation software program.

"Rather than having a well-rehearsed SPC representative give the theatre presentations, we decided to try a very fun and different approach this year", said Brad Peppard, vice president of marketing at Software Publishing. "ASAP makes it incredibly easy for even first-time users to create a slick presentation in a few minutes, and we wanted to back this claim by giving audience members the chance to demo the product themselves."

In another Comdex first, a group of prominent journalists broadcast information focused on the small office/home office (SOHO) market live from the trade show floor. Sponsored by SyQuest Technology, a leading maker of removable data storage devices, the week-long radio project featured interviews with many successful entrepreneurs.

On the Internet

Incidentally, if you missed Comdex because: (a) Vegas is too far away; (b) you don't own a computer retail store; (c) you are claustrophobic; or (d) you didn't feel like forking over nearly $700 to Softbank, the new owners of Comdex for a door pass — don't worry. Comdex is coming to you.

Already taking centre stage at this show, the Internet will in future enable millions of PC enthusiasts to get direct access to the heart of this Mecca of high-tech religion. A consortium of companies — including Array

Comdex 1995

Microsystems of Los Gatos and Best Internet Communications of Mountain View — arranged to transmit 'Comdex TV', the convention's in-house TV show, on the Internet. Anyone with a computer linked to the Internet, and some free available software, was able to watch 120 hours of nonstop programming throughout the show. The picture quality left much to be desired, though, especially for users with nothing more than an ordinary modem.

New Comdex boss

For 16 years, Atley Adelson nursed his Comdex baby to become the epicentre of the computing universe. But the 17th running of the event took place under the control of the new owner, Softbank of Japan. And by all accounts, the new owner fits the show's razzle-dazzle personality perfectly. And if Adelson was able to turn Comdex into a 'lean and mean money-making machine', all indications (including a doubling of show fees to more than $600) are Softbank's 38-year old founder Masayoshi Son is just adding turbo power to the engine.

Like Adelson, Masayoshi made no efforts to keep the intense media spotlight away from him. At a 'getting-to-know-you' gathering with the huge press corps, Masayoshi made no secrets of his huge ambitions — detailed in a business plan that spans the next 300 years!

"I have to be responsible now not only for *my* life. So 50 years is not good enough. That is why I am making a 300-year plan for the whole group of companies", he said.

Included in that plan appears to be the buy-out of anything and everything related to leading PC trade shows and publications. Shortly after shocking the PC world with its US$862 million purchase of Comdex, Softbank also concluded negotiations for its US$2.1 billion takeover of the Ziff-Davis publishing empire.

"Somebody said I am the rising Son," Masayoshi quipped.

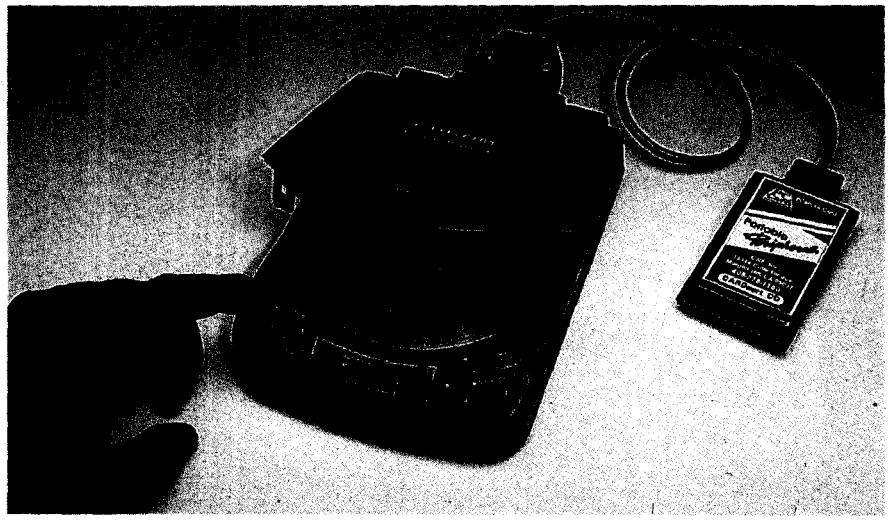
To be sure, the Comdex investment is starting to pay off handsomely. Already highly profitable at the US$250 entrance fee charged in 1994, Softbank reaped in more than US$100 million this time by charging the 225,000 visitors between US$400 and $700 to get into the show. A bargain by Tokyo standards, no doubt.

Masayoshi struck out on his own at the age of 16, migrating to the United States. While at Berkeley University he invented a pocket translator he sold to Sharp for US$1 million. The invention was the basis for the Wizard product line design. Before graduating he sold a second invention, a computer game, for another $1 million.

Referring to billionaire oilman Paul Getty who, on his death bed, said he regretted not thinking bigger when he was young,

Masayoshi said "I like to dream big, and I keep on growing our company". Already he controls 38 computer trade shows around the world. The current high-tech trade books he owns have a combined circulation of nine million, a figure that will increase to 50 million in Masayoshi's plan over the next 10 years.

Softbank had just 650 workers in 1994, but will have more than 6000 by the end of 1996. Masayoshi said he intends to increase the firm's cash flow from just US$40 million to more than $400 million in 1996.



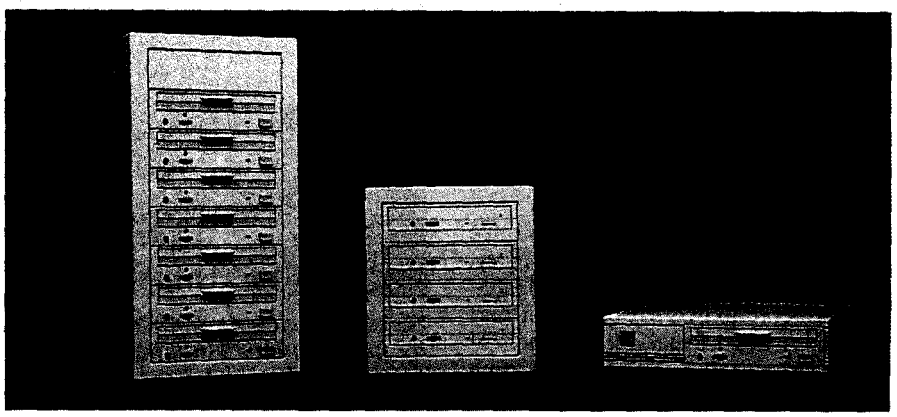
PCMCIA products took a backseat to the Internet at Comdex, but the proliferation of the new technology was unmistakable. CNF of Silicon Valley showed the industry's first truly portable PCMCIA based CD-ROM drive for Windows 95 and OS/2 WARP support.

Internet rules, OK

As mentioned earlier, the hottest item in this latest Comdex was the Internet. Concentrated in a relatively small hall at the Hilton Hotel, the Internet pavilion resembled the multimedia exhibition of two years go: small and crowded.

Only about 60 companies exhibited in the Internet pavilion, but the exhibit drew a packed house throughout the five-day event, setting the stage for yet another major expansion of the already massive show next year.

The Internet and its many facets in education, communications, and data research took centre stage in most presentations at the show. "It's the next wave", said Bill Thompson of



Multimedia junkies will love the Short Stack from Grado, which allows PC users to gain simultaneous access to a number of CD-ROM drives while working on different applications. The Short Stack starts at US$995 for a three CD-ROM tower and $1295 for a four drive system.

Integrated Data Systems, a company that recently launched V-Realm, a program that allows PC users to explore 3D images on the Internet and World Wide Web. With V-Realm, PC users can go into a virtual reality auto showroom and explore the car model they're interested in.

"You can ask to see colours and different options, and have them put in the VR model. Then you can print out the specs and take it to a dealer."

At the Netscape Communications booth, Rosanne Siino said "We are opening up a whole new way of thinking with Web pages. I think it will release a lot of creativity."

The Internet was also uppermost in the mind of Microsoft chief Bill Gates. "The Internet is kind of like the gold rush — the excitement is really unbelievable," Gates said. "Now fortunately this is a gold rush where there really is gold."

He added that the prospect that tens of millions of PCs will soon be able to work together over the Internet via high-speed access lines "will have a fundamental impact. In fact it will mean our industry will be changing the way people do business, the way they learn, and even the way they entertain themselves far more than I think people outside our industry expect."

End of an era?

It may also have a fundamental impact on Microsoft, in that in the world of networked computing, the network may well provide the operating system, not Microsoft — a transition that could spell the end of Microsoft's reign over the operating systems business.

That is exactly what IBM is banking on, according to its chairman Louis Gerstner who opened the Comdex show. Gerstner said powerful worldwide computer networks will soon replace the modern computer operating system, allowing individuals and institutions to download, store and share information more cheaply and efficiently.

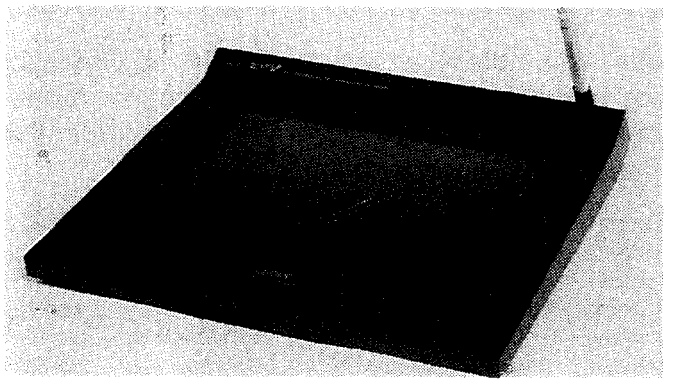
Network-centric computing will not strip personal computers of their power, but will make both hardware and software less expensive to maintain and upgrade. What users will give up in making this shift, he said, are "those arcane things we call operating systems".

"I hope you get the idea we're serious about network-centric computing", Gerstner said. "I'd say we're betting much of our future on it."

IBM, he said, is determined not to lose in this major industry shift to networked computers. In IBM's future vision, corporations and individual computer users alike will be linked together with group software which sits on top of invisible, ubiquitous operating systems.

For that reason, IBM was willing to pay US$3.5 billion this summer for Lotus Development and its crown jewel product for working in groups, Notes. "We're already seeing the Notes phenomenon", Gerstner said. Notes currently links over two million users in secure, internal corporate networks, as collaborative software to link employees, who can share documents around the world.

And Notes now can also connect to the Internet, making Notes is the perfect choice for network-centric computing, Gerstner said.



Above: Among the many innovative Internet security systems at the show was this signature verification system from Cadix International of Atlanta, Georgia. The ID-007 tablet is used in combination with Cadix's Cyber-Signature Identifier for Global Networks (C-SIGN) system, to verify signatures from Internet users wherever they may be in the world. The system recognises signatures in any language, including Chinese, Arabic, and Hebrew.

Below: If colour laser print-outs are just not good enough, you may be interested in the new A6-size Fujix digital image printer from FujiFilm, which uses 'Thermo-Autochrome' print technology to produce high quality 24-bit, 150dpi colour images in less than two minutes. Fuji said its technology can be integrated into printers for image sizes up to 33 inches.

Apple rumour mill

Of course Comdex wouldn't be Comdex without a few good rumours. This year the talk around Vegas was once again centred around a possible sale of Apple Computer to either IBM or Hewlett-Packard. Those rumours have been going around in Silicon Valley for more than a year. And some of the rumours actually turned out to be true, but the interested parties (Oracle, Motorola, Canon) didn't act. At Comdex trade publication *InfoWorld* reported that both IBM and Hewlett-Packard have recently made offers for Apple, only to have the bids spurned as inadequate by Apple chief Michael Spindler.

IBM has long been alleged to have an interest in Apple, and its latest bid, according to the magazine, was for US$70 to $75 a share — a $9 billion undertaking that would deplete IBM's cash hoard. H-P was said to be offering between 0.8 and 1.1 shares of its stock for each share of Apple, valuing the company at between US$8.5 - 11.5 billion.

Tim Bajarin of Creative Strategies in San Jose said H-P has been talking with Apple for 18 months about licensing its software, but said his sources don't believe H-P is interested in buying the entire company. He also said IBM is no longer interested in buying Apple. ❖

THE SERVICEMAN

The 1995 TETIA/TESA National Convention, and fun fixing a modern electronic volume control...

Towards the end of last year I was able to attend the TETIA/TESA National Convention in Hobart, and I found it so interesting that I'm providing a report here this month. But there's also a frustrating tale from my own bench, concerning the fun I had trying find the cause of 'no sound' in a late-model colour TV set fitted with an electronic volume control.

The 1995 TETIA/TESA National Convention was held at the Wrest Point Hotel Casino in Hobart over the weekend October 28, 29 and 30. There were about 40 servicemen and service company representatives at the convention, and I was lucky enough to be among them. It was the event of the year as far as I was concerned, and I wouldn't have missed it for worlds.

The inimitable Rod Humphris, a senior lecturer from the Royal Melbourne Institute of Technology (RMIT) opened proceedings on Saturday morning with one of his memorable lectures — on digital servos in VCRs. You have to listen very carefully to everything that Rod says, since he slips humorous comments into his talks and if you're not paying attention, you find yourself wondering what everyone else is laughing about!

The second session was to be divided between Tony Stevens of Winscot Trading Company in Melbourne (the distributors of Matchmaster antennas) and Peter Keenan, a principal engineer from the Matchmaster company.

Trouble was, Tony got so wound up with his talk on satellite antennas and distribution systems that he left only 10 minutes for Peter to cover the equally interesting subject of Pay TV! But delegates didn't miss out — both gentlemen have promised extensive 'apres convention attention'.

After lunch it was the turn of Ruben Ferrero, National service manager for Mitsubishi Electric Australia Pty Ltd, to talk on the subject of 'Where the service industry is going in the immediate future'. In fact, Ruben led a Q&A discussion that had most of those present thinking about their own destinies. There's no doubt that servicing as we have known it is fading fast, and the only future for the industry is to invest heavily in new tools and specialised training. As the next speaker showed...

Kevin Saillard, from Solder Static Pty Ltd in Melbourne, showed the new range of Pace soldering and desoldering tools, then gave a dramatic demonstration of the tools in use. He removed a 120-pin PLCC in little more than a second, after perhaps 10 seconds of preparation. He also demonstrated the removal and replacement of the tiniest chip resistors and capacitors.

The thought of handling tiny SMD components is frightening until you see it done with the proper equipment. Sure, the cost of these special tools is high, but they are going to last forever and are designed to be compatible with every type of component package now in use — and even with those that haven't been designed yet!

At the convention dinner on the Saturday evening, Robert Clifford, Managing Director of International Catamarans Tasmania Pty Ltd, told us about crash-testing cars and Super Cats! Although his accident (see footnote) cost the company $8 million in recovery and repair bills, they received $80 million worth of free publicity, including lots of front-page coverage which couldn't be bought for any amount of money.

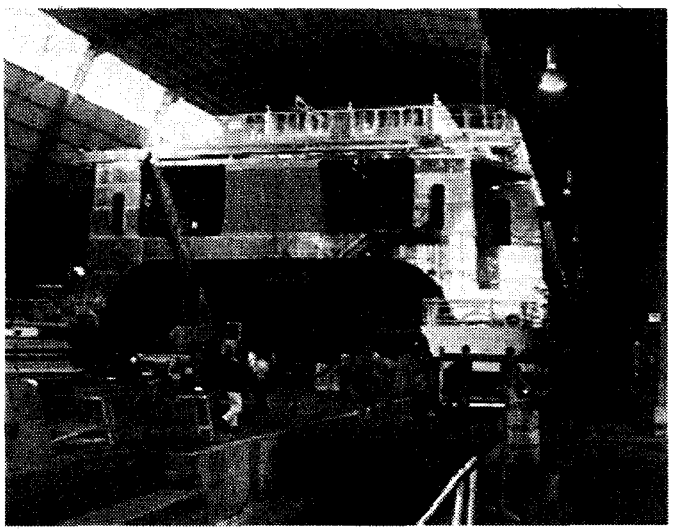
Mr Clifford revealed that his company would produce five super-cats in 1996 (at $40 million each) and expected to confirm orders for seven boats to be completed in 1997, at $50 million each. World-wide demand for his catamarans is 12-15 boats a year, but so far, no other Australian or foreign shipbuilders have been found with the expertise to do the job.

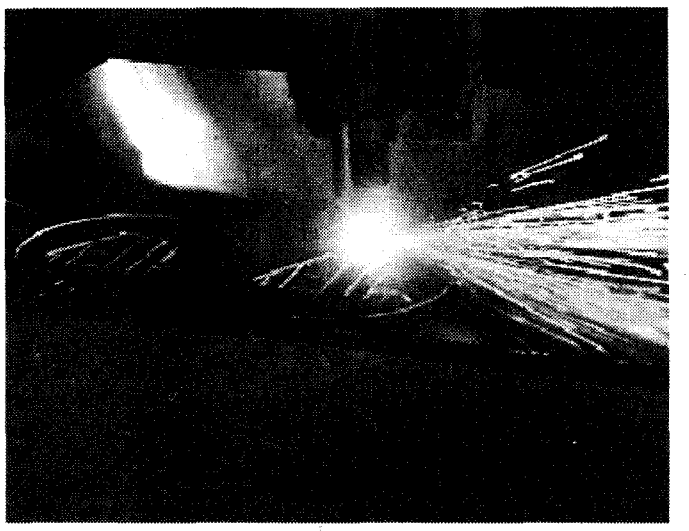
On Sunday morning Rod Humphris was back again, this time talking about switch-mode power supplies. As usual, his talk was illustrated with appropriate diagrams on a large screen projector, and generous handouts repeated the diagrams for close up study on delegate's tables.

Then Richard Chapman, from the Hobart company Global Lightning Technologies Pty Ltd gave us some interesting information about lightning and what it can do to buildings and other installations. (It was an unusually interesting talk, in view of what we were going to see at the GLI plant the next afternoon.)

Things didn't work out as planned for the next speaker, John Hogarth from Telstra Corporation. John had planned to give us a live demonstration of the Internet and Telstra's Video Conferencing system. Unfortunately, the required ISDN line could not be installed into the conference room at Wrest Point. Instead, John had to make do with samples saved to disc from a working installation.

His talk on video conferencing was most interesting and showed something of what video telephones might be like





Left: International Catamaran's vessels are the biggest cats built anywhere in the world. This towering structure is the stern of a 75 metre passenger/vehicle catamaran, being built under cover at the Company's shipyard near Hobart. Right: This is the hot end of International Catamaran's drawing office. The plasma arc can cut the most intricate designs into aluminium plate an inch or more thick. Here it is cutting TETIA logos in 4mm sheet.

in the future. The TETIA Federal Council has approved video conferencing as an alternative to face-to-face meetings, and the technology will eventually deliver enormous savings in travel costs to its users. It's a pity that the ISDN line wasn't available for a live demonstration; it was the only disappointment of the whole weekend.

After some light refreshments, we boarded a coach for the first of three technical visits scheduled for this Convention. First stop was at Incat Tasmania's plate store, to watch a computer controlled plasma arc cutting TETIA logos out of 4mm aluminium plate. This cutter is linked directly to the CAD computers in the drawing office, and in one blow has eliminated acres of drawings and thousands of rolls of tracing paper!

Then it was down to the building shed, to see two of Mr Clifford's 'boats' under construction. The mainland conventioners were staggered by the size of the so-called 'boats'. More than one visitor was heard to say "They're not boats! They're full sized bloody SHIPS!"

On Monday morning, we took a coach into the city and the ABC radio and TV studios. The ABC in Hobart is one of the Corporation's smallest installations, but it is built up from the very latest hi-tech components. The fully remote controlled pedestal camera was an example — visitors were intrigued as the seven-foot high robot wandered around the studio floor, panned and tilted the camera head and zoomed in and out, all without a human operator anywhere within sight.

Then we were off for a delicious luncheon at the Moorilla Winery, some 10 miles north of Hobart. This picturesque vineyard on the shores of the Derwent River was once the hobby farm of industrialist Claudio Alcorso. It was the forerunner of all commercial vineyards in Tasmania, and is still the source of some of Tasmania's best wines. The lunch was every bit as good as the setting, the company, and the wine.

Finally, it was back into the coach for the short trip to Tasmania's Technopark, the Government sponsored home of several of the State's small high-tech industries. Our goal was Critec Pty Ltd, the parent company of Global Lightning Technologies.

We had heard the day before about the company's products, but it was another thing to see them being produced. Critec produces a wide range of power supply protection and conditioning equipment, made in batches ranging from 20 items to hundreds and even thousands. The smaller batches are made by employees with highly skilled hands, while larger numbers come from the very latest pick-and-place SMD machines.

There is no truth in the allegation that Australia's electronic industry is dead. Critec is living proof that innovative products, well made in efficient factories, can be sold worldwide at a good profit. Critec is presently doubling its floor space in order to meet demand for its products.

After all that, it was back into the coach and off to the airport for the quick flight back to the mainland — for most of us. A lucky few were able to take more days off for a leisurely tour around Tasmania. I've spoken to some of them since they got home, and all I've heard is praise for the Tasmanian organisation and programme. It was a weekend I wouldn't have missed for quids!

As a matter of interest, TETIA and TESA are not the only organisations to arrange these technical seminars. But as far as I know they ARE the only groups that permit non-members to attend their functions. If you're ever invited to join a TETIA or TESA seminar, grab the opportunity with both hands. As a non-member, you'll probably be asked to pay a premium on the registration fee — but it will be a small price to pay for the knowledge you'll gain and the interesting people you'll meet.

Back to work

After that enjoyable weekend away, it was a real drag to get back into the workshop, even if it is only for a couple of days a week.

The first job continued the high-tech theme from the weekend and left me pining for the old days, when radios were wireless sets and had just five valves and rotary volume controls — particularly the rotary volume controls.

Volume controls were always a good source of income. Noisy pots were a great annoyance to their owners, but usually responded to a quick squirt of cleaning fluid. Even a 'worst case' pot could be dismantled and cleaned with alcohol and a soft rag. Then, when the pot was completely ruined and had to be replaced, you'd find that the new pot would mount directly in the hole left by the old one. The pot body might be larger or smaller, but the mounting hole was the same for all types.

Then came slider pots. Have you ever tried to fit a 47mm slider into the space vacated by a 52mm slider? Or worse

still, a 52mm slider into a 47mm space? I reckon the real old days had a lot going for them.

The job started when the customer brought in a reasonably late model Akai 12" CTV (model number CTK115) and complained that the sound had gone completely. There was nothing unusual about this — it could have been any one of a number of problems, most of which are common and respond quickly to the appropriate treatment.

With the set on the bench, I confirmed that there was no trace of sound, either on or off channel. The picture was perfect and the available controls all seemed to work as they should. Only the volume control didn't respond (and this is where I began wishing it was an old type rotary control!)

'No sound' in a television set can be caused by a fault anywhere from the tuner to the loudspeaker and finding the fault, without having to test everything from one end to the other, requires a bit of cunning. The thing to do is to start in the middle!

If there is sound at that point, you have eliminated the entire front end of the set. If there is no sound at the test point, then the fault must be in the detector or SIF stages. (If the picture is normal, it is unlikely that a sound problem could be in the tuner or video IF stages.) Thus one quick test can localise the fault, and the best place for that test has always been at the volume control.

The traditional volume control had three terminals. One connected to the output of the audio detector, another went to ground, and the middle terminal took the adjusted signal to the audio amplifier. Nothing could be simpler and what's more, the control's position on the front panel provided an easily accessible point for testing. Well, usually!

Unfortunately, the volume on this Akai was microprocessor controlled, via + and - buttons on the front panel. As a result, there was no easily recognisable point where a test probe might expect to find a signal, and I was forced to change the habits of a lifetime and seek another test point.

Another gripe about these modern sets is that all signal processing is done in anonymous black boxes. Back in the good old days you could always identify a component characteristically associated with a particular circuit. The ratio detector coil can was a good audio circuit starting point. Nowadays, there are no ratio detectors and no coil cans to identify. Unless you are very familiar with a particular chassis, the circuit diagram is absolutely essential, as it was in the case of this Akai.

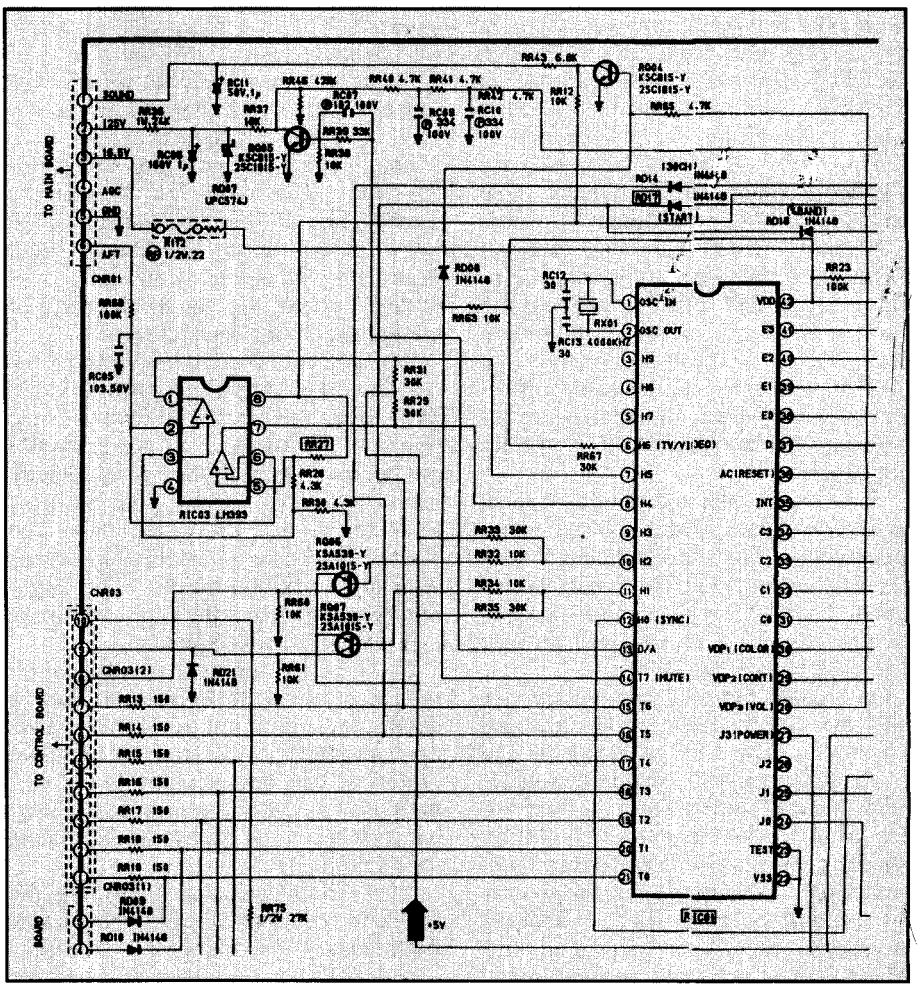
The diagram didn't make clear just how the volume was controlled, but I was able to work out that it used a DC attenuator, with a control voltage apparently derived from a digital signal initiated by the plus and minus buttons on the front panel. Complicated? I agree!

Fortunately, the IC responsible for the audio processing was shown on the circuit diagram with its internal arrangements and pinouts. This enabled me to determine that I had no access to the early audio stages, only to the driver stage output.

A quick prod with an audio test amplifier showed that there was clear audio at pin 5, and further testing located signals all the way to the audio output transistors.

There was even low level audio on the speaker terminals. At this point I considered the likelihood of a faulty speaker, since I have found a number of these tiny units suffering from seized voice coils. However, even after changing the speaker there was still only low level audio on the terminals and not a whisper of sound from the cone. So it wasn't the speaker...

It was about this time that I noticed a pencilled note on the circuit diagram. It said 'Low sound — IC101 LA7520'. Quite obviously, someone had found trouble in this area before. So I acquired a replacement IC and prepared to change it. But before I had a chance to do anything, a colleague commented "Are you getting any control voltage on pin 29?" I had to admit that up to that point, I hadn't thought of that one! Referring to



This is the volume control circuitry around the remote control IC in this month's second story. The control signals enter the chip at pins 20 and 21 (lower left) and pin 39 (top right). The control voltages exit the chip on pins 14 and 28, just below the centre of the chip.

the IC block diagram, I surmised that the control voltage should appear on pin 29, after being generated somewhere else in the set.

I checked the pin, first with a multimeter and then a CRO, but neither showed any sign of activity. The pin voltage is shown on the circuit diagram at 7.2V, with no indication of the range to be expected. I found about 5V, which may or may not have been close enough. What I didn't find was any variation when the volume up and down buttons were pressed. So it was as well that I didn't change the IC, and I've now got a new IC in stock with no immediate use for it!

Going back to the circuit diagram, I traced the control voltage to pin 1 on connector CH01, via decoupling components R604 and C652. The resistor was OK at 100 ohms, but the capacitor was much more doubtful. It was a 2.2uF electro, and I do not trust low value electros one little bit. It would have been nice to find a faulty capacitor, thus vindicating my mistrust of the little beggars, but this one was perfect in every respect.

There were no further clues on that sheet of the circuit diagram, so I turned to the remote control diagrams on the next page. It wasn't easy to find the appropriate connector on this diagram since all the plugs and/or sockets had different prefixes. The one I was looking for turned out to be CNR01. (I suppose there is some logic there, but matching prefix/numbers would make the task of a busy serviceman much easier.)

I traced the line marked SOUND from pin 1of CNR01 to the collector of a transistor labelled RQ04. The base of the transistor was connected to the master IC via two paths. One went via a diode to pin 14 marked MUTE and the other went more or less directly to pin 28, marked VOL.

Further examination suggested that the transistor was actually the bottom half of a voltage divider across the 12V rail. The transistor appeared to be OK in an in-circuit test, but I wanted to be sure. I removed it and then turned the set on, just to see what would happen. The sound blared out at full volume — which, besides scaring me witless, proved that the audio system itself was in first class order.

The transistor checked out perfectly so it was replaced, only to find that the sound had once again disappeared. I left the transistor in place, but isolated the base connection. The sound returned. So quite obviously, the trouble was being fed into the base of the transistor via one or other of the two paths from the IC. I felt the most likely culprit was the MUTE line, from pin 14 via diode RD08. It was easy enough to isolate the pin by removing the diode. Had it been the mute holding off the sound, this should have restored sanity; but it didn't.

Next I removed RR65, to isolate pin 28 (VOL) — and with both the diode and resistor out of circuit, the sound was back at full bore. But with the diode and/or resistor in place, the sound disappeared. So it was beginning to look very much as though the IC was dodgy.

There was just one other possible source of the trouble. That was the VOL +/- button switches, and the diode matrix on the control panel PCB. Checking this was complicated by the fact that the switches and matrix board were tucked away at the front of the cabinet, right in under the picture tube and were not in the least accessible.

In the end, I traced the volume control lines to the IC, at pins 20, 21 and 39. The last of these pins is common to both buttons, so I attached to it one lead of the meter. The other two pins connect to the common line via a diode and the button switch. So once I got the meter polarity sorted out, I could see that both buttons were working properly and delivering the correct connections to the IC.

Remote control ICs don't often give trouble, but this one was very questionable, to say the least. Strangely, it was only the volume function that was faulty — every other control worked normally. But it was clearly time to order a new chip. And that is all it took. 42-pin chips aren't all that easy to get out, and are only marginally easier to replace. But the job was eventually done and the set worked perfectly from there on.

I suppose I should be grateful that modern volume controls are so complicated. This one has provided a page of story for this column. It would have been hard to work up that much copy from 'replacing a volume pot' in an old TV! The job itself would have been a lot easier though...

No free lunches

Now, before I close this month, I'd like to say a few words about a subject that has been worrying me for some time.

I frequently get letters from readers asking for help in solving a service problem with some item of equipment. The writers generally describe the symptoms in considerable detail, then relate all that they have done to try to find the fault. They invariably finish up with "Can you help me please?"

Well, in a word, the answer is 'No' and this is what has been worrying me. It's not because I don't want to help, but because I can't afford to. For these reasons:

No description of a set of symptoms is ever complete. Even after the longest and most complicated repair, I usually realise that there was a symptom I had disregarded, consideration of which would have helped solve the problem much earlier.

Service manuals and circuit diagrams are a great help in tracing faults, but they are not infallible. Manufacturers often change details of their products and without actually seeing the chassis, I can't tell if it's a modified version or not.

Then again, there's the economic problem. Labour charges vary enormously, but most are presently around $50 per hour. If the problem has already taken *you* many hours without success, it's hardly likely that it will take me less than one hour, and who is going to pay the rent? If I spend an hour on *your* problem, I'll have to charge it to the next customer who comes in my door! I'm sorry, but it's just a hard economic fact.

And then, there is the sheer cost of replying to your letter even if it doesn't involve any time in the workshop. Someone has to sit down and compose the reply, then type it up, address an envelope, stick on a stamp, and get it into the nearest post box. Every letter we write costs someone about $4 or $5. That's no problem if it's only occasionally, but repeated several times a week and it becomes an expensive exercise.

So, I'm afraid that I can't offer to solve your problems for you, as much as I'd like to. My suggestion is that if you can't do it yourself, strike up a friendship with your nearest serviceman. You'll have to pay him for his help of course, but the alternative is to buy a new 'whatever' (and they can be expensive).

I have some more interesting contributions lined up for next month, so don't go away.

Footnote: Robert Clifford was at the helm of Condor 11 when the $40 million catamaran slammed onto Black Jack Rocks, just outside the Derwent River. The super-cat was travelling at 36 knots when it hit the rocks, finishing up high and dry with extensive but superficial damage. It was six weeks before the ship could be freed and towed back to Hobart for repairs. ❖

AUTOMOTIVE ELECTRONICS

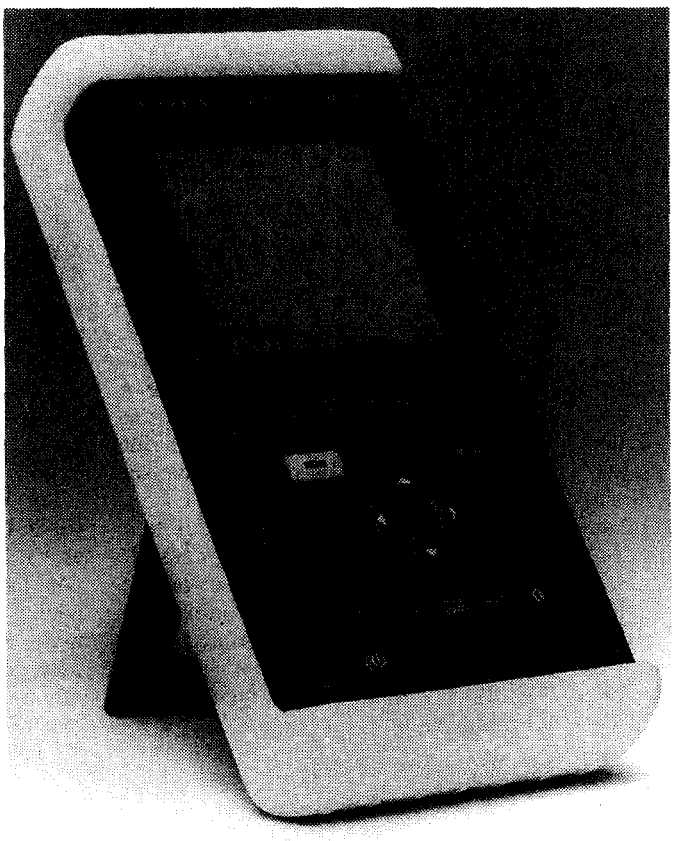
with NICK de VRIES MIAME, AMSAE, FI Diag.E..

Fluke's Model 98 Automotive ScopeMeter

This month we review another piece of 'hand-held' test equipment, the new Fluke 98 Automotive ScopeMeter from the Fluke/Philips Global Alliance. It seems to me that the traditional suppliers of electronic test equipment have discovered a new market niche, in the form of the automotive repair industry, and all manner of exciting new products are being launched into this lucrative market segment.

When contacted by Fluke/Philips to see if I was interested in doing a 'road test' of the new model 98 Automotive Scopemeter, for *EA*, my answer was very definitely in the affirmative. I was already salivating at the thought of an 'automotive specific' version of their well known ScopeMeters.

Delivery day duly arrived, and my first impression was of 'quality first' in every aspect of the presentation. The standard package as supplied includes a deluxe carry case, comprehensive user manual, automotive style inductive trigger probe, 10,000:1 capacitive probe for ignition signals, a wide range of test clips and probes in a zip-up case, plus an AC adaptor. Some optional extras are available as well, and the 0-600 amp DC current clamp priced at about $350 makes excellent value, compared with competing products.



Simplified layout

The Fluke 98 Automotive ScopeMeter is a new and exciting development of the 90 Series ScopeMeters, which takes away the excess complexity of the earlier 'not for motor mechanics' versions and adds a customised range of menu-driven tests.

For those who have been playing with the idea of taking the plunge into 'labscope land' but have been daunted by the perceived difficulties of learning a complicated control panel, this is one beautiful little analyser — one that will make the transition a totally painless and rewarding experience.

The adaptation of a successful electronics labscope for use in the automotive environment has a lot going for it. If you take the view that it is always better to own a scaled-down Mercedes in the form of the 190E, because of build quality, than to option-up an economy Volkswagen to become a high performance GTi, then it makes similar sense to indulge yourself in this scaled-down ScopeMeter.

The Fluke 98 still features a magnificent 50MHz analog 'front end' for faithful signal tracking and boasts a 25MS/s digitiser (that's 25 million samples per second, for the uninitiated). And the designers at Fluke have obviously paid attention to their market analysis people, because the range of automated sensor tests is comprehensive to say the least.

Engine tests

Until now, the autoranging timebase feature for ignition signals in 'Parade' mode has been exclusively in the domain of the larger engine analysers, and it's refreshing to see this inclusion in a hand-held tester like the 98. The autorange facility hasn't spilled over into its sensor tests as yet, but given the software basis of the tests, if enough prospective customers ask for a particular feature it may well be included in a subsequent release.

If you are wondering what the relevance of the auto-ranging timebase is when testing sensors, let me explain.

A customer comes in complaining about pre-ignition. You drive the vehicle and agree that the customer is always right. You set about testing the cooling system and state of tune, looking for the obvious faults, and come up with a blank. You suspect that one of the com-

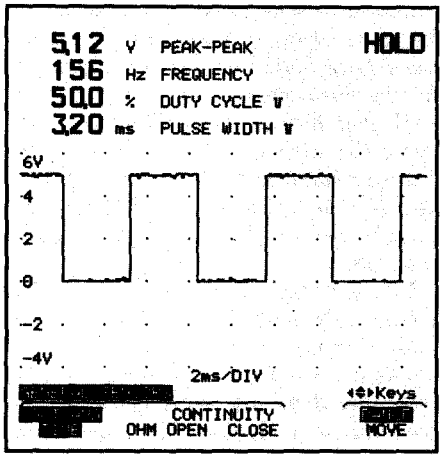


Fig.1: A printout of the Model 98 displaying the signal from a Ford MAP sensor. What more could you want?

bustion chambers has a hot spot, and one way to find out which one it is, is to swap the spark plug in one cylinder at a time with a colder heat range and road test the vehicle with each change, until the 'pinking' sound disappears.

Obviously this approach is less than satisfactory, and a quicker method by far would be to trigger the scope from number one spark plug lead and connect to the knock sensor. Then a road test or dyno run will immediately provide the answer, with the knock sensor activity in line with the problematic cylinder — simple, no?

Translate the aforementioned procedure to other sensors like the oxygen sensor, for example, and a whole new range of accurate analysis opens up.

Plots and trends

To a novelist, a plot might well involve the unfolding of a great drama; while to the gardener, it's the best flowerbed. But to the motor mechanic in search of a conclusive diagnosis in the least possible time, it's a set of measurements to pinpoint the cause of 'Le Problem'.

If, for example, the ScopeMeter is connected to a frequency-type MAP sensor, the waveform may look somewhat like the illustration in Fig.1. When the display is switched to 'Plot' the readings, the ScopeMeter kicks-in some clever software that reveals the change in values over time for the four readings displayed digitally at the top of the oscilloscope (Fig.2). You'll notice that the frequency and pulse width graphs have the most variation, indicating in the most obvious way the possible area of concern.

Now if you thought that was good, the Min/Max Trendplot function is another powerful way of capturing that elusive little glitch.

Combine these with the Flight Recorder capabilities and the diagnostic power of this latest offering from Fluke is beginning to look rather ownable, wouldn't you agree?

The major implication for the recording of voltage waveforms is, of course, the capturing of intermittent faults. That hard to spot 'hesitation-only-on-left-hand-turns' syndrome is the bane of every mechanic's life. It's hard enough trying to sort out the bugs that are *always* there, without the complication of difficult terrain!

The range of recording capacity on the 98 depends on what the timebase is set at. The total record length that can be stored is 1280 screen divisions. With a timebase flexibility from 1ms to 60s per division, this translates to a 1.28ms recording, right up to a 21.33 hour stint. If you can't find the problem with this kind of technology, burn the car!

Print it or else

Probably the most important aspect of any digital oscilloscope today is the ability to link it to a printer, to produce a 'hard copy' of your diagnosis.

Months, or even years from today, a new member of staff can refer to the dossier of printouts that you have thoughtfully organised into 'by manufacturer' folders; can see your 'before and after' waveforms, along with your hand written notes, and save themselves hours of diagnosis time. The implications for more efficient throughput and the resultant profitability, I feel sure is not lost on the management professional.

I thought the Model 98's 'optically

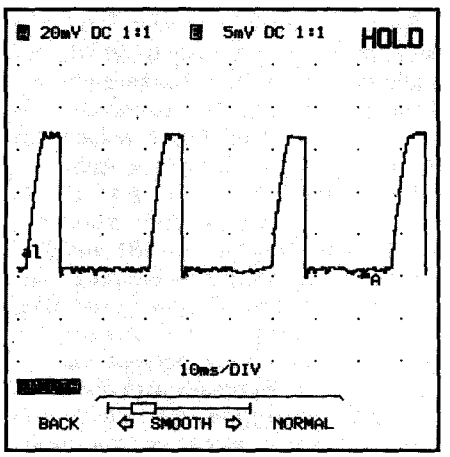


Fig.3: The charge-up characteristics of the ignition coil, showing the current limiting coming into effect at 6.5 amps.

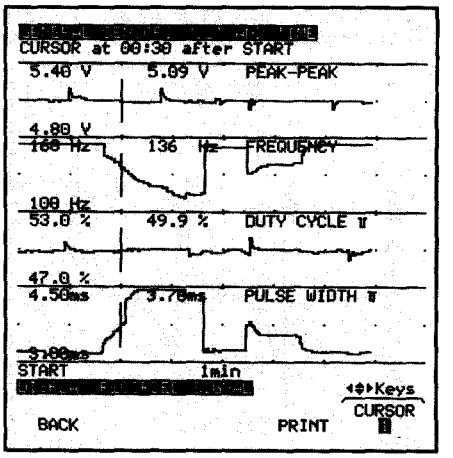


Fig.2: Almost a whole minute of recording the Ford MAP sensor signal, revealing variations in frequency and pulse width.

isolated' RS-232 printer port was a nice touch, and shows how much thought has gone into this piece of engineering brilliance from Fluke.

The combined efforts of Gary Costa and Ian Mulford of Philips Scientific came together to loan me the 98, plus the optional current probe and 'FlukeView' communications software as well as the hardware to print these pictures for you.

My 486SX33 computer and HP560C printer combination seemed to take an inordinate amount of time to print the pictures, with much accessing of the hard drive going on, even when printing from the database. So I gather that there is a lot of conversion happening when the 'print' command is invoked.

Smoothing function

The 'Smooth' function of the ScopeMeter is a neat bit of soft/hardware that allows you to filter out the unwanted hash and electromagnetic interference from the signal you are observing, and leaves you with a clean waveshape from which to take your measurements.

You will notice from the picture of the ScopeMeter that the ignition pattern displayed is somewhat fat'n'fuzzy, as though it were drawn with a broad marking pen. The Smooth function reduces the fuzziness in five selectable steps, to make the viewing of the waveshape itself more meaningful.

I found that depending on what type of signal I was connected to, I could go too far and slightly distort the shape of the wave, as the program switched in more and more filtering capacitance. The operation of this function is quite intuitive though, and the right level was perfectly obvious with the first use.

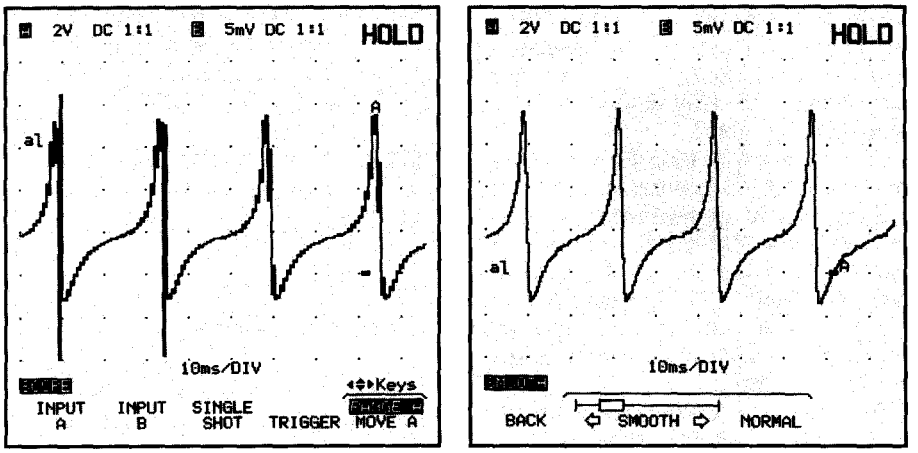


Fig.4 (left): The signal at terminal seven on the Bosch 024 series ignition module, displayed without any massaging by the Model 98's 'Smooth' function. Fig.5 (right): The same signal as shown in Fig.4, but with the 'Smooth' function at one step — much cleaner and easier to read.

Ignition module tests

One of the most difficult devices to test with any certainty has been the electronic ignition module. By using the optional current probe, a waveform of the current consumption by the ignition module can be viewed.

By setting the timebase to 'autorange' and clamping the current probe around the power supply to the coil, the characteristics of the module's current waveform can be critically inspected. Suddenly it has become easy to be absolutely positive that the ignition module is good or bad, with hash in the waveshape indicating a bad transistor or uncertain ground path.

I was unable to simulate a poor ground on my test engine, however from the illustration in Fig.3 I think you can see clearly the characteristics of a current limiting ignition module. On the 10mV per amp setting, this equates to approximately 6.5A of primary current flowing through the coil and module.

Notice the 'flat top' of the waveform, indicating the current limiting section. At high speed this flat bit disappears altogether, as the time constraints placed on the ignition mean full current saturation is required to saturate the coil. A faulty module or contact points would show a whole lot of hash on the rising edge and the top of the peak, which is usually somewhat lower than normal.

You may have observed that I had the Smooth function turned on just one notch in Fig.3, and that was because of the ignition 'breakthrough' making a mess of the waveform for printing purposes.

The other part of the electronic ignition equation is of course the triggering device, which is checked just as simply with the voltage scope on terminal seven of the module (see Fig.4 without smoothing, and Fig.5 smoothed).

I am happy to say that as time goes by, the mysteries of electronics in motor cars have become less of a problem, due in large part to the availability of test equipment from companies like John Fluke *et al.* Thanks, Philips/Fluke — the Model 98 is a very nice bit of gear.

The quoted price for the Fluke Model 98 Automotive ScopeMeter is $3990, not including sales tax. The optional FlukeView software is $435, again ex tax. For further information on the Model 98, contact Philips Scientific and Industrial at 34 Waterloo Road, North Ryde 2113; phone (02) 888 8222.

ABS: reader responds

Back in October last year, I wrote a description of ABS systems in which I made some statements that have drawn a response from one Rex Newsome of St Lucia in Queensland. I have included his letter here for your interest as well:

Your article in October EA on ABS was of much interest. Your statement, though that a well-sorted ABS and TCS system is essentially a 'good thing' may be over-optimistic. Williams and Wall (Accident Analysis and Prevention, 26(6), 1994) report a German study of taxi drivers of Mercedes with and without ABS, which found no reduction in claim frequency or payouts for insurance claims. Surreptitious observations found the ABS drivers drove more aggressively and performed more dangerous manoeuvres.

Studies in other countries have noted the same change of driving behaviour and I have heard one senior advanced driving instructor remark that clients think that having ABS allows them to 'drive like Fangio'. W & W also found that over half a sample of drivers of ABS cars in North Carolina and Wisconsin thought they still had to pump the pedal in a skid.

A concern of mine is the driver who deliberately uses the ABS facility to delay stopping until the last moment (a report from a fleet driver/trainer indicates that there are many truckies who drive this way, to save trip time). What happens when the ABS fails, or when it is found that the car they've borrowed does not have ABS? What happens if maintenance has been neglected? The electronics may be self testing, but the mechanics may not be.

Air bags, by the way, like ABS is another engineering solution to safety. These may now be under a cloud too. Peterson and Hoffer (J. Consumer Research, 1994) analysed 10.5 million vehicles worth of HDLI data to compare matched makes of vehicles with and without airbags. They concluded that airbag adoption did not decrease, and in some analyses increased, personal injury and accident claims.

Part of the explanation may be that the sense of security of having a supposedly 'safe' car induces a change in driving — such as a greater willingness to take a longer trip, and drive at higher speeds.

Another possibility is that crash tests with dummies (or cadavers) do not simulate adequately the effect of decelerative forces to the human neck and brain. There is some suggestion that while airbags may be 'face-saving', the neck area becomes more vulnerable to injury.

Thanks for your letter, Rex. Maybe the 'face saving' aspect of airbags is more to do with manufacturers being 'seen' to be doing something about the problematic issue of facio-cranial injuries arising from accidents?

I personally feel the 'gambler' in all of us is the major obstacle to safety, and until someone finds a way to cure us, society will continue to look to the engineering profession to come up with 'foolproof' appliances, tools, machines — and of course, motor cars.

Here's to the next crop of engineers who will be responsible for the new vehicle designs of the future, I hope *EA* has made a contribution to your view of the profession! ❖

Experimenting with Electronics

by DARREN YATES, B. Sc.

More op-amp circuits

This month, we continue our look at some interesting and useful op-amp circuits and also discuss the question: Is the op-amp is as good as many people believe it to be?

Over the last couple of months, we've looked at a number of different circuits which take advantage of the op-amp's capabilities very nicely. It is indeed one of the most versatile components around.

We've seen how the op-amp can complete a circuit with fewer components, in most cases, than a transistor based one — but does that make it *better* than the transistor?

The simple answer to this is to sit on the fence and say, "It depends on the application". Just as you wouldn't use a spreadsheet package to write up a letter, there are many applications where you wouldn't use an op-amp either. The main trick is to remember each component's limitations — and that requires a little bit of reading around, looking at other circuits and some good old-fashioned trial and error.

Ever since the op-amp's arrival back in the late 1960s, designers have tended to become lazy and throw one in whenever and wherever they could. While this often made for quick turn-around during design time, op-amps were then and still are more expensive than transistors. As a result, the engineer has become more skilled at justifying its use.

"It saves time/money/space and is easier to repair/replace/diagnose" was one of the gems that evolved. The engineer simply then circled the combination he thought best suited the situation...

But what's *wrong* with the op-amp? Well, the first hint can be gleaned from looking at a few data books. There are more op-amps available than I've had hot dinners. There are also more transistors as well, which probably supports the idea that *neither* component can be considered perfect.

Most op-amps suffer badly when it comes to noise. If you're trying to design a low noise audio preamplifier with op-amps, your only real option is to consider some of the few low noise op-amps that are available. National Semiconductor's LM833 is an example, as is the Analog Devices' AD797. Neither are cheap when compared to transistors, and you pay for the level of performance you require.

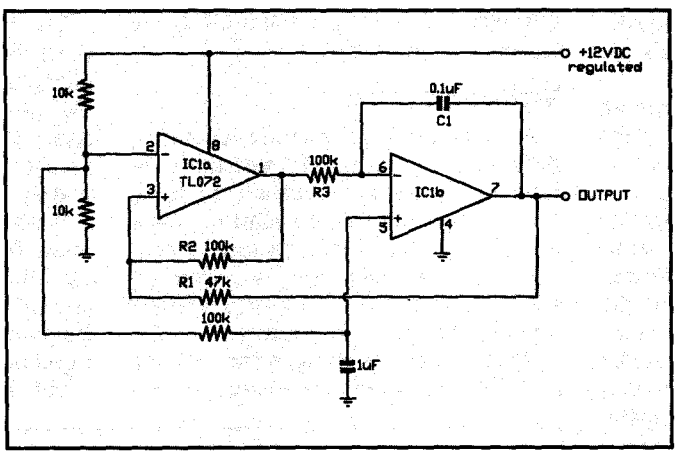


Fig.1: A simple audio oscillator which generates both sine and triangular waveforms.

Secondly, most of the commonly available op-amps have a low end-frequency point — for some, this is as little as 1MHz.

Over the last couple of years, there's been a fair bit of noise about a different type of op-amp called the 'current feedback' type.

While most op-amps use a voltage feedback technique, which you can see from the relatively high resistor values used, these new op-amps use current instead — which enables the op-amp to amplify signals anywhere up to 300MHz or so.

Now before you start thinking about the best FM radio mike you've ever seen, current feedback op-amps are far more unstable than their older stable mates. It only requires bad circuit layout for one of these to start oscillating its silicon lungs out. What's more, this end-frequency quoted is often at a particular gain, usually greater than five. This can further add to the problems...

If we go back to the regular op-amps that we know and love, one area that seems to get little attention is the problems caused by multiple op-amps in the one package. Now while this is all well and good when you're just using them as simple comparators, the close proximity of the pins in the IC package can cause signal coupling between op-amps.

An example of this occurred in a circuit I was designing some time back, which included a low-level amplifier and a comparator. Each circuit element required a single op-amp, so naturally a dual op-amp package came to mind. The problem though was that the spikes from the comparator output would feed back into the amplifier. The solution was found by using two *single* op-amp packages instead.

Now granted this was an unusual case, but it does underline the fact that you shouldn't mix circuit elements within the one package. This is true particularly where the amplification of low-level signals is required.

As a general rule, most general purpose audio and mathematical functions can be performed adequately with stan-

dard op-amps, but transistors are the better way to go when it comes to video/RF and high-quality audio.

Some circuits

Of course, there are plenty of circuits which are performed well by op-amps and easier than with transistors alone. The first circuit we'll look at this month is a square/triangle wave function generator, shown in Fig.1.

At first glance, it can be fairly difficult to see how this circuit oscillates — since neither op-amp's direct task is to oscillate. Instead what we have is two circuit elements, a Schmitt trigger and an integrator, which when connected together with the appropriate feedback, oscillate in a regular fashion.

Last month, we saw from the drill speed controller that we can obtain a triangle wave from a single op-amp oscillator by using the voltage across the capacitor — but this required a fair bit of care so as not to cause the oscillator to stop altogether.

This circuit provides two low-impedance outputs, one for the squarewave and one for the triangle waveform. Another bonus is that we can change the frequency of both waveforms easily via a single pot.

We already know from last month how the Schmitt trigger works, but the integrator is a new circuit element so let's look at it more closely in Fig.2.

The circuit on its own is quite simple — an op-amp, a capacitor and a resistor. If we now connect the non-inverting input to half the supply voltage and the circuit input to the supply rail, the output ramps down as the capacitor charges. Connect the input to ground, and the output ramps upwards again. Obviously, once the output voltage reaches the extremities of the supply rails, it remains at that point.

If we now go back to Fig.1, we can see that the output of the integrator is connected to the input of the Schmitt trigger, and the output of the Schmitt trigger becomes the input to the integrator.

If we assume the output of the Schmitt trigger starts off at the supply rail, the integrator (IC1b) begins to ramp downwards as its capacitor begins to charge up. Once it reaches the lower threshold of the Schmitt, the output of IC1a goes low, causing the integrator output to ramp upwards again.

As it rises, it reaches the upper threshold level of the Schmitt trigger and its output goes high again, causing the integrator to ramp down once again.

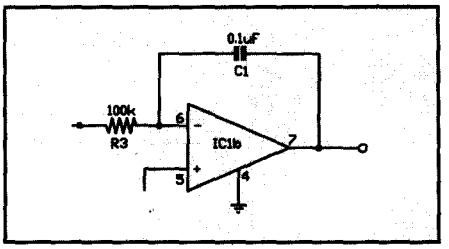


Fig.2: An op-amp can be used as an integrator by connecting it like this.

This continues on indefinitely, and the speed at which it continues is controlled by pot VR1. This changes the current level which is added to and taken away from the integrator, and becomes the main timing element. The Schmitt trigger here simply acts somewhat like a reversing switch, to tell the integrator to ramp in the opposite direction.

The frequency of the circuit is calculated from the following formula:

Freq = (1/(4 x VR1 x C1)) x (R1/R2)

where R1, R2 and VR1 are the respective resistances in ohms and C1 is the capacitance in Farads.

Voltage control

As standard as the previous circuit is, it requires a change of resistance to cause a change in frequency. In some cases, this is not easy to achieve. What is easier to achieve is a change in voltage. What we now need to come up with is some way of using a voltage input to change the frequency.

With a little rearrangement and the addition of a single transistor, we can create a voltage controlled oscillator as shown in Fig.3. This circuit has quite good linearity and with the use of an LM358, the input voltage can go all the way to ground and still control the circuit.

Looking at Fig.3, the major difference is the addition of the NPN transistor between the output of the Schmitt trigger and the input of the integrator.

The capacitor in the negative feedback loop of IC1a is charged by a constant current, courtesy of the op-amp. The level of the constant current is determined by the voltage level of the input, and so the output of IC1a falls linearly. Once the lower threshold of the Schmitt trigger has been passed, the output of IC1b switches high, turning on transistor Q1.

The capacitor in the integrator circuit now begins to discharge and the output of IC1a rises linearly. This continues until the output rises above the upper threshold of the Schmitt trigger, at which point the output of IC1b falls low and Q1 switches off. The integrator now begins to fall again and the process continues.

The input voltage controls the speed at which the capacitor charges and discharges — the higher the input voltage, the faster it charges and discharges, and vice versa. With the components as shown, the duty cycle is approximately 50%.

With a 47nF capacitor the maximum frequency, which occurs when the input equals the supply voltage, is around about 140Hz. To increase this frequency, reduce the value of the capacitor.

This is a very useful and easy to build

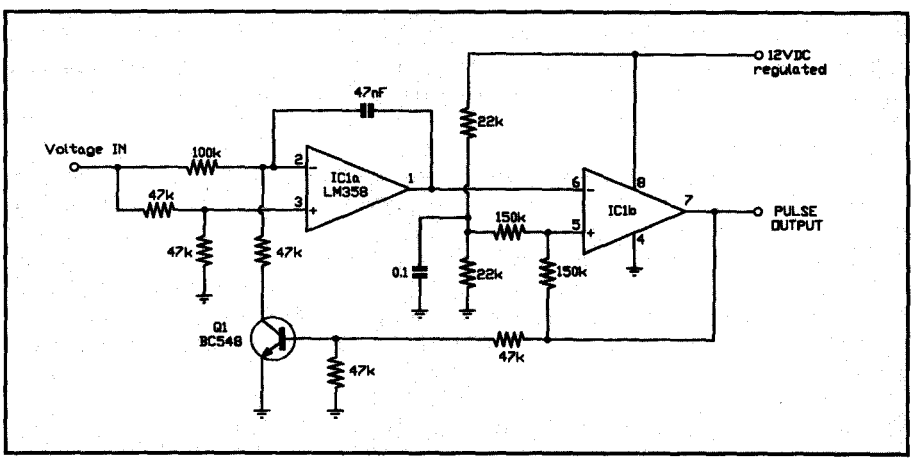


Fig.3: A modified version of the simple audio oscillator of Fig.1, which allows the frequency to be varied by an input voltage.

circuit, which can be used in many projects. To give you a couple of ideas, you could use this circuit in conjunction with a frequency meter to make a simple voltmeter. By calibrating the VCO to a conversion of 1V/kHz, every kilohertz on the frequency meter is equal to 1V.

A VCO is also a simple analog-to-digital converter, and can be used to turn audio signals into digital. A similar result is used to propagate FM radio signals, where the station frequency is modulated or varied by the amplitude of the incoming audio signal.

Dual rail supply

Although we've managed well up until now, the time is coming when we will need a dual rail power supply — i.e., a power supply with a positive rail, negative rail and ground. Most op-amps and op-amp circuits are designed for dual supply rails, even though many can be converted across to single rail format.

It seems appropriate then, that the job of making a dual rail supply, with two supply voltages that are equal and opposite in magnitude, can be done quite easily using an op-amp.

This type of supply is often called a 'dual tracking power supply' because whatever the positive supply rail does, the negative rail follows or 'tracks' it...

In the past, supplies such as this would have been made using a dual ganged pot, which is a double potentiometer with the two sections 'ganged' together so they're controlled by the one shaft.

The schematic for this type of circuit is shown in Fig.4. The problem is that dual ganged pots are notorious for never being able to provide precisely the same resistance in both sections — certainly nowhere near close enough for our purpose.

At best, you'd be lucky to get within +/-10% difference. Our op-amp based circuit will get us to within 1%.

Looking at the new circuit in Fig.5, you can see that it's based around two LM3XX three-terminal regulators — one for the positive rail and one for the negative. The positive side of the circuit is pretty much as normal, with a pot connected to the regulator's 'adjust' terminal to vary the voltage. The major differences occur on the negative rail, where we have an op-amp placed instead.

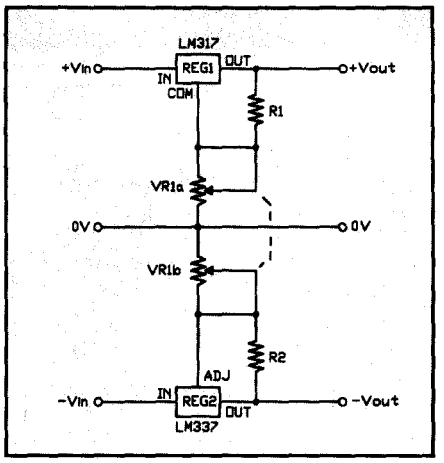


Fig.4: A simple dual-rail power supply, using a ganged pot for voltage control.

Now the LM3XX regulators work in a similar way, so closely in fact that if we put a particular voltage on the adjust terminal of the LM317 to get a voltage on the output, we can put that same voltage, opposite in sign, on an LM337 negative regulator and get the same output voltage — only opposite in polarity.

The job of the op-amp is to invert the DC signal from the adjust pin of REG1 and apply a proportional current to the adjust pin of REG2. The op-amp is run with dual supply rails, with the reference point for the non-inverting input being ground via a 22kΩ resistor.

Normally, you could remove the 22kΩ resistor and just connect the non-inverting input straight to ground, but to ensure higher accuracy the 22kΩ resistor is the closest E12 value to the parallel combination of the two 47kΩ resistor used in the negative feedback loop. This balances out the current drawn by the inverting and non-inverting inputs, and reduces the errors in the output voltage. Note too that the 1kΩ output resistor is connected inside the negative feedback loop. This effectively changes the output from a voltage source to a current source, to drive REG2 correctly. The end result is that since both adjust terminals match each other in voltage magnitude, so should the voltages from the regulator outputs — and that's what happens.

One of the things you need to be careful of when using the LM3XX series of regulators is that they have internal thermal shutdown. Which is a fancy way of saying that if the regulator gets too hot, it will automatically switch the output off.

This can occur when drawing high current, but also when drawing medium level currents at low output voltages. The power dissipated by one of these devices is not equal to the output voltage times the output current, but rather the *difference* between the input and output voltages of the regulator, times the output current.

For example, if the input voltage to the regulator is 30V and you're pulling 200mA at 5V from the output, the regulator power dissipation is not 5V x 0.2A but rather 25V x 0.2A, or five watts. Simple answer: make sure you have a suitable heatsink.

Audio filters

One area where op-amps have made circuit design much easier is in the area of analog filter design.

Briefly, the idea of a filter is to allow some frequencies to pass through unaffected, while blocking or changing others. They're used in CD players and computer sound cards as well as communications equipment.

The following circuit is often used in the latter of those fields. It allows those frequencies within the 'speech' bandwidth (300Hz to 3kHz) to pass through, while all other frequencies are blocked off. Basically, it's a filter which stops frequencies below one level and above another.

There are two ways to make a filter of this type. You can make what's called a *bandpass* filter, or you can make a high pass filter and a low pass filter, design them so that they overlap and then join them together. This may

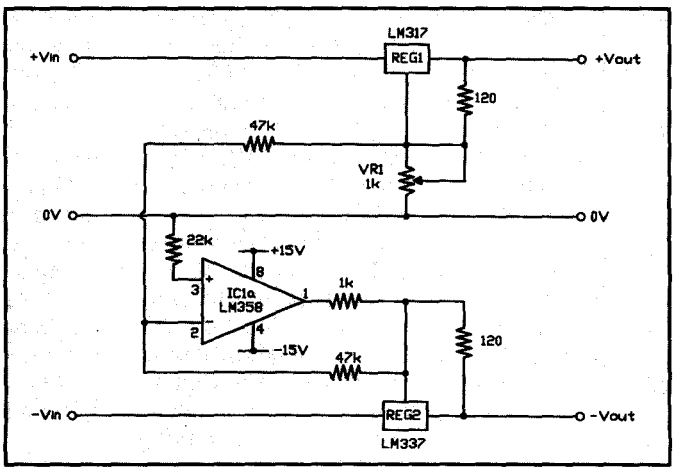


Fig.5: By using an op-amp as an inverter, our dual-rail supply can be varied with a single pot.

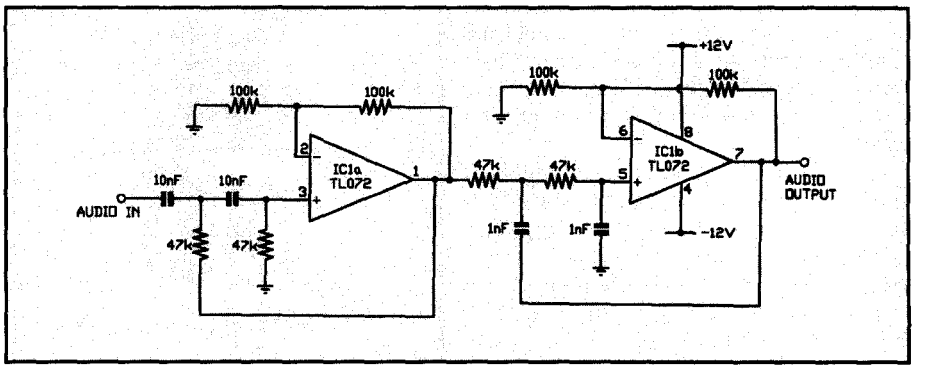


Fig.6: A simple audio bandpass filter, made up from a highpass filter around IC1a and a lowpass filter around IC1b.

seem overly complicated, but it's actually easier to do. The circuit for this is shown in Fig.6.

It uses two audio op-amps from a TL072 package, with IC1a forming the low pass filter and IC1b the high pass. The low pass filter is designed to allow all frequencies below 3kHz to pass, while the high pass filter is design to allow everything above 300Hz to pass through. By feeding the audio signal through both of these filters, we end up with the narrow band of frequencies we are after — namely 300Hz-3KHz.

Well, that's the theory anyway. In practice, some of the unwanted frequencies still get through, but they are attenuated in a regular and repeatable way.

Each filter has what's called a *cutoff* frequency, which is defined to be the point where the output amplitude is 3dB (decibels) below the input signal. Frequencies below this are attenuated at the rate of 6dB per octave per filter order. So what does *that* mean?

Well, 6dB means that the output is half the input voltage; an octave is the same as in musical terms, being the difference between any given frequency and double its value — i.e., 200Hz and 400Hz. The filter *order* refers to the type of audio filter used. The types used in this circuit are second order filters. So the attenuation is 2 x 6dB per octave, or 12dB per octave.

As a rough guide, the order number can be picked up by looking at how many capacitors are used in each section of the audio filter chain. In this case, each filter has two adjacent capacitors. This rule of thumb works in most cases, but you have to careful not to include power supply decoupling capacitors and the like.

Let's take an example of what we just learnt. Using the circuit in Fig.6, let's say the amplitude of the output with a 3kHz signal is 1V RMS — how much output signal is there when the frequency is 24kHz?

Firstly, we figure out how many octaves up 24kHz is from 3kHz. And the answer is... three (3kHz to 6kHz, to 12kHz and to 24kHz). One of the common mistakes is to simply divide the end frequency by the initial frequency. In that case, we would have had eight, which is wrong.

We know we have a three octave difference. Multiplying that by 12dB per octave gives us 36dB — BUT we said the output signal was at 3kHz. This is the 3dB-cutoff frequency for the high pass filter, so the signal there is already 3dB down. So we subtract that 3dB from 36dB, and we end up with 33dB.

In other words the 24kHz output signal would be 33dB down on the 3kHz signal of the same input amplitude, or around 22mV. To convert a ratio in voltage to dB, use the following formula:

$dB = 20 \times \log (V1/V2)$

where V1 is one voltage level, V2 is the other and log is the logarithm to base 10. You can find this easily on most scientific calculators. If you don't have one, it is a good investment that will only set you back around $25...

This circuit will work, but I have left out quite a number of components which would improve the overall performance, so that the main circuit elements can be seen clearly. We'll look at the complete version as well as some extra improvements next time.

OK, that's enough for this month. Remember that most of these circuits can withstand a goodly amount of experimentation, so don't be afraid to try changing a few things to see what happens. ❖

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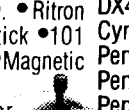

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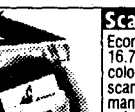

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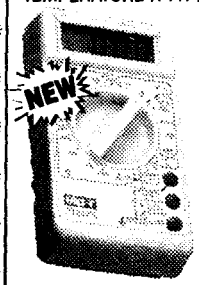

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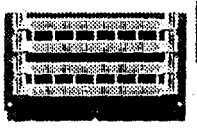

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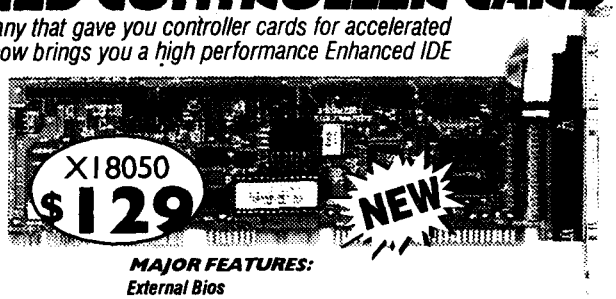

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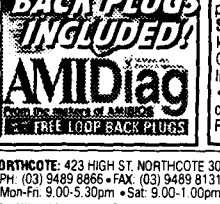

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When I Think Back...

by Neville Williams

Dr Ernest Benson: A brilliant career in electronics, academic and practical - 2

While the development of an electronic keyboard carillon might appear to have been a diversion for a committed academic, Ern Benson was no stranger to music. He was already planning construction of an ambitious electronic organ. Ahead lay visits to Woomera; research into hifi techniques, loudspeakers and large scale sound reinforcement systems, television technology and loudspeaker enclosures.

As an ongoing member of an Anglican church family, it was not surprising that Ern Benson should have an interest in organs, and in the possibility of installing one in his own home. As a young man, he'd taken lessons on the classical pipe organ at St Anne's (Ryde) and with his wife-to-be had enjoyed the sound of the State Theatre's Wurlitzer, played by Mannie Aarons.

At a humbler level, I went through a similar phase myself, as described earlier in this series: 'On Organs — Electronic and Otherwise', in *EA* for May 1989.

I made the point then that, musically desirable as they might be, a pipe instrument was neither affordable nor practical in the average home. A so-called 'American' organ or harmonium was smaller and cheaper, but offered a pale 'reedy' sound which was a poor substitute for the rich, 'round' tone of pipes.

In the mid 1930s, however, Laurens Hammond had patented an electronic organ using audio waveforms generated by spinning specially machined steel discs adjacent to magnets carrying a sensing coil (see Fig.1).

By driving 12 or more spindles at selected speeds with a synchronous motor, and fitting to each multiple discs with selected numbers of serrations or 'teeth', it was possible to generate a range of semitones and/or overtones appropriate for an organ. No less to the point, the system could produce waveforms and tones suggestive of pipes rather than reeds.

The production of a practical organ called for the provision of keyboards, waveform filters, drawbars or stop tabs, an 'expression' pedal and so on, to provide playing facilities. Add certain electronic extras such as vibrato/tremolo, synthetic reverberation, variable attack and sustain, and the end result could be a potentially gratifying do-it-yourself instrument, styled for home, church or entertainment venues.

DIY 'Hammonds'

Quite a few enthusiasts at the time considered the possibility of building their own Hammond derivative, but Ern Benson was one of a half dozen of so in the Sydney area who were really serious.

How they all fared I'm not sure, but Ern got his version going circa 1940, biased towards his devotional background. I remember visiting his home in company with the magazine's popular science writer, Calvin Walters. I don't recall much about the finer points of the instrument, mainly because Cal — a party pianist with a repertoire of singalong melodies — was so intrigued that he insisted on playing rather than talking!

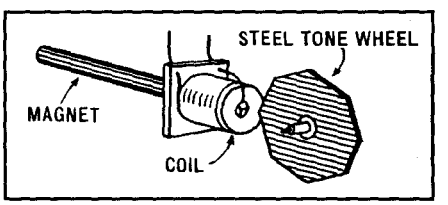


Fig.1: From the May 1989 issue, illustrating the principle of tone generation used in the Hammond electronic organ.

What I do remember is that Ern had installed the rotating mechanism in the basement, where it wouldn't be audible in the mechanical sense. A multi-wire cable carried the source tones up through the floor to the console in the lounge room. I gather that one of the other enthusiasts had crammed the 'machinery' into the organist's bench, boxed and padded to suppress possible rumble.

When I mentioned this to Mavis Benson, who had helped with the construction of the Benson version, she had a wifely reaction: "I used to call it the oily bit; not that it was all that bad, but to me, it didn't quite belong in a carpetted room!"

That the original Hammonds were not impeded by noise or oil, I can only attribute to the fact that they were devised by a clockmaker, rather than by hobbyists following machine shop practice.

Building a keyboard carillon and a Hammond style electronic organ epitomised the practical side of Ernest Benson's capabilities. But as a member of the AWA research staff, he was entrusted with a variety of other assignments, at the behest of top management or knotty problems facing the Production Team.

According to his wife, he made several trips to the rocket range in Woomera SA, to study the nature and effect of

vibration to which miniature valves were being subjected in that environment. This was before the development of solid-state technology. He also did round-the-world tours to study television, and later, sound reinforcement in operatic venues.

In later life, according to Neville Thiele, he was involved in the work of Standards Australia (SA) on electroacoustics, and had served as a chairman for the International Electrotechnical Committee (IEC). He was a Fellow of the IREE (Aust), the IEE and the IE (Aust); also a member of the Audio Engineering Society Inc., (AES) and Australian Acoustical Society (AAS).

The television era

After the war, when television loomed on the Australian horizon, it was evident that AWA would need to develop wide ranging expertise in the subject — from systems and standards to possible participation in TV programming and transmission; then on to the production and marketing of domestic receiving equipment. Over and above his overseas tour, Ern Benson was encouraged to work through the questions and appropriate responses likely to concern Australia.

This he was happy to do because religious bodies such as the C of E Synod, with which he was connected, were also seeking practical and social information about the new technology. But more about this later.

In the early 1950s AWA gave a tangible clue to company thinking by purchasing a Marconi 625-line 50fields/s camera and developing a prototype receiver to the British standards — obviously in preference to the American technology based on 525 lines and 60f/s.

In February 1954, the equipment was used to televise the arrival of Queen Elizabeth II at Sydney Cove, from Mrs Macquarie's Chair. For the occasion, the equipment was set up in an old Arnott's biscuit van, which had been repainted to serve as an 'OB' (outside broadcast) van.

The signal was conveyed by microwave radio link to a receiver at the Spastic Centre in Allambie Heights. Although a closed circuit system, the occasion was publicised as Australia's first outdoor TV telecast. AWA also provided the PA system for the occasion, using Benson-designed loudspeakers.

Later, using their own resources, AWA telecast the opening of the NSW Parliament to the nearby Sydney Hospital. Moving to Canberra, they also telecast the opening of the Federal Parliament, the Royal Ball and a Returned Soldier's Function.

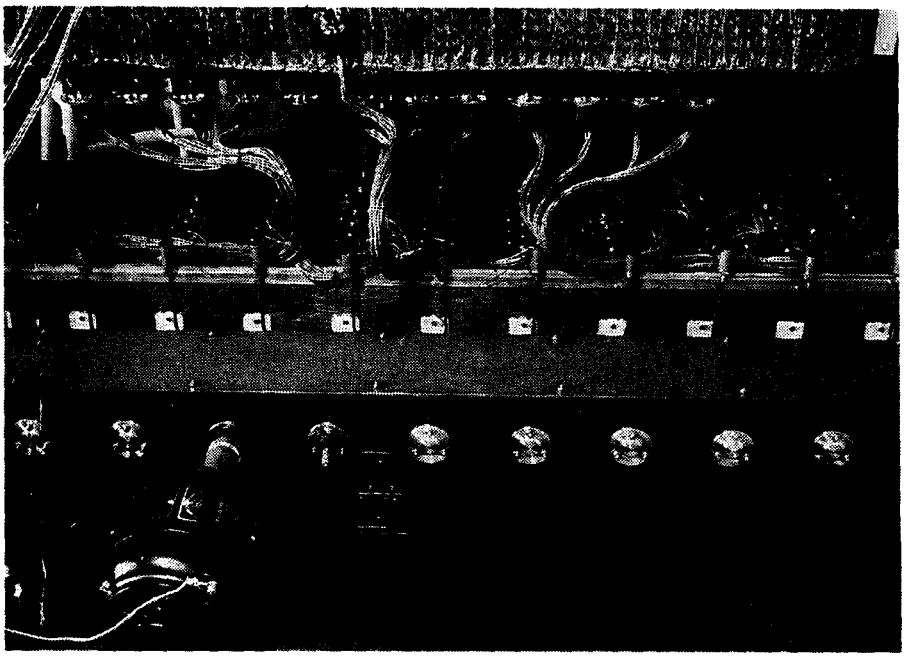


Fig.2: Dismantled following Ern's death, this is the only remaining photograph of his Hammond-style organ. The drive motor is in the foreground, with the housing (centre) containing the tone generators. Leads at the rear were anchored on terminal boards before passing to the console, drawbars and keyboard switching.

In both Sydney and Melbourne, lecture/demonstrations were arranged to show that television could be used to give medical students a more detailed view of operations in real time than was otherwise possible.

Adjusting to TV

Back to the social aspect: apart from the Anglican Synod, Ern Benson also had access to the World Council of Churches. Meetings and conferences, including one at the Central Methodist Mission (Sydney) were addressed on the general subject of churches rising to the challenge of the new technology. In January 1953, Ern took part in a discussion broadcast by 2CH with Rev Bill Hobbin of the Methodist Church and Ray Watson — later Judge Watson of the Family Law Court.

Fig.3: Graduation ceremony at Sydney University. Ernest Benson is on the right. With him is Cyril Murray, perhaps best known in the industry for his research into high quality audio power amplifiers.

Fig.4: A young J.E Benson receives the IREE N.W.V Hayes Award for 1952 from A.S. McDonald, Chief Engineer and Assistant Manager of AWA. The award, refereed by the British Institute of Radio Engineers, was for Benson's paper on the Colorimetric Principles of Colour Television.

In February 1953, a Royal Commission was set up to examine the social impact of television and the response of the churches. Ernest Benson spent several months in AWA Head Office, conferring with AWA Managing Director Sir Lionel Hooke on the company submission.

As the date approached for commencement of TV broadcasting in Australia (1956) the Sydney Division of the IREE decided that the time had come to schedule lectures on the subject for their members. Out of the blue, I received a letter inviting me to start the ball rolling with a lecture on, say, 'An Introduction to Television in Australia'.

To say that I was taken aback would be an understatement. I had limited first-hand experience in the subject. The TV sets I had built had been contrived mainly from oddments. For sure, I had delivered lectures and written tutorial articles on other subjects, but television — that was something else. The obvious man to have been invited was Ern Benson! Why me?

Perhaps, with the intensity of pre-TV industry politics, Ern Benson of AWA might have been seen as having a vested interest, and that would never do! Similarly anyone from Philips or, say, Jackson Industries or Admiral (horrors — *they* favoured 21" picture tubes!) Perhaps I had been invited as someone who was 'uncommitted'!

Anyway, I finally accepted — only to realise a couple of weeks beforehand that I simply didn't have enough time to prepare adequate notes and whiteboard illustrations.

Fortuitous strike!

That's when the unions inadvertently 'made my day'. They turned on a strike over an industrial matter, and in the critical week before the lecture I didn't have a job to go to!

So I prepared a lecture instead, resorting to the time-honoured approach of stating facts with which the audience was familiar and enlarging upon them to encompass the new material:

"You are all familiar with a superhet radio receiver. Well, a modern TV set is also a superhet with an RF stage, an oscillator and mixer valve and an IF amplifier. But there are differences..."

"A radio set has to convey sound information involving a modulation bandwidth of around 20kHz, which can be accommodated quite conveniently on a carrier of a few hundred kHz.

For television the bandwidth required to convey a sound moving picture is something over 5MHz and that, in turn, calls for a carrier of at least 50MHz or so. We therefore have to think in terms of a wide-band superhet designed to operate in the VHF and UHF bands..."

So it went on, for a mercifully patient standing room only audience. Afterwards the very first person to thank me for the presentation was Ern Benson! For him it would have been kindergarten stuff, but condescension was not part of his make-up.

Later on, a member of the IREE committee observed — on the side:

"You know who put you in?"

"No..."

"It was Ernie Benson!"

In fact, Ern emerged as a tower of strength to the industry in the months that followed, with his understanding of principles and components and the international standards affecting them. I provided an outline; Ern was one of these who filled in all the hard bits!

Colour television

In truth, Ern's reading and contacts had carried him way beyond monochrome technology to the inevitable next step: colour television — into which AWA's associate in the US, RCA, had sunk so much money as to endanger the very viability of the company. Realising that the technical fraternity in Australia knew very little about the physics of colour, Ern set about writing a paper on the subject for publication in the *Proceedings of the IRE (Aust).*

Published in July and August 1951, it was titled 'A Survey of the Methods and Colorimetric Principles of Colour Television'.

Singled out for special mention in Neville Thiele's tribute I, too, remember it as a landmark paper of value to anyone involved with colour — be they television buffs, photographers, printers, artists or painters.

At the time, the staff at *Radio, TV & Hobbies* knew little more about colour than what we had picked up from art lessons at school and/or casual reading. Paint boxes contained a typical range of hues which could be supplemented by mixing the various pigments. Red, blue and yellow were 'primary' colours, we had been told, because they could be mixed to produce intermediate hues. Blue and yellow, for example, could give a wide range of greens. The principles also applied with paint from the hardware store. End of lesson!

Funny about television: it used red, blue and *green* as the primary colours.

How the heck do they produce yellow out of those? Dunno!

Ern's paper set our thinking straight. Neville Thiele told me how he had commended it's author, confessing how he, personally would have found such a project sheer hard work. Said he: "But your paper flows so effortlessly, so smoothly..."

To which Ern replied: "You weren't there when I was writing it!"

As I remember the paper, Ern mapped out the colour spectrum to clarify optical wavelength and the relationship between the various hues.

He showed that when all are presented simultaneously to the eye as high intensity light, the visual sensation is white. At reduced intensity, the visual resultant diminishes through grey towards black. That's why a black and white film can be routinely reproduced in grey tones on a colour TV set.

How colours mix

A high level of one primary colour and a moderate level of the other two reduces the colour saturation so that, for example, a rose may be portrayed as pink rather than red — virtually red plus white.

Endless confusion has occurred because colour mixing can involve two distinctly different processes: subtraction and/or addition. Subtractive mixing occurs when filters, dyes or pigments have the effect of blocking particular colours. An artist or painter may choose a yellow pigment, without realising that it appears yellow because it has absorbed bluish light and is reflecting only the greenish and reddish rays of the incident white light.

Which brings the reader to the point that the true primary colours for subtractive mixing are not really yellow, red and blue. To be precise, they should be defined as yellow, magenta (a bluish-red) and cyan (a bluish green)

By contrast, *additive* mixing occurs when the component colours from an object or scene are presented to the viewer's eyes simultaneously. This occurs when viewing a scene or a colour image on a cinema or other such screen, or on a TV picture tube.

In the last-named, the picture is presented to the viewer by a myriad coloured lights, each a tiny fragment of luminous phosphor. Each makes its own separate contribution to the image, and although flashing at the rate of 25 times per second, are rendered virtually continuous and simultaneous by time lag of the phosphor and persistence of vision.

As an additive system, the appropriate primary colours are red, blue and green. For all practical purposes there is no other option for television; that's the way it works.

Against this background, it is possible for a picture tube manufacturer to plot the exact locations on a colour spectrum map where a given set of phosphors fall. By joining them up, a so-called colour triangle is produced enclosing the range of hues and saturation levels which can be reproduced on the screen.

So the paper went on, dominating two issues of the *Proc.IREE* and making special demands on the printers — who had to produce (for the reader) credible colour maps using the hybrid methodology that governs their craft.

I should mention here that, for his paper, Ern Benson received not only the plaudits of his Australian readers but also a commendation from the British IRE (Fig.4).

From sight to sound

For good measure during this median period, Ern Benson became progressively more involved in audio, particularly as it involved loudspeakers. We noticed it at the magazine because, in the early days, we used to talk loudspeakers to Max Cutts of Amplion (Aust).

Over the years, however, Amplion became involved with other products and we got into the habit of discussing Amplion loudspeakers with AWA — who had been supplying Amplion, anyway. When the conversation had to do with special applications or quality, the spokesman on the other end of the phone often turned out to be Arthur McClean — or Ern Benson.

In the 1940s, it was Ern Benson who, on behalf of AWA, became consultant engineer to do with the public address system in the Sydney Town Hall. As most readers will know, the main auditorium is quite huge, with a hard floor and hard-surfaced walls supporting a lofty arched ceiling, also acoustically hard.

Across the front is a large elevated orchestral stage, backed by tiered seating for a choir and an array of huge pipes for one of the world's great organs. Galleries around the sides and rear carry further seating. It is a grand building for grand occasions, but it is also a huge, cavernous echo chamber.

When I attended a function there in the 1930s, it had been fitted out with a public address system relying on the use of dozens of small loudspeakers bracketed to the pillars supporting the galleries. Still others covered the audience in the aforesaid galleries.

The result was utter chaos except for the fortunate few in the immediate range of any particular speaker. For the rest, a lone voice from the stage became a babble of amplified voices from all around the hall, randomly time-delayed by distance and muddied by a host of echoes.

Talking it over recently with Harry Freeman, AWA's one-time Commonwealth Manager for Audio Products, he gave as his impression that the system had been installed initially to support banquets and conferences, so

Fig.5: Five audio specialists in a 'talk fest' at the height of Ern Benson's acoustics career in the mid 1960s. Left to right are Paul Klipsch, Ernest Benson, Neville Thiele, Prof Bob Ashley and Dick Small. One overseas visitor later described Ern as 'Australia's Harry Olson'.

that a participant anywhere in the auditorium could hopefully make him/herself heard with the aid of roving microphones.

Improved system

The situation I described came about when the system was used to reinforce a performance on stage. In the 1950s AWA was accordingly asked to suggest a more appropriate installation, and Ern Benson was nominated as their consultant.

Ern's answer was to suggest tall column loudspeaker systems, slim enough and so styled that they could be mounted unobtrusively on either side of the stage and more or less camouflaged by the giant organ pipes.

By its very nature a well-positioned column system tends to project a flat wedge of sound over the audience, above the heads of patrons in the front rows and blanketing those towards the back. An important corollary is that minimal acoustic output is directed up into the ceiling, greatly reducing the resulting — and significantly delayed — echoes.

This, I gather, was the installation that I heard on the next visit, with enormously improved sound. The voice seemed to come from the on-stage performer(s), and the clutter of echoes had disappeared.

But, said Harry Freeman, there was more to the system that met the eye. Ernie had set up a huge column on each side of the stage, supported and camouflaged by the pipe structure and reaching literally from the stage floor to the ceiling. Each comprised a vertical stack of four-column loudspeaker systems, each using four special AWA 12" diameter drivers in Benson's pet twin chamber enclosure.

Each column/stack therefore involved sixteen 12" drivers, making 32 in all. Their role was purely to handle the bass.

The mid — or voice — frequencies were handled by two less pretentious columns, one positioned to either side of the organ console. As best Harry could recall, they used a mix of AWA oval drivers, 9x6" and 7x5", numbering about 42 altogether. Although partially camouflaged by the pipes, these would probably be the columns I had noticed from the audience.

For the high frequencies Ernie had installed a twin array of Goodmans Trebax horns, for the most part heard but not seen.

Fig.6: Louis Challis (right) and Ern Benson (left) were two of the four delegates who represented Australia at the Electrotechnical Commission (IEC) held in Sydney in July 1980.

Electrically tapered

In the course of this work, Ernie realised that there was an inherent conflict in using long columns to cover a wide frequency spectrum, because they would produce an increasingly shallow wedge towards the top end of the range.

His ultimate answer was to decouple the outer loudspeakers progressively from the drive with high frequency filters, so that the column became effectively shorter towards the upper limit of its allotted spectrum. Such columns were designated as 'electrically tapered'.

Harry said he could not remember much about the amplifiers at the Town Hall, except that channel splitting was done at the input end, with separate amplifiers feeding each bank of loudspeakers. They were 'bristling with 807 beam power tetrodes' and the system could be fed in either mono or stereo mode.

Ern had talked in terms of 'hundreds of watts' effective drive, and claimed that the sound pressure level available from the loudspeakers was marginally greater than from the organ itself at 'full bore'.

Harry Freeman said that by way of demonstration, they had recorded a

recital on the organ and could play it back through the above PA system. "With the reproduced sound emanating from among the pipes, it was amazing how little difference there was in the auditorium between the recording and the real thing".

All who heard it were vastly intrigued to hear the elderly organ apparently playing at full bore, with no one at the console!

One of the most fascinating experiences, however, was to play one of the early stereo demonstration records containing a steam train segment. The illusion of a full size steam locomotive traversing the Town Hall was nothing short of shattering... (According to Ern Benson's records, the Town Hall system was featured in the *IREE Proceedings* for May 1959)

Sydney Opera House

The work of the AWA/Benson team at the Town Hall made them a natural choice when the Sydney Opera House was under construction. Neville Thiele records that such was the performance of the sound system using Benson's electrically tapered column loudspeakers that the Benson/AWA team received a Duke of Edinburgh Prize for Industrial Design.

In October 1964, at the suggestion of Opera House designer Mr Utzon, Ernest went overseas to inspect typical amplifier systems. He visited Telefunken at Hanover, Prof Cremer at Munich and opera houses at Hanover, Hamburg, Nuremburg, Copenhagen and in American cities on his way home.

Subsquently, Benson/AWA were involved in updating the sound systems in large churches such as St Andrews (Anglican) and St Mary's (Roman Catholic) cathedrals in Sydney. In Canberra, Benson/AWA technology found its way into the new Parliament House.

Ernest Benson retired from AWA in March 1975 but he maintained his technical interests from his home, particularly in the area of loudspeaker technology and sound reinforcement in large buildings.

The Synergetic Audio Concepts *Newsletter* (Vol.16 No.1, 1988) reports a conference in Sydney and a group visit to the then-new National Acoustic Laboratory's Special Acoustic Test Facilities. One of those present expressed the wish to meet Mr Benson (then in retirement), and a visit to his home was arranged.

Mention is made of his unique papers on loudspeaker enclosures (three papers of 240 pages in all, originally published in the *AWA Technical Review*, 1968, 1971 and 1972), and the fact that he had been the examiner for Richard Small's PhD paper.

It goes on to say that he had a unique 5x5 Bessel Array in his laboratory, and also auditioned a pair of loudspeakers in his home "which demonstrated some of the best imaging we have been privileged to hear".

By arrangement, SynAudCon have reprinted the above mentioned papers in a single book for the American market, *Theory And Design of Loudspeaker Enclosures* by J.E. Benson DSc, ME, FIEE. An advance copy has been loaned to me by Mrs Benson, but sadly, Ernest did not live to see it.

In bringing this biography to a close, my mind turns to another incident dating back to the late 1950s which epitomises Ernie, the man whom I knew best in mid-career.

Although I didn't know it at the time, AWA was concerned at the sharp drop in radio sales following the introduction of television. They reasoned that there just might be a niche market for a radiogram that offered special features at an affordable price.

There had been reports in the press about stereo sound, but it seemed to have bogged down, especially in respect to disc records. As an interim measure, somebody came up with the idea of a radiogram that would split mono signals into separate bands and produce a more distributed sound: do-it-yourself stereo!

It was not a new idea, but AWA might — just might — be able to do it better and/or cheaper. So it was, I gather, that the (confidential) proposition ended up in Ernie's proverbial lap.

Meanwhile, our Editor, John Moyle, who had well informed overseas contacts, was doing his best to penetrate the hifi industry smokescreen: where was stereo really at?

Out of the blue, a sample stereo disc arrived in our office. A few days later, an advance sample of a new Cosmocord stereo crystal pickup reached us, via Max Cutts of Amplion. We set it up in John Moyle's lounge room in North Ryde and invited Max Cutts and Ern Benson — both of whom lived nearby — to an impromptu audition next evening. Far from being diffident, Ern was strangely keen to come.

It was an unpretentious crystal pickup compared to John's favourite Ortofon mono models but, to ears conditioned to mono, the stereo sound was sensational and there was no doubt that a new era had arrived.

Ern's reaction was to listen intently, then graciously take his leave with the words — as I remember them:

"Gentlemen, I thank you. What you have demonstrated tonight has just cancelled out plans that we have been pursuing over the last twelve months."

I heard the rest of the story next day, but his reaction that evening lingers as a measure of the restraint and self-discipline that characterised Ernest John Benson.

In her biographical notes, his wife concludes with Ern's transition from a kid in a bush Sunday School to a key figure in the outreach to the community of the Anglican Church and the World Council of Churches; thence on to the Inter-denominational Christian Television Society. Of his own personal philosophy she says:

"As a scientist be found himself an inhabitant of two worlds: the external world of nature, the world of matter — and the internal world of human consciousness — the world of the spirit. In the ultimate 'Matter is itself no longer an absolute reality but another form of energy: not merely matter in motion but waves of energy in space'." ❖

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. 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 responibility, enter into correspondence or provide further information.

Digital code lock

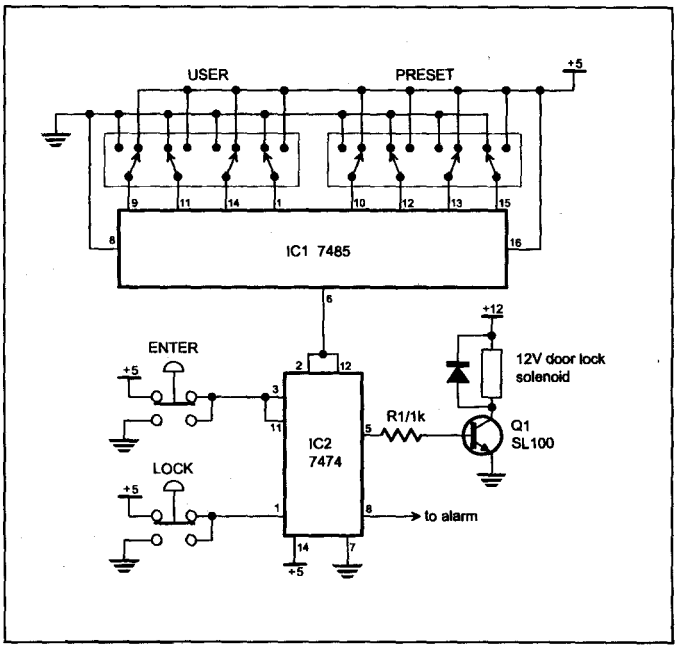
This circuit is a simple programmable digital combination lock. It has eight SPDT switches, four that determine the digital entry code (marked as PRESET) and four for the user. When the user code agrees with the presets, the output of IC1, a 4-bit magnitude comparator, switches high. Otherwise this output is low.

The output of IC1 is fed to the D inputs (pins 2 and 12) of IC2, a dual D flipflop. Pressing and releasing the ENTER button gives a high-low-high transition to the clock inputs of IC2. When the user and the preset codes are the same the D inputs are a logic 1, so pressing the ENTER button causes output Q1 (pin 5) to switch high, and output Q2 bar (pin 8) to remain low. As a result, Q1 turns on, operating the door lock solenoid.

To lock the door after opening it as just described, push the LOCK pushbutton. This gives a momentary low to the clear input of the flipflop operating the door lock solenoid, thereby resetting output Q1 to a low, turning off Q1 and the door lock solenoid.

If the ENTER pushbutton is pressed when the user and the preset codes differ, the low at the output of IC1 will leave output Q1 low, and cause output Q2-bar to become a logic 1. This signal can be used to trigger an alarm. The only way to reset this output is to enter the correct code, and press the ENTER button.

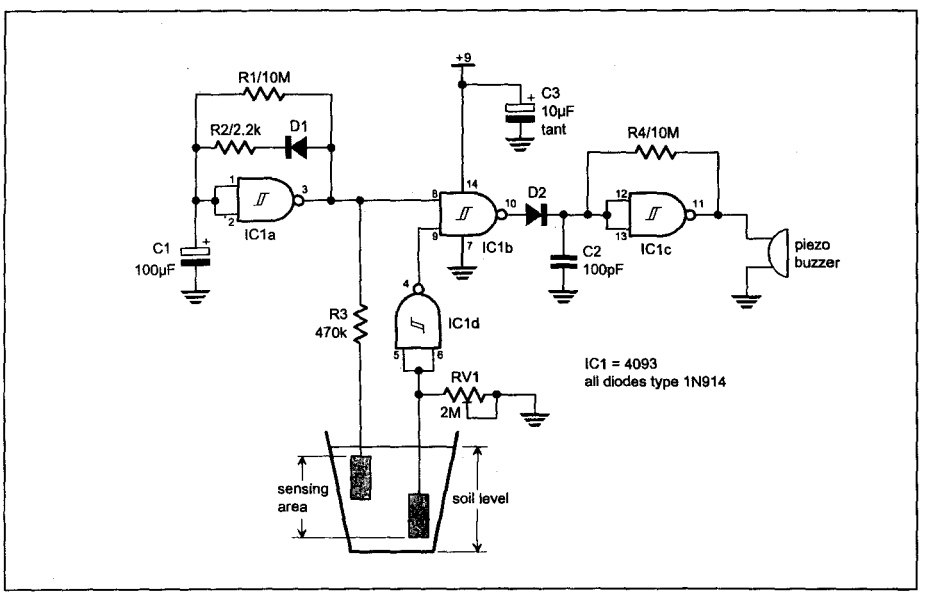
The four preset switches should be concealed, along with the rest of the circuitry. The ENTER, LOCK and code select switches are mounted near the door being controlled. There are 16 possible entry codes, but cascading another 7485 comparator will allow another four switches, increasing the number of codes to 256.



P.G. Priyesh,
Kerala, India. **$45**

Plant moisture monitor

This circuit sounds a buzzer when the soil in a pot plant is dry. IC1a is an oscillator that produces a half second positive pulse every three minutes. The pulse is fed to one input of IC1b and to a sensor plate buried in the pot plant, via R3. The timing of this pulse was chosen to have a negligible effect on the pot plant.



If the soil is moist, the pulse is conducted through the soil to the second sensor and then to the inputs of IC1d, which is wired as an inverter. Because of the inversion, the signal from IC1d to IC1b is out of phase with the signal at the other input of IC1b. This keeps the output of IC1b high, disabling the oscillator around IC1c.

If the soil is dry, the output of IC1b will change state with the input signal at pin 8, enabling the oscillator and sounding the buzzer. The sensitivity of the circuit is adjustable with RV1. The power consumption is low because of the use of high value resistors and CMOS gates. A new alkaline 9V battery should be able to power the circuit for up to 45 days.

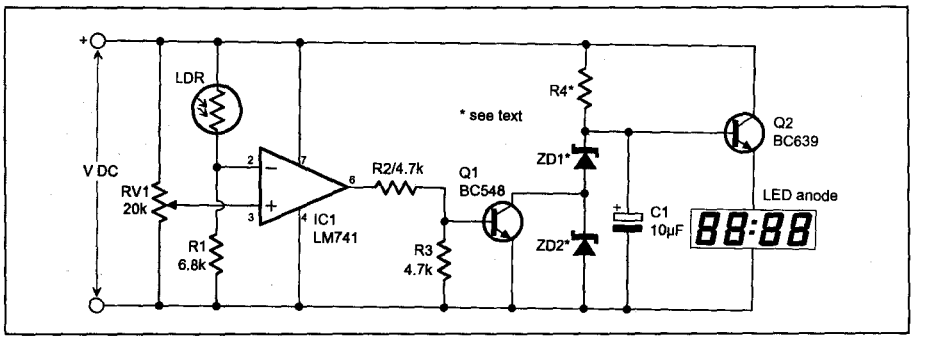
B. Avi,
Rose Bay, NSW **$45**

Clock auto dimmer

This circuit was designed to add an automatic dimming feature to a cheap LED clock. In daylight, the LDR has a low resistance and so holds the output of the op-amp low, holding Q1 off. When the light level falls, the resistance of the LDR increases, making the output of the op-amp go high, turning on Q1.

So in daylight, Q1 is off and the voltage drop across its base-emitter and clock display circuit equals the sum of the zener voltages of ZD1 and ZD2. This voltage should be high enough to turn Q2 on to almost saturation, giving maximum current through the display.

In the night, Q1 is on and the voltage drop across the base-emitter and clock display circuit equals the zener voltage of ZD1 only, as Q1 has shorted ZD2. As a result, the current through the display is reduced, and the display dims.



To determine the voltage of the zener diodes, connect a variable resistor (trimpot) in place of the two zeners, with the wiper of the pot connected to the collector of Q1. Adjust this pot to give the required operation, measure the voltage drops across both sections of the pot, and replace the pot with two zener diodes whose voltages equal the measured voltage drops. Using resistors to give the required voltage drops will work, but voltage fluctuations will cause the clock display to change brightness. This doesn't happen with zener diodes.

The value of R1 is chosen to give a current within the rating of the zener diodes. Capacitor C1 prevents sudden light changes affecting the circuit.

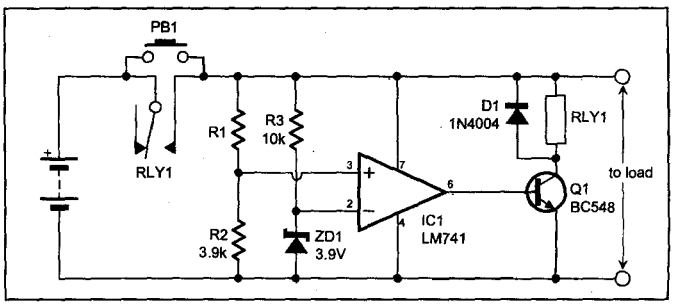
Andrew Chin,
Heidelberg, Vic. **$35**

NiCad auto cut-off

If you're a NiCad user, you probably know that if cells connected in series are discharged below 1.1V per cell, the cells with the higher voltage will reverse charge those with lower voltages. This can reduce the life of, or cause permanent damage to these cells. This circuit will prevent reverse charging and is connected between the battery pack and the load. The circuit monitors the battery voltage and shuts off the power to the load when the voltage reaches 1.1V per cell.

Pressing PB1 starts the circuit by shorting the N/O contacts of the relay. The voltage at the inverting input of the op-amp is 3.9V, as determined by ZD1. The voltage at the non-inverting input of the op-amp is determined by the voltage divider of R1 and R2, and is normally higher than the voltage at the inverting input. This makes the output of the op-amp high, turning on Q1 and the relay.

The relay's contacts are held closed and current flows through the contact to the load. When the battery voltage falls so the voltage at the non-inverting input of the op-amp is less than 3.9V, the op-amp output is low, de-energising



the relay, opening the contacts and shutting off power to the load. The value of R1 depends on the battery voltage, as shown in the table.

Don't use this circuit if the load draws a heavy current, as the battery voltage can dip below the cut-off voltage and false trigger the circuit.

Andrew Chin,
Heidelberg, Vic. **$35**

Voltage	R1
6	1.6k
7.2	2.7k
8.4	3.9k
9.6	4.7k
10.8	6.2k
12	7.3k

Low voltage monitor

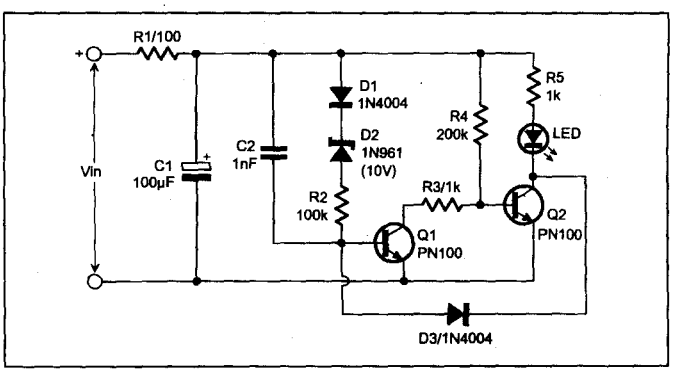
This circuit lights a LED when the voltage at its input is less than 12V, perhaps from a 12V battery. It uses transistors to keep the current consumption as low as possible and takes 170uA when the LED is off (input voltage greater than 12V) and around 9mA when the LED is on. In the circuit, the 12V threshold is created by the voltages dropped across D1, D2 (10V), R2 and the base-emitter junction of Q1. If a different threshold voltage is needed, change D2 or (for a higher voltage) add more diodes in series with D1.

When the input voltage to the circuit is 12V or more, Q1 is held on by the current flowing in the series circuit of D1, D2, R2 and its base-emitter. This allows all the current in R4 to flow through Q1, rather than the base-emitter of Q2, holding Q2 off. If the input voltage is less than 12V, Q1 will not conduct as much, depending on the input voltage, and a point is reached when Q2 starts to turn on.

The falling voltage at the collector of Q2 is fed to the base of Q1 through D3, which makes Q1 turn off more, helping Q2 turn on even more, and so on. This means the LED switches on quickly, rather than gradually turning on.

R1 and C1 increase the stability of the circuit when it is changing state, and C2 prevents it oscillating. The transistors can be any NPN type, such as BC547, 548, 549.

Juan Akkad,
Runcorn, Qld. **$40**



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With 130dB Siren and flashing red LEDs, you can use this as a body or bag alarm or use as a warning light for cycling or jogging. It's pull-pin activated and includes belt clip, strap and bulldog clip for attaching to bags.

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2-Hour Automatic AA NiCad Battery Charger

Charges 2 or 4 "AA" size Nickel Cadmium rechargeable batteries. Fully automatic operation with automatic discharge before charging, timed 2-hour fast charge, and pulse trickle charge.
Won't overcharge batteries and minimises "memory effect". LED status indication.
Reverse polarity protection.

Cat M-9500

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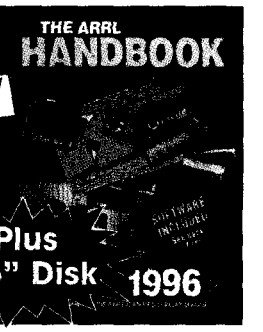
Handbook - ARRL *1996 Edition*



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Plus 3.5" Disk 1996

Transformer 4.5-0-4.5V

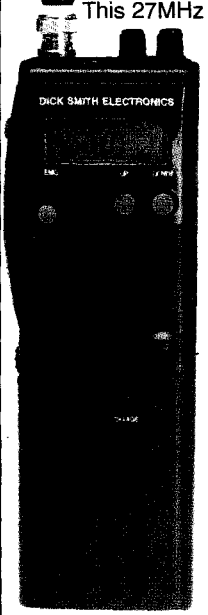
Secondary Output: 4.5 - 0 - 4.5V
Secondary Current: 150mA
Terminations: Flying Leads
Dimensions: 31(h) x 57(w) x 29(d)mm

Cat M-2842

$3.95

Affordable Ways To Keep In Touch

Dick Smith Electronics 40-Channel Hand-Held CB

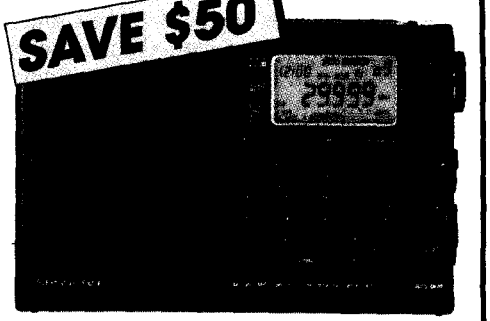


This 27MHz hand-held is compact and scans 40 channels. The backlit LCD screen shows received signal strength, battery condition, and relative transmitter output. Features auto battery save, high/low output power, emergency channel 9 switch and transmit and emergency channel indicators. Supplied with a BNC-style antenna, belt clip, and battery holder.
Uses 8 x "AA" alkaline or 10 x "AA" NiCad batteries.

Cat D-1121

$169.95

SAVE $50



45-Memory Shortwave Receiver

Catch your local AM/FM stations plus exciting shortwave listening from around the world! The ATS-808 provides continuous 150kHz to 30MHz coverage. Select wide or narrow filters on SW bands (as well as attenuation for extremely strong stations) to ensure optimum reception quality under differing conditions. Requires 6 x "AA" batteries or mains adaptor.

Cat D-2829

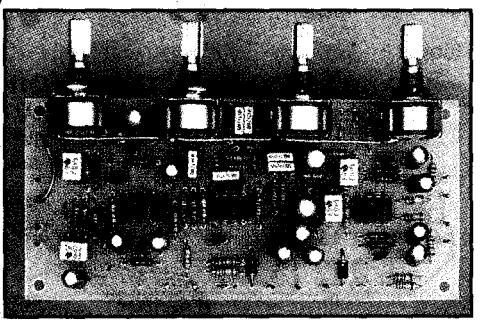
SANGEAN

$249

Kits Kits Kits

DISCOVERY SERIES

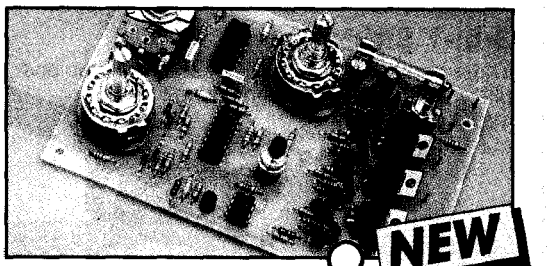
Stereo Pre-Amp



This compact high quality module makes it possible to upgrade your bare power amplifiers into a complete audio system by adding volume, bass, treble and balance controls. The circuit is stereo with an extra input to both channels that can be used for either multi-channel mixing or gain control applications. Supplied with components, hardware and silk-screened, solder masked PCB.

Cat K-2811

$34.50



Light Sequencer kit

A safe, simple light sequencer or light chaser for decorations, party lights, advertising signs. Four lamp outputs are provided each of which drives filament lamps or LED's up to 2Amps. 10 Selectable light sequences. Lamps can be connected in parallel, or series combination for a total channel output of 24 watts. Uses any battery or DC supply between 8V and 18V with a power rating at least equal to the total lamp load that is to be used. The kit comes complete with silk-screened solder-masked PCB, components and hardware items. (Plugpack or battery not included.)

Cat. K-2812

$36.50

PC Driven EGO Analyser

This low-cost analyser is designed to monitor your car's engine performance by examining the Exhaust Gas Oxygen sensor (EGO sensor) directly. Supplied with software, the results will be displayed on your PC. Project is complete with all components, hardware, PCB, pre-punched silk-screened front panel, case and software.

Cat K-4214

$49.95 EA Jan '96

ESR & Low OHM Meter

Measures the equivalent series resistance (ESR) in a capacitor which is often difficult to check with capacitance meters, also if you need to measure very low values of resistance, this project can save you lots of time and aggravation. Kit is supplied with all components, hardware, PCB, case and pre-punched silk-screened front panel.

Cat K-7204

$59.50

EA Jan '96

Woofer Stopper MkII

Now you can quieten your neighbours' dog . The Woofer Stopper MkII will give a blast of high intensity sound (Inaudible to humans) sufficient enough to deter the dog. This new, more powerful version of the Woofer Stopper is 12V battery operated and can drive a maximum of 4 super horn tweeters. The kit is supplied complete with all specified components, PCB, hardware, plastic case, front panel label and one super horn tweeter (Cat. C-2205). Extra speakers, 12V battery (Cat S-3317) or 12V DC plug Pack (Cat M-9670) are optional.

Cat. K-3033

SILICON CHIP Feb '96

$69.95

Experiment with TTL and CMOS logic IC's

Logic Trainer Kit

Great for designing simple circuits. Based around a central prototyping board it has a regulated +5V DC power supply connection nearby, which can be run directly to the proto-board as a supply for the ICs. +5V supply is current limited and therefore protected against short circuits. Features Logic Input Switches, Clock Pulse, Logic Status LEDs and an on-board Logic Probe. The kit comes complete with all components, hardware, PCB, slopping case, pre-punched silk screened front panel, protoboard, test lead and 9V DC plugpack.

Cat. K-3010

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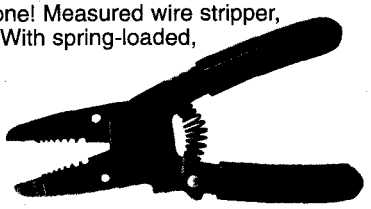

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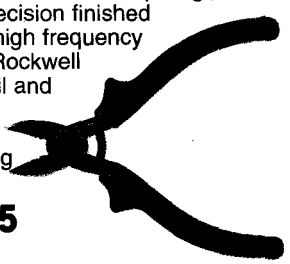

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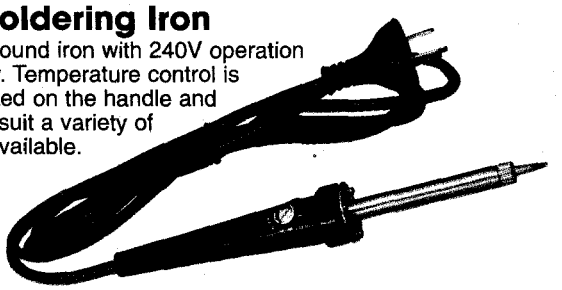

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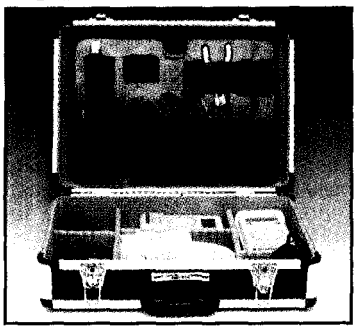

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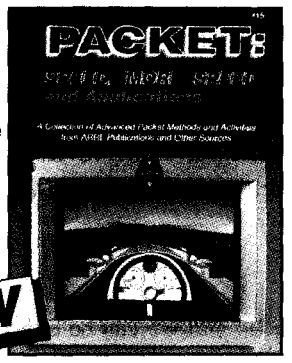

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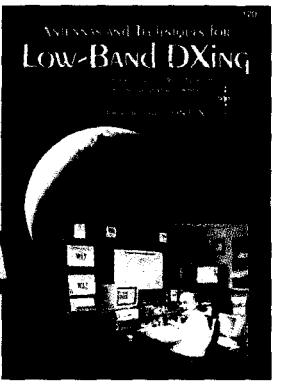

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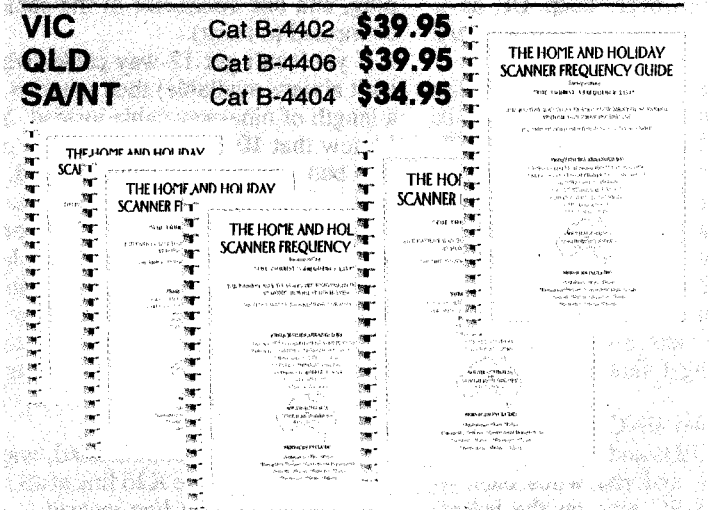

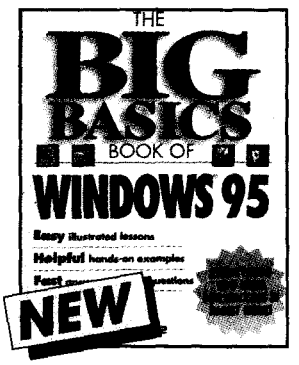

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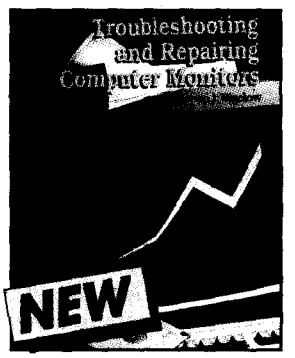

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Construction project:

PC-DRIVEN EGO SENSOR ANALYSER - 2

This month we look at the construction, testing and calibration of our new analyser, and we also go into some detail about 'driving' the software, which constitutes a major part of the project.

by GRAHAM CATTLEY

Having covered the more theoretical aspects of the analyser in last month's issue, as well as the circuit's operation, this month we'll go into the more practical details of actually building and using it. We'll also cover the operation of the software in some detail, as it constitutes perhaps the major part of the analyser itself.

We'll start where we left off last month, with the construction of the analyser. Begin by installing the 19 terminal pins in the PC board. These are often a tight fit, and you may find that a small pair of pliers will help persuade them to go in to the board.

The pins are followed by the five wire links. Use short lengths of tinned copper wire (resistor legs are ideal) and solder them flat against the board.

The rest of the passive components can now be installed in almost any order, except that you might start with the resistors — as it is easier to mount these without the other components getting in the way. (As these resistors are all 1% tolerance and it is often quite hard to read their values easily, we recommend that you use a multimeter to verify the value of each resistor before soldering it in.) Also note the polarisation of C6 and the diodes D1 to D4 — these should be installed as shown in the overlay diagram.

The 5V voltage regulator REG1, along with the ICs U1, U2 and U3 can now be soldered in place, noting that U1 faces away from the other two ICs with pin 1 toward the edge of the board. Observe the usual anti-static precautions when mounting the binary counter U3, as it is a CMOS device and therefore prone to static damage.

Optocouplers

U6 is a 6N138 high speed optocoupler and can be soldered straight onto the board, while U4 and U5 can be either a 6N138, or the somewhat slower (and cheaper) 4N28 optocoupler. While we used the faster 6N138s throughout in the prototype, there is no reason why you couldn't use 4N28s for U4 and U5, as these two devices will be running well below their top speed.

You must, however, keep U6 as a 6N138, as it needs to run at very high speeds.

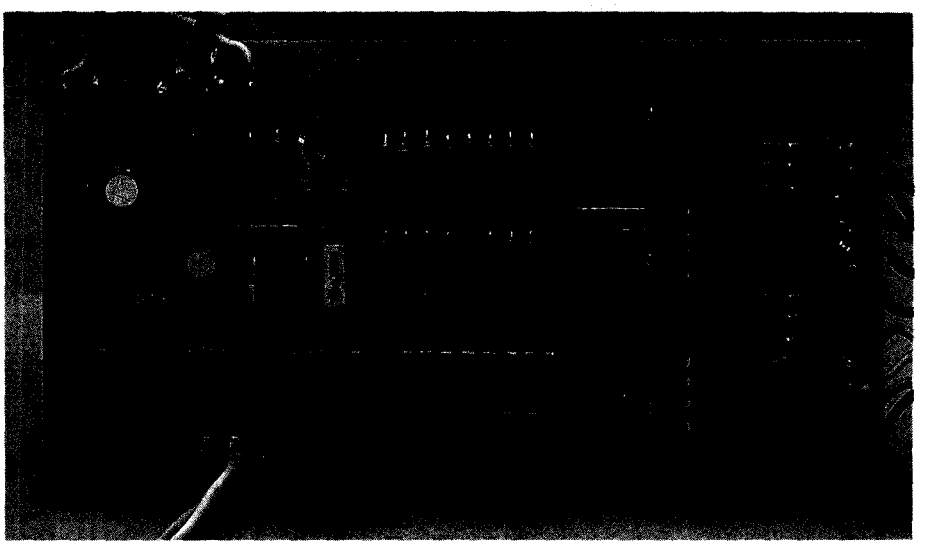
If you decide to go for the 4N28s for U4 and U5, you'll find that they have six legs as opposed to the eight of a 6N138. No problems though, just ensure that you mount each 4N28 with its pin 1 going to the square pin 1 pad on the PC board. This will leave a pair of unused holes at the end of the IC (where pins 4 and 5 of the larger IC would normally go), which are left disconnected — a quick look at Fig.1 should help clear up any problems.

Mount the two BNC sockets, power and sampling LEDs and on/off switch in the front panel, and run wires back to their respective PC pins on the board. Use shielded cable between the input and output pins and the BNC sockets, and perhaps some heatshrink on the LEDs to prevent shorts.

Wire up the DB25 plug using a two metre length of 12-core data cable to connect to pins 2 to 9, 11 and 18-25 (pins 18-25 are shorted together at the plug, and one conductor of the cable is connected to them).

If you can't get 12-way cable (which isn't always available) then you can use a length of nine-way cable instead. Yes, I know that 10 lines are needed to connect between the plug and the board, but there are a couple of ways (if you are devious enough) to get around this problem. The first is to use the uninsulated drain line that wraps around the cable's foil shield for the ground line (pins 18-25). While this will work, we don't recommend it because the line, having no insulation, is intrinsically weak and prone to breaking.

The other, and recommended, way is to not use the pin 5 to R26 line at all, and use it as the ground line instead — the



other two lines will provide more than enough drive for the optocoupler. (Of course you could always use a length of 12-way ribbon cable instead, and avoid the whole problem...)

Thread the cable through a suitably sized hole in one end of the box, and connect each line to its respective pin on the board — and use a large nylon zip tie as a cable clamp to prevent the cable from being pulled out of the box.

Calibration

To calibrate the analyser, you will need a digital multimeter and a BNC lead terminated in a pair of crocodile clips. Set the meter to read around 10 volts DC and connect it via the lead to the 'Test voltage output' socket on the front of the analyser.

Having connected a 9V battery to the analyser and switched it on, plug the analyser's data cable in to your computer's parallel port. (Yes, thanks to the optocoupler isolation you can 'hot-plug' the analyser, without fear of damaging either the analyser or the computer.)

Load and run the calibration program EGO-CAL.EXE, and you will be presented with a screen containing a number of buttons. Using a mouse, click on the button labeled 'Generate 0.00 volts' and the meter should indicate a reading of (sure enough) 0.00 volts.

Now click on the 'Generate 1.25 volts' button; the meter will now read somewhere between 0.8 and 1.8 volts. Using a small screwdriver, adjust the trimpot VR1 (labeled 'CAL' on the circuit diagram) so that the meter gives a reading of 1.25 volts.

If none of the buttons seem to have any effect on the analyser, then the most likely reason will be that the parallel port address on your computer differs from that indicated in the lower left panel on the screen. To change this, simply click in the list on the correct port address for your computer, and the new address will appear in the panel.

Once you are happy that the analyser is operating correctly and calibrated in terms of full-scale output, you can move on to the linearity calibration stage. This isn't as bad as it sounds; all that happens is that the EGO-CAL software produces a calibration file that is used whenever the analyser is to generate a voltage. By using this file as a lookup table, the analyser can compensate for any errors due to component tolerance.

To start this procedure, click on the 'Cal. file' button and the screen will change, giving a 'voltage generated' and 'meter reading' display, both of which

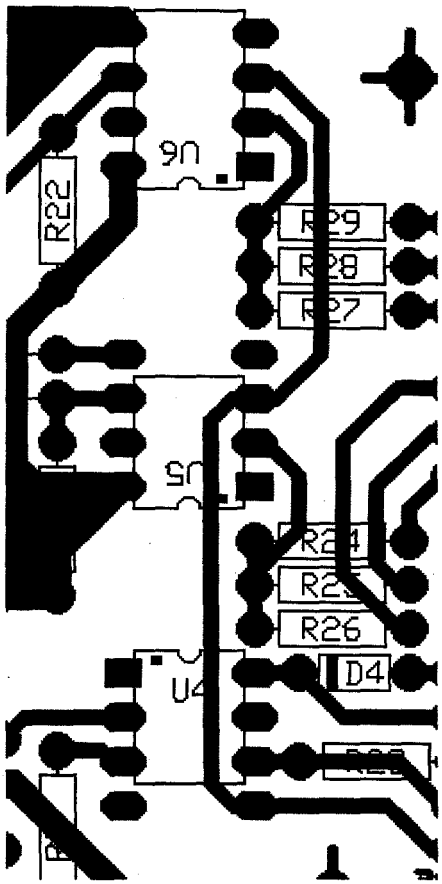
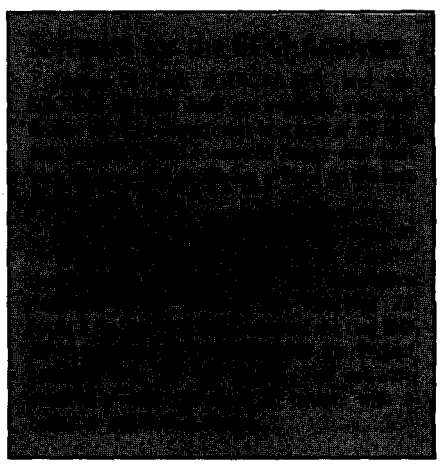


Fig.1: This diagram shows how to install two 4N28s instead of 6N128s for U4 and U5. Just make sure that pin 1 goes into the square pad as usual and you'll be alright.

will be set to 0.00 volts. With any luck the analyser will also be producing 0.00 volts — but if the meter begs to differ, click in the small 'meter reading' box, and enter the voltage indicated by the meter.

Now click on the 'Increment voltage' button, and the voltage generated box will change to show 0.05 volts. Again, enter the actual meter reading and click on the increment button. Keep doing this



a total of 25 times, as the output voltage slowly rises in 50mV steps to the maximum voltage of 1.25 volts.

Once the output voltage reaches 1.25 volts, the increment button becomes inactive, and you can now click on the 'Display graph' button. This graph shows the analyser's actual output voltage (in white) compared with an ideal output (in blue). It is important to have a look at this graph, as it shows just how linear the analyser's output is.

These two plots should track quite closely, but if they *don't*, it's going to be for one of two reasons. The first is a misplaced resistor in U3's resistor ladder network; this will produce a trace with a bit of a 'wobble' to it. (The frequency of the wobble can give you a fair indication of the resistor causing the problem — the lower the frequency, the closer to the highest order output the errant resistor will be.)

The other kind of difference is when the two traces don't run in parallel; This will be because the analyser's maximum output voltage has not been set to 1.25 volts. Of course this is easy to fix: just click on the 1.25 volt button again and tweak RV1 to bring the output to exactly 1.25 volts. A quick run through the self calibrate procedure should then ensure that the analyser is ready for use.

Configuration

Before you can start monitoring, you will need to configure the EGO.EXE software to run on your system. Click on the 'Setup' button and a screen will be displayed allowing you to set such parameters as Parallel Port Address, Screen Mode and Speed Correction Value.

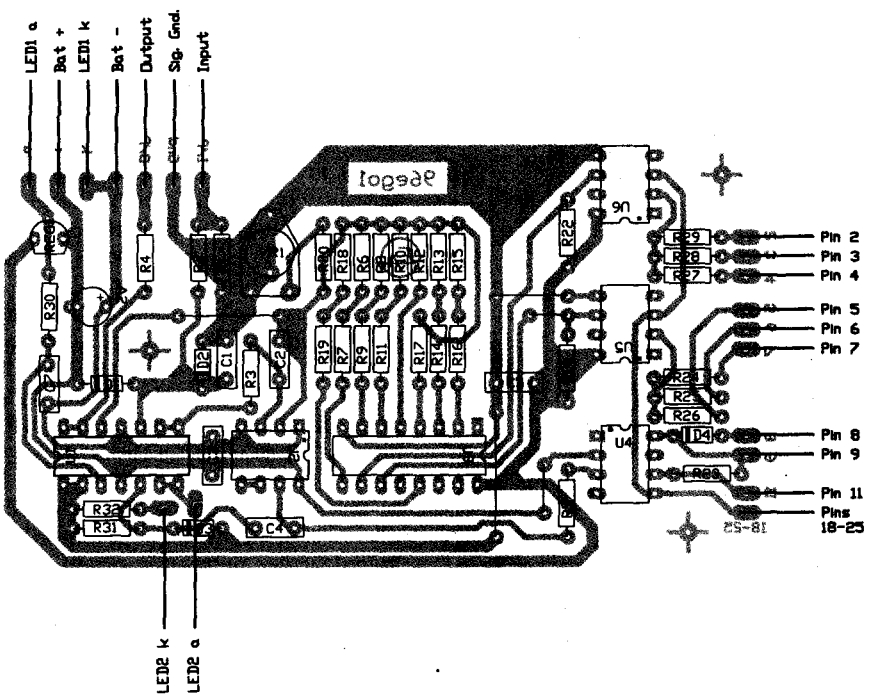
The port address is set, as in the EGO-CAL program, by clicking on it from the list of common addresses, or entered directly into the box below the list.

The Speed Correction Value control allows you to compensate for different speed computers. Because the analyser's maximum sample rate is determined by the speed of the optocoupler U6 and not the computer, we must ensure that the sampling section of the software runs at a specific speed on any computer regardless of that computer's clock frequency. What this boils down to is that the sampling part of the software needs to run more slowly on faster computers.

This is achieved by inserting a delay in the sampling routine, with a delay length set by the value selected in the Speed Correction box.

Obviously you want to sample at the highest rate, so this value should be set as low as possible. Clicking on the

PC-Driven EGO Sensor Analyser - 2



Here's the component overlay diagram showing the placement of all components. Note that U4 is installed facing the other two optocouplers.

'Calculate' button will cause the computer to run a simple routine designed to calculate a suitable correction value for your computer. And while this value is not always spot on, it at least gives you a starting place, and you can work down from there.

"Hmm", you're no doubt thinking, "How do I know if I have the right value?", Well, simply click on 'OK' to get back to the main menu, and then select 'Read sensor'. (It doesn't matter whether or not the analyser is plugged into the computer, at this stage.) Select 'Continuous monitoring', and you should then see a thin yellow trace being drawn across the bottom of the trace window. Once this has finished, you will see at the bottom of the screen the label 'Time:' and this should be indicating around 13 seconds. If it is more than this, go back to the Setup menu and reduce the Speed Correction value and try again.

Once the analyser is up and running, you can come back to this setting and trim it, to squeeze that little bit more speed out of the analyser (we found that a Speed Correction value of 11.6 was the fastest we could go on our 33MHz 386DX, while the 66MHz 486 laptop on last month's cover needed a minimum value of 65).

The only other setting on the Setup menu is the 'Screen mode' control. This lets you select Mono (black and white), or colour for the main Read sensor display screen — useful if you are using a mono computer monitor, and also for taking screen shots as they will reproduce more clearly on a black and white printer.

Once you have everything set up correctly, clicking on the 'Save config' button will save all settings to a configuration file (EGO.CFG) on disk, so that they can be loaded in automatically each time the EGO software is run.

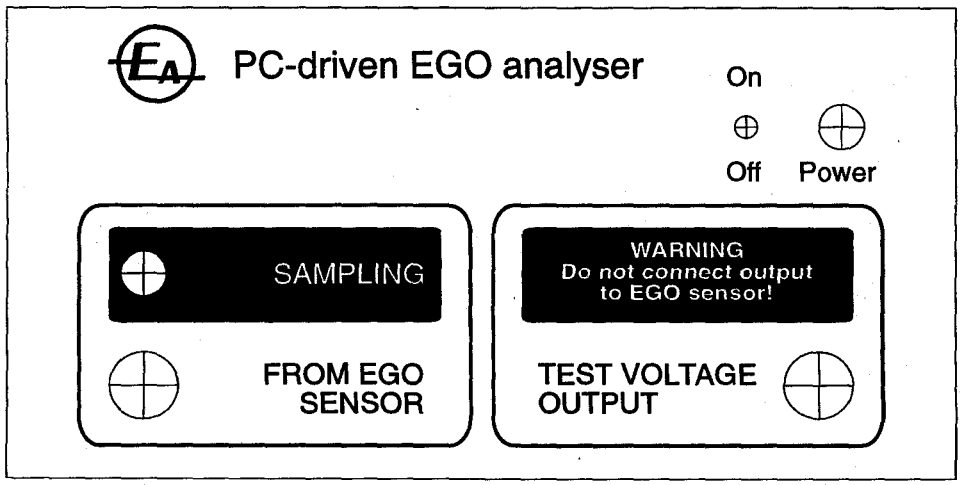
EGO sensor

To use the analyser, it needs to be connected to the exhaust gas oxygen sensor (also known as the lambda sensor) located in the engine's exhaust manifold. Lift the bonnet of the car and have a bit of a look around the engine. The EGO sensor itself looks much like a longish metal 'spark plug', and will have one or three leads emanating from the end.

To connect the analyser you will need to splice into the sensor's output lead; with a single leaded sensor this doesn't present much of a problem, but if you are presented with a three-lead sensor, you will have to determine which of them is the signal out, and which is the power for the heater.

Why would the sensor have a heater? Well, the temperature of the sensor affects both its switching time and output voltage, and in some engines the sensor is maintained at the correct temperature with a small (15 watt) electric heating element.

This brings the sensor up to its operating temperature of around 350 to 850°C. (Other engines rely on the exhaust gas itself to heat the sensor — these are the single lead types, as they don't use a heater.)



The full sized front panel artwork. This can be used both for making your own front panel, and as a template for drilling the box lid.

To determine the power lines of a three leaded sensor, you will have to measure the voltage on each of the leads with the engine running. You will find that one will have +12V on it, while another will be sitting permanently at chassis potential. The other lead will be the sensor's output, and this is the one that you will need to tap into.

If you are only going to be using the analyser on a temporary basis, a simple way to do this is to push an ordinary dressmaker's pin through the sensor's lead, making sure that it passes straight through the centre of the conductor. You can now attach the BNC lead used earlier in the calibration procedure to hook onto the pin, with the ground clip connected to the body of the sensor or as close as possible, to reduce electrical noise.

Of course if you have one of the commercial wire-tapping probes then you can use that. But no matter which system you use, be sure to cover the hole in the wire's insulation afterwards with a piece of waterproof tape or similar, to prevent water ingress and possible corrosion of the internal conductor.

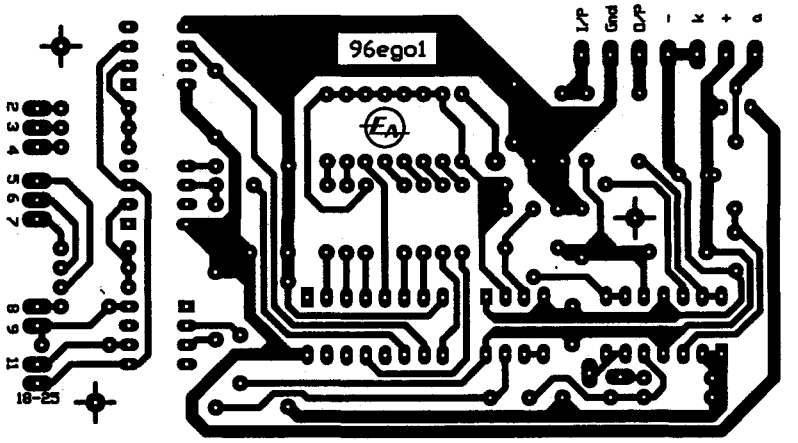
Getting back to the analyser, connect the other end of the BNC cable to the 'From EGO sensor' socket on the front panel, and plug the analyser's data cable into the computer's parallel port. Now switch on the analyser and the computer, and run the EGO.EXE software, whereupon you should be presented with the program's main menu.

Click on 'Read sensor' and 'Continuous monitoring', and start the car's engine. As the engine warms up, you will notice that the yellow trace slowly rises, reflecting the gradual increase in voltage from the sensor.

As the sensor's output voltage approaches the stoichiometric point of 0.45 volts (shown as a dashed blue line on the screen), the engine's control unit (ECU) switches the sensor into its automatic fuel injection control loop, and as a result the air/fuel ratio of the engine changes. You can see this change as a slight drop in the sensor voltage, followed by a larger rise in voltage as the ECU compensates.

This process repeats as the ECU tries to maintain a reasonable AFR. As the amplitude of the waveform will increase as the sensor is heats up to its operating temperature, it may take a couple of minutes before you get any meaningful readings from the analyser.

Now go back to the main menu by Pressing [ESC], and select 'Read sensor' again, this time selecting 'Sample and hold'. In this mode the analyser will read in the waveform, show the readings and then freeze the display to let you examine the waveform. A red dotted line indicating the sensor's average voltage will be visible, and this line should be as close as possible to the dashed blue line representing the stoichiometric point.



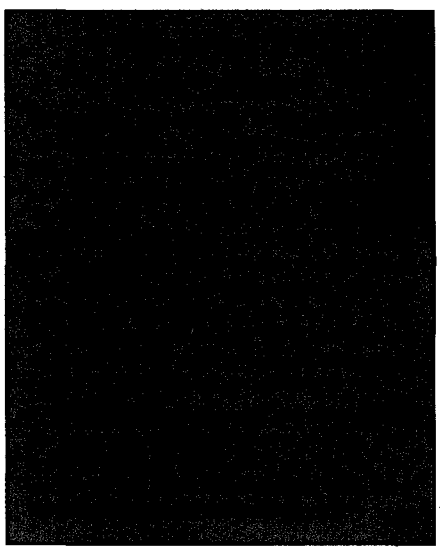
And finally, above is the full sized pattern for the PCB for use if you make your own boards.

As the ECU can only respond to changes *after* they occur and are detected by the EGO sensor, all the ECU can do is to try and keep the *average* AFR at stoichiometry, with the alternate excursions into rich and lean fuel mixtures averaging out.

The closer the average voltage is to the stoichiometric voltage, therefore, the closer the engine is running to its ideal AFR.

Saving waveforms

You'll notice that while in the sample and hold mode, the message 'Press [space] to save' is displayed on the left hand side of the display. If you press the space bar, the screen will clear and a file requester will pop up, letting you enter the file name to save the waveform under.



Of course you can load in a waveform that was saved earlier — just click on the 'Files' button in the main menu. Here you get a different file requester, and you can select any previously saved waveform by clicking on it and then clicking on the 'Display' button. The file will automatically load and then display the selected waveform.

One other option that we haven't covered yet is 'Autosave', available just before entering the read sensor mode. If you select Autosave, every complete waveform will be saved automatically without the need for any button pushing on the part of the user.

This mode is particularly useful if you are on your own, as you can set the analyser running and have it monitor the engine continuously while you are inside the car.

More useful readings can be taken while the car is in motion, as then the readings will reflect the car's performance on the road.

This can be somewhat inconvenient with a desktop computer to say the least, but if you have a laptop computer (or can borrow one), there is no reason why you can't run a line in from the EGO sensor and set the system up on the passenger seat.

You can then monitor the engine's performance as the car climbs hills, accelerates, decelerates etc. (Do this in Autosave mode **only**. You can view the

Continued on page 87

Construction project:

SMART DUAL 12V BATTERY CONTROLLER - 2

Here's the second and final article describing our new auxiliary battery manager for four-wheel drive vehicles, cars and boats. This month we'll show you how to assemble, test and install the unit, plus how the circuit can be modified to suit particular installations.

by ROB EVANS

As you can see from the photos of the prototype, the battery manager is housed in a relatively small diecast aluminium box which thanks to its solid metal construction, provides excellent protection for the unit's circuitry and acts as a convenient heatsink for the BUK456-60A MOSFETs. To provide even further protection from the harsh environment in a vehicle's engine bay we have also elected to use one of the sealed-type diecast boxes, which are now available from a number of major part suppliers.

The box itself measures just 115 x 65 x 30mm, and is equipped with a lid locating slot and groove system with a matching rubber gasket, plus box-mounting holes that are outside the sealed area — very neat indeed. To save a couple of dollars though, you could use one of the more common diecast boxes, and just pay more attention to the sealing process. Note that this would need to be the slightly larger 122 x 67 x 41mm variation.

As shown in the internal photo, the circuitry is held on two small circuit boards; the control PCB (coded 96bm1a and measuring 85 x 40mm) which is mounted onto the box lid, and the MOSFET drive board (96bm1b, 53 x 40mm) which is installed in the bottom of the box and mounts directly onto the MOSFET leads. The two boards are interconnected by a couple of light-duty leads, and the main high current connections pass directly from the MOSFET tabs and drive PCB to two binding posts on the side of the box. The remaining two leads pass through one end of the box and ultimately connect to the vehicle's ignition circuit (IGN) and the auxiliary battery's positive terminal (AUX MON).

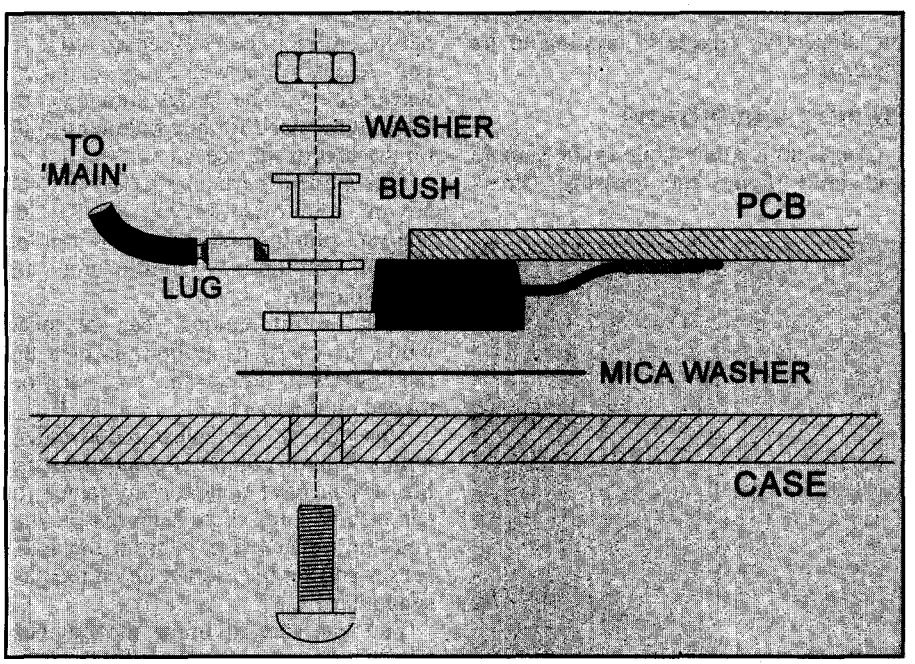


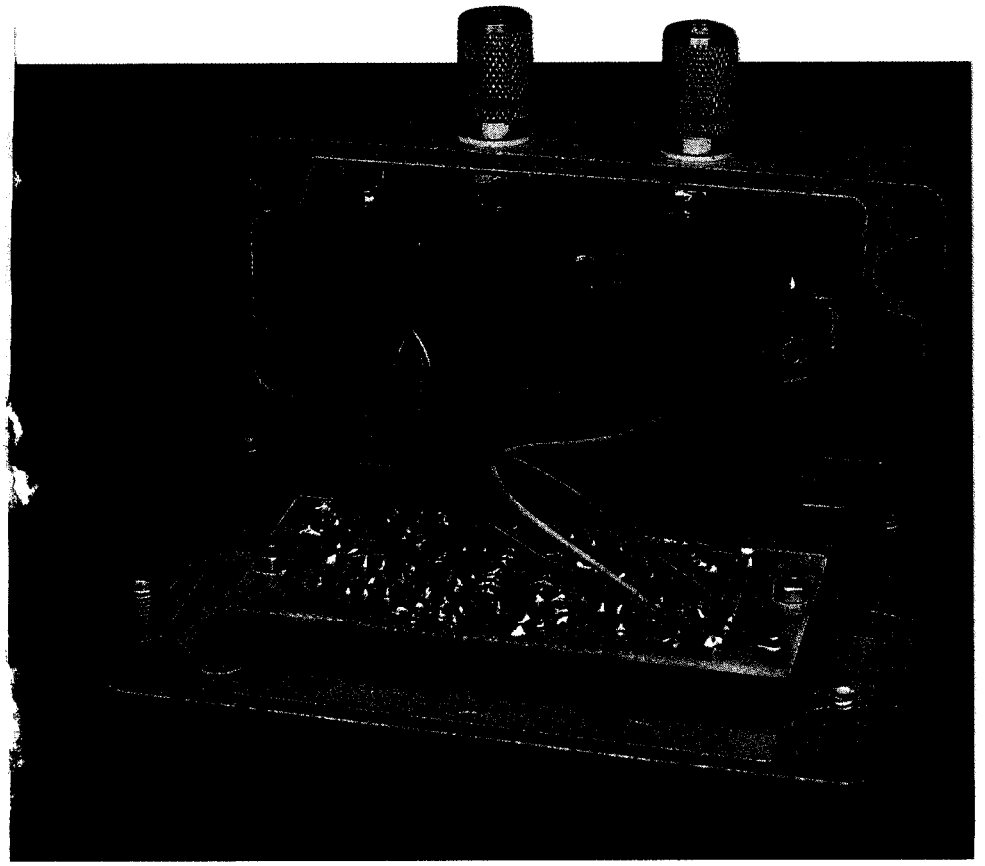
Fig.2: The MOSFET drive PCB is mounted in the bottom of the case via the MOSFET tabs, as shown here. Note that the insulating bush should be the correct type for the BUK-456 MOSFETs, and the AUX terminal lead (not shown) must safely clear the bottom of the case.

Begin the construction process by drilling the appropriate holes in the box, using the front panel artwork and photo of the prototype as a guide. The front panel holes for the three LEDs should be a neat fit to aid the sealing process, and the mounting screw holes should accurately line up with those on the PCB itself.

Also note that the two mounting holes in the bottom of the case must ultimately line up with the MOSFET tab holes, so these should be drilled *after* you have completely assembled the MOSFET drive PCB, which can then be used as a template. If these were drilled first, you would then need to go though the awkward process of soldering the MOSFETs in exactly the right place on the PCB.

When it comes to completing the PCB assemblies, refer to the overlay diagrams at all times and take particular care with the orientation of polarised components (semiconductors and tantalum capacitors) in the usual way. As there is not a great deal of room inside the box, install all components hard down on the PCB surface and if your tantalum capacitors appear unusually large, try mounting them in a horizontal rather than vertical position.

Note that the control PCB's three LEDs should not be soldered in place until the board has been mounted onto the front panel, so that they can first be aligned to the panel surface. Just slide the LEDs into their matching holes with the correct orientation (see overlay dia-



gram), then when the board has been mounted as close as possible to the panel's inner surface (we used 8mm spacers), manoeuvre the LEDs through the front panel holes to the correct position and solder the legs in place. If you are keen to have the box fully sealed, try adding a smear of silicone sealant around each LED body before the assembly is fitted to the front panel.

The MOSFET control PCB should also be completed with attention paid to the orientation and flush mounting of components, and the parts shown on the additional *bottom* overlay diagram (including the MOSFETs) installed last. Here, the MOSFETs should first have their leads trimmed as shown while using the PCB pattern as a guide, then soldered in place with the plastic body hard against the PCB and the tab hole centres close to 66mm apart (see Fig.2). Note that the MOSFET's centre lead is not needed, since the drain connection to the 'AUX' terminal post is made at MOSFET's metal mounting/heatsink tab.

Once you are happy with the MOSFET connections, the short lengths of tinned copper wire can be soldered in place and the heavy-duty AUX output lead connected, as shown in the bottom overlay diagram. Note that the tinned copper wire lengths are needed to bolster the current carrying capacity of the PCB track between the MOSFET source pins, and both these and the output lead should be soldered in place with a iron that has sufficient heat capacity for the job.

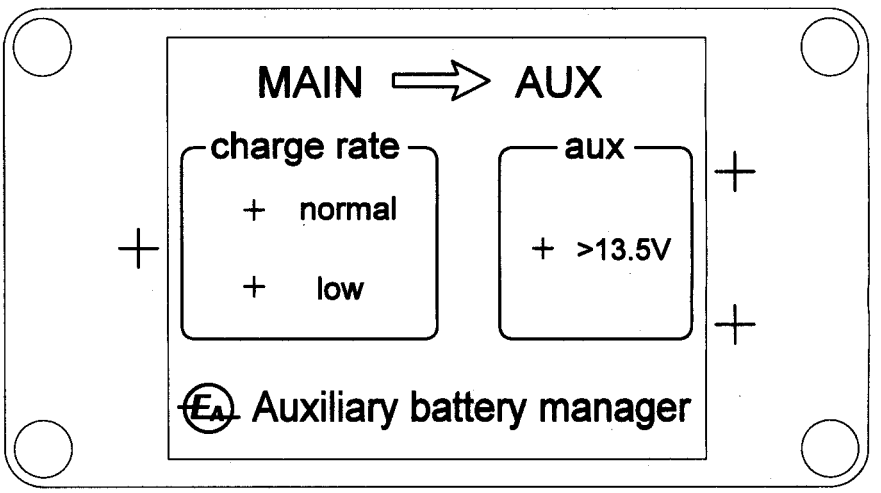
Then using the completed MOSFET drive board as a template, mark and drill the MOSFET mounting holes in the bottom of the box, as mentioned above, and remove any sharp ridges around the holes with an oversize drill bit and emery paper.

Next, fit the two light-duty leads to the board as shown in the top overlay diagram, and mount the complete assembly into the bottom of the case via the MOSFET mounting tabs, while using Fig.2 as a guide. Note that the bush shown in the diagram is an insulating type (and must fit the BUK456-60A MOSFET), and is used to electrically isolate the connecting lug and MOSFET tab from the mounting bolt.

Follow this assembly diagram closely, and make sure that the AUX terminal lead is well insulated from the metal case; the solder lugs make a reliable connection to the MOSFET tabs (clean the lug first); and finally, that both sides of the the mica insulating washer are well coated with heatsink compound. When the assembly is bolted in place, use a multimeter to check that the MAIN connecting lugs and MOSFET tabs are indeed isolated from the case.

With both PCBs now installed, the final wiring can be completed as shown on the overlay diagrams and photo of the prototype. The insulated binding posts used for the AUX and MAIN connections should be locked firmly in place so that they will not become loose during normal use, and the three internal heavy-duty leads soldered to the connecting tags as shown. Use a robust soldering iron as mentioned before, and don't forget to include the control PCB's 'main' supply lead at the MAIN terminal post lug — that's three leads in all.

As a final point, note that we've connected the control PCB's earth reference lead to an unused PCB-mounting platform inside the case. While this is a convenient arrangement, it *does* assume that the battery manager's box is reliably



Front panel artwork and panel drilling guide for the battery manager, reproduced here at full size. Note that the actual artwork is contained within the square outline, while the three mounting holes for the control PCB are outside this area.

Smart Dual 12V Battery Controller - 2

connected to the vehicle chassis, and the lead will otherwise need to be connected at some chassis point outside the box.

Testing

If you have access to a bench power supply with a variable output voltage, we would highly recommend that you test the battery manager's main functions, before it's installed in the vehicle. This is quite a straightforward process and in the end, is much easier than removing the battery manager from the vehicle should there be a construction problem.

To prepare the battery manager for testing, rotate the low current adjustment trimpot (RV1) fully counterclockwise, connect the flying AUX MON lead to the AUX binding post, and attach the flying IGN lead to the MAIN binding post.

Then adjust the bench supply voltage to significantly less than 13.5V (say 12V) and connect its output leads to the MAIN and ground points on the battery manager, while taking care with the polarity — the MAIN terminal is positive. With the above connections in place, the power supply is effectively taking the place of a vehicle's MAIN battery.

Next, advance the supply voltage until the manager's 'normal charge' and 'aux >13.5V' LEDs illuminate, indicating that the main and auxiliary battery comparators are performing correctly. You can double check this, and note the power supply voltage as the LEDs activate — as you would expect, it should be close to 13.5V..

Now disconnect or turn off the supply and connect a shorting lead (or very low value 5W resistor) between the AUX terminal and the negative supply lead (ground); then reapply the supply voltage and note the action of the manager's LEDs. If the input voltage (at MAIN) is above 13.5V, now only the 'low current' LED should illuminate since the AUX terminal is at a low voltage (0V), and the unit is therefore in the low charge current mode.

This is also indicated by a degree of illumination in the 3mm LEDs (LED1 to LED3) on the MOSFET drive PCB, by the way.

If you have a convenient means of measuring the 'low' current flowing from the AUX terminal to ground, you should find that since RV1 is at its minimum setting there is less than 100mA flowing. You can then adjust RV1 for an output reading of say 2.5 amps — if your supply can cope. This is a suitable setting for the final installation.

Note however that the combination of the MOSFETs and the low current drive circuitry is not an *ideal* constant current source, and the low current charge into the auxiliary battery (rather than a short circuit) will probably be less than this initial figure. Ideally then, RV1 should be readjusted after the battery manager has been installed.

Installation

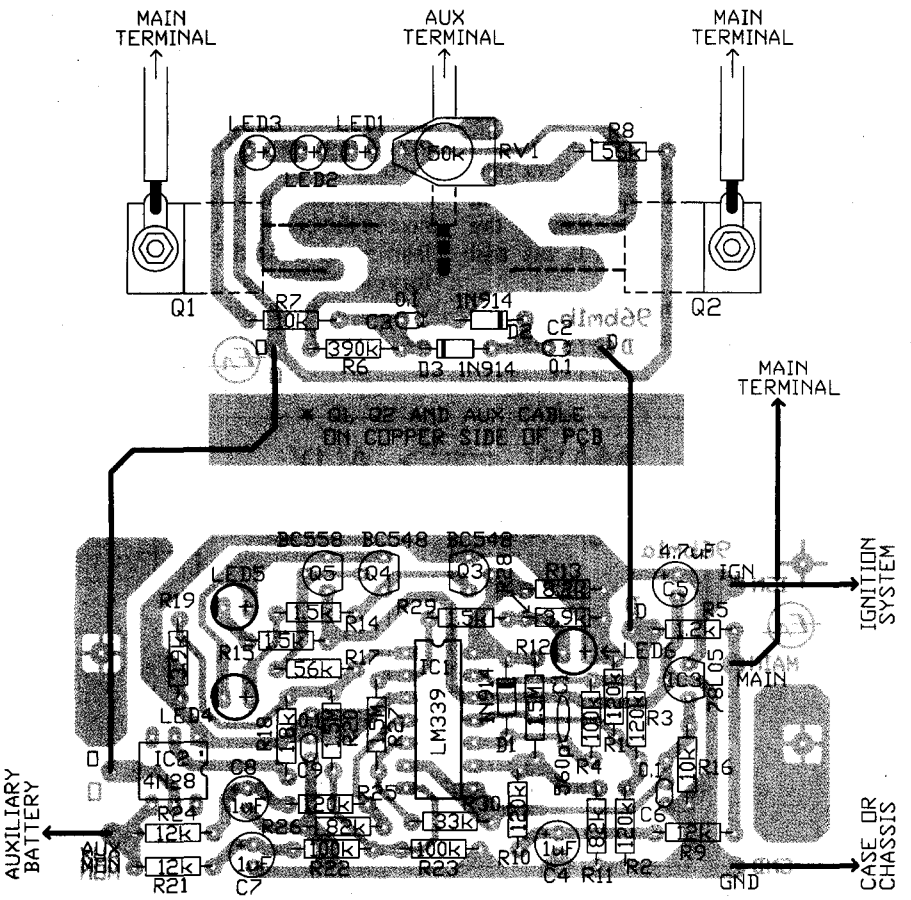
The battery manager can be installed in a vehicle without the need to modify any existing wiring, and should therefore be a fairly straightforward process. Assuming that you have already fitted the vehicle with a suitable auxiliary battery, the first step is to find a convenient mounting position for the battery manager itself.

If at all possible, this should be on a solid metal section of the engine bay to provide a reliable ground connection and assist the heatsinking capability of the box — well away from the engine exhaust system and its associated high temperatures, and in a position where you can easily view the unit's status LEDs.

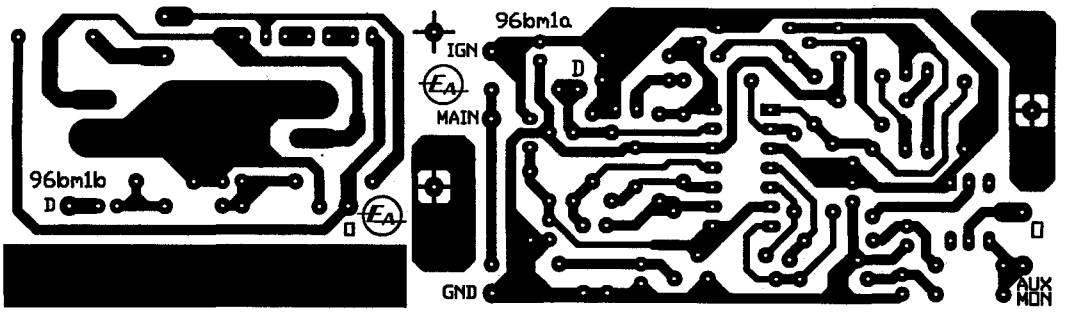
Fortunately the battery manager is quite a compact unit though, and you shouldn't have too much trouble in finding a suitable mounting spot. With any luck this will be near the top of the engine bay and close to the main battery, which helps to make the wiring both direct and accessible.

Once the unit is firmly mounted in the vehicle, the next step is to select a suitable gauge and length of hookup wire for the auxiliary battery connection. Note that this lead should have a small but significant resistance (RL on the schematic), and therefore provide a degree of current limiting protection for both the auxiliary battery and the battery manager itself.

In practice the actual resistance of the lead is not overly critical, and just



Closely follow this component side overlay diagram when assembling the battery manager. The MOSFETs and AUX terminal lead are soldered to the copper side of the MOSFET drive PCB (95bm1b).



The actual size PCB artwork for both battery manager boards.

about any medium to heavy duty hookup wire can be used for the job. The resistance of *very* heavy duty cable such as that used in conventional battery leads and starting jumper cables is just too low however, and the type typically found in a vehicle's wiring loom is of the right order.

To select the appropriate length of cable for the job, first use a generous length (say, two or three metres) to temporarily connect a 12V accessory (say, a spotlight, pump or refrigerator) to the main battery. Next, use a multimeter to measure both the current flowing into the accessory load and the voltage drop across the temporary lead, then calculate the lead's resistance from these figures.

So if a two metre test lead drops 550mV when passing 3.5A to the load for example, a one metre length would be suitable (0.08 ohms) for the battery manager. If this is too short for your particular installation — say, the auxiliary battery is located on the opposite side of the engine bay — then you will need to consider a more robust cable that offers a lower inherent resistance.

And by the way, beware of using a standard multimeter on its low ohms range to directly measure the cable resistance, as the reading can be quite inaccurate when dealing with very low resistance values.

The actual resistance of the cable is not *too* critical as mentioned earlier, but keep in mind that a very low value will offer little current limiting protection and a high figure may overly restrict the charge current when the battery manager is in its 'normal' charge mode. If possible, the final cable resistance (RL) should be somewhere between about 0.05 and 0.2 ohms.

Once you are happy with the auxiliary battery hookup lead, all of the manager's cables can be connected to the vehicle wiring using suitable connectors. Note that the MAIN terminal to main battery lead should be formed with heavy-duty cable, and the AUX MON lead can be attached (with tape or cable ties) to the auxiliary battery cable, then run as a pair.

Problems & changes

We should emphasize at this point that like other automotive monitoring and management systems, the battery manager will only perform correctly if the vehicle's electrical system itself is up to scratch.

If there are significant voltage losses in the wiring loom or the batteries are in poor condition, the voltage levels around the system will tend to significantly shift in response to changing load conditions, thereby 'confusing' any voltage monitoring circuits.

In the case of the battery manager, this may cause the unit to rapidly drop in and out of the normal charge mode or misbehave in some other way. Rather than go into a longwinded discussion about this type of problem here though, it perhaps sufficient to say that you should confirm that the vehicle's electrical system is in good order *before* pulling the battery manager apart to see what's wrong!

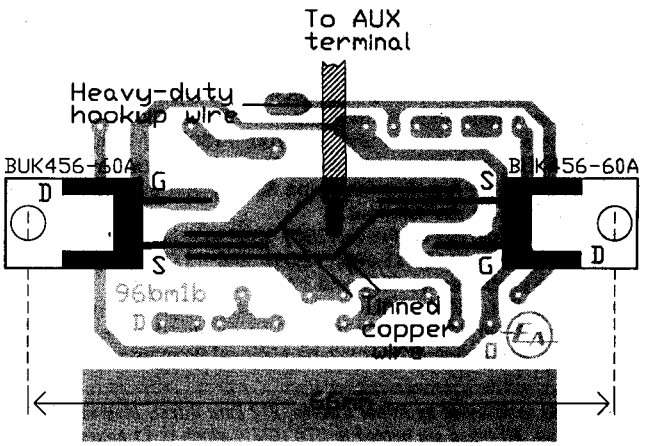
In general though, the status indicator LEDs will provide valuable feedback as to the state of the vehicle's charging circuit, and how the unit itself is performing. By using the circuit description given last month to familiarise yourself with how the manager actually works, you should be able to track down most problems in short order.

If the battery manager is performing correctly but doesn't quite suit your needs however, there are a couple of relatively simple changes that can be made. For a start, you might like to have the three status indicator LEDs mounted on the vehicle's dashboard or instrument panel, so that you can monitor the manager's activity — and therefore the state of both batteries — while you are travelling.

The LEDs can be remotely mounted in this way by passing five additional wires through the battery manager's case and on to the vehicle's interior, where the LEDs are then wired in the normal way. The additional exit hole and vacant LED mounting holes (if any) would then need to sealed against moisture and dust intrusion.

If you need to charge a potentially 'flat' auxiliary battery in the shortest amount of time — as is the case when you're camping in one location for a number of days, and you must start the vehicle's engine with the sole purpose of charging the batteries — the battery manager can also be modified so that its high charging level is enabled at a *lower* auxiliary battery voltage, or in effect, *earlier* in the charge cycle. This will reduce the overall charge time for conventional heavy-duty (rather than deep-cycle) auxiliary batteries in particular, which can otherwise take a considerable time to come up the 10.5V

Continued on page 72



The overlay diagram for the copper side of the MOSFET drive PCB. These parts should be soldered in place last, just before the final assembly stage.

SHORTWAVE LISTENING

with **Arthur Cushen, MBE**

Red Cross returns to shortwave

The International Committee of the Red Cross, which uses the facilities of Swiss Radio International, is to renew its broadcasting after a break of several months. It will be heard every fourth week in several transmissions.

The Red Cross Broadcasting Services began during the final days of World War II, when the ICRC broadcast lists of prisoners awaiting repatriation, and of people who were missing because of the war. In 1948 the ICRC was granted the use of a frequency in time of major crisis, and then began test transmissions. Today, RCBS has its own recording studio in Geneva and its programmes are broadcast by Swiss Radio International in English, French, German and Spanish. The International Committee of the Red Cross, which gave rise to the International Red Cross and Red Crescent Movement, is an independent humanitarian institution.

National Red Cross or Red Crescent Societies exist in nearly all countries of the world. The Societies' work includes emergency relief, health services and social assistance, first aid courses, training of nurses, blood services and youth programmes.

The broadcasts can be heard every four weeks and in this area at 0800 - 0805UTC on 9885, 12,070 and 13,635kHz, with a further broadcast at 1245 - 1250 on 9885, 11,640 and 13,635kHz. Broadcasts are scheduled for Friday January 19, February 16 and March 15, 1996.

GMT now Universal Time

It is over 100 years since Greenwich Mean Time was introduced and world time zones were created. In recent years, following the introduction of atomic clocks, the title has been changed to UTC or Universal Time Co-ordinated. The fact that UTC is not a good expression of the new time calculation has meant the Voice of America have announced that they plan to introduce their time announcements as Universal Time, which is part of the present time reference.

The present world time zones which are known as GMT or in more recent times UTC, were the idea of Sir Sanford Fleming, a Canadian who worked with vigour on the idea of better time reference throughout the world. Sir Sanford Fleming went to Canada from his native Scotland in 1845, began work as a surveyor in Ontario and then worked with the Canadian Railways. In 1851 he designed Canada's first postage stamp and also planned the city of Toronto. He progressed to become chief engineer in the Inter-colonial Railways in 1863, at the same time as he was chief engineer of the Canadian Pacific Railway.

As trains and ships got faster, Fleming realised that it was essential to have a more satisfactory time system. Each railway station had its own local time. In the province of Ontario there were four different times, recognised in four cities within six hundred kilometres of one another. In the United States over 100 time standards were in use.

It was in 1876 that Fleming proposed a time system of 24 hourly time zones around the world. Because of confusion between AM and PM, Fleming saw the value of a 24 hour clock which deleted this type of time reference.

In 1884, twenty five nations met in Washington to adopt his concept of Standard Time. At that conference 22 countries agreed, one country voted 'no' and two abstained.

Because the conference was international and there was a certain amount of national pride, many were reluctant to adopt Greenwich as the prime meridian. But already some 60% of charts used by the world's shipping were based on the Greenwich meridian and it seemed natural that it was adopted.

This meant that every clock throughout the world used the same minute and second indication, with the only difference being the hour.

Band expansion

The mediumwave AM band in this area covers 531 - 1602kHz, but in the United States it has been extended to 1700kHz.

Already test transmissions have been carried out at a recent National Association of Broadcasters Conference on 1660kHz using the call sign of KUSA, and they have been heard by listeners in Australia and New Zealand. The FCC has received applications from 687 stations to use part of the extended band and WGDM in Elizabeth, New Jersey has received permission to use the expanded band.

The station will use 10kW during day time and 1kW at night on 1660kHz.

The extended part of the band has already been used in Australia, for stations operating as Radio for the Print Handicapped, and using frequencies of 1620 and 1629kHz. But in recent months, all of these stations have been moved back inside the usual AM band.

However, another station has appeared on this part of the band on 1620kHz, and this is 2AM, Sydney, using 400W and operating 24 hours a day with tourist information and Australian country music.

In New Zealand these Tourist Information stations use the FM band. English is on the low end at 88.2MHz, while at the top end German is on 100.4MHz and Japanese on 100.8MHz. ❖

AROUND THE WORLD

BELGIUM: Radio Vlaanderen International has English to Australia at 0730 - 0800 on 9920kHz and to Africa at 1000 - 1030 on 15,510 and 17,595kHz.

DENMARK: Radio Denmark has introduced English for the last 15 minutes of their broadcast once a month, on the first Sunday of the month. Radio Denmark uses Radio Norway's transmitters for the last 30 minutes of each hour, so the schedule to this area is: 0700, 7180kHz; 1300, 7315kHz; 1900, 6195kHz; and 2200, 6170kHz. These frequencies from Norway carry English for the first 30 minutes on Sunday and the broadcast from Denmark follows on the half hour.

FRANCE: RFI, Paris, lists English as 1200 - 1300 to Asia on 7140kHz; 1400 - 1500 to Asia on 7110, 11,600, 12,030 and 15,045kHz. Their other broadcasts in English are at 1600 and 1700.

INDONESIA: RRI, Jakarta is heard with national programme on 9680kHz with news at 1000, 1100 and 1200UTC proceeded by the Song of the Coconut Isle, and announcing as Jakarta National Programme. The Foreign Service is now heard on 9525kHz with English at 0800 - 0900 then Malay, 1100 in Thai. At 1130 an English announcement indicates the following programme is in Japanese, also heard to Europe; Spanish 1730; German 1800; French 1900; English 2000; sign off 2100. On Saturday Mailbag is heard at 0830 and 0030.

ISRAEL: IBA is heard in Hebrew, at 0400 - 0700 on the new frequency of 7500kHz, noted in parallel with 9390kHz. It has music up to 0530, then time signal, news for 10 minutes, then music programme.

ITALY: RAI, Rome, in English 2200 - 2225 is well received on 9710kHz and 11,815kHz in this area. Also in Italian 1000 - 1100 on 11,925kHz, via BBC Singapore.

SUDAN: Sudan National Broadcasting Corporation (PO Box 572, Omdurman), is heard with English news at 1800 and then several feature programmes and news highlights at 1855.

Sign off with Sailing (orchestral version) at 1900, then a programme in Arabic follows. ❖

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 11 hours behind Australian Eastern Daylight Time and 13 hours behind New Zealand Daylight Time. ❖

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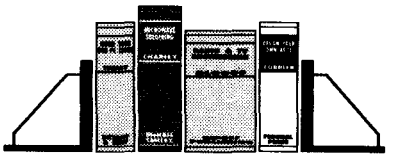


Radar primer

RADAR FOR TECHNICIANS, by Frederick L. Gould. Published by Tab Books (McGraw-Hill), 1995. Hard cover, 236 x 155mm, 277 pages. ISBN 0-07-024062-0. RRP $110.

With a lot of domestic electronic gear becoming more reliable and needing less frequent servicing, many service technicians are having to expand into other areas. The author of this book, with long experience himself in both military and civilian radar, suggests that radar is one area worth considering. His book is intended to provide a good grounding in the subject, sufficient to allow most experienced technicians to tackle radar maintenance and servicing.

He begins with basic radar concepts, and then progresses through transmitter system operation, waveguides and antennas, receivers, displays and ancillary equipment (such as cooling systems, IFF equipment, etc). As well as describing the operation of each section, these chapters also discuss maintenance procedures. Two final chapters then deal with important safety procedures and precautions, and general maintenance considerations.

The author has spent many years as a radar instructor in the US military, and clearly knows his subject. However the text is a bit cursory in places, and not entirely satisfying. Also some of the diagrams seem to be incomplete, while others don't seem to agree with their text references. On the whole, though, it gives quite a good introduction to radar principles.The review copy came from McGraw-Hill Australia, of PO Box 239, Roseville 2069. (J.R.)

Using op-amps

OPERATIONAL AMPLIFIER CIRCUITS, by John C.C. Nelson. Published by Butterworth-Heinemann, 1995. Soft cover, 152 x 235mm, 138 pages. ISBN 0-7506 9468-8. RRP $45.

This book takes a traditional approach to op-amps, making the claim (on the back cover) that the reader merely needs a background knowledge of basic circuit analysis to understand the contents. A quick scan through the book soon reveals the reader also needs a knowledge of *j* notation, Laplace transforms and ideally, a knowledge of the Pascal computer programming language.

There are six chapters and an extensive appendix containing a number of computer programs, written in Pascal. Basic op-amp circuits are described in Chapter 1, with practicalities such as frequency response and offset errors discussed in the next two chapters. Waveform generator circuits are described in Chapter 4, and the next chapter looks at active filter circuits.

The last chapter describes nonlinear circuits, including precision rectifiers, logarithmic amplifiers and limiters. The computer program listings are all relatively short and include programs to design filters and other op-amp circuits.

The author points out that the book makes no attempt to give practical circuits, and refers the reader to Jung's *IC Opamp Cookbook* for these. A list of reference books is also given at the end of each chapter.

The author has a PhD from the University of Leeds, UK and is currently a lecturer at that university. His book is aimed at university students, and is not really suited to beginners. It covers the topics thoroughly, though in a rather academic way. The writing style is clear and appropriate to the subject matter.

The review copy came from Butterworth-Heinemann, PO Box 345, North Ryde 2113. (P.P.)

The human side

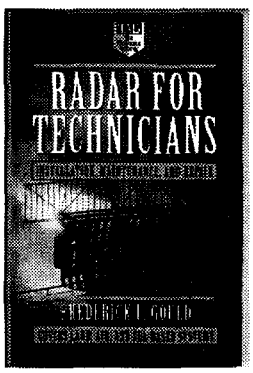
THE ART AND SCIENCE OF ANALOG CIRCUIT DESIGN, edited by Jim Williams. Published by Butterworth-Heinemann, 1995. Hard cover, 260 x 182mm, 398 pages. ISBN 0-7506-9505-6. RRP $90.00.

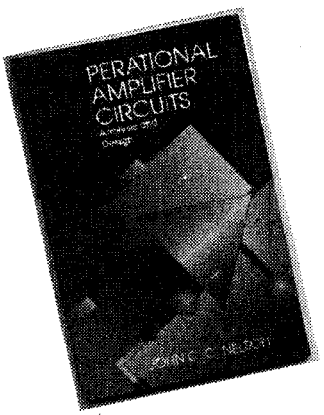
Why *do* people get so keen about designing analog circuits, when it's well known that they rarely behave as predictably as digital circuits? For example amplifiers frequently oscillate, and oscillators just as frequently don't!

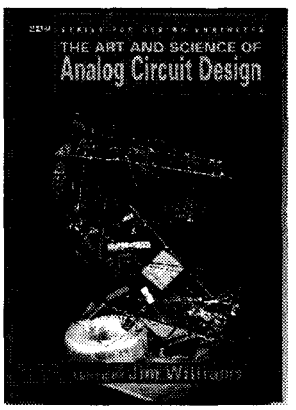
This is the second of two books conceived and edited by highly respected US analog design guru Jim Williams, staff scientist at Linear Technology and a frequent contributor to *EDN* magazine. Like the first volume, titled *Analog Circuit Design — Art, Science and Personalities*, it's essentially a collection of articles by a group of experienced analog designers, encapsulating their personal approaches and experiences, and in the process conveying at least some of the rewards and satisfactions of analog circuit design as a vocation. Some of the articles have already appeared in *EDN*, like Williams' own pieces 'The Importance of Fixing' (on the educational value of servicing your own equipment) and 'There's No Place Like Home' (extolling the value of a home workshop/lab).

It's all very readable and enjoyable stuff, as well as providing an excellent and timely introduction to the 'nitty gritty' of analog circuit design. The first volume was extremely popular, and I'm sure this one will be as well.

The review copy came direct from publisher Butterworth-Heinemann Australia, of PO Box 146, Port Melbourne 3207. (J.R.) ◆







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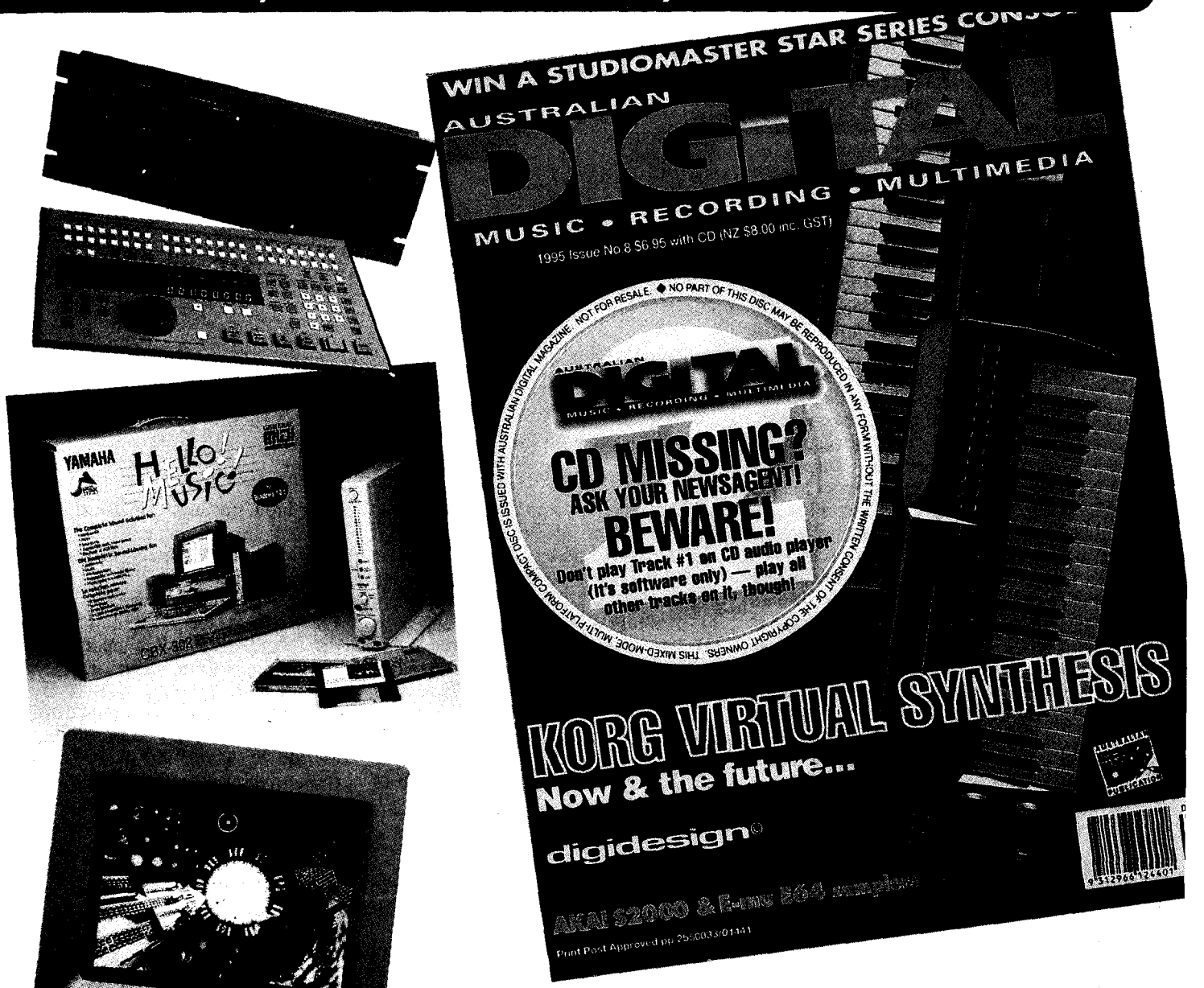

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DSE 'Discovery Series' Construction Project:

FOUR CHANNEL LIGHT SEQUENCER

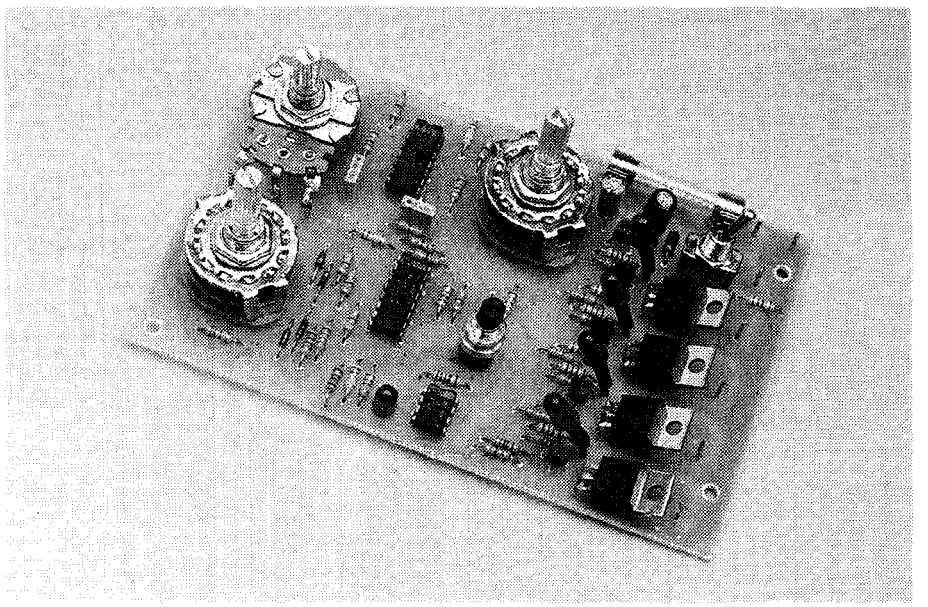
This new low cost, safe light sequencer/chaser design is the latest release in Dick Smith Electronics' Discovery Series of learning kit projects. It has four lamp channels, each of which can drive parallel-connected filament lamps or LEDs up to a total current of two amps. The kit is available from DSE's stores as Cat. No. K-2812, priced at $36.50.

If you are looking for a safe (no 240V lamp wiring), simple light sequencer or light chaser for decorations, party lights, advertising signs, etc., then this project should suit you. For the electronics enthusiast it also has some interesting circuit features to ponder over.

Four lamp outputs are provided, each of which can drive filament lamps or LEDs up to a total output current of 2A. This current is equivalent to a total lamp power rating of 24W per output at 12V. There are 11 different selectable light sequences, including a random one, with a cycle rate that can be varied over a wide range.

The low voltage operation and high current capability means that large numbers of low power lamps can be connected in parallel, for jobs such as Christmas tree decorations. Using parallel rather than serial lamp arrays has the advantage that when one lamp blows, it does not cause the other lamps on the same output to all 'go out' with it.

The project can be powered from any battery or DC supply between 8V and 18V, providing it has a power rating at least equal to the total lamp load that is to be used. All controls can be soldered directly to the PCB to avoid messy wiring, and the completed unit fits into a low cost 'zippy' box (Cat No H-2851). The power supply and box are not included with the DSE kit.



Circuit description

The main component in this project is IC2, a 74HC194 four stage shift register. A four stage shift register is basically made of four flip-flops, each of which can remember or register one 'bit', which is the smallest possible quantity of information. The word 'bit' is short for *binary digit*, and a bit can have only two values: 0 or 1. In this circuit, they correspond to the voltage levels 0V and +5V respectively.

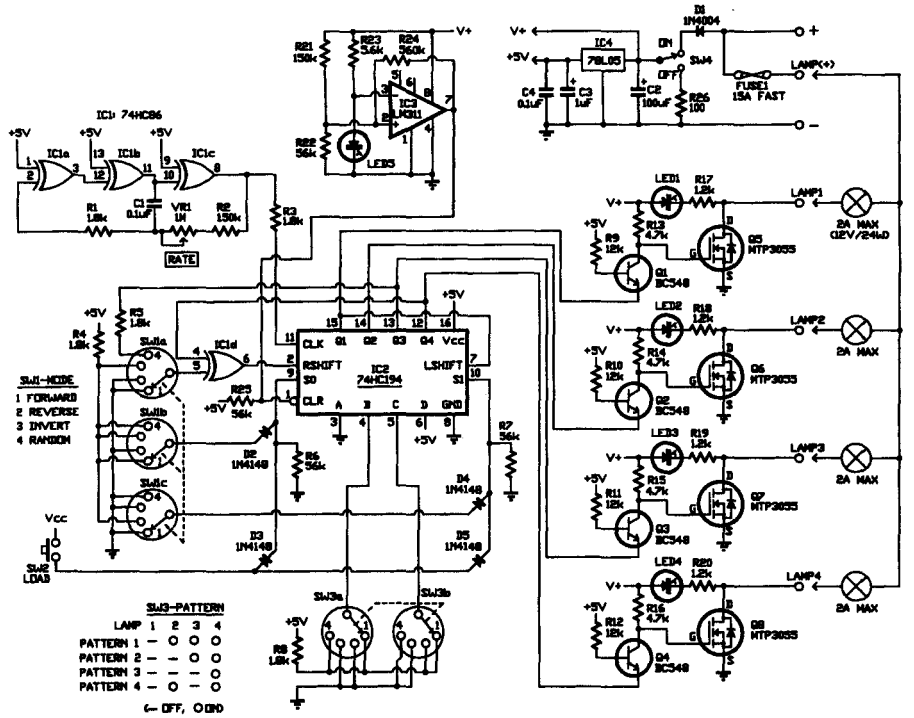
IC2 is called a 'shift' register because the four bits of information stored in it can be shifted along serially from one flip-flop to the next, by the application of pulses to the CLK (clock) input at pin 11. The four flip-flop outputs appear at Q1-4 and the four bits are entered in one of three ways. They can be entered in parallel via input terminals A-D, serially into the leftmost flip-flop via the RSHIFT (right shift) terminal, or serially into the rightmost flip-flop via the LSHIFT (left shift) terminal. Which of these input methods is in use at any time depends on the logic levels that are applied to mode inputs S0 and S1, as shown in Table 1.

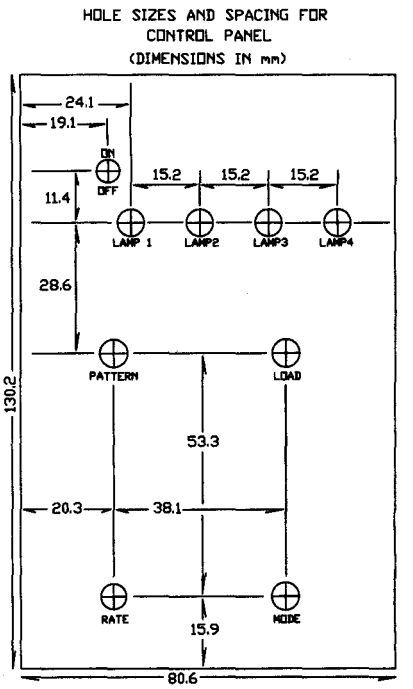
SPECIFICATIONS

Operating supply voltage	8 - 18V DC
Absolute maximum supply voltage:	20V
Maximum lamp load per output:	2A (24W @ 12V)
Supply current:	typ 20mA plus lamp current
Pattern cycle time:	0.1 - 1.2 sec

The remaining terminal on the 74HC194 is the CLR (clear) input. Applying logic 0 to this input causes all the flip-flops to be reset; i.e., Q1-4 all become logic 0.

Each of the four Q outputs of IC2 is used to control an MTP3055 power MOSFET switch, via a level shifting stage which uses a BC548 bipolar transistor. To ensure that the very low 'on' resistance (Rds) of the MTP3055 is achieved at high lamp currents, a gate to source voltage of about 7V or greater is needed. The IC2 logic 1 output level is only 5V, which precludes direct connection to the MOSFET gates. The MOSFET gate bias is supplied instead from the V+ supply rail via a 4.7k resistor. When the Q output is 5V there is no bias for the BC548 and so its collector rises to V+ and allows the MOSFET to switch on. When the Q output is 0V, current





As you can see from the schematic, the heart of the sequencer is a 74HC194 quad shift register, with its outputs driving four power MOSFET devices via matching transistors. A variety of patterns can be loaded into the register.

Fig.1: Use this diagram (not actual size) as a guide when you are drilling the holes in the front panel.

can now flow from the 5V rail down through the 27k resistor into the base of the BC548. The BC548 switches on and pulls the MOSFET gate voltage down to about 0.2V, switching it off.

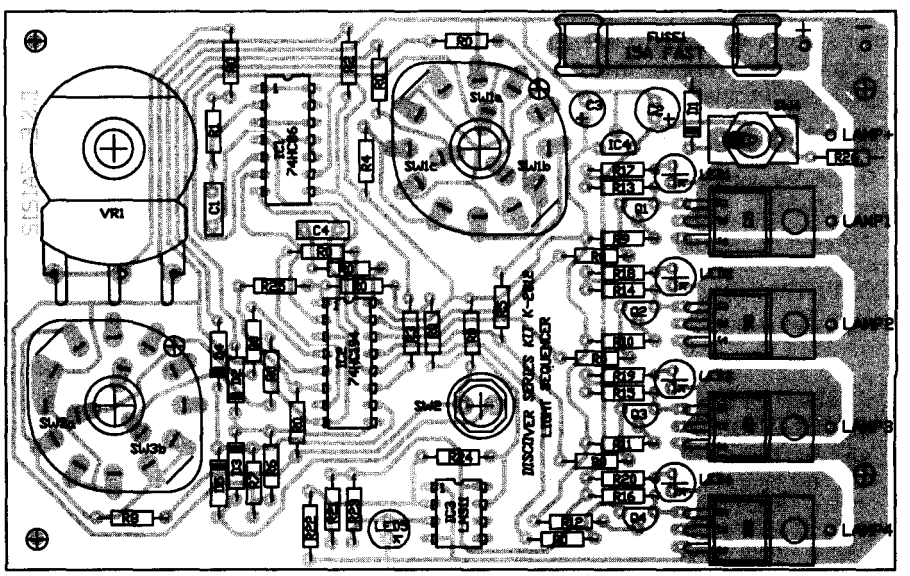
The lamp pattern is loaded into IC2 by selecting a pattern of four bits with the PATTERN selecting switch SW3, and then pressing the LOAD switch SW2 to transfer the bits to the flip-flops and the Q1-4 outputs. As soon as SW2 is released, the clock pulses start to shift the pattern through the shift register in the direction selected by the MODE switch. Refer to Table 3 for a listing of all the light patterns that can be produced.

The pattern is made to cycle continuously without being reloaded by connecting the output of the last flip-flop to the input of the first flip-flop. This forms a continuous loop around which the pattern shifts.

When the MODE switch is set to REVERSE, logic 0 is applied to S0 and logic 1 to S1. This causes the data to be clocked from right to left through IC2, out of Q1 and through the link to the LSHIFT input. In FORWARD mode an exclusive-OR (XOR) gate IC1d has been inserted in the loop between the Q4 output and the RSHIFT input. This allows three extra pattern sequences to be added to the operation. The truth table for an XOR gate, where A and B are the two inputs, is shown in Table 2.

When the MODE switch SW1 is set to FORWARD, a logic 0 is applied to one of the XOR gate inputs. From the truth table it can be seen that the XOR gate output is now always the same as the other input. In other words, the XOR gate acts as a direct link between the Q4 output and the RSHIFT input, and the data is clocked from left to right through IC2.

With the mode switch set to INVERT, a logic 1 is applied to one of the XOR gate inputs. From the truth table it can be seen that this causes it to act like an inverter for the other input. The shift direction is still left to right, as in the forward mode, but now the data appearing at the Q4 output is inverted before



This overlay diagram shows where everything goes on the PCB, and also the correct orientation of each part. Note that there are a number of zero-ohm 'resistors' shown on the board — these are actually links.

Four Channel Light Sequencer

being fed back in to the RSHIFT input. The result of this is that a different sequence is produced.

With *SW1* set to RANDOM, the shift direction is again left to right but now one XOR input is fed from Q4 and the other from Q3. This forms a 'pseudo-random' pattern generator, with a sequence that includes all possible combinations of outputs except all zeroes. This sequence is independent of the pattern selected by SW3.

Diodes D2, D3 and resistor R6 form an OR gate, as do diodes D4, D5 and resistor R7, which allows LOAD switch SW2 to take precedence no matter what states the inputs S0 and S1 are in. Resistors R4, R5 and R8 prevent the make-before-break operation of rotary switches SW1 and SW3 from short circuiting the 5V supply, or the Q3 output, as the switch rotates.

Clock pulse generator

The remaining three XOR gates of the 74HC86 package are conveniently used as the clock pulse generator. With one input tied to logic 1, each of the clock gates act as an inverter, to form the fairly commonly used CMOS oscillator configuration shown. The frequency of oscillation is given by the following formula:

$F = 1/(2*C1*(0.405*Req + 0.693*R1))$

where $R1 = VR1 + R2$

and $Req = R1*R2/(R1 + R2)$

Potentiometer VR1 is used to vary the clock frequency, and hence the lamp cycle rate. Resistor R3, in conjunction with the clock input capacitance of IC2, is used as a low pass filter to remove any ringing that may occur on the clock transitions.

Low voltage cutout

If the V+ supply rail voltage should drop below about 7V while the sequencer is switching high lamp currents, the low gate voltage on the MOSFETs will cause their drain to source resistance to increase, resulting in excessive heat dissipation. This may occur, for example, if the project is operated from a battery which is allowed to go flat.

To prevent the MOSFETs from being damaged in this way, the CLR (clear) input to IC2 is connected to a low voltage detector circuit built around IC3, an LM311 comparator. Within this circuit, a reference voltage has been provided by LED5 which, although an ordinary light emitting diode, makes a surprisingly accurate 1.9V reference.

As the supply voltage varies, the voltage at the inverting input (pin 3) of IC3 remains at 1.9V but the voltage at the non-inverting input (pin 2) varies in proportion to the supply voltage. While pin 2 is at a higher voltage than pin 3, the output voltage at pin 7 is close to V+ and IC2 is not effected.

But when the voltage at pin 2 drops below that on pin 3, which occurs when the V+ drops below about 7V, then pin 7 of IC3 drops rapidly from V+ to 0V and clears IC2, forcing all the lamps to switch off. Due to the hysteresis (positive feedback) introduced by R24, V+ has to rise above about 7.5V before the circuit returns to normal.

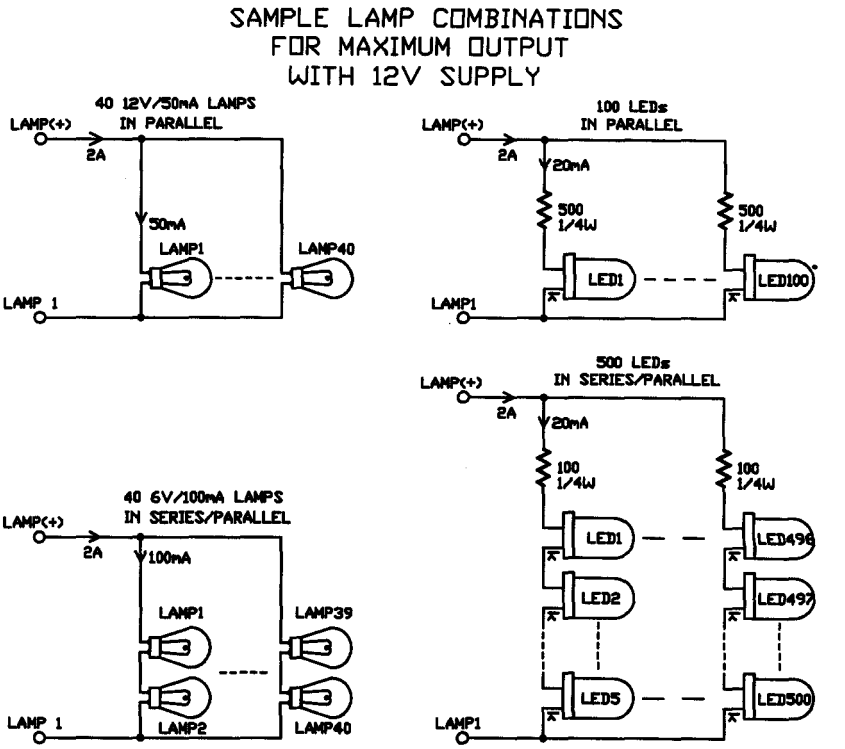


Fig.2: Four different ways of connecting either incandescent lamps or LEDS to any of the four outputs of the sequencer. As you can see, it's quite flexible.

Power supply

The project requires a single DC power supply of between 8V and 18V, connected to the (+) and (-) terminals. The MTP3055 MOSFETS have a gate to source breakdown voltage rating of +/- 20V, so the power supply voltage must never exceed 20V peak, even for a short time.

All of the lamp current is provided from the (+) terminal via FUSE1, a 15A fast blow fuse, which protects the MOSFETs against short circuits in the lamp wiring. The remaining circuit current is supplied from the (+) terminal via

TABLE 1
74HC194 SHIFT REGISTER DATA DIRECTION CONTROL

S0	S1	FUNCTION
0	0	data remains unaffected
0	1	data clocked from right to left via the LSHIFT input
1	0	data clocked from left to right via the RSHIFT input
1	1	data is loaded from the A-D inputs

TABLE 2
74HC86 EX-OR GATE TRUTH TABLE

A	B	OUTPUT
0	0	0
0	1	1
1	0	1
1	1	0

reverse polarity protection diode D1.

The power switch SW4 does not directly switch the lamps off, but ensures that the MOSFETS are turned off by removing power to the rest of the circuit and connecting a 100Ω resistor R26 across the V+ supply. The regulated +5V supply provided by IC4 ensures that the +6V limit of the CMOS devices IC1 and IC2 is not exceeded, and also allows poorly filtered power supplies to be used.

Construction

To mount the components on the PCB, start with the low profile components and then work your way up to the taller components.

To place the components, refer to the overlay diagram which shows how the components actually appear on the PCB. Read the label of the component — C1, for example — from the overlay and then look up the description next to that label in the parts list. The parts list describes C1 as an MKT type capacitor which has a value of 0.1uF and may be marked either 100nF, 0.1uF or 104 (i.e. 10 times 10^4, in picofarads).

Occasionally one of the supplied capacitors may be marked with a voltage rating greater than is shown in the parts list; this is acceptable as long as it fits on the PCB. But 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.

Begin construction by installing the resistors. Resistors have their values marked on them as a colour code, which is 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, 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 are labelled R0 on the overlay. These are actually wire links, built like resistors, and have a single black band in the centre. They are used in place of wire links wherever possible because they are easier to insert and look neater.

TABLE 3
AVAILABLE LIGHT SEQUENCES

Mode	Pattern	Sequence
FORWARD	1	(-OOO)(O-OO)(OO-O)(OOO-)(-OOO) etc
	2	(—OO)(O—O)(OO—)(-OO-)(—OO) etc
	3	(—O)(O—-)(-O—)(—O-)(—O) etc
	4	(-O-O)(O-O-)(-O-O)(O-O-)(-O-O) etc
REVERSE	1	(-OOO)(OOO-)(OO-O)(O-OO)(-OOO) etc
	2	(—OO)(-OO-)(OO—)(O—O)(—OO) etc
	3	(—O)(—O-)(-O—)(O—)(—O) etc
	4	(-O-O)(O-O-)(-O-O)(O-O-)(-O-O) etc
INVERT	1	(-OOO)(—OO)(—O)(——)(O—), (OO—)(OOO-)(OOOO)(-OOO) etc
	2	(—OO)(—O)(——)(O—)(OO—), (OOO-)(OOOO)(-OOO)(—OO) etc
	3	(—O)(——)(O—)(OO—)(OOO-), (OOOO)(-OOO)(—OO)(—O) etc
		(note that the above three sequences are identical)
	4	(-O-O)(—O-)(O—O)(-O—)(O-O-), (OO-O)(-OO-)(O-OO)(-O-O) etc
RANDOM	1	(-OOO)(—OO)(—O)(O—)(-O—), (—O-)(O—O)(OO—)(-OO-)(O-OO), (-O-O)(O-O-)(OO-O)(OOO-)(OOOO)(-OOO) etc
	2	(—OO)(—O)(O—)(-O—)(—O-), (O—O)(OO—)(-OO-)(O-OO)(-O-O), (O-O-)(OO-O)(OOO-)(OOOO)(-OOO)(—OO) etc
	3	(—O)(O—)(-O—)(—O-)(O—O), (OO—)(-OO-)(O-OO)(-O-O)(O-O-), (OO-O)(OOO-)(OOOO)(-OOO)(—OO)(—O) etc
	4	(-O-O)(O-O-)(OO-O)(OOO-)(OOOO), (-OOO)(—OO)(—O)(O—)(-O—), (—O-)(O—O)(OO—)(-OO-)(O-OO)(-O-O) etc
		(note that the above four sequences are identical)

The remaining components are installed as follows:

Diodes D1-5: These have a band on them close to one end and must be mounted in the direction shown on the overlay.

IC's 1-3: These have a package with two parallel rows of pins, called a dual-in-line or DIP package. There is a dot or notch on the top, at the end near pin 1, and the overlay shows which way around the IC has to be mounted. The IC pins count anticlockwise from pin 1, looking at the top of the package.

IC4: This has a three-pin package which looks the same as the BC548 transistors

Q1-4: These must be mounted so that the flat faces are in the direction shown on the overlay.

MOSFETs Q5-8: These can be either mounted on the PCB or on a heatsink. It is better, but not necessary, to mount them on a heatsink so as to keep the temperature of the PCB to a minimum. To mount them on a heatsink, an insulating washer must be used between the metal tab of the MOSFET and the heatsink. When mounting them on the PCB, they will have to be bent over at an angle of say 45° to clear the panel above them. Do not lay them flat on the PCB, as this will restrict air circulation around the metal tab.

Capacitors C1, C4: These two types of capacitors are non-polar, so can be mounted in either direction.

Electrolytic capacitors C2, C3: These capacitors are polarised, which means they must be connected the right way around or they will be damaged. They will have a negative (-) or positive (+) sign printed on them (normally the (-) lead is marked). The overlay shows where the positive lead goes.

Light emitting diodes LED1-5: These have two terminals, a cathode (marked (k) on the overlay) and an anode. The cathode is normally identified with a flat edge on the plastic case of the LED. Note that LED5 is not used as a lamp in this circuit and can be mounted hard up against the PCB. LED's 1-4 can either be mounted on the PCB or fixed onto a panel and then connected by wires. Tubular insulation (called 'spaghetti') has been provided for putting on the legs of the LEDs. To mount the LEDs on the PCB, cut eight pieces of spaghetti of equal length to act as spacers between the LEDs and the PCB, so that they are at the right height to show through the panel.

Fuse clips: Insert the fuse clips fully into the PCB and bend their solder tags down firmly, so that they are mechanically secure before being soldered.

PCB pins: The PCB pins are normally inserted short end first through the top of the PCB. When soldering wires to the PCB pins, wrap the wire around the pin first so that the joint has mechanical support as well as the solder support.

Four Channel Light Sequencer

Switches SW1-4 and pot VR1: These controls can be either mounted on the PCB or connected by wires to the PCB. They are not specifically designed for PCB mounting, but provision has been made in this kit for doing so, to reduce the amount of wiring needed.

Refer to the diagram of Fig.1, which shows the hole spacing and sizes for inserting the controls through a panel. If they are mounted on the PCB, and the whole assembly is to be supported by the controls, then some care has to be taken that stress is not placed on their soldered joints.

Unfortunately, except for the two rotary switches SW1 and SW3, the controls have different heights.

For the two rotary switches, insert their solder tags fully through the PCB and bend the tags over so that they can be easily soldered to the large copper pads. The small metal tag on the top of the switch won't be needed, so bend it over or break it off.

If the PCB is to be supported by the controls, then these two switches will provide the main support. The remaining controls (except the pot) should also be inserted fully into the PCB before soldering them.

The threaded section of the shafts on these controls may pass far enough through the panel to have their nuts screwed on, but will need spacing washers or a second nut under the panel to give them the right height.

When the assembly of the board is complete, carefully check all of the soldering. Look especially for dry solder joints, and solder bridges shorting the tracks together.

PARTS LIST

Resistors

All 1/4W 1% metal film unless otherwise stated:

		Colour Code Four band	Five band
R0	0 ohm link	- - blk -	-
R1,3-5,8	1.8k	brn-gry-red-brn	brn-gry-blk-brn-brn
R2,21	150k	brn-grn-yel-brn	brn-grn-blk-org-brn
R6,7,22,25	56k	grn-blu-org-brn	grn-blu-blk-red-brn
R9-12	12k	brn-red-org-brn	brn-red-blk-red-brn
R13-16	4.7k	yel-vio-red-brn	yel-vio-blk-brn-brn
R17-20	1.2k	brn-red-red-brn	brn-red-blk-brn-brn
R23	5.6k	grn-blu-red-brn	grn-blu-blk-brn-brn
R24	560k	grn-blu-yel-brn	grn-blu-blk-org-brn
R26	100Ω	brn-blk-brn-brn	brn-blk-blk-blk-brn

Capacitors

C1,4	0.1uF	(100nF, '104')	100V MKT
C2	100uF	25VW	electrolytic
C3	1uF	50VW	electrolytic

Semiconductors

IC1	74HC86 quad XOR gate
IC2	74HC194 4-bit shift register
IC3	LM311 comparator
IC4	78L05Z +5V 100mA regulator
D1	1N4004 power diode
D1-5	1N4148 small signal diode
Q1-4	BC548 NPN transistor
Q5-8	MTP3055 12A/60V power MOSFET
LED1-5	5mm round, red LED

Miscellaneous

VR1	2M linear pot, 24mm
SW1,3	3 pole 4 position rotary switch
SW2	SPST momentary NO pushbutton
FUSE1	15A 3AG fast blow fuse

2 x 3AG PCB mount fuse clips; PCB, 123mm x 74mm, coded ZA1212; 10 x PCB terminal pins; 15cm spaghetti sleeving.

Testing it

Before connecting any lamps to the finished sequencer, check the operation as follows. With the power switch SW4 off, connect a suitable DC power supply (refer to the specifications) to the (+) and (-) terminals.

When the power is first switched on, it is most likely that all the LEDs will be off until the LOAD button is pressed. Now rotate the RATE control fully anti-clockwise for the slowest rate, set the MODE switch to FORWARD, and hold the LOAD button down. Set the PATTERN switch to each of its four positions in turn and check that the following LED patterns occur:

LED:	1	2	3	4
Pattern 1:	-	O	O	O
Pattern 2:	-	-	O	O
Pattern 3:	-	-	-	O
Pattern 4:	-	O	-	O

(here O indicates LED on, and - indicates LED off)

Table 3 shows the light sequences that should be produced for the indicated settings of the PATTERN and MODE switches (the LOAD button must be momentarily pressed after each setting change).

If the LED operation is correct then it can be tested with lamps connected to the output. The diagrams of Fig.2 show possible lamp configurations using a 12V power supply. Although these diagrams show only the LAMP 1 output being used, the same arrangements can be used with all four outputs. ❖

Smart Dual 12V Battery Controller - 2

Continued from page 63

changeover point when charged at a low (say, 2.5A) rate.

As the auxiliary battery monitoring circuit controls the low to high current switching then, you will need to alter the voltage level at which comparator IC1c disables IC2. By changing R22 to 82k and R23 to 150k in the auxiliary sensing circuit for example, the changeover point should shift from around 10.5V to about 8.5V — that is, earlier in the charge cycle. Note that as the auxiliary battery is then at a lower terminal voltage when 'high' current charging is applied, the initial surge current can be very high indeed...

If you plan to make such a change however, bear in mind that this sort of vigorous charging is not really recommended for the less rugged (but expensive) deep-cycle batteries, and should be confined to the heavy duty types that can withstand this sort of treatment. You should also consider the potentially large currents being switched with this arrangement too (as mentioned above), since there is the possibility of disruptive spikes being induced in the vehicle's electrical system.

And as a final point, don't be tempted to set the low charging current rate too far beyond the recommended figure when adjusting RV1. While this would certainly speed up the first part of the charging cycle, it could easily exceed the safe initial charging level for a deep-cycle battery, would compromise the battery manager's own overload protection, and may cause excessive heat dissipation in the unit's MOSFETs. ❖

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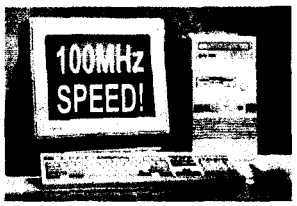

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Phone:(03)9602-3499 Fax:(03)9642-8551

Melbourne suburb:
Cnr. Blackburn & Wellington Rds., Clayton, Vic. 3168
Phone:(03)9562-9501 Fax:(03)9562-9261

SHOP HOURS: Mon.~Thurs. 8:30~5:30 Fri. 8:30~8:00 Sat. 9:00~1:30
ADELAIDE: 223-2225 BRISBANE: 229-4086 DARWIN: 814-070 SYDNEY: 262-3093

POSTAGE RATES:

$1.00 ~ $9.99	$3.75
$10.00 ~ $24.99	$4.00
$25.00 ~ $49.99	$4.95
$50.00 ~ $99.99	$6.50
$100.00 ~ $199.99	$7.50
$200.00+	FREE

N.B. Above rates apply to small packages only. Bulky or fragile items will only be sent by road or air freight. Insurance extra.

Freight charges:

Melbourne metro.	$7.00
Road Freight	$12.00
Overnight Air Freight	$12.00

Above rates are minimum charge applicable to packages of up to 3Kg. Please enquire for larger items such as computer systems. Insurance extra.

N.B. Normal prices charged unless ad prices quoted. Errors & omissions excepted. Prices & specifications subject to change without notice.

Free Call Mail Order Hotline!!
(1800)335-901

Tax exempt orders: TECS Imports P/L. 88 South Pde. Blackburn. Vic. 3130
Phone:(03)9877-7071 Fax:(03)9877-7081

Need more memory to run Windows `95?

30pin SIM

1M	$54
4M	$195

72pin SIM

4M no parity	$185
4M with parity	$239
8M no parity	$359
8M with parity	$499
16M no parity	$749
16M with parity	$969

FLOPPY DISK DRIVES

1.44M 3.5"	$45
1.2M 5.25"	$75

Hard disk drives

WD - Western Digital
QT - Quantum
CN - Conner

630M	WD	$299
850M	QT	$329
1G	CN	$389
1G2	QT	$419
1G7	IBM	$589

CD-ROM DRIVES

CD-ROM drives have now become an integral part of any computer system. Fortunately, they have also come down in price to an affordable level.

Panasonic 562J double speed $85
Panasonic 581 IDE quad speed $199
Panasonic SCSI quad speed $319
Sony CDU76E IDE quad speed $199
Creative IDE hex speed $329

Plug and Play Sound Cards

Installation of sound card is now a breeze with these new Plug and Play aware products. No need to set any jumpers for IRQ ,etc. ... Let the software and the BIOS sort out the conflicts.

Audiowave Green 16	$110
Audiowave Green 32	$239
Creative Sound Blaster 16	$139
Creative Sound Blaster 32	$279

Pentium CPU and motherboard

These days, more and more games and other software require a very fast processor to handle the complex graphics. Even the 486 machines are no match for some of these fancy programs. You need the power of the Pentium processor.

All motherboards features PCI bus, 256K cache, Triton chipset, and "Plug & Play" BIOS.

Pentium-75	$575
Pentium-90	$725
Pentium-100	$799
Pentium-120	$899
Pentium-133	$1175

TECS TECS TECS TECS TECS TECS TECS TECS

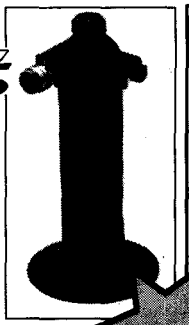
READER INFO NO. 10

FEBRUARY PRE CATALOGUE SALE

Hot-Spot Gas Stand Up Soldering Iron

NEW 96 in

New for 1996. This butane gas powered soldering tool is ideal for soldering applications when you need both hands free. It has piezo ignition and comes with an assortment of tips. These include: •2.4mm solder tip •needle solder tip •chisel solder tip •polyfoam cutting tip •hot knife tip Height 155mm, diameter 33mm. Use gas Cat NA-1020. Up to 2 hours each gas fill.



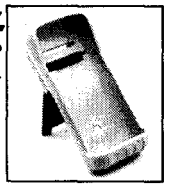
Cat. TS-1420 ONLY $49.95

Universal Rubber Holsters For DMM's

NEW 96 in

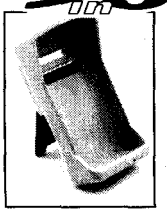
Two brand new holsters for 1996. Keep your DMM from being damaged. Both are yellow in colour, include a double tilting bail on the back and holsters for the probes.

MEDIUM Suits most medium sized DMMs, like our old model QM-1300. Overall size 175(H) x 95(W)mm.



Cat. QM-1515 $9.95

LARGE Suits most large sized DMMs including the Metex and our larger Jaytech units as well as the Jaytech Digital Capacitance Meter. Size 195(H) x 92(W)mm.



Cat. QM-1510 $9.95

NEW CATALOGUE NEXT MONTH

Pocket Autorange DMM

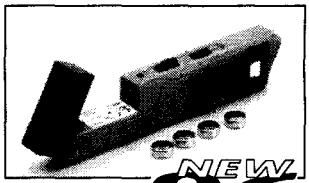
NEW 96 in

•3.75 DIGIT •DATA HOLD •3999 COUNT •WRAP AROUND LEADS •DIODE TEST •SMALL SIZE •ONE HAND OPERATION •CONTINUITY BUZZER

Quality Pocket DMM. Its small enough for the top pocket or tool box. Supplied with carry pouch and the test leads wrap around the body for easy storage. Other features include: overload display, low battery indicator and auto turn off.

Cat. QM-1540 $49.95

Metal Locator - Electronic Tester



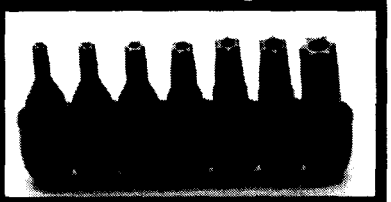
NEW 96 in

Brand new pocket tester that includes a metal locator!!! Find cables and water pipes etc from behind walls. Allows you to check the following:

AC voltage: •Find AC volts in a cable/conduit etc •Locate a break in live wire •Check appliances are earthed •Check active, neutral wiring on appliances •Find AC signals behind wooden walls •Check negative ion generators are working Continuity: •Check globes, fuses etc •Signals with LED and buzzer when resistance below 5MΩ •Get an idea if capacitors are OK •Check transistors DC polarity: •Identify polarity of batteries •Check approx condition of a battery Microwave oven leak detector •Check if your microwave leaks All this in a pocket tool!!!

Cat. QP-2270 $15.95

Tamper Proof Torx Screw Bit Set

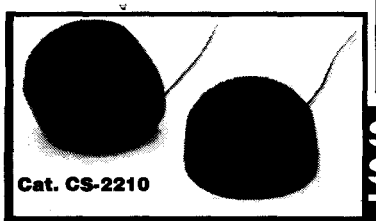


The set consists of 7 Tamper Proof Star pieces which fit the 6 point STAR type screws with tamper proof pins, as those found on computer systems etc. They are T10, T15, T20, T25, T27, T30, T40. Made from chrome vanadium - steel and heat treated. **CAT PRICE $14.95**

Feb Only $10!!!

SAVE

SAVE $4.95 Cat. TD-2034



Cat. CS-2210

Save $10 Super Car Tweeters

SAVE

Top quality car tweeters. Beware of cheap lookalikes!! See cat P64.

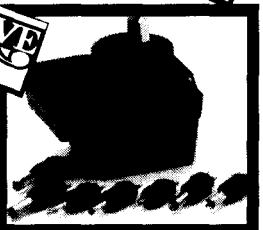
CAT PRICE $59.95PR Feb $49.95pr SAVE $10

Plug Pack Bargain

SAVE

240VAC Input. 3, 4.5,6, 7.5, 9, 12VDC Output 500mA. Supplied with 7 reversable plugs.

NORMALLY $24.95

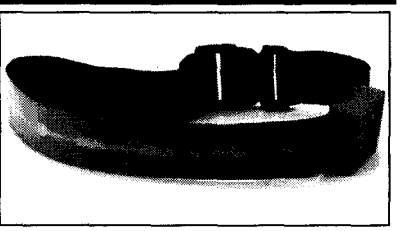


Feb $20 SAVE $4.95 Cat. MP-3012

Illuminated Safety Belt

NEW 96 in

This belt will make you much more visible at night. It uses the latest technology "EL" light. These are flexible flat light strips that blink when a voltage is applied. They are extremely visible at night. The belt is worn over the clothing, and the EL light is across the back. Light length is 300mm. The batteries, voltage inverter and on/off switch are all in a small plastic case that is part of the belt. There is a section of the belt made of stretch material so one size fits just about all.



Ideal for joggers, walkers, bike riders, road workers and anybody who needs to be seen at night.

Cat. SL-2880 $24.95

CPU Cooler

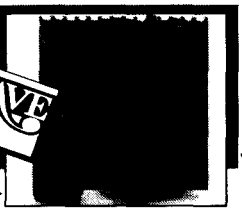
Keep your 486 cool.

CAT PRICE $22.50

SAVE

Feb $12.50

SAVE $10 Cat. XC-5040



SAVE $10

Unidirectional Microphone

600Ω imped with on/off switch

CAT PRICE $9.95

SAVE

Feb Price $7.95

SAVE $2 Cat. AM-4090

DC-DC Converter 800mA

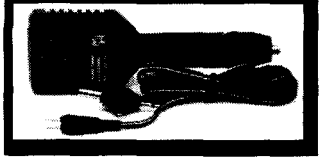
Reduce 12V to 1.5, 3, 4.5, 6, 7.5 & 9V

CAT PRICE $14.95

Feb $10.00

SAVE $4.95

Cat. MP-3014



JAYCAR ELECTRONICS IS NOW A QUALITY ENDORSED COMPANY!

Our Purchasing Dept, Warehouse, Wholesale Sales and Kit Department are now Quality Assured to AS9002.

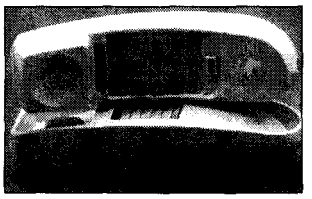
Quality System

Quality Endorsed Company

Thinfone 10 Memory Telephone

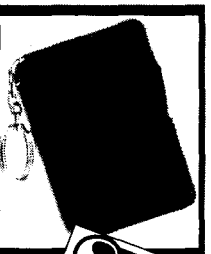
NEW 96

Thinfone is a reliable phone at a very reasonable price. It has a 10 number memory, is pulse and tone switchable, last number redial and is Timed call / Easy call compatible. Can be wall mounted or placed on a flat surface. White in colour. Full 12 months over the counter replacement warranty on this unit.



Cat. YT-7050 **$39.95**

20 Second Voice Recorder



Keep in the car to remember that important phone number you've been told on the phone.

NORMALLY $24.95

Feb $20

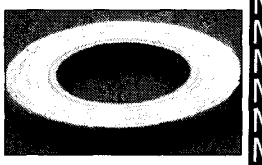
SAVE

SAVE $4.95 Cat. XC-0276

DOUBLE SIDED TAPE

NEW 96

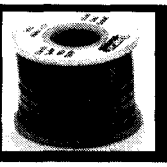
Never run out of double sided tape again. Thousands of uses from mounting printed circuit boards in plastic cases to holding up posters. This is white in colour, 2mm thick, 12mm wide and comes on a roll of two metres.



Cat. NM-2820 **$3.95**

BUY 10 LESS 10%

STOCK UP ON SOLDER!!!



CAT	DIA	WEIGHT	WAS	FEB	SAVE
NS-3005	0.71mm	200g	$6.95	$4.95	$2
NS-3010	1.0mm	200g	$6.75	$4.75	$2

RS232 Breakout Box

See cat P102 for details.

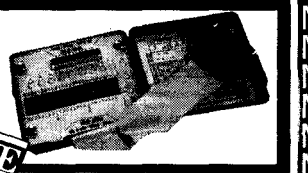
CAT PRICE $49.95

Feb $35

SAVE $14.95

Cat. XC-5085

SAVE



Save $$$$ On Stainless Steel Cutters & Pliers

For details see cat P91 & P92.

CUTTERS: Cat. TH-1890

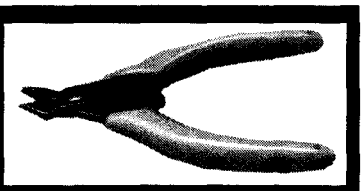
PLIERS: Cat. TH-1893

CAT PRICE $13.95

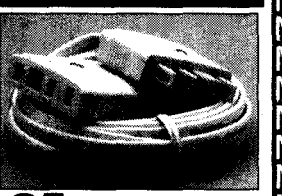
Feb $10ea

SAVE $3.95EA

SAVE



Commander/PABX Phone Extension Leads



Many Commander and Office telephone systems require 6 wires to work correctly. We now have them. Australian plug to Australian socket.

3 metre	Cat. YT-6016	**$15.95**
10 metre	Cat. YT-6018	**$18.95**
15 metre	Cat. YT-6019	**$22.95**

NEW 96

2 Computer To 1 Printer Auto Switch

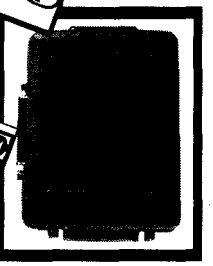
See cat P102 for details.

NORMALLY $32.95

Feb $23.95

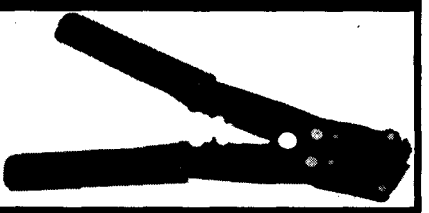
SAVE $9 Cat. XC-5088

SAVE



Heavy Duty Wire Stripper / Cutter / Crimper

Designed for easy wire stripping. Strip wire from (0.13 - 6.0mm). Incorporates a precision cutting blade for easy wire cutting. Also incorporates quality crimping jaws. • For insulated terminals (1.5 - 6mm) • For non insulated terminals (1.5 - 6mm) • For auto ignition terminals (7 - 8mm)



NORMALLY $23.50 Feb $20 SAVE $3.50 Cat. TH-1826

Monitor OFC Speaker Cable

273 strands of 0.12mm per conductor

NORMALLY $4.20MTR

Feb $2.50mtr

SAVE $1.70MTR Cat. WB-1735

SAVE

DELUXE ANTISTATIC DESOLDERING TOOL

If you desolder a lot, and want the best hand tool available, then try this unit. Its suction power is immense, the vacuum chamber itself is almost twice as large as our other models. Supplied with antistatic desolder tip. A quality hardworking tool. Total length 325mm. ANTISTATIC REPLACEMENT TIP Cat. TH-1866 $4.95

Cat. TH-1865

NEW 96

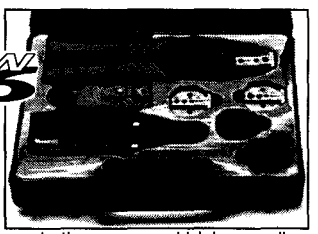
$24.95

Coax Crimping Tool Kit

NEW 96

The Professional Coax Plug Crimping Tool Kit.

The kit includes: •one crimper with 5 interchangeable crimping dies which covers just about every size crimp ever needed •one cable cutter, 6.5" long with curved blade, cuts wire up to 10.5mm diameter •one rotary coax cable stripper. Simply rotate clockwise around the cable 3 to 6 times. Same as our stripper cat TH-1820 •screwdriver for changing dies •plastic carry case which houses all.



Cat. TH-1878 **$149.50**

Two Station Wired Intercom

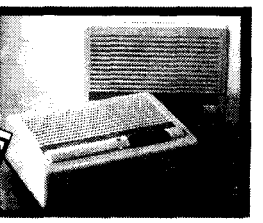
See cat P184 for details.

CAT PRICE $29.95

Feb $23.95

SAVE $6 Cat. AM-4310

SAVE



Alarm Reed Switch Magnets

N/O and N/C on the one. Use on windows and doors on home alarms. See cat P76.

CAT PRICE $5.95

Feb 5 for $20

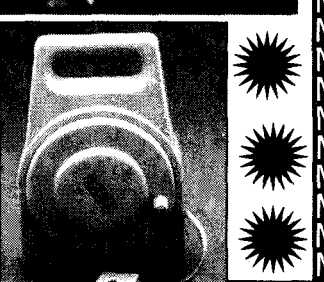
SAVE $9.75 Cat. LA-5070

SAVE

TELEPHONE CORD EXTENSION REEL

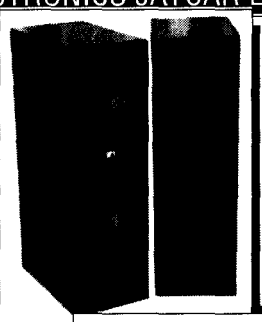
NEW 96

This handy reel has 15 metres of cable, and can be easily pulled out and reeled back in for easy storage. Ideal for an afternoon by the pool or gardening. Simply take the phone out and plug it into the reel. Don't miss any calls.



Cat. YT-6010 **$22.95**

Jaycar vifa SAVE $$$$$ ON SPEAKER KITS



JV40 JAYCAR VIFA SALE

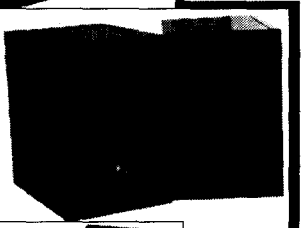
See catalogue and EA September 1995 for full details.

	Cat Price	FEB	Save
SPEAKER KIT (PR)	$489.00	$439.00	$50.00
WITH CABINETS	$699.00	$629.00	$70.00

SAVE ON JV20 SPEAKER KIT

See catalogue and EA July1995 for full details.

	Cat Price	FEB	Save
SPKR KIT (EA) CS2580	$169.50ea	$149.50ea	$20.00ea
WITH CABINET	$239.00ea	$215.00ea	$24.00ea

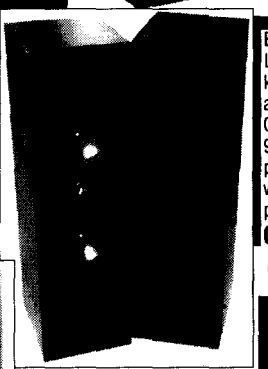


Pair Price $430 Save $48

SAVE ON JAYCAR VIFA JV60

See catalogue and EA August 1995 for full details.

	Cat Price	FEB	Save
SPEAKER KIT (PR)	$579.00	$509.00	$70.00
WITH CABINETS	$849.00	$759.00	$90.00



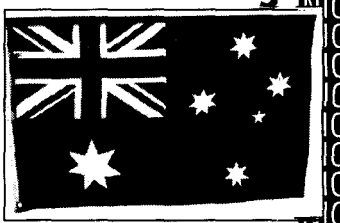
Telemate Shoulder Rest

NEW 96

Telemate easily attaches to the hard piece of your phone. If you spend a longtime on the phone, Telemate allows you to rest the phone on your shoulder. No more sore necks! Attaches to all phones by double sided tape (supplied).

Cat. YT-6025 Phone Not Included $9.95

Australian Flag



Be Patriotic! Let others know that you are proud to be an Australian! Our Australian flag measures 900 x 600mm and is made from polyester. Hang one outside your home, over a window, on a flagpole, anywhere you like and at this price you can afford it too!

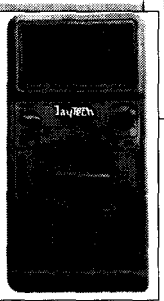
NEW 96

Cat. BF-8500 $9.95

FREE TEMP PROBE WITH DMM

Buy our QM-1300 DMM in Feb (Features: *Frequency •Temperature •Transistor •Capacitance - see 1995 catalogue P27) and receive absolutely free - the temperature probe worth $12.95 only $69.95

DMM: Cat. QM-1320 / Probe: Cat. QM-1282

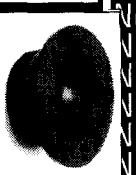


FREECALL FOR PHONE ORDERS 008 022 888

Save On Speakers

Jaycar RESPONSE

DOME MIDRANGE 8Ω Hi Fi



See cat P39.
CAT PRICE $39.95
Feb $29.95
SAVE $10 Cat. CM2090

10" CARBON FIBRE 8Ω WOOFER

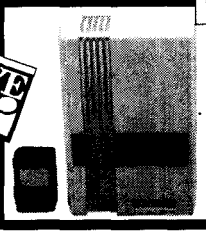
See cat P44.
CAT PRICE $169.50
Feb $129.50
SAVE $40 Cat. CW-2143

SAVE

16 Tune Melody Doorbell

SAVE

Includes push button and wiring. Uses 3 AA batteries.



CAT PRICE $14.95
Feb $10.95
SAVE $4 Cat. LA-5012

12V Battery Backup Siren

As used with our car alarms. Includes batteries in the siren, so if power is cut off siren continues to sound.

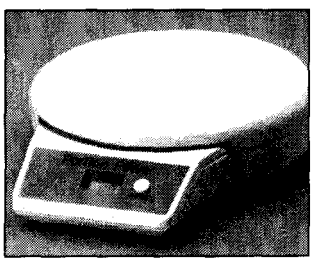
NORMALLY $64.95
Feb $49.95
SAVE $15 Cat. LA-8910

SAVE

2KG Digital Scales

NEW 96

These small scales are extremely handy around the house or office. Ideal for measuring foodstuffs for cooking, or parcels and letters for mailing etc etc etc. Features auto power off.

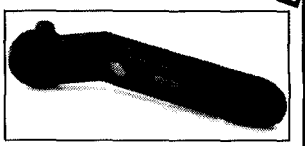


Specifications: •Capacity: 2000g (2kg) •Resolution: 1gm •Display: LCD •Power supply: lithium battery - 100,000 operations •Dimensions: 165L x 130W x 35H mm approx

Cat. QM-7245 $49.95

Digital Tyre Pressure Gauge

Keep an eye on your tyre pressure. This handy gauge is easy to use, and small enough to store in the glovebox or console. Measures in the old PSI - Pounds Per Square Inch. Specs: •Accuracy ±1 PSI



NEW 96

Cat. QM-7235 $19.95

Vero Type PC Board

Alpha numeric spacing, pre-drilled 0.9mm, 2.5mm spacing.

Size: 95 x 152mm

Cat. HP-9542
CAT PRICE $4.25
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Size: 95 x 303mm Cat. HP-9544
CAT PRICE $7.50
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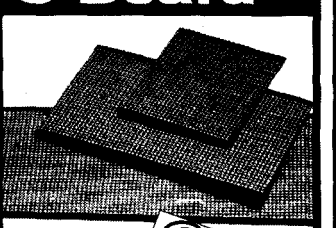
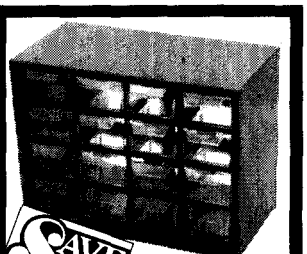


SAVE

16 Drawer Parts Cabinet Deal

See 95 cat P126
NORMALLY $13.95EA
Feb - 6 Sets (96 Drawers) for $69
SAVE $14.70 Cat. HB-6320



SAVE

1 Amp AA NICADS!!!

NEW

Yes, thats correct. They do exist, and we've got them at very low prices.

AA 1.2V 1A/HR Cat. SB-2440 **$4.75ea**

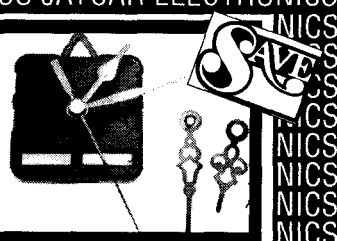
AA 1.2V 1A/HR with solder tags Cat. SB-2441 **$5.00ea**

NICKEL METAL HYDRIDES ARE ALSO AVAILABLE

AA 1.2V 1.1A/HR Cat. SB-2455 **$5.95ea**

AA 1.2V 1.1A/HR with solder tags Cat. SB-2457 **$6.25ea**

Clock Movements



SAVE

Make your own clock or fix that old clock. All come with three sets of hands.

STANDARD MOVEMENT:

CAT PRICE $9.95

Feb $7.50

SAVE $2.45 Cat. XC-0100

MELODY MOVEMENTS:

Plays a tune and gongs the time each hour. 2 types available.

Westminster Chimes: Cat. XC-0106

Twelve Melodies: Cat. XC-0107

NORMALLY $21.50 EA

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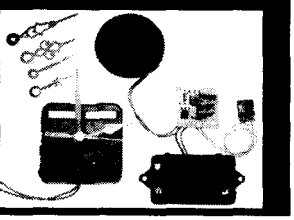
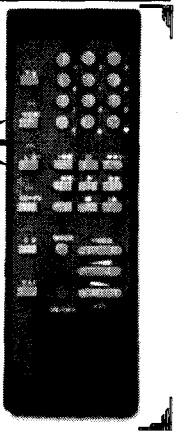


PROGRAMMABLE REMOTE CONTROL



NEW

This remote control will "learn" the functions of other remotes. If your TV / stereo coffee table has a row of remotes, you can actually retire them all and just use this one. Also ideal if one of your remotes is "on the way out". Before it dies, buy one of these and it will learn the functions. Brand name replacement remote controls cost a fortune.

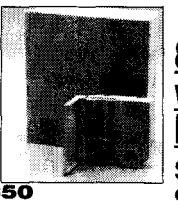
Specs: •Memory capacity: 150 commands •Memory hold without batteries: About 8 minutes •Suitable equipment: Most brands of infra red remote controllers for audio/video devices •Effective range: 8 metres •Power source: 4 x AAA batteries (not supplied) •187(L) x 64(W) x 15(D)mm

Cat. AR-1710 **$43.95**

DSC HOME ALARM PANELS

See cat P69 for full details.

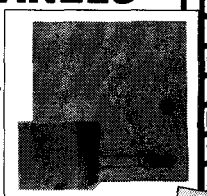
5 Sector with Dialler



$285

Cat LA-5350

8 Sector with Dialler



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Cat LA-5360

FEBRUARY DEAL-DSC PIRs

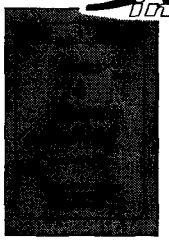
NORMAL PRICE AROUND $60 EACH

5 Sector Purchase Buy up to 4 at $29.95ea Cat LA-5018

8 Sector Purchase Buy up to 6 at $29.95ea Cat LA-5018

Hums & Buzzes Explained

NEW 2nd ed.



This pocket book was written by a veteran of 22 years in the professional sound industry. It is written for Sound Operators and Musicians who own or operate professional sound systems. It covers problem areas like: earth loops, poor shielding, inputs, outputs, cables, magnetically induced hums and buzzes and gives examples. A small book full of extremely valuable information. 30 pages 150 x 100mm

Cat. BF-4170 **$5.95**

"Tweety Pie" Screamer Siren

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Incredibly small - 57(L) x 33(H)mm. Unbelievably loud - 116dB.

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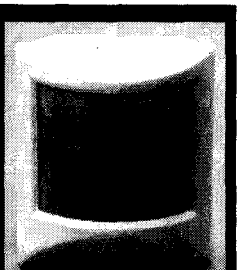
PIR MADNESS!!!



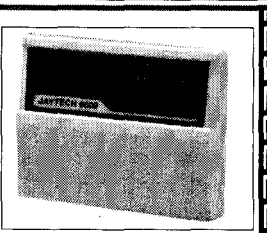
We have made a scoop purchase of a quantity of Micron Pulse count passive infrared detectors. The Micron PIRs are designed by an English company and manufactured in Asia. This unit is currently being sold to the installer market, at a price which is higher than what we can offer you. But remember, this is a once only deal, and cannot be repeated. Stock will not last. The Micron is the ultimate low cost/high performance PIR detector. Specifications: •selectable 1, 3 or 5 pulse count •operating voltage 9-16VDC •current 17mA •alarm contacts - NC •operating temp -10 to 55°C •pyroelectric detector dual element.

NORMALLY WOULD COST AROUND $35 TO $40 Cat. LA-5030

ONLY $25 OR 10 FOR $200

NEW

JayTech 6 Sector Alarm Panel



$139.50

Cat LA-5430

See cat P71 for full details.

FEBRUARY DEAL

Buy up to 4 Micron PIRs at $10ea Cat LA-5030

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INFORMATION CENTRE

by PETER PHILLIPS

Can anyone out there help?

This month's line-up includes a look at stereo TV sound, home theatre speakers, dry cells and CDI units, plus a number of letters from readers seeking advice from other readers. But first we present some opposing views on the merits of reader contributions to this column...

I recently received a letter from a reader suggesting we introduce a 'Can Anyone Help?' column, in which readers write in with a question, we present the letter and other readers reply. I wrote back saying we already have such a column, called Information Centre! But if you read the December 1995 column, you would have seen a letter from another reader suggesting this is a recipe for mis-information and technical incompetency — *"You shouldn't have people outside the magazine giving your writers 'guess how it works' material, so it can be printed and mislead others."* So given these conflicting opinions, it's worthwhile examining them.

Information Centre has always been a column for an exchange of information, based on reader enquiries. And to keep your interest, I like to vary its format. For instance I'll occasionally present one or two topics only; sometimes there's a theme, other times a potpourri of topics with no connecting thread.

Most importantly, as far as possible I like to ensure variety, although this is when my technical limitations are likely to be exposed.

As anyone who has studied electronics knows, there's no possible way for one person to have a good knowledge of all areas of the field. So when the subject matter is outside my expertise, I have to rely on readers for the information being sought. A typical example is the braid breaker — a topic well known to some, but not to me.

My role is therefore a presenter (or conductor), not a technical guru. I think it's important to make this point, as sometimes it's easy to forget that the technical staff of an electronics magazine are no different from other technically skilled people. We don't know everything! And nor should we claim to.

I'm sure most readers agree that a general column like Information Centre is an ideal place to air ideas and to seek or exchange information. But as our detractor points out, a format like this has its dangers, and it's also my role to ensure the presented information is as complete and correct as possible. I also choose the letters we present, but it's not appropriate for me to limit the content to my favourite topics.

As for accuracy of the material, you might like to know that after I write this column, it's read by at least two more technically competent staff members. That doesn't necessarily mean all errors are eliminated, but at least you can see we try to get it right.

So providing we try our best to keep the content technically accurate, I believe this column is the ideal place for you to share your experiences, take part in a discussion, ask questions or supply answers. It's really a combined effort, and if we occasionally show our technical limitations, then too bad!

Now let's get on with this month's topics. We'll start with a few short letters from people who do need your help.

Z80 and maths

I would appreciate it if you could pose this question to your readers. I am developing a Z80-based microprocessor project in which I have to do some interesting maths. I cannot use lookup tables. The task requires multiplication and division of 16/32 bit numbers with decimal points, possibly with exponents. Are any readers aware of books or information that describe suitable algorithms, or how to do this? (Peter Baxter, PO Box 1232, Lane Cove 2066)

When I taught microprocessors (including the Z80), I always advised students that an assembly language program was not the way to go when complex maths were involved. A better way is to use a higher order program like BASIC. However that's not saying it can't be done; just that it's not easy. If any readers can help, could you write to Peter.

50 ohm BNC connector

Recently while searching through the odds and sods box I came across a packet containing a BNC connector. The packet stated that it was a 75 ohm type. But is it reasonable to assume there are also 50 ohm types? If so, is the difference simply the size of the hole for the cable, or are there other differences? (David Allen, Findon, SA.)

There are indeed both 75 and 50 ohm BNC connectors, David. But even after asking a number of people with experience in this area, we still haven't learned of any clear way of distinguishing between them — other than measuring the impedance at the specified operating frequency.

Just to confuse the issue, there are also BNC 'terminating load' plugs used in computer networks, which seem to be a modified BNC plug (presumably of the 50Ω type) with a 50Ω resistor inside it.

Like most things in electronics, there's probably an easy way to tell the difference between normal 50Ω and 75Ω BNC connectors, when you know how. If anyone can give more information, I'd be pleased to include it in future editions.

OC926 substitute

I am writing seeking help through your magazine in the hope that some of your readers can recommend a substitute transistor for the OC926. Thank you for a fine magazine. (William Basterfield, 11 Warland Road, Moorabbin 3189)

I tried to find information on this transistor in some early data books in my collection, but to no avail. I'm fairly sure it's a germanium device, but I'm not able to confirm this.

Again if anyone can help, please let either William or ourselves know.

Baluns

The subject of baluns has been raised before. The next letter asks a question almost identical to that posed by a reader in December 1994:

Could you please advise me if the balun circuit in the August 1975 edition of EA is correct. I cannot see how it can possibly work as it seems one of the windings is a short circuit. If the circuit is wrong, could you advise me of the correct circuit. (Bruce Hunt, Heathmont, Vic.)

The circuit is correct, Bruce, or at least it agrees with balun circuits from other sources. A balun circuit from a textbook (*Basic Television* Grob) is in Fig.1, which as you'll see is identical to that in the magazine. If you want a more detailed description of how baluns work, see my account in *EA* December '94 edition, page 86, and February '95 page 95.

Ignition coil tester

This letter is from the reader who suggested we have a Can Anyone Help? column:

I am looking for design details of a circuit that can test the ignition coil of an air-cooled engine, particularly for the electronic types used today. These coils have only one end of the coil accessible, as the other goes through an electronic circuit sealed in a container.

Commercial testers are quite expensive, but they can simulate and change the induced waveform which tests the coil under working conditions. The resulting spark also makes a good tester for spark plugs. (L.W. Fairbrass, 60 McMillan Drive, Port Macquarie 2444)

Hopefully a reader can help you Mr Fairbrass, as this is something we are not familiar with. I've included your complete address so readers can contact you directly. And staying on the subject of automotive ignition...

CDI unit

In July '95 I included a letter from a reader who had traced out the circuit of a faulty CDI unit for a Kawasaki motorcross bike. Unfortunately he was unable to identify a component in the circuit, and sought our opinion.

We've had a number of letters about this, and I included two in October '95 that had different solutions to the problem. I've since received two more, one of which we've space for now. The other includes circuit details from a Kawasaki manual, and I hope to include it next month.

I noticed recently that a reader wants to build a substitute CDI unit for a motor bike. The reason for doing this is the ridiculous cost of a replacement unit. I designed a CDI circuit for a motor boat for the same reasons, and this was published in your Circuit and Design Ideas section in December '94. It might be useful to your reader. (David Francis, Cannonvale, Qld.)

Thanks for reminding us of your circuit, David. It's difficult to keep track of everything we publish, and it's quite likely the circuit will be useful to the original correspondent, and to anyone wanting such a circuit.

Mono to stereo TV

A stereo TV set costs a lot more than a mono version, although I suspect part of the reason for the $500 or more extra cost is for other goodies that make the set more upmarket. But whatever the rationale, the fact remains; TV stereo sound costs! So it's not surprising that readers prefer to seek other, cheaper ways, like the next writer.

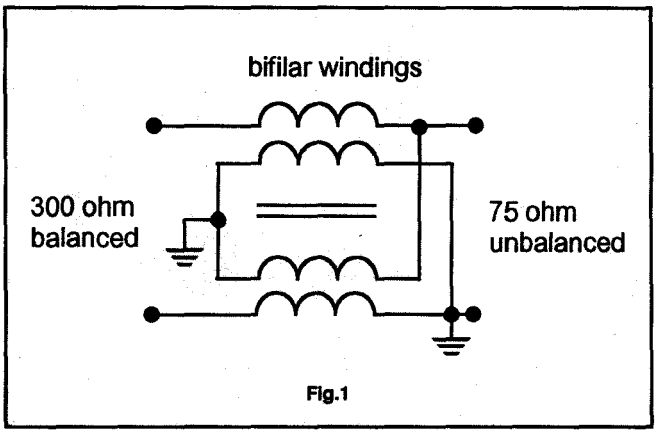


Fig.1

I own a Palsonic model 5139 colour TV set, fitted with two mono speakers. Can a two-speaker mono TV set be converted to stereo? If so, has there been an article in EA detailing how to convert such a set, and are any kits available to do this? (James Tennant, Canberra, ACT.)

First up James, it's not really feasible to convert a mono TV receiver directly to stereo, regardless of how many speakers it has. The processing for the stereo sound signal usually starts from the tuner, with an IF stage for the video and a separate IF stage for the sound. This is done to get rid of frame buzz and other video related signals that otherwise affect the sound.

The output of the sound IF gives two signals, one on a 5.5MHz carrier (the original mono signal) and a second on a 5.742MHz carrier. These two signals are separately amplified by additional IF stages that feed separate FM sound detectors. The output of one detector is the sum of both channels (R+L), while the other detector gives the right channel only (2R). These two signals are fed to a matrix decoder, which combines them to give separate right and left audio signals that are then amplified with separate audio amplifiers. Adding all this to a conventional TV set is not practical, as it requires too much interference with the existing circuitry. However it's eminently practical to build your own stereo decoder. The most recent article explaining how to do this is our Stereo TV Sound Receiver, presented in January-February 1995. And yes, a kit of parts is currently available, from Dick Smith Electronics (DSE).

Basically, the system includes a tuner and IF stage that supply the required signal to a dedicated IC. The outputs of this IC are the aforementioned L+R and 2R signals, which are fed to an opamp-based matrix decoder. The outputs of the decoder include left (L) and right (R) signals that you connect to your own sound system. Other outputs are an L-R 'surround' signal, an L+R (mono) centre signal, and signals for a subwoofer channel. In all cases you add your own audio amplifiers. If you don't have the necessary audio amplifiers, try our Shoestring Stereo Amplifier described in December 1994.

Another way is to buy a stereo VCR, but these are also more expensive than a basic mono version.

The price of the Stereo Sound Receiver kit from DSE is around $250, but as our next letter explains there might be a way to reduce this cost.

Low cost stereo TV

I was re-reading your January issue recently when I noticed the article on the TV Stereo Sound Decoder. I began to take a closer look at the design, but when I saw the cost of the kit I dismissed the idea of building it. However I might have a way to reduce its cost.

Several months ago I picked up a small colour TV set which had been left on the footpath, and judging from the

on the footpath, and judging from the damage, it had hit the ground very hard. The main PCB was split in two, rather untidily separating the small signal RF, IF and colour decoding sections from the switchmode power supply and the EHT section.

Amazingly when I applied power to the small signal section, I was able to pick up the sound and video signals quite easily, as all this section needs is a supply and a TV signal. I was hoping to use this section to replace the more expensive tuning and IF modules in the stereo sound kit.

I connected a spectrum analyser to pin 20 of the M51354 IC in the old TV set and I could clearly see both the 5.5 and 5.74MHz carriers. At pin 19 of the IC only the 5.5MHz carrier was left, as it had been filtered through a 5.5MHz filter.

Would it be possible to connect the output of this IC into pin 15 of the stereo sound decoder chip (TDA3857). The TDA3857 has an internally generated intercarrier sound output, so I know I would lose the advantage of having the quasi-split sound system, but even listening to the mono sound from the M51354 chip I could not hear any frame buzz.

The other alternative would be to pick off the 36MHz carrier from the final video amplifier of the M51354 IC, and feed this to the TDA3857 in the stereo decoder. What do you think? I would imagine that by removing the tuning and IF modules and all their associated circuitry, I could probably build this kit for $50 instead of $250. (Mark Allen, Artarmon, NSW.)

Mark also included details of the M51354 IC, which is a typical 'jungle' chip used in today's TV sets. These ICs have most of the receiver's low signal processing functions built in, but from the data Mark enclosed, I can find no reference to its use in a stereo TV set. In fact Mark, the idea as you describe it won't work, as pin 15 of the TDA3857 is an output. However, it's possible you might get results by feeding the signal from pin 20 of the M51354 to the junction of R8 and R9 in the stereo decoder, if this junction is first lifted from pin 15 of the TDA3857. I suspect this is what you meant anyway.

Even with this connection, I doubt you'll get satisfactory results as the signal levels may not be compatible, and you might upset the decoder's AFC system. We're not in a position to test this for you.

However, I feel confident you'll get good results by using the tuner and IF sections from the old set to replace those in the stereo decoder. This will eliminate quite a lot of components from the stereo decoder, without seriously compromising its performance. After all, the input signal to the stereo decoder section is simply the signal that normally goes to any TV receiver's IF stage. You should be able to pick this up from the set's tuner.

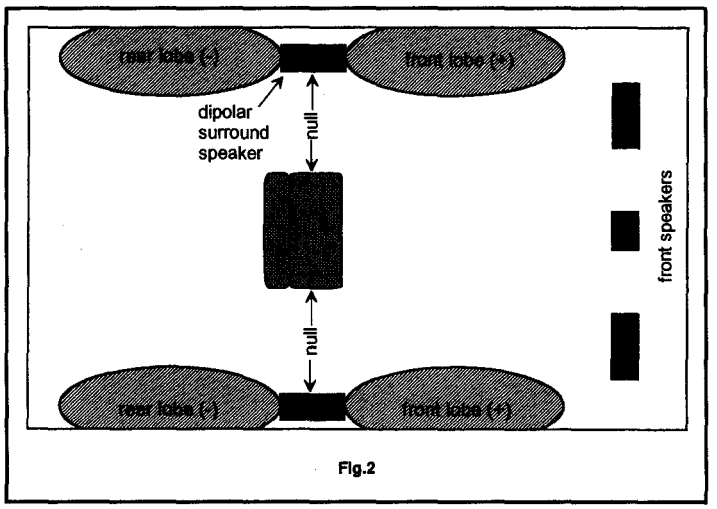


Fig.2

In fact, I further suggest the decoder could be connected to *any* TV set in this way. As I see it, if your TV set has a tuner with an accessible IF output terminal (36MHz), all you need do is connect C6 in the decoder to this terminal. This might cause loading problems for the tuner, but the AGC action of the TV set will probably compensate.

Apart from a cost saving, you also get the advantage of an integrated system, with one tuner doing everything. You might even be able to power the decoder from the TV set.

A problem is that DSE sells the kit as a complete unit. To get a cost saving, you'll need to either buy the parts separately or convince DSE to sell you a reduced kit. If any readers have succeeded with this idea, let me know.

THX system

A buzzword of the '90s is 'home theatre', so it's appropriate we include discussion on the subject. The following letter is from a reader who asks a number of interesting questions that give us the opportunity to discuss home theatre, THX and so on. First the letter, which I've abbreviated somewhat:

My query concerns suitable speakers for a Kenwood KC-X1 amplifier-tuner and a Kenwood KM-X1 power amplifier. When I bought the Kenwood system, the supplier agreed that my existing Dali Mk4 four ohm 140W speakers could be used as the main front speakers. To complete the system I bought a Dali C52 six ohm 100W centre speaker and two Dali Mite 50W eight ohm rear speakers. I've since added a powered Kenwood subwoofer. I now have three questions about this system.

1. I have since noted that the Kenwood KM-X1 manual advises against using speakers of less than six ohms. I've had conflicting advice from suppliers, two saying they use four ohm speakers with this amplifier, a third (who doesn't sell Kenwood) advising against this. Is it practical to increase the impedance of these speakers by adding an appropriate series resistor?

2. The manual also describes the use of dipolar speakers, placed alongside the listener rather than behind. Could I make a dipolar speaker by connecting two Dali Mites back to back, connected in series? If so, are they connected in or out of phase?

3. If I buy a pair of dipolar speakers, how close can they be placed to a wall? I notice Kenwood doesn't suggest dipolar main speakers.

During my research I've found a general lack of knowledge about THX. One supplier was adamant that I should only buy THX approved speakers, including a THX approved subwoofer. Any light you can shed about all this in your column will be greatly appreciated. (Tom Jackson, Beenleigh, Qld.)

I'll take your questions as you pose them, Tom. I don't know the Kenwood KM-X1 unit, so any comments I make are of a general nature. The main reason a manufacturer recommends a minimum impedance value for speakers is to ensure the current capability of the amplifier is not exceeded. In principle, if you don't exceed this current, you won't cause any damage.

Kenwood have obviously found that four ohm speakers can cause an

overload, and possible damage to the amplifier.

This will only occur if the volume level is high enough to cause the overload, so you can happily use four ohm speakers providing the output level is not excessive. But without knowing more about the amplifier, I can't tell you what this output level is. I suspect it's quite high, which is why some suppliers have told you there's no problem with four ohm speakers.

Most amplifiers have output protection which shuts down the amplifier when there's an overload. I'm sure the Kenwood unit would have this. So unless you regularly run the amplifier at full power, I suggest the four ohm speakers won't be a problem.

While it's possible to increase the impedance of a speaker by adding a series resistor, I certainly don't recommend it. The effect is reduced output from the speaker, loss of damping and possible alteration of the frequency response. So forget that idea!

THX is a system developed by Lucas Film in cooperation with Dolby Laboratories. It is purely for movies, and a good THX system is claimed to give a more accurate reproduction of the movie sound track than conventional Dolby Surround. However to get the best effect you have to follow the rules, which is achieved by buying THX approved components. This doesn't mean components without the THX approval are not suitable; it simply means they are, well, not THX approved.

A dipolar speaker is an essential part of a THX system, as it gives a better and more subtle sound placement. Some argue that the effect is sometimes too subtle. I tried dipolar speakers when I got into THX, and found the effects excellent.

However I opted for conventional rear speakers, as I often listen to music in 'concert' mode, which requires rear speakers for best effect. Movies still sound great, although I'm perhaps missing out on some of the subtleties.

I don't advise making your own dipolars with two speakers back-to-back, as there's more to it than that. Either buy THX approved dipolars, or if the effects you're presently getting are pleasing, stick with what you've got. To me, a home theatre system has to provide two things: good audio (from CDs and so on) and a good sound for movies. The two are not compatible as a rule, and the more you go one way, the worse it is for the other.

The placement of dipolar speakers is quite critical, as shown in Fig.2. The speakers are placed on walls either side of the 'hot' seat, and the walls act as reflectors. You need to be in the hot seat for best effect. Rear speakers are less critical in this regard.

Some might see the THX approval requirement as a marketing ploy, but from my experience there's no doubt THX approved components ensure the best results. As you might expect, though, you pay more.

Leclanche cell

It's not often we get letters about the Leclanche cell, the forerunner to the well known carbon-zinc dry cell:

In the library where I work, I've had a number of requests for information on the Leclanche cell or the dry cell. I've not been able to find a lot of information about the subject. Probably the best account I've seen is the 1969 Basic Electronics produced by Electronics Australia.

One interesting point in this book is that it states the role of the manganese dioxide in a dry cell is to prevent the formation of gas, notably hydrogen. Other books I've read say that hydrogen is formed at the positive electrode. Have you produced other books on this subject, or have there been any articles on these cells? I'm quite interested to know whether hydrogen is produced or not. (Greg Sheehan, Montrose, Vic.)

The Leclanche cell is generally recognised as the first practical primary cell. It was developed in the 1860s, some 60 years after Volta had demonstrated his voltaic 'pile'. Its main feature was the addition of a chemical called a depolariser, made of manganese dioxide, the purpose of which is to get rid of the hydrogen build-up around the carbon anode of the cell. So yes, Greg, hydrogen is most definitely formed around the anode of a dry cell during discharge. The hydrogen combines with the oxygen in the manganese dioxide depolariser to form water.

The main difference between the Leclanche cell and today's dry cell is the way the cell is made. The electrolyte is now a paste, rather than a liquid as in Leclanche's wet cell. Otherwise much the same chemicals are used.

The most recent article we've done on this subject is one I wrote for our new Basic Electronics series. The article is in the March 1990 edition, and we hope to produce a one-shot production of all the articles in this series. This should be available soon.

What??

As I mentioned in January, I'm bereft of What?? questions, so I'm drawing this month's question from a book called *101 Puzzles in Thought and Logic* by C.R. Wylie Jr. I've modified the question to give it an electronic feel.

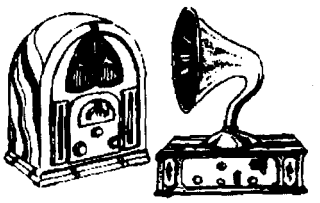
Clem, David and Fred earn their living as an electronic technician, an electrician and a plumber, though not necessarily in that order. The electrician recently tried to get the technician to do some work for him, but was told the technician was doing work for the plumber. The plumber makes more money than the electrician. David makes more money than Clem. Fred has never heard of David. What is each man's occupation?

Answer to January's What

The answer is the bubble in a spirit level. To demonstrate this, lay a spirit level on a table and give the level a quick push directed at one end. That is, lengthwise acceleration. The bubble in the level will race ahead, exhibiting negative inertia. ❖

Vintage Radio

by PETER LANKSHEAR

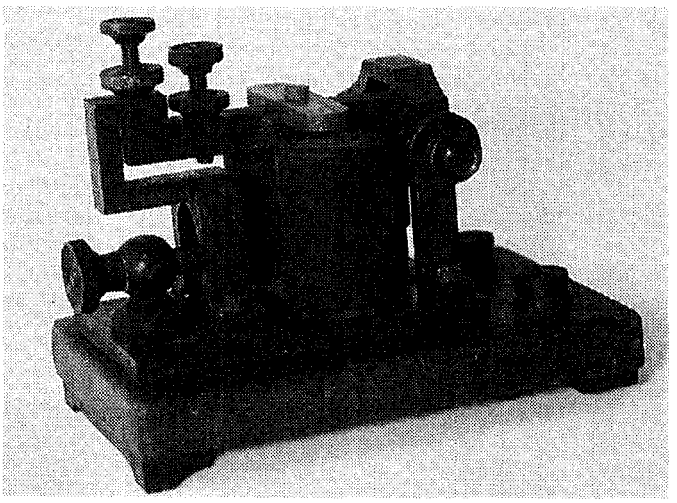


Ancestral Electronics — 2

As we recalled last month, it is just 100 years since Guglielmo Marconi was able to demonstrate telegraphy without connecting wires. His rapid progress in developing his invention owed a lot to his building upon the existing and advanced technology of the electric telegraph. By then telegraphy had already been established for 50 years, and had suitable instruments readily available.

The world as we know it today would be impossible without rapid communication. Even had the telegraph not been in existence, I am certain that radio communication of some sort would have evolved before very long. One could speculate as to when and the form that it could have taken. Perhaps it would have been some form of telephone or maybe a facsimile system based on photography.

As to who, or when, we will never know. But one genius who had the necessary imagination was Nikola Tesla, an early specialist in alternating currents, and who in 1893 had demonstrated the transmission of RF energy. Tesla was to devote much of his life to researching a global network of wireless power transmission, and had the ability to visualise complete systems in considerable detail.



The Morse sound is a classic example of simple and functional industrial design that changed little over many years. This is a standard British Silvertown model.

There were four standard telegraph instruments that Marconi worked with in his original demonstrations. These were the Morse key, the relay, the register and the sounder.

As we saw last month, the register was a direct adaptation by Alfred Vail of Samuel Morse's original receiving instrument, and had the advantage of creating a permanent record on a paper tape — which, by the way, was the origin of the terms 'space' and 'mark'. However operators soon found that, rather than reading the code from the tape, they could translate it aurally in real time from the sound of the armature hitting its limiting stops. It was but a short step to eliminate the tape mechanism to make a compact and efficient classically simple little instrument, the Morse sounder.

An electromagnet attracted the armature mounted on the arm, whose range of movement was limited by the adjusting screws. On the downward stroke the screw in the arm struck the bridge, with a very audible click. When the current was broken the spring connected to its rear returned the arm, so that it made an equally loud sound hitting the top adjusting screw. The duration between the clicks denoted the dots and dashes.

Fundamental design of sounders did not change for more than a century. One popular model in the 1965 catalog of the major American manufacturer J.H. Bunnell was their '1892' Giant Sounder, basically an 1875 pattern!

Sounders commonly were wound to a resistance of around 20 ohms and required an operating current of 75 to 100 milliamps. To drive this order of current through a line more than a few kilometres in length would have required an inordinately high battery voltage. The solution to the problem was the relay, a device with many uses still. Relays enabled operation over lines several hundreds of kilometres in length to be achieved. Over greater distances the familiar open wire lines encountered problems from capacitance and inductance which slowed signalling speed, and leakage across insulators in damp weather could bypass a considerable proportion of the line current.

Telegraph relays were designed to be quick acting and were often fitted with make-before-break contacts. Polarised relays had a permanently magnetised or polarised core, to respond to current flow in one direction only.

The remaining instrument, the Morse key, is so familiar as not to need any description. There was an enormous range and variety made, and whereas most radio keys are single circuit, some telegraph keys had multiple contacts. There is a very active collecting fraternity, especially in America.

Century old diagrams

The two basic telegraph circuits are shown in Fig.1. By the way, some of the circuit symbols may seem a little strange, but these diagrams are reproduced from books printed more than a century ago. *EA* does not often print such out of date material!

Open circuit operation had the advantage of not using any current when inactive, and was best suited to Leclanche or dry batteries — whereas the closed cir-

cuit system was better for Daniel batteries, which deteriorated if left idle. An advantage of the closed circuit system was that the batteries, being in series, were flexible as to location, and if divided along the system, leakage was minimised as the line voltage to earth at any one point was reduced.

Telegraph lines are very expensive to build and maintain and as traffic increased, efforts were soon being made to increase line capacity. The first was the *duplex* system, which was based on the Wheatstone bridge. An essential method of obtaining the correct balance of all bridge duplexes was by means of the artificial line, which had the same characteristics of resistance and capacitance as the main line.

If a relay has two balanced windings, as in Fig.2, a current introduced at the centre tap will flow equally and in opposition through the windings and core magnetisation will be cancelled. However, a current coming in from the line will energise the core by flowing to earth through one winding directly via the back contact of the key, or both windings via the artificial line. The result is that the relay will respond only to the key at the other end of the circuit, and simultaneous traffic is possible in both directions. This is known as the 'single current' differential duplex system. By suitably tensioning the relay return spring, the relay can be made to respond only to currents greater than a selected minimum.

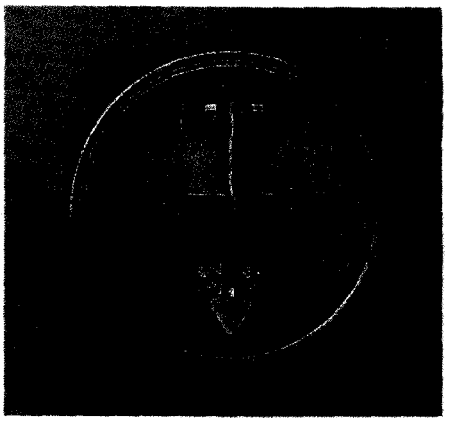
A polarised relay is used for a 'double current' duplex system as in Fig.3. A special sending key, or in some cases a relay, with reversing contacts selects the polarity depending on whether a mark or space is required. Voltages across the windings will deflect the relay tongue to one side or the other depending on their polarity, and irrespective of their strength.

Poser answered

There were, therefore, two basic duplex systems: one current dependent, the other polarity dependent. This is the basis of last month's poser of how to transmit four independent signals over a single wire, using direct currents only.

Duplexing could double the signal capacity of a simplex circuit, but with the increase in traffic as the telegraph became established, congestion was still a problem. In 1873 Thomas Edison — who was, incidently, in his younger days a crack telegraphist — patented the quadruplex system which could transmit the traffic for eight operators, four sending and four receiving, over one wire.

What Edison did was to combine the two basic duplex systems. The intensity dependent single current system was adjusted to respond to relatively heavy currents, while the double current duplex worked with weaker currents. The single current system depended on changing intensity, the double current system on changes in polarity. Fig.4 shows the essentials.



Telegraph instruments were good examples of the 19th century brass and mahogany tradition, as the top view of this more than 100 years old Siemens polarised relay shows. Telegraph instruments are very collectable.

An interesting exercise is to work out all the combinations and currents which can exist depending on which keys are down. It is important to remember that only one current can flow in the line, and this is the algebraic sum of all transmitted currents.

Actually, it is the changes in the balances of the network which actuate the correct relays, and it is quite possible for the current through a relay winding to change during the duration of a mark signal. Setting up a quadruplex system was a skilled exercise, the more so as only very primitive measuring instruments were available!

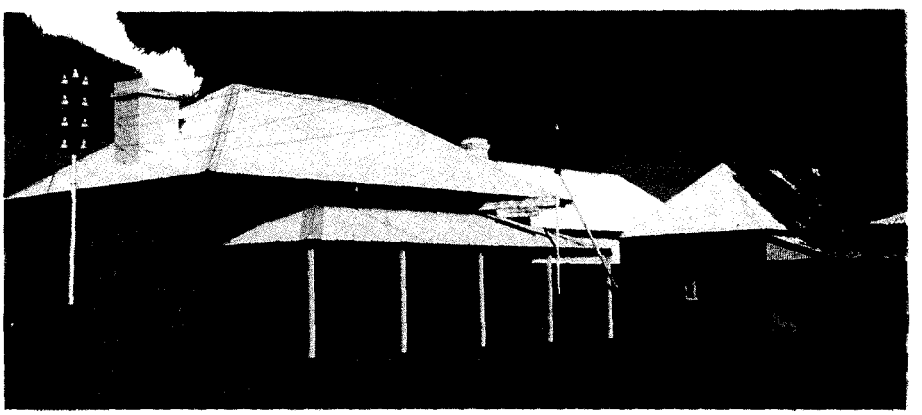
Heroic enterprise

As well as establishing vital communication between Australia and the rest of the world, one epic project in telegraph engineering played a major part in Central Australia's development and settlement. This was the famous Overland Telegraph, completed in 1872, and which for the next 60 years, operated over the nearly 3000 kilometres of line between Port Augusta and Darwin.

Prior to 1872, Australasia was very isolated. The only communication was by sea, and by the time they were received, news reports and mail from Europe were weeks or even months old. Some improvement was possible after 1860, with the connection of India and Ceylon into the expanding world telegraph network. Ships often made their landfall in Western Australia, isolated telegraphically from the rest of Australia before 1877. Continuing on, they called at Adelaide, which had been linked by telegraph to Melbourne and Sydney since 1858. Extensive newspaper reports were then promptly transmitted to the news-hungry eastern cities, much to the financial benefit of the South Australian telegraph system.

In the late 1850's a British scheme proposed laying a cable from Singapore and Java, to connect by landline into the Queensland telegraph system from a terminal in Northern Australia or even the Queensland coast, and thence into the Australian interstate telegraph network.

However the impecunious South Australians did not think that this was a very good idea at all. Traffic for Adelaide would have to be handled on the way by Brisbane, Sydney and Melbourne, who would all extract their



At Alice Springs, seven buildings of the Overland Telegraph station have been carefully restored to provide some idea of what life was like for that isolated community. In the foreground is the telegraph office, housing a range of Morse instruments operating with recorded messages. The pole at the left carried the lines from the battery building, which housed four operational batteries and one spare set — each comprising 100 Daniel cells.

tolls instead of the other way round. A better scheme for the South Australians, prompted by the reports from the explorer John McDougall Stuart, was suggested by their 'live wire' Superintendent of Telegraphs and Chief Astronomer, Charles Heavitree Todd, who accompanied by his wife Alice had arrived from London in November 1855.

Various early explorations had led to the belief that access to Central Australia was barred to the south by the salt lakes, and that the country beyond was extremely inhospitable. However reports from the intrepid John Stuart on his early expeditions, which were financed by prospective graziers, painted a different picture.

In 1859, after reading Stuart's latest promising report, Todd suggested building an overland telegraph line north from the existing terminal at Port Augusta to intercept the cable on the northern coast of Australia at the Victoria River. This would guarantee for South Australia the transit fees for all traffic.

Six expeditions

Although in indifferent health, Stuart continued his valiant and persistent efforts to cross the entire continent and now had the additional commission to find a route for a telegraph line. Finally, on the 24th July 1862, during his sixth expedition, he reached the northern coast at Chambers Bay near what is now Darwin — and was able to confirm that construction of a line appeared to present no insurmountable difficulties.

After some manoeuvring, the Northern Territory was annexed from New South Wales to South Australia, and the next few years were spent trying to establish a settlement to exploit the new country that Stuart had discovered. The trouble was that the pattern and effects of the wet and dry seasons were not understood, and the whole business of the Northern Territory colonisation ended in a fiasco.

Meanwhile, submarine cable technology was having its own problems, with several of the early cables failing. There were to be three Atlantic cables laid before success was achieved in 1866, and the cable to India had failed. Any plans for an Australian extension were on hold.

Eventually, in June 1870, after some tough bargaining and attempts at political sabotage, especially from Queensland, a contract was made between the South Australian Government and the British cable company — but there were some very stringent conditions. South Australia agreed to complete a telegraph system between Port Augusta and the new settlement of Port Darwin by the end of 1871. There were to be heavy penalties if the line was not completed by the due date. South Australia shrewdly insisted on a counter clause of a similar penalty if instead the submarine cable failed.

Today, even with modern mechanisation, 18 months to complete such a project would be a tall order. In 1870, with only animal transport and no maps other than John Stuart's reports, this enterprise can only be described as a classic example of nineteenth century engineering optimism.

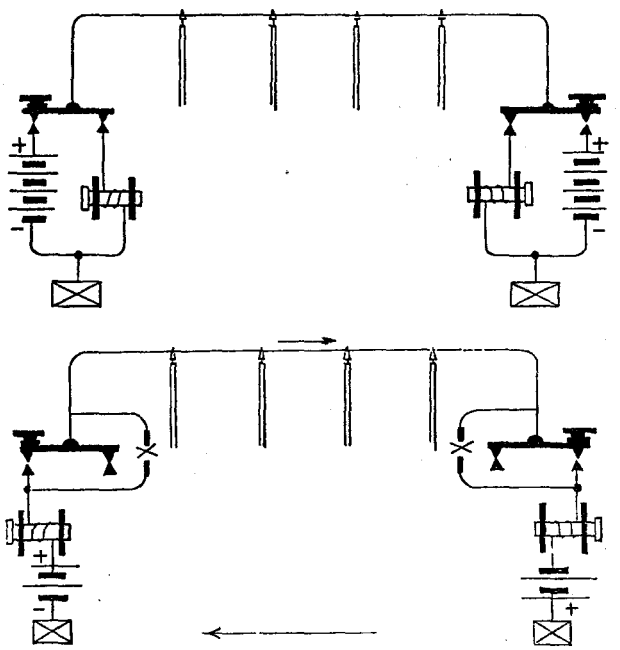
Overall supervision of the project was by Charles Todd, who split construction into three sections. Private contractors were used at the northern and southern ends, and Government teams for the central section, which was from just north of Oodnadatta to Tennant Creek.

Impressive logistics

The logistics involved were most impressive. Somehow provisions, 36,000 poles, insulators and pins and several hundreds of tonnes of eight-gauge iron wire had to be obtained and then transported and erected, and the line maintained and operated. Ten repeater stations and depots had to be established in the wilderness. Transport required hundreds of horses, bullocks and camels, and materials for the northern section were sent by a long sea voyage from Adelaide to Darwin.

As an instance of the travel times involved, a round trip for a bullock team from Port Augusta to the Central depot at the junction of the Finke and Hugh Rivers took four months, and the team building the section from Barrow Creek to Tennant Creek was eight months on the trail after leaving Port Augusta, before they arrived on site!

Most northern repeater stations took



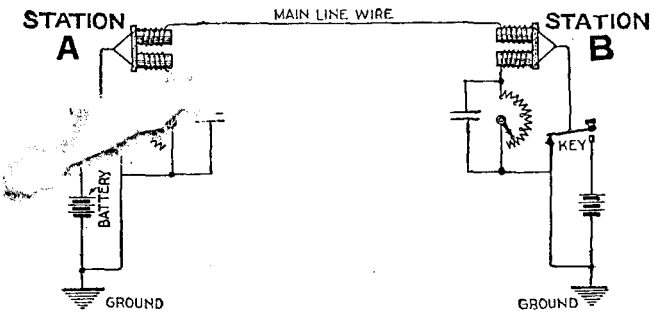
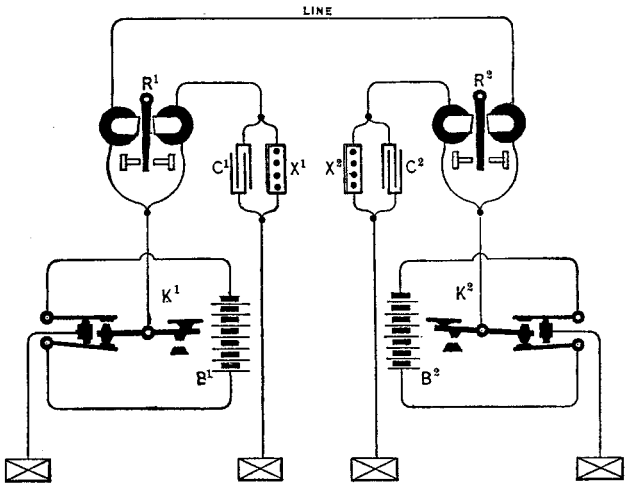


Fig.1 (left): The two basic simplex systems, with the open circuit type shown at top. This system was suited to dry cell batteries and low traffic densities. With serious operation, shown below, the closed circuit system required only half the number of cells, and was best suited to continuous current batteries.

Fig.2 (above): A simplified diagram of the single current duplex system. The sending current from the key was ignored locally, as it split equally through the relay windings, cancelling any magnetic effect. For simplification, local sounders are not shown in the multiplex diagrams.



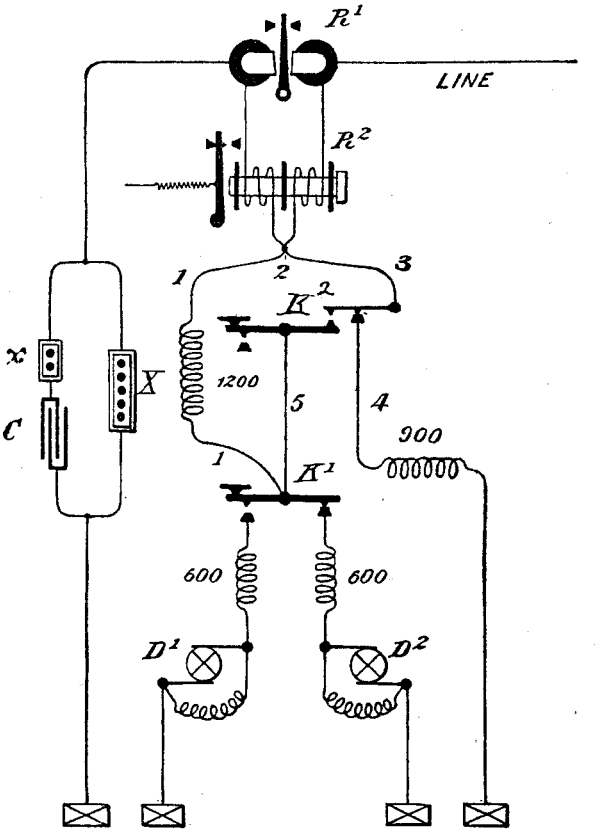


Fig.3 (above): The basics of double current duplex, which was based on polarity rather than current changes. Operation was much like the single current system, but polarised relays were used.

Fig.4 (right): Quadruplex telegraphy combined the single and double current duplex systems to permit the simultaneous transmission of four messages, two in each direction. Dynamos were used to supply the relatively high voltages and currents required by the single current section.

the name given by John Stuart to a nearby geographic feature, but there is one notable exception. As Stuart's route through the McDonnell Ranges was not suitable for wagons, Surveyor W.W. Mills searched to the east for an easier path through the barrier, eventually finding a passage with a water course. These he named Heavitree Gap and the Todd River, in honour of his boss. Today, the telegraph line has gone, but Heavitree Gap still carries the river, and alongside it the Stuart Highway and the Central Australia Railway.

Following the water course about 5km upstream, Mills found a fine waterhole — which, to make naming a family affair, he called Alice Springs, after Mrs Todd. Here, situated at about the mid point of the line, was built what was to become the most important of the repeater stations.

The southern and central sections of the Overland Telegraph were finished just in time for completion of the cable laying. But inept administration and continued lack of understanding of the monsoon weather delayed completion of the northern section until August 22, 1872.

The delay was getting South Australia into trouble, with the cable company threatening to shift the terminal to Queensland. But fortuitously the submarine cable failed, on the 24th June. This gave a welcome breathing space for the Australians, and their cheeky counterclaim clause provided a welcome refund of the penalties. Finally, the cable was repaired on October 21st 1872, and Australia's isolation was over.

The system provided a vital link with the outside world, and at first messages were repeated manually along the line. But as technology improved, automatic repeaters were employed. As well as successful telegraph operations, the stations provided a vital social service until the line was closed in 1932.

Today there is little left but the remains of some of the buildings at repeater sites. Alice Springs Station has been skilfully restored as a museum, depicting life at the lonely outpost and, complete with working instruments and friendly personnel, it is well worth a visit.

This has been a very brief summary of an epic story. A much fuller story was published by Frank Clune in 1955. Titled *Overland Telegraph* there is a detailed account of the history, politics and difficulties of exploring and constructing one of Australia's great nineteenth century engineering achievements.

An excellent, well illustrated booklet *Telegraph Stations of Central Australia* has been prepared by the Northern Territory Conservation Commission and is available from the Alice Springs museum.

Satellites have now revolutionised long distance communications, making Morse a dying language commercially. A few months ago the American Coastguard announced that they were ceasing all code operations. Some amateur radio operators keep the tradition alive, but it can be only a matter of time before Morse ceases to be mandatory even for ham tickets. ❖

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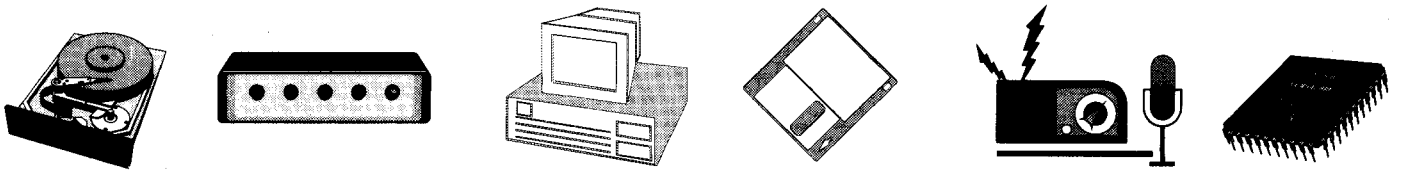


PC-Driven EGO Sensor Analyser - 2

Continued from page 59

waveforms later — Do **NOT** watch the screen while you are driving!)

Turned around

As mentioned last month, the analyser can be driven in 'reverse', producing an output voltage that can be used to check the operation of both the ECU and the rest of the fuel injection system.

In order to test the engine in this way, you will have to break the line from the EGO sensor temporarily in order to feed the voltage from the analyser into the ECU. This break should be somewhere accessible, as you'll need to reconnect it afterwards.

Connect the BNC leads to the ECU side of the break, and the plug into the 'Test Voltage Output' socket on the EGO analyser.

Now run EGO.EXE, and click on the Generate Voltage button from the main menu. A new screen will appear, prompting you to either type in a voltage between 0.00 and 1.28 volts, or to select a voltage from the list. Do so, click on 'OK', and the analyser will produce the required voltage.

In this way, you can simulate an EGO sensor, for the testing and adjustment of the ECU itself. For example, by selecting 0.45 volts, you can see how the ECU behaves at stoichiometry. This allows you to set such things as the mixture and base idle settings without the ECU sensing the change and attempting to compensate.

You can also see how the ECU responds to changes in the oxygen content of the engine's exhaust, simply by clicking on a new voltage. This would simulate a richer or leaner mixture and the ECU should adjust the engine's actual AFR to compensate. Oh, and don't forget to reconnect the EGO sensor to the ECU before using the car again, as the results could be — well, unpredictable.

Again, use some form of secure waterproof connector or even some waterproof tape around the joint, to prevent water ingress.

Seeing the display on the screen is one thing, but it would be nice to obtain some form of printout that can be kept for reference. As the EGO software can be run under Windows, perhaps the easiest way to obtain a printout of the analyser's main screen is to run the EGO.EXE file from windows' File Manager and then use the [Shift+PrintScrn] function to copy the analyser's screen to the clipboard.

The clipboard image can now be imported into almost any paint/draw package and consequently printed using your normal Windows printer drivers. If you are doing this, you may find that you get better printouts if you select Mono as the screen mode in the setup menu, as you will then only be dealing with a black and white image to print.

Well, that's about it. As you can see, using the analyser is more a case of driving the software than twiddling knobs and dials. But as a fair amount of effort has gone into developing the software, I hope you'll find it straightforward and easy to use. ❖

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

February 1946

Fingerprint by radio: Scotland Yard has successfully sent a photograph of a fingerprint by radio to Melbourne. It was the first time the British police force had transmitted a fingerprint abroad by radio.

Within 24 hours the Melbourne police were able to notify London by radio that identification had been established.

A Scotland Yard official said that, in view of the success of the experiment, the service could be used to other parts of the world, irrespective of distance.

Self healing paper condensers: A recent issue of 'Wireless World' reports the development of a line of unique self healing metallised paper condensers.

They are made for working voltages of 150, 250 and 350 volts and in capacitance values from .05 to 2 mfd.

They differ from ordinary paper condensers in that the test voltages are very little higher than the rated operating voltage and sudden excessive surges can prove harmful. However, within certain limits, they have self healing properties and are very much smaller, in the low voltage ratings at least, than comparable condensers of conventional pattern.

February 1971

Light water reactor: The state owned Electricite de France has switched to a light water technique pressured water reactor (PWR) for nuclear power after a year long evaluation of it and of the boiling water technology.

Prior to this the power utility had used a third technology based on sodium graphite.

It has selected the Westinghouse light water nuclear technology PWR for the first of several new nuclear power stations it is to build. The first new station will be a 850MW PWR plant at Fessenheim on the Rhine.

Lonsdale exchange: A new 17-storey automatic trunk exchange at Lonsdale, Melbourne, built at a cost of $9.5 million, was brought into service recently. The exchange will increase the STD capacity for Melbourne telephone subscribers' services. It will be an important link in the national STD grid to which 75% of the 2.7 million Australian telephone services already have access. Manual operating position will be installed to meet expanding requirements for handling international calls and special services such as directory assistance.

Accommodation is available in the building for switching equipment associated with a common user data network the Post Office plans to bring into operation early in 1972. ❖

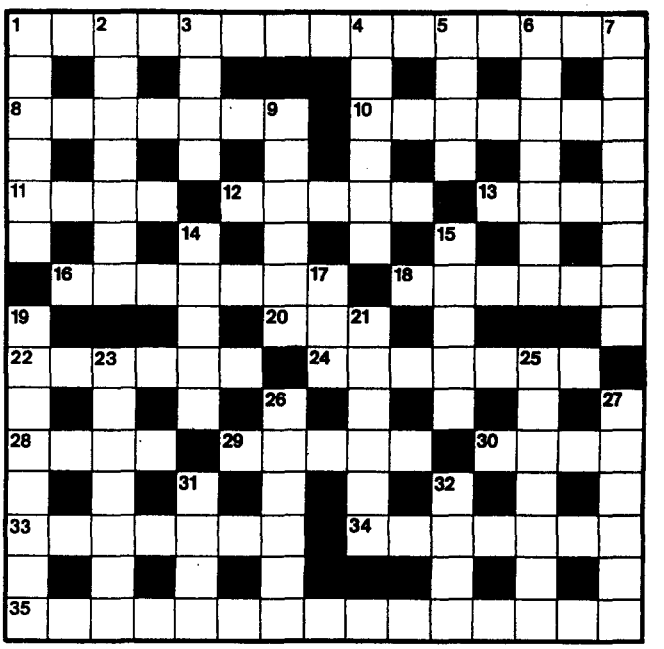
EA CROSSWORD

ACROSS

1. Said of assured power supply. (15)
8. Period of one circuit! (3,4)
10. Valve. (7)
11. Average. (4)
12. Planet. (5)
13. Regular puzzle in EA. (4)
16. Pause in playing. (7)
18. Inventor of the planar process. (6)
20. Authority that manages use of e/m spectrum. (1,1,1)
22. Determine position. (6)
24. Part of a transformer. (7)
28. Technician's item. (4)
29. Brand of test equipment. (5)
30. Sub-atomic process, ---- production. (4)
33. Mercury, for example, but not 12 across. (7)
34. Broadcasting base. (7)
35. Said of a system of radio receiving. (15)

DOWN

1. Ultra-violet light source.(1,1,4)
2. Said of matching waves. (2,5)
3. Vehicular fitting, the ---- light. (4)
4. Disconnect an electrical appliance. (6)
5. Adjust for optimum performance. (4)
6. Brand of electronic typewriter. (7)
7&26. Domestic appliance. (8,6)
9. Activates removal of cassette. (6)
14. Radiates; gives off. (5)
15. Changes setting on a camcorder. (5)
17. Electrical unit. (3)
19. Output devices that draw. (8)
21. Assemblies of antenna elements. (6)
23. Focusing range when camcorder does 15 down. (5-2)
25. Imaging system, virtual ----. (7)
26. See 7 down.
27. Coulomb's country. (6)
31. Cochlear implants enable one to ----. (4)
32. Metric prefixing factor. (4)



SOLUTION TO JANUARY 1996

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Electronics Australia's

Professional Electronics

S • U • P • P • L • E • M • E • N • T

TECH SEMI CONSORTIUM TO BUILD CHIP FABS WORTH US$8 BILLION IN SINGAPORE

NEW OEM MANUFACTURING PLANT FOR BRISBANE

ACEL LAUNCHES ONLINE DATABASE WITH INDEXING VIA LOCAL CD-ROM

REVIEW OF PROTEUS 'PROPAK' SCHEMATIC/PCB CAD PACKAGE

BANKSIA'S NEW V.34 VOICE MODEM: A 28.8kB/S RAW DATA RATE, PLUS FEATURES THAT TURN A PC WITH SOUND CARD INTO A TELEPHONE ANSWERING MACHINE, WITH FULL VOICE-MAIL FACILITIES...

NEWS HIGHLIGHTS

MARCONI REMEMBERED

As noted in our last issue, the Hobart Local Area Committee of the IREE Society was planning to attempt a 'multi mode' communications link with St John's Newfoundland at their Annual Foundation Day Dinner on 12th December 1995, to commemorate the 94th anniversary of Marconi's historic transmission on December 12, 1901 between Poldhu in Cornwall (UK) and Signal Hill in St John's. David Edwards of the IREE Society has reported that the link was successfully made, at 10:30pm in Hobart — corresponding to 11:30am in Greenwich and 8:00am in St Johns.

Radio contact using Morse code was made with Joe Craig (VO1NA), Len Zedel and Ian Clark in Newfoundland. The IREE Society was represented by David Edwards, Richard Rogers (VK7RO), Graeme Cohen (VK5BC0) and Andrew Boon (VK7AW). As well as Morse contact, the two groups exchanged greetings via standard e-mail, talk e-mail, cellular phone and standard phone.

A live broadcast from Signal Hill was made earlier in the evening/morning by Len Zedel.

US$8B CHIP FABS FOR SINGAPORE

Singapore's role as a leading centre of semiconductor production is set to expand further, as consortium Tech Semiconductor announced that it will invest about US$8 billion in three or four new 8" wafer fab facilities which will be built over the next eight years.

Tech Semiconductor currently has two wafer plants in operation. Tech's move follows a recent announcement by another Singapore government-backed company, Chartered Semiconductor, which said it will double its investment in new wafer plants to US$10 billion.

Tech Semiconductor is a joint venture between Singapore's Economic Development Board, Japan's Canon, and US firms Texas Instruments and Hewlett-Packard.

Singapore is the second Asia Pacific nation that is trying to become a major centre for chip production. Last year Taiwan-based companies announced plans for at least 16 new 8" fabs that will require investments totalling US$20 - 30 billion.

The rapidly rising investments in fab plants in all areas of the world has raised fears a glut might result around 1997, when as many as 80 new fabs will have come on line. However chip industry executives point out that mounting demand for digital products in more and more geographic markets will keep many chip types, including DRAMs, in short supply even with the added capacity. They also point out that every year 20 or so fabs are retired, having become too inefficient to keep open.

ONLINE SERVICE LINKS CD-ROM, ISDN

Sydney based company ACEL Information has officially launched a new online information technology which it calls CD-Connect. The technology, which Managing Director Alan Philips claims is a world first, is a marriage between CD-ROM and ISDN technologies.

ACEL developed the technology as a response to its need to deliver large image databases to its Australia wide customer base. The company provides a number of specialised, managed information services across Australia, spanning the fields of engineering, construction, architecture, electronics, environment, occupational health and safety, and standards. The services are typically annual subscription based with prices in the $1000 - 6000 pa range.

Until now, most of these databases have been provided on microfiche with CD-ROM indexing. There has clearly been a need for full electronic delivery. But because of the disparate sources of much of the data it has been stored as facsimile images rather than in character format. A typical ACEL database, such as ACEL Electronics File, runs to up to 50 to 60 gigabytes.

Leading US and British database suppliers deliver large image databases on multiple CD-ROMs — scores of them in some cases — with one CD acting as the index. Some of these services are also sold in Australia.

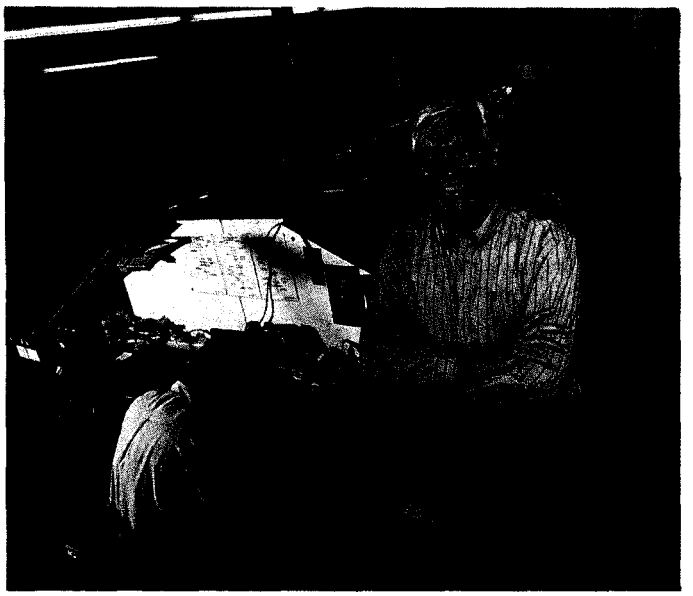
ACEL believes that the multiple CD-ROM avenue is not an appropriate use of technology, while wholly online options have many drawbacks too — as a high proportion of costly online time is spent browsing an extensive indexing system.

ACEL's new approach combines indexing locally on a CD-ROM with fast online access of the desired information using the ISDN network. With channel aggregation, effective data transfer rates of over 100kb/s can be achieved and ISDN lines connect virtually instantaneously. At these speeds, data transfer rates of under three seconds per page can be achieved — about the time needed to read an image from a CD. Once delivered the data is available locally for printing, pasting into other files or storage for future use.

CD-Connect also differs from most online systems by eliminating the need for complicated passwords and login procedures. All verification is done automatically and invisibly to the user.

NEW MANUFACTURING PLANT IN BRISBANE

A new electronics hardware and software manufacturing facility has been set up in Brisbane to meet the rapidly growing demand in Australia for locally based world class facilities. The new company, Oz Electronics (OEM), is a joint venture involving a number of local indigenous information technology and electronics companies and industry identities.



The establishment of Oz Electronics Manufacturing is the outcome of the Brisbane Electronic Network programme, initially spawned by Queensland's Information Industries Board to look at local manufacturing needs and encourage local IT&T companies to get together to find business solutions.

Mr Max Rose, managing director of OEM, claims the new company's presence will provide tremendous assistance to Australian IT&T developers seeking to become internationally competitive.

"OEM is able to foster the potential in Australian developers by providing local access to world class facilities, and by offering expertise in the manufacture of componentry that meets the stringent requirements of European and North American markets" he said.

Over half a million dollars has been spent establishing the OEM joint venture. This investment has largely been in capital equipment, including ultra-fine pitch pick and place facilities, automated surface mount and plated through hole assembly, and cable looming.

Services offered by OEM include advice on design to manufacture, affordable prototype assembly and testing, component sourcing, PCB loading and automatic machine soldering of PCBs, cable looming, and final assembly and testing.

Existing customers include Mitec, Stallion Technologies, Ranger Instruments, Night-Life Music Video and MicroElectronic Technologies (MeT).

Mr Rose said the company was currently negotiating manufacturing contracts with several interstate developers and some key internationals.

STANILITE SIGNS $700M AGREEMENT

Australian owned Stanilite Electronics has signed a four-year Fixed Term Agreement with the Federal Government that will bring more than $733 million in exports, research and development, and investments, according to Minister for Industry, Science and Technology Senator Peter Cook.

Stanilite now employs more than 700 people worldwide, and has major offices in New Zealand, Hong Kong, Cyprus, the USA, India and South America. The company's global strategy is built on the rapid growth of wireless applications for connecting fixed telephone equipment to the public switched network.

"Stanilite's fixed-term agreement comprises research and development into innovative techniques for using radio frequencies, meaning higher network capacity and higher data throughput", said Senator Cook. The projected global market for fixed wireless access is US$13 billion by the year 2000.

Stanilite was founded in 1977 by joint managing directors John and Robert Harriss. Projected 1995 revenues were $125 million, up 30% on 1994 figures.

The company recently won contracts in Queensland and South Australia for the supply of its Trunkswitch trunked radio systems, worth a total of $480,000. These were the first orders for Trunkswitch systems within Australia, although systems are already operating in Africa, Poland, China, Russia and Belgium.

INTUSOFT ON THE WEB

US firm Intusoft, well known for its IsSPICE circuit simulation tools, has established both a site on the World Wide Web and an address for file transfer protocol (FTP). These are in addition to the CompuServe forum that the company has conducted for some time.

Both new sites offer free SPICE model libraries for components, software modelling utilities and a great deal of SPICE reference material such as application notes and full technical articles.

"We are striving to become the first place engineers look, for information on SPICE related topics", said Intusoft VP Charles Hymowitz.

The Intusoft Web site address is **http://www.intusoft.com**, while the FTP address is **ftp://ftp.intusoft.com**.

Intusoft has also posted a free working model of its popular ICAP/4 simulation system, which includes schematic entry, a SPICE model library, SPICE 3F.4 simulator and post processor.

In August 1995 Intusoft celebrated its 10-year anniversary, and also shipped its 14,000th SPICE package.

MULTIMEDIA LINKS FOR MONASH UNI

Siemens is installing a new high speed network for Australia's largest university, Monash University in Clayton (Melbourne). The first phase involved installing two ATM (asynchronous transfer mode) based switching systems at the university's main site in Clayton. In the second phase, it is planned to link all six of the university's sites to one another, so that, for instance, lectures and teaching material can be relayed to other sites and video conferences can be held.

The technology for the new multimedia network is based on the ATM procedure in which large quantities of data can be transferred very quickly and new broadband communication applications can become a reality. The current speed of 155 megabits a second is equivalent to around 2000 simultaneous, digital-signal-quality telephone conversations or 7700 typewritten pages per second. The individual sites, which are as much as 170km apart, will be connected using private line of sight radio links. It is planned to integrate the university's

existing voice and data network into the new high speed network.

COSMIC RAY MYSTERY SOLVED?

Physicists from Japan and the United States have discovered a possible solution to the puzzle of the origin of high energy cosmic rays, which bombard Earth from all directions in space. Using data from the Japan/US X-ray astronomical satellite ASCA, physicists have found what they term 'the first strong observational evidence' for the production of these particles in the shock wave of a supernova remnant, the expanding fireball produced by the explosion of a star.

Cosmic rays were discovered in 1912 by the Austrian physicist Victor Hess, who subsequently received the Nobel Prize in Physics for that work. They are subatomic particles, mostly electrons and protons, that travel near the speed of light. Ever since their discovery, scientists have debated where cosmic rays come from and how ordinary subatomic particles can be accelerated to such high speeds. Supernova remnants have long been thought to provide the high energy cosmic rays, but the evidence has been lacking until now.

The international team of investigators used the satellite to determine that cosmic rays are generated at a high rate in the remains of the supernova of 1006 AD — which appeared to medieval viewers to be as bright as the moon — and that they are accelerated to high velocities by a process first suggested by the nuclear physicist Enrico Fermi in 1949.

The satellite contains telescopes for simultaneously taking images and spectra of X-rays from celestial sources, allowing astronomers to distinguish different types of X-ray emission from nearby regions of the same object.

The tell-tale clue to the discovery was the detection of two oppositely-located regions in the rapidly expanding supernova remnant, the debris from the stellar explosion. The two regions glow intensely in what is called synchrotron radiation, which is produced when electrons move at nearly the speed of light through a magnetic field in space.

The cosmic rays are accelerated in the two regions that glow with synchrotron radiation, the physicists concluded. Specifically, charged particles are accelerated to nearly the speed of light and energies of 100 trillion electron volts, as they bounce off turbulent regions inside the shock front from the supernova explosion.

This amount of energy is over 50 times higher than can be produced in the most powerful particle accelerator on Earth.

"Since we found cosmic ray acceleration under way in the remnant of Supernova 1006, this process probably occurs in other young supernova remnants", according to Dr Robert Petre, of NASA's Goddard Space Flight Center's Laboratory for High Energy Astrophysics, Greenbelt, MD.

Astronomers estimate that there is a supernova explosion in the Milky Way galaxy, which contains the Earth, about once every 30 years.

California based semiconductor production equipment maker Lam Research has introduced its new Deep SubMicron 9800 chemical vapour deposition (CVD) system, designed to support chip makers in producing devices with 0.35 micron and smaller design rules.

JAYCAR KITS NOW MADE UNDER AS9002

Jaycar Electronics Head Office, Warehouse and Kit Department has successfully passed all requirements and has been accredited to AS/NZ ISO 9002:1994.

"We realised that sooner or later we would have to seek this level of quality of management, documentation and quality control", commented Managing Director, Gary Johnston.

"As it turned out, our existing organisation was close to the high standards required anyway, so achieving the AS9002 level of quality was not particularly difficult. Our kits have always been very high quality — now we have independent proof that they are."

Mr Johnston added that the accreditation is part on an ongoing commitment by the company to provide the highest standard of service in the industry.

BIG PLANS FOR PC 96 SHOW

PC 96 will be the first Australian PC show ever to be held in four halls, when it is staged at Sydney's Darling Harbour Exhibition and Convention Centre on 5-8 March. Over 170 exhibitors have confirmed their positions at the show, and given the 33% increase in the size of the exhibition, PC 96 looks certain to build upon the tremendous success of the 1995 PC Shows. Show organisers Australian Exhibition Services expect that some 55,000 visitors will attend the show over the four day period, encourage by the opportunity to see the latest technology in the IT industry from the biggest names in the business.

"I am extremely excited by the prospect of PC 96 being the biggest computer show ever", said Gabrielle Stephens, Exhibition Director. "With a massive 20,000 square metres of exhibition space, a greater number of exhibitors will be able to participate in the show. Given the number of companies who had to be turned away last year through lack of floor space, this increased exhibitor participation will ensure an even wider variety of products are on show," she said.

A number of big names within the computer industry have already committed to the show, including Canon, Hewlett-Packard, Epson, Novell, Lotus, Olivetti, Telstra, DEC and others.

The exhibition will also contain the largest ever component of overseas

exhibitors, with international groups from Bavaria, Taiwan, UK, NZ and many more.

FIRST LOCAL DIGITAL MOBILE

Optus Communications and Queensland company Voxson Sales have joined forces in a multi-million dollar push to complete development of the first mobile digital phone designed and developed in Australia. When completed, the project is expected to result in the creation of up to 150 additional jobs for Queensland as well as income of around $100 million per year for the state.

Voxson Sales has designed and developed the GSM (Global Standard for Mobile) handset, which is currently undergoing Type Approval Testing in the UK. In a moved aimed to support local industry, Optus has committed to pay Voxson more than $1 million to help fast track the handset to market.

Optus Chief Operating Officer, Mr Ian Boatman, said: "Optus has a policy of supporting and fostering Australian research and development. We are delighted to support another Australian company in its development of advanced telecommunications equipment."

Optus has a commitment to achieve 80% Australian content in its research and development spend by 1997. With projects such as our support of Voxson, we have already exceeded that figure."

Chairman of Voxson Sales, Mr Lucas Longginou, said: "The successful completion of the project will mark the first mobile handset designed and developed in Australia. Voxson recently signed a US$16 million contract to supply GSM chip sets for the Voxson handset.

DIGITAL COMPRESSION FOR ABC'S LINKS

The Australian Broadcasting Corporation is the first major domestic broadcaster to use digital compression technology. The ABC has purchased Scientific-Atlanta's MPEG-2 based digital compression system PowerVu, for trial purposes.

When acceptance tests are completed, the ABC plans to use this system to send news programs throughout Australia via satellite. Digital compression will then enable the ABC to transmit additional TV signals across its existing satellite links.

Typically, three digital channels can run on satellite links using compression in place of one analog channel. The ABC will initially use only one digital compression link to transmit programming in the transponder.

"Digital video compression is a cost effective way for us to distribute news feeds, current affairs reports and other programs," said Ray Reynolds, national manager of technical operations ABC Television. "Compression lets us increase the number of programs transmitted on the same amount of bandwidth."

The ABC selected Scientific-Atlanta's PowerVu system, which is a digital compression system based on MPEG-2 encoding algorithms (specifications). MPEG-2 is optimised for higher data rate video applications, including HDTV, primarily in the four to 15Mb/s range. PowerVu has a variable bit rate capability. This lets the ABC change the bit rate to suit the picture quality of the program material being sent across the link.

HIGH SCHOOL SOLAR POWER PROJECT

The Australian Solar High Schools Project, developed by the University of New South Wales, aims to prepare students for the energy choices of the 21st century. The first Solar Power Station in the project has been installed at Sydney's historic Fort Street High School. A solar photovoltaic power station will be installed in each school involved in the project, and teaching resources will be made available to integrate the operate of the power station into a wide range of subject areas. Each installation of the Australian Solar High Schools Project will consist of a solar photovoltaic power station; a computer controlled display panel showing the amount of energy generated by the station (this information will be networked to the school's computer system); and teaching materials that integrate the solar photovoltaic power station into a range of subjects, including science, mathematics, computer studies, industrial arts, economics and social studies.

The overall objectives of the Project are to demonstrate to students that solar photovoltaic power and other renewables are serious sources of energy; to raise awareness of energy and environment issues in high school education; to raise the profile of engineering as a profession involved in environmentally beneficial activities; and to enhance educational opportunities. In particular, the project will give students the opportunity to use computers to acquire and manipulate online data.

FIRMS TO PUSH INTERACTIVE TV

A group of major companies from the electronics, telecommunications and advertising industries is establishing a new organisation, the Intertext Consortium, to promote and encourage early development of a new interactive television system in Japan, with the goal of starting such broadcasts in 1996.

The consortium will provide a forum for information exchange on the new interactive TV system, originated by Toshiba, Sony, Matsushita Electrical Industrial, and Nippon Telegraph and Telephone Corporation.

The new interactive TV system makes use of Japan's current terrestrial TV and teletext broadcasting system and standard telephone lines, and offers substantial advantages in installation and operating costs over fully digitised interactive systems.

The Intertext Consortium will promote the new interactive TV system to broadcasters, TV program production companies and advertising and marketing companies both in Japan and overseas. The system consists of an interactive TV broadcasting system, network server. telephone lines and home-use TV receiver. The broadcasting system consists of an interactive program production system, data storage system, TV program transmission system and multiplexing equipment. ❖

NEWS BRIEFS

- ***Electric Factory*** has been appointed as the Australian distributor for TL Audio products, manufacturers of a range of audio equipment based on a combination of solid state and valve technology.
- ***Banksia Technology*** has appointed John Papanidis as Public Relations Coordinator, Michelle Carrick as Marketing Coordinator, and Sharon Fung as Database Administrator.
- The 10th ***Australian Cable & Satellite Television*** conference and exhibition will be held at the Sydney Convention Centre, Darling Harbour, February 6-8 1996. For details phone (02) 210 5777.
- Semiconductor device distributor ***Zatek*** has moved offices. The new postal address is PO Box 228, Burwood, 2134. The new phone and fax numbers are (02) 744 5711, (02) 744 5527.

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

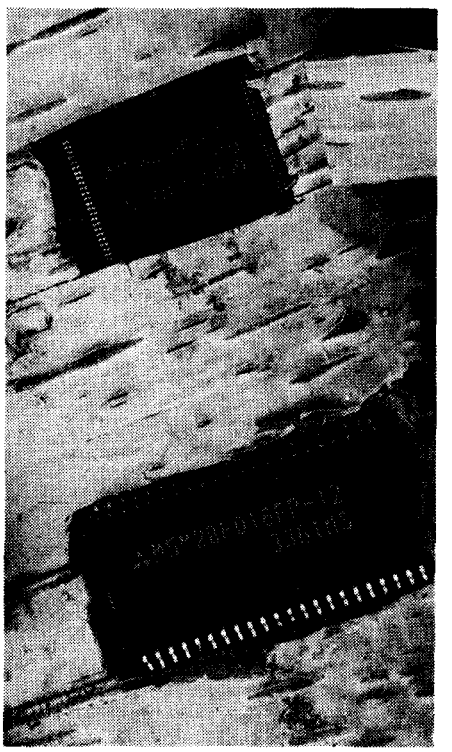
16Mbit DINOR Flash device

Mitsubishi Electric has announced the introduction of its second generation 16Mb Flash devices based on 0.5um CMOS design rules and DINOR (divided bit line NOR) architecture. The devices provide the important combination of high performance with low power operation in a very small package for portable applications including mobile telecomms and computing, as well as solid state disks, memory cards and resident Flash arrays.

The 3.3V devices feature a built in sequence controller which allows automatic program and erase functions without needing complex external control. Time to erase is typically 10ms/block. Other functions include software command control, selective block lock, erase, suspend or resume and status register read.

Block erase is provided for up to 32 blocks of 64KB/block. Programming time is typically 1ms/256bytes. A deep power down mode minimises power consumption.

The 2M x 8-bit devices are available in 80, 100 and 120ns versions. In operation they consume 108mW for read cycles, 216mW for program and erase cycles and 0.36mW on standby. In deep power down mode consumption falls to typically 3.6uW.



For further information circle 251 on the reader service coupon or contact Mitsubishi Electric Australia, 348 Victoria Road, Rydalmere 2115; phone (02) 898 0484.

Low cost 68HC11

Motorola has launched the MC68HC11EDOCFN3, a low cost member of the Motorola 68HC11 family. It has a multiplexed address/data bus and 512 bytes of RAM.

The usual 16-bit HC11 timer is retained, offering three input capture and four output compares plus an additional channel capable of being an input capture or output compare. These channels can also be used as general purpose I/O. One additional eight bit I/O port is also offered. The typical HC11 family attributes of SCI, SPI, COP and real time interrupt circuitry are also included. It is available in a 44-pin PLCC package.

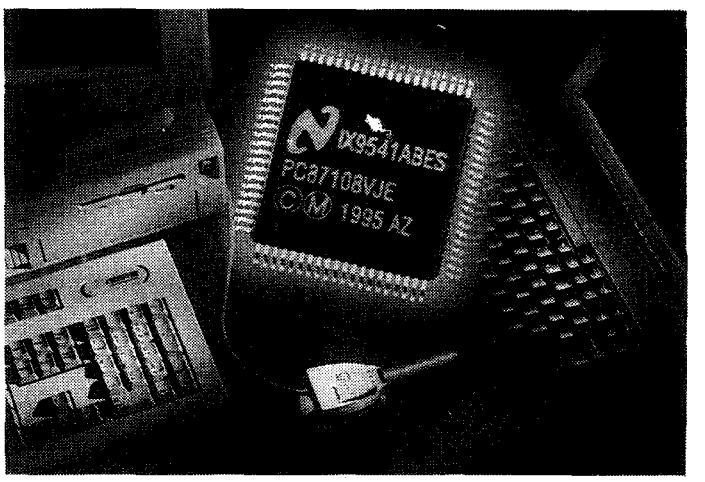
For further information circle 253 on the reader service coupon or contact Veltek Australia, 18 Harker Street, Burwood 3125; phone (03) 9808 7511.

4Mbps infra-red controller

National Semiconductor has announced sampling of what is claimed as the industry's first 4Mb/s high speed infra-red serial interface controller for personal computers. The PC87108VJE IR controller is compatible with the IrDA 1.0 standard and the high speed extensions to the IrDA standard, as well as specifications for TV remote control IR and Sharp DASK-IR. It is the first member of a family of fast IR/TV remote devices.

The broad compatibility range of the device allows users many cableless choices for exchanging files among laptop, notebook, personal digital assistant and desktop computers; sending data to peripherals such as printers, modems, and game controllers; connecting to network nodes; moving data to and from calculators; and controlling televisions, VCRs and related equipment.

The PC87108VJE replaces or adds an additional UART in a PC or other system, and is an enhanced 16550 UART. On the system side of the controller, the device has an ISA bus interface and complete support for PC '95 features, including a choice of seven interrupts and three DMA channels. The ISA interface has full 16-bit address decoding, a selection of all primary and secondary ISA UART addresses (COM1-4), selectable base address, and an optional chip select mode that allows the device to be used as a peripheral.



On the IR side, the controller implements four IR functional blocks that can be configured via software to connect to the chip's IR interface. The device comes in an 80-pin plastic quad flatpack (PQFP) package.

For further information circle 252 on the reader service coupon or contact National Semiconductor, Business Park Drive, Monash Business Park, Notting Hill 3168; phone (03) 558 9999.

Digital wireless receiver IC

Philips has released the SA639, a new low cost intermediate frequency (IF) receiver for digital wireless communications applications. The IC receiver features high sensitivity, wide bandwidth, small size, and low power consumption, which are important for handheld and PCMCIA format communication devices. The IC suits applications such as Digital European cordless telephones (DECT), North American 900MHz cordless telephones, IEEE 802.11 wireless LAN adaptors, as well as low power FSK and ASK receivers.

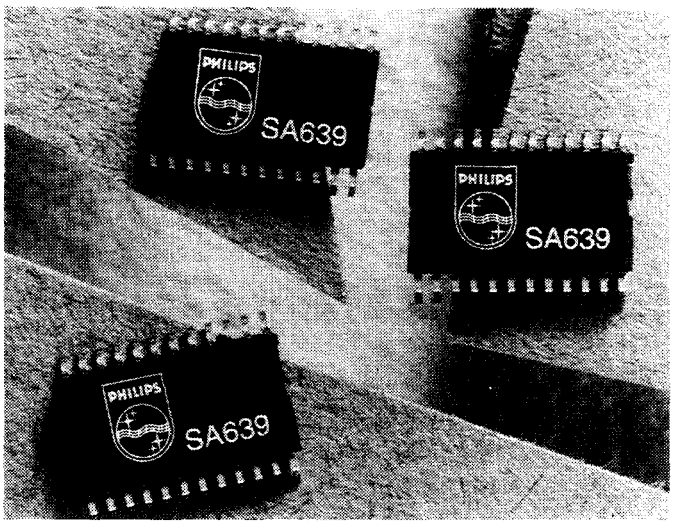
The device draws 8.3 milliamps at 2.7 volts (minimum), and is claimed to have the greatest sensitivity available in comparable receivers today.

The SA639 plays an important role in superheterodyne receivers by down-converting an incoming RF signal of up to 500MHz to a second IF of typically 10MHz. An integrated detector strips off the carrier signal and leaves the digital data.

The IF signal processing system of the IC is suitable for dual or single conversion systems with input frequencies as high as 1GHz.

The bandwidth of the IF amplifier is approximately 40MHz, with a gain of 44dB(v) from a 50 ohm source, and a limiter bandwidth of 28MHz with about 58dB(v) of gain from a 50 ohm source. It has a 3dB bandwidth of at least 4MHz.

The SA639 expands the capabilities of the previously released SA636 by incorporating external components such as the filter amplifier and data switch. This saves board space, design time and improves reliability.



For further information circle 254 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 805 4479.

Data comm controllers

Zilog has announced the Z80189 and the low power Z8L189, the newest members of the Z180 data communications controller family. Designed for a wide range of embedded control applications including modems, printers, terminals, electronic games, fax machines, and wireless datacom equipment, the devices feature integrated on-chip peripherals that reduce system level costs. The Z80189/Z8L189 are claimed to be cost effective eight bit alternatives to 16-bit datacom controllers.

The enhanced Z180 core in the new devices, has two UART channels that have an increased data rate from 115kb/s to 512kb/s. Two DMA channels can be chain linked together to transfer data with less CPU intervention.

The improved 16mA 16550 MIMIC output drive provides a direct interface to the IBM PC ISA bus, removing the need for '245 bus drivers.

For applications such as high speed modems that interface with the PC ISA bus, the chip's COM port decode circuitry allows COM ports and IRQ settings to be set through software, eliminating the need for discrete COM port decoder devices such as jumpers and DIP switches.

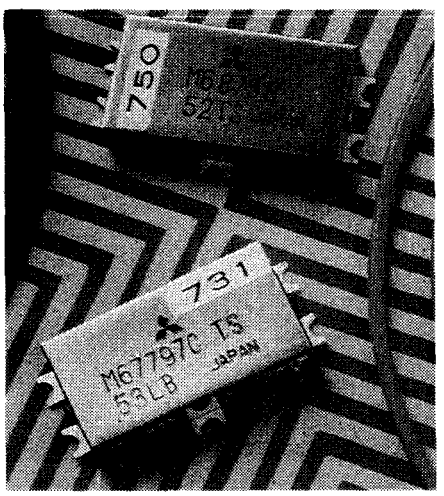
Featuring five low power modes, the Z80189 operates at 33MHz with 4V and in 'standby mode' current is reduced to under 20uA. The Z8L189 operates at 20MHz with 3.3V. Zilog's support program includes evaluation boards, software drivers to support the new UARTs and C compilers and assemblers.

For further information circle 256 on the reader service coupon or contact GEC Electronics Division, 1/38 South Street, Rydalmere 2116; phone (02) 638 1888.

MOSFET RF PA for GSM cellphones

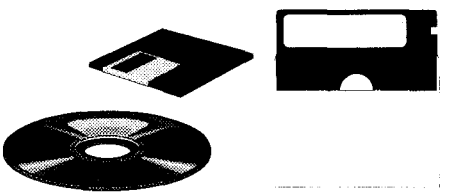
Mitsubishi has announced two new four cell silicon MOSFET hybrid IC RF power amplifiers, designed for GSM class IV cellular phones. The thick film hybrid devices feature extremely low power consumption. The M68738 operates from 4.8V and the M67797C operates from 6V. Bandwidth for both devices is 890 to 915MHz.

Mitsubishi claims major advances in gain versus efficiency for the new devices. The 4.8V device provides 37% efficiency at 35.5dBm and the 6V device has 40% minimum efficiency at 35.5dBm. Maximum input power for both devices is 10mW and maximum output power is 5W, 35dBm. Power consumption is around 1.5mA. The hybrid RF power amplifiers operate at case temperatures ranging from -30° to +100°C.



For further information, circle 258 on the reader service coupon or contact the semiconductor dept., at Mitsubishi Electric Australia, 348 Victoria Road, Rydalmere 2115; phone (02) 684 7777. ❖

SPOTLIGHT ON SOFTWARE



The Propak design system

Over the last few years, a number of PCB design programs have come onto the market, presenting a bewildering array of software packages. One of these, a complete circuit design/emulation and board design system aimed more at the professional market, is the Proteus suite of CAD software distributed in Australia by Don Alan Electronics.

by GRAHAM CATTLEY

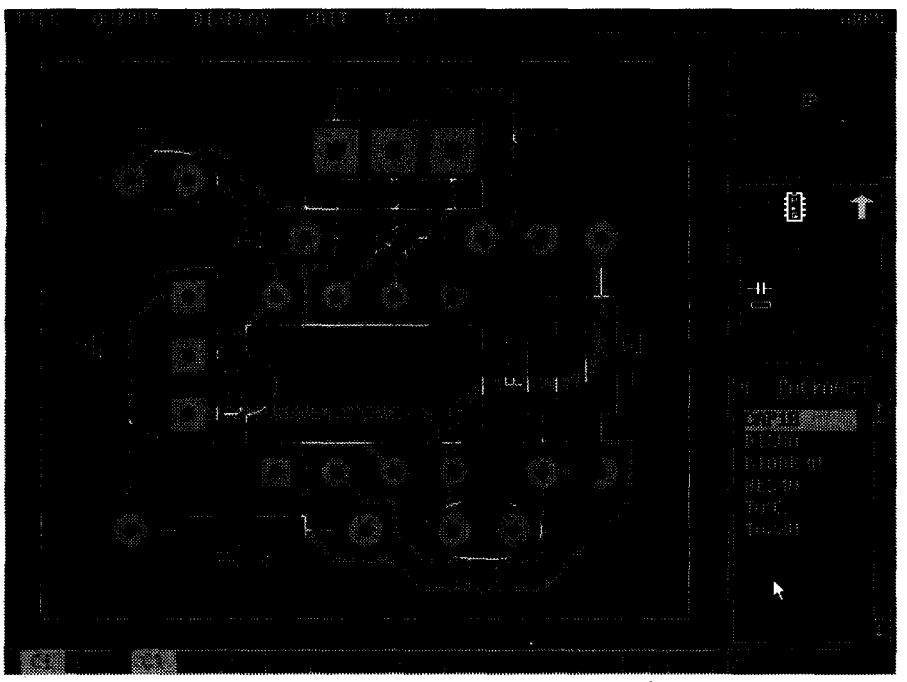
The Proteus system is based around three major components: ISIS, a schematic capture and design environment; LISA, a circuit simulation package; and ARES, a comprehensive PCB design system. These three components are designed to work with each other, providing a consistent environment for circuit design and simulation and PCB production.

All three packages are supplied together in the 'Proteus Complete' package, while the ISIS and ARES schematic and PCB design software are available together in the 'Propak' package. Due to the limited space for this review, we decided to look at the Propak package as this would probably be of interest to a greater proportion of our readers.

On opening the box, we were in for a couple of surprises. The first was the size of the Propak manual — a large format book with over 170 A4 pages covering all aspects of the two programs, along with a comprehensive command reference and an excellent tutorial.

The second surprise was that the box contained only two disks, one each for the ISIS and ARES programs. In these days of nine-disk software packages, it is refreshing to encounter such professional software without the usual hour-long session of feeding floppies into the machine.

Needless to say, installing ARES and ISIS was simplicity itself, requiring you to simply run the INSTALL program and supply your name and 'Magic Number'. This is one feature that appealed to us, having battled with 'dongles' — the usual copy protection system used by professional software packages. The Magic Number system allows you to make any number of backup copies, each traceable back to the registered user.



Here is an example of a board produced by the ARES PCB design package.

ISIS

Perhaps the best place to start in describing the Propak system is with the ISIS schematic capture software, as circuits drawn with it can be used with both the emulation software LISA and the PCB design program ARES. When first run, ISIS gives you the option of either VGA (640 x 480), or one of two SVGA modes, 800 x 600 or 1024 x 768. As the software talks to the video card directly, you will need to enter details about your specific video card if you want to take advantage of the higher screen modes.

While we are on the subject of hardware, it is worth mentioning that ISIS comes in two flavours, ISIS DESIGNER+ which will run on a minimum of a 286 with 640K RAM and an EGA monitor, and ISIS 386 which needs a 386 or better and at least 2MB of RAM. ISIS 386 can handle much larger circuit diagrams — over several pages if necessary, and can take full advantage of all the memory in your machine, not just the 640K available to standard DOS programs.

The user interface itself is quite straightforward, with a large window for the schematic diagram, and a pair of smaller toolboxes down the right hand edge of the screen. The upper toolbox contains a number of icons for selecting

the various editing modes, while the lower box lists previously selected components from the component libraries.

After following through the tutorial, we were quite impressed with a couple of features that made drawing schematic diagrams a relatively straightforward process. One of these features was some intelligence in the program in determining whether you want to place a component or a wire on the drawing. If you click on an empty part of the drawing, it will place the currently selected component on the screen.

If, however, you click on the pin of an already positioned component, a green 'rubber' line is drawn between the pin and the pointer. You can now drag this line over to another component pin and click, and the Wire Auto Router will take over.

The WAR is one of those features that, having used it a few times, becomes so natural that you couldn't think of living without it. All the WAR does is to draw a line between the two selected points, keeping to right angles and crossing as few other lines as possible. This gives a very professional look to the circuit, and you don't even have to remember to dot your connections as the program will do this for you automatically.

Of course all the usual block move, copy and erase functions are available, as well as such features as Auto Wire Repeat (useful for multiple bus connections) and an Auto Name Generator for labeling components automatically — a lot easier than doing it all by hand, particularly on a multi-page circuit!

A built-in device editor lets you edit existing component symbols to your liking, or create new components using circle, square, line and text tools. We found this job a bit fiddly, as the minimum grid size selectable is five thou — which is fine for laying out schematics, but too coarse for editing component symbols. This meant that we had to turn off grid snap, making any fine detail more a matter of guesswork than artistic prowess.

With a bit of effort though, we managed to come up with a 'zig-zag' resistor to our liking, while a symbol for a 2732 EPROM was remarkably simple to produce, with the Auto Name Generator being pressed into service to label all the address and data pins.

The only real problems that we encountered with the ISIS package involved the ease with which components can be deleted; re-selecting an already selected component or wire will instantly remove it from the layout — the 'Undo' function was somewhat overused because of this.

A slightly more serious problem comes about when placing components in the circuit. If you place (say) a resistor on the diagram and one of its pins occupies the same point as a pin of an existing component, say an IC, the IC will be deleted.

This is not a bug in the software, but a powerful design feature allowing you to easily change a component by simply placing the new one on top of the old one — useful for replacing a multi-part component (a quad op-amp for example), as all parts of the component will be changed automatically.

The annoying thing is that you cannot un-delete the removed component. If you do attempt to do so, ISIS will un-delete the last component that you intentionally deleted. Instead, you have to move the new component (the resistor) slightly, select the deleted IC from the component library again, and place it on the board as a brand new component. Unfortunately, any annotation or values associated with the original IC are lost, and you have to go back to edit mode and re-annotate the component.

On the plus side, an electrical rules check can be undertaken at any time, looking for obvious errors such as output pins connected to other output pins, and un-connected inputs. This can help prevent silly mistakes filtering through into the final design stages.

Output

The whole point of having a schematic capture program over a fancy drawing package is that it produces a netlist that can be used in either a circuit emulator or a PCB design program. Of course ISIS is no exception; it's the backbone of the Proteus system, producing a netlist that is used both by the LISA and ARES packages.

ISIS produces netlists in its native (SDF) format, but it is easy to generate a netlist in one of nine other formats, including SPICE, RACAL, FUTURENET and TANGO.

It is also a simple matter to print the circuit diagram, using anything from a nine-pin dot matrix printer through to a 600dpi HP Laserjet. ISIS will also drive a host of plotters, and can even export images in IMG, EPS or BMP formats.

ARES

The other half of the Propak package is the ARES 386 PCB design program. This works in conjunction with ISIS, using the netlist generated to produce the finished PCB design.

Like ISIS 386, ARES 386 needs a minimum of a 386 PC with 2MB RAM in order to run. There are other versions of ARES (ARES and ARES AUTOROUTE) that will run a 286 if you don't have one of the higher powered machines.

On first running ARES you could be forgiven for thinking that you were back in ISIS — the two programs look virtu-

The ISIS package shown above is very similar in operation to ARES, with a pick-list of components on the lower right hand side.

ally identical, and for very good reason. The idea is that once you have learned to use one package, it is a simple matter to switch over to the other one without having to learn a whole new system.

Having used ISIS for a while, it was easy to design a small circuit board using components from the library pick list, and 'join-the-dots' track laying, without even looking at the manual. (One thing we found, though, was that you have to place all of the components first and connect them all up afterwards — ARES doesn't like 'floating' tracks.)

Doing this was all very well, but it certainly wasn't using ARES to its full potential. ARES 386 takes full advantage of the CPU's 32 bit instructions, and as a result its auto-routing is fast. In fact it is faster to let it auto-route a track than it is to lay it yourself.

To try it out, a microprocessor circuit netlist with around 280 'ratsnest' connections was imported into ARES running on a 386SX 20MHz computer (this is about as low as you can go in a 386 machine). In under two minutes ARES had routed 98% of the tracks on a double sided board, leaving only one track that couldn't be placed. (A 386DX 33MHz took less than a minute, and you can expect even better results on faster computers.)

There was some talk here at EA, that 98% of the tracks placed is as good as none of the tracks placed as far as the circuit is concerned — as without those last tracks the circuit wouldn't work. This may be true, but with ARES it is a simple matter to change the routing strategies for the board and try again.

Strategies

ARES uses a total of three different strategies when auto-routing: Power, Bus, and Signal. Each has about 10 parameters that can be changed to suit that strategy's requirements, including priority, track width, corner optimisation, and how close tracks can run to other tracks and pads.

Auto Track Necking can also implemented, as well as Via Minimisation which looks at each via (between top and bottom layers) to see if it can be eliminated. Because of the speed of the auto-routing algorithm, making small changes to some of the strategies (or even moving a couple of components slightly) and re-routing the board was a practical way of achieving 100% track placement. Of course you can go and move and place the tracks yourself, but this is perhaps where a couple of quirks of ARES appear. You can't just pick up a track and move it somewhere; instead you have to right-click on the offending track to highlight it, and then left-click on the starting point of the new track (which must be somewhere on the original track). You then mark out the route for the new track, right-clicking on each corner, with the last point back on another part of the original track. ARES now lays down your new track and then deletes the 'short circuited' piece of the old one.

As with ISIS, re-selecting an already selected track or component deletes it with no questions asked. This can get slightly infuriating. Also there isn't any way to place a track if it doesn't join onto anything — it seems that all tracks must join onto other tracks or components at both ends.

Having said all that, you might ask the question: why would you want to move tracks or change the layout anyway? If the auto-router has placed a track, it has done so having followed its auto-routing strategies, and as these strategies can be easily modified, it is much simpler to change various parameters and re-route.

The final output from ARES can be in a multitude of formats including Postscript, Gerber plotter, HPGL, DXF and H180 plotters and 9- to 24-pin dot matrix printers, as well as HP Laserjet, T-codes for NC drilling machines and all the file formats as listed for ISIS.

Conclusion

The ISIS/ARES 'Propak' forms a very professional software package, which if linked to the circuit simulation package LISA will provide all the tools needed by any small circuit design /manufacturing company.

The price ($1190) reflects the kind of market it was designed for, though; it's probably not the package for making the occasional PCB. There are, however, many configurations and cut down versions available for as little as $160, which could bring this very capable package within reach of the casual hobbyist. Demonstration kits are available for free, and a Proteus evaluation package is only $60, refundable if the manuals are returned in good condition.

At time of going to press, we were informed that a Windows version of Propak is available at the slightly cheaper rate of $990. For more details and a comprehensive price list, contact Don Alan Electronics, 107A Burbridge Rd, Hilton SA 5033; phone (08) 43 3957 or fax (08) 234 5339. ❖

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Review of a new low cost

RADIATION DETECTOR

We look here at an inexpensive, compact device that, depending on the type of probe, can detect gamma and beta radiation particles, and also X rays. It features a computer interface, detachable probe and a very low cost.

by PETER PHILLIPS

These days we are all more aware of the dangers of radiation — be it RF, nuclear, electromagnetic, X ray or whatever. The most dangerous types of radiation are nuclear and X ray, both of which can be detected by the device we're reviewing here.

In its basic form, the detector comes with everything shown in the photo: a plug-in Geiger probe sensitive to gamma and beta radiation, a plastic box measuring 70 x 52 x 35mm that contains the electronics, and a connecting lead to interface to the serial port of a computer and to an external power supply. A 3.5" disk containing sample software written in C is included.

The detector probe plugs into the electronics via an F connector, and is 125mm long with a diameter of 20mm. It can also be connected with 50 ohm coaxial cable to separate the electronics from the probe, if necessary.

The electronics inside the plastic box is built on a single, compact PCB and supplies the EHT to the detector probe. It also has an audio stage driving a piezo transducer that sounds each time a particle is detected by the probe. There are two LEDs, one to indicate power, and the other giving a visual indication of the pulses sent to the piezo transducer.

The power supply can be either AC or DC between 12 and 14V, either from a plug pack, or for portability, a 12V battery. Current consumption measured around 90mA on the review sample. The power source connects to the unit via a 3.5mm phono plug. Because the electronics has its own full wave rectifier, the polarity of a DC supply doesn't matter.

The power lead and the computer interface lead share the same connector that plugs into a five-pin socket fitted to the plastic case. The RS-232 serial computer interface is via a 25-pin D connector (female), that also houses more electronics, powered from the external supply.

Computer interface

The software that comes with the device is written in C, and includes a runtime version and the original source code. The program only operates with serial port COM2, but Oatley Electronics, who provided the review sample, has advised that additional files will be added to the disk so you can select the file to suit the COM port you intend using. These files will be named GeigerX.exe, where X is a number from 1 to 4, for COM ports 1 to 4.

The software is not sophisticated, and is really only a demonstration program. A typical screen display is shown in Fig.1, where each record shows the time between particles, followed by the time to detect eight particles.

The screen scrolls as each record is received, although pressing CTRL P before running the program will usually allow you to print each screen display.

For serious use with a computer, you will need to further develop the software, a task that is relatively easy to a computer programmer.

X ray detection

To detect X rays and nuclear particles, you need another probe, which is supplied instead of the original Geiger probe, at a slightly higher cost. This probe contains two detectors, mounted end to end, giving a probe length of around 400mm.

One detector is a conventional Geiger tube, as in the previously described probe. The other is for X rays. As the two detectors are effectively in parallel, the detector can't dif-

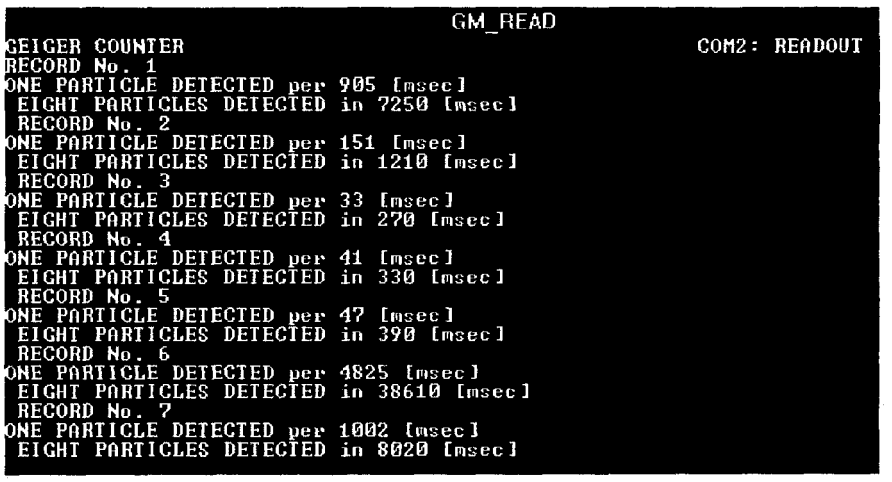


Fig.1: This screen shot shows the computer display when the probe is near a mildly radioactive source. The source code for the program (written in C) is supplied.

ferentiate between the types of radiation; it simply alerts you that there is radiation of some sort.

For most users this is all you want, as it's not really important whether the detected radiation is nuclear or X ray. Either way there's danger!

Using the device

The plastic case has two lugs so the unit can be attached to a wall or any surface. This way it can be mounted as part of a security system, or in a process control system.

We tried it as a portable hand held unit, testing both types of probes. When placed near a mildly radioactive source, the detector goes into a frenzy (as you'd expect), indicated by a rapid series of beeps from the piezo speaker in synchronism with the flashing LED.

Under normal ambient conditions, the detector beeps irregularly, indicating the normal radiation we are exposed to all the time.

The combined X ray/particle detector probe exhibited the same response to nuclear radiation, but we were mainly interested to see its response when placed near a colour TV screen.

As you know, X rays are produced when an electron beam strikes a metal surface at a high speed, as in the shadow mask of a colour TV tube. We tried it around a range of colour TV sets, including a computer monitor. Because of the background radiation triggering the nuclear particle detector, it was difficult to tell if the detection indications were X rays or not.

In general, the 'beep' rate stayed fairly constant for all TV receivers, no matter where we placed the probe. This was heartening, although all the sets we tested were recent models.

It would be interesting to try this probe on an old model colour TV set, where X ray shielding was not so effective...

The rated energy response of the particle detector probe is 30keV to 1.2MeV, with a sensitivity rated by the manufacturer as high. It certainly seemed sensitive to us. No data is yet available on the X ray detector probe.

Our only criticism of this remarkable unit is the push fit of the probe connector in the case.

We found by removing and replacing the probe a few times that the connector became loose, and if you weren't careful, it would end up inside the case. When this happened, it was easy to fix, by removing a single screw to expose the electronics and the connector. A spot of glue would fix this.

Summary

This neat little detector is remarkable for its sensitivity, size and cost. Other than the loose connector problem, it is solid and well built. The software is simply for demonstration, but if you're a C programmer, you have a head start with the supplied source code.

The cost of the standard detector (gamma and beta particle only) is $75. The approximate cost for the detector unit with the combined gamma/beta particle detector and X ray detector probe is $100.

For further information contact Oatley Electronics, PO Box 89, Oatley 2223, phone (02) 579 4985. ❖

NEW PRODUCTS

Non-contact thermometers

Optex built in temperature sensors are infra-red non-contact temperature sensors, suitable for all stationary industrial applications.

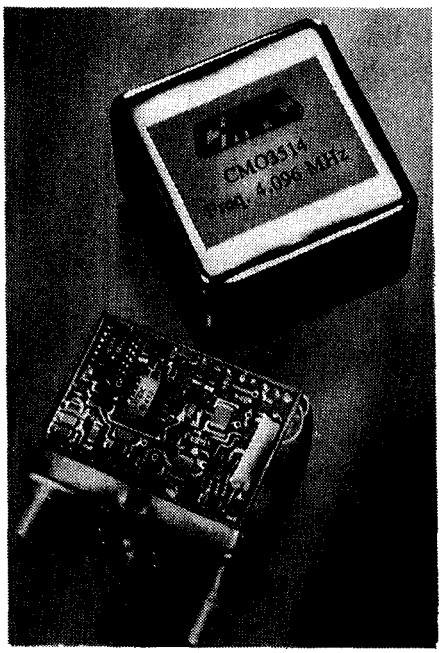
The sensors measure 32 x 77 x 77mm, and are encased in a waterproof aluminium diecast enclosure.

Numerous configurations are available including sensors with a fast response time (3ms), spot measuring (4mm), built in amplifier (BA series), separate amplifiers and sensors (BS series) and the BF series, which uses optical fibre cable to connect the sensor to the amplifier control unit.

For further information circle 232 on the reader service coupon or contact RAE Industrial Electronics, 62 Moore Street, Austinmer 2515; phone (042) 67 3722; e-mail RAEOZ@OZEMAIL.COM.AU.

Oven stabilised crystal oscillators

C-MAC Quartz Crystals has released the CMO 3513 and CMO 3514 oven stabilised crystal oscillators (OCXOs). The CMO 3000 series has been designed for applications which demand high stability in a small space, with rapid warm up. These devices are particularly suitable as reference oscillators in telecommunications applications, global positioning systems and test instrumentation where good long term stability and high accuracy of output frequency



has to be maintained over the full temperature operating range.

The 3000 series is contained in a package size conforming to the IEC CO19 outline. It maintains a long term frequency stability of less than five parts in one billion (5ppb) per day, and remains within two parts in ten million (0.2ppm) of the nominal frequency over the temperature range of -55 to +65°C. This is achieved with a peak power consumption of less than 5W on warm up and less than 1.5W at 25°C after warm up. The warm up time is less than five minutes.

The oscillators are available at certain standard frequencies or can be designed on request to frequencies in the range of 4MHz to 20MHz.

For further information contact Vertical Marketing Ltd, Millstream House, 39a East Street, Wimborne, Dorset BH21 1DX, England; phone 44 (0) 1202 842250.

'Smart' handheld thermometers

A range of handheld digital thermometers featuring microprocessor control has been introduced by Obiat.

The Delta Ohm series of thermometers is available in a number of configurations, to suit various applications. The base model HD 9214 is a single input instrument for measuring temperatures from -200 to +600°C. Using a Pt 100 platinum sensor, the instrument has an accuracy of +/-0.1°C over the range -200 to +200°C.

The next model HD 9219 can store minimum and maximum readings and read in either Celsius or Fahrenheit. Calibration is done from the front panel membrane keypad. Another model, the HD 9218, is similar to the HD 9219 except it uses type K thermocouple probes, enabling much higher temperatures to be measured.

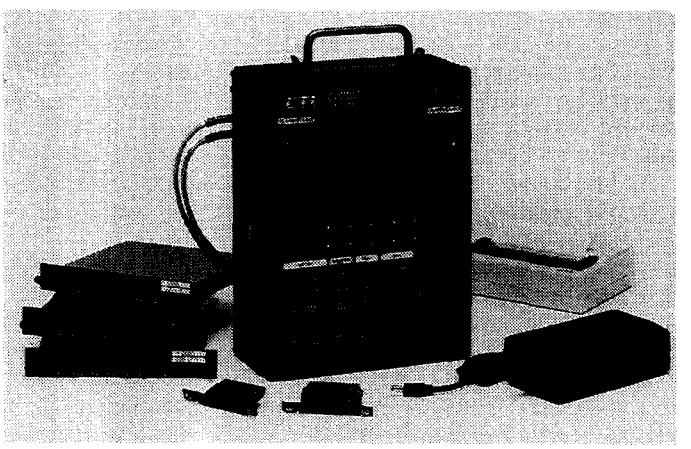
Model HD 8704 has two thermocouple inputs, so differential and relative temperatures can be measured and logged. It also stores and displays min/max. readings in either °C or °F. The HD 9117 is a similar styled unit but

AMPS, GSM and TDMA test set

The T-Star test set is a universal communications analyser for many different applications in telecommunications for carriers, private networks and cellular networks. Tests are included for AMPS, GSM and TDMA.

The T-Star performs end-to-end routing testing, transmitting frames across the network to a specified destination, to another T-Star or loop-back. Testing of full duplex BERT, VF and NX64kb is provided.

Automated repeater span fault sectionalisation can be performed with automated loop-back. BERT performance testing is provided on satellite circuits up to 50Mb/S end-to-end or through loop-back. The tester monitors, loops and performs link management emulation at the CSU, monitors frame relay and encapsulated X.25 or TCP/IP protocols. Bit error tests at 56kb/s can also be performed.



For further information circle 231 on the reader service coupon or contact Telaware, 7/245 Springvale Road, Glen Waverley 3150; phone (03) 9802 0599.

uses a PT 100 type sensor and incorporates an RS232 serial data output for connection to a computer.

For further information circle 233 on the reader service coupon or contact Obiat, PO Box 37, Beaconsfield 2014; phone (02) 698 4111.

Video graphics distribution amp

Quest Electronics has released a new video graphics distribution amplifier, the VG-PRO, following the success of its model VGD4. The new design allows a single cable to connect to a VGA adaptor or MacII, and to loop out to the original monitor without any adaptors.

Graphics may be blanked without loss of sync, to allow the operator to make changes to the source computer (via the looped-through monitor) without the audience seeing. This function can be remotely controlled from up to 100m away.

The bandwidth has been more than doubled, for crisp and clean outputs on hi-res graphics, and RGB gains may be internally adjusted up to +/-6dB without loss of resolution.

Three separate outputs are provided, two via DB9 sockets (to suit VGD4 cables) and the third via five BNC sockets. Composite sync made be added to the green video output (sync on green), while the output sync may be switched between horizontal and composite. The amplifier features automatic monitor sensing and input loop termination.

RRP for the VG-PRO is $449.00 including tax. A full range of matching cables and adaptors is available.

For further information circle 250 on the reader service card or contact Quest Electronics, PO Box 548, Wahroonga 2076; phone (02) 477 3596.

Automatic parking access

Fumbling for cash or a magnetic card to gain access to a car park has been made obsolete, according to Texas Instruments, who have launched TIRIS, a low frequency ID tag. Mounted on the windscreen of a vehicle, the tag permits authorised drivers to enter and exit secure parking areas without doing a thing.

The TIRIS tag has over three times the read range of popular 'proximity' access systems, yet having a comparable price, it allows parking stations to be easily upgraded.

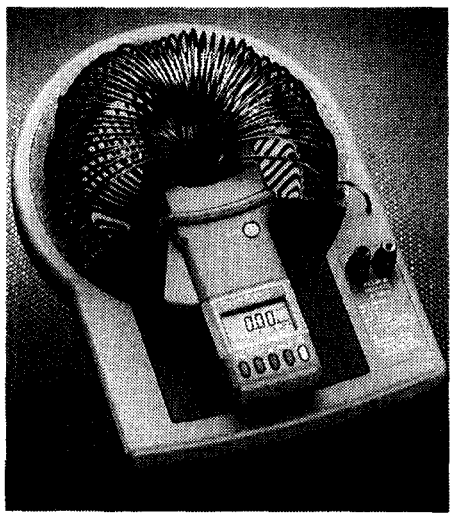
The battery-free, disk shaped radio identification (RFID) tag mounted to the inside windscreen of a vehicle can be read by an antenna up to two metres away, so you don't need to open a window, manoeuvre to get close, or extend an arm to display or insert a card.

Since the reader itself has no slots or openings, it is also

completely resistant to harsh weather conditions or vandalism.

Each car tag has its own unique ID code, with the system's reader maintaining an easily upgraded list of authorised ID numbers. As a vehicle approaches, the reader sends out an interrogation signal and once the tag is within range, the power pulse charges up the passive tag — allowing it to return a signal carrying its code. If the code is valid, the barrier gate opens, and the vehicle continues. The whole process takes only milliseconds.

For further information circle 236 on the reader service coupon or contact TIRIS Application Centre on (08) 255 2066.



Clamp meter calibrator

Philips S&I now has available an accessory for the Fluke 5500A calibrator that adds the capability to calibrate current clamps and clamp meters. When used with a 5500A calibrator, the new Fluke 50-turn 5500A/COIL calibrates and verifies current clamps and clamp meters that operate as AC current transformers or by the AC/DC Hall effect. The 50-turn coil design, recommended by current clamp manufacturers including Fluke, allows it to simulate 50A for every 1A of input, up to 550A.

The coil design minimises inductive loads, making the accessory suitable for use with a wide variety of sources. Though designed to complement the 5500A, the 5500A/COIL can also be used with the Fluke 5700A, 5100 series, and other calibrators. To calibrate a current clamp meter, the meter is positioned on the coil's stable work surface. Specifications include an output uncertainty as low as 0.25%.

For further information circle 234 on the reader service coupon or contact Philips Scientific & Industrial, 34 Waterloo Road, North Ryde 2113; phone (02) 888 8222.

Video adaptor for microsurgery

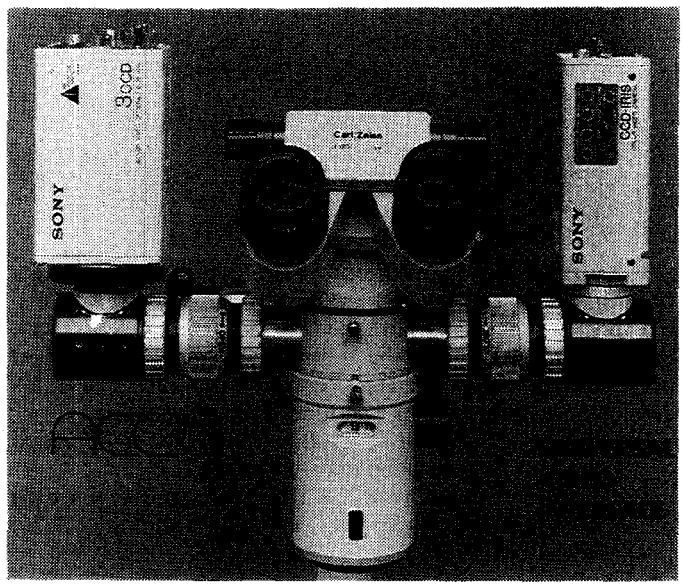
Newly released in Australia is the ACCU-beam universal microsurgical video adaptor that provides a choice of image magnification with either single chip or three chip video cameras. The unit is adaptable to all major brands of microscopes.

It has a wide selection of relay lenses, camera mounts, beamsplitters and beamsplitter adaptors, to allow any video camera to be interfaced with surgical microscopes, colposcopes, examination microscopes and slit lamps.

The iris aperture adjustment optimises image brightness and depth of focus. The desired field of view and video image size is achieved by selecting the appropriate relay lens.

Lens magnifications range from 1.0x to 3.0x. Camera mounts are available for standard video cameras with bayonet mounts, V-mounts and C-mounts. Specific mounts are also available for endoscopic video cameras.

For further information circle 236 on the reader service coupon or contact Zenology Sales, PO Box 332, Glen Waverley 3150; phone (03) 9802 0599.



6A-64A chokes

Schaffner has launched a range of compact chokes which have current compensated windings or toroidal ferrite cores to provide very high inductance/volume ratios. Known as the RD series, the range offers 42 different versions — including dual, triple and quad configurations — and covers currents from six to 64A, with inductances from one to 25mH.

The chokes provide excellent immunity to saturation, making them particularly suitable for interference suppression in high current applications such as uninterruptible and switch mode power supplies, and the DC stages of inverters. The chokes are also ideal for applications where space is at a premium.

All chokes in the series are suitable for voltages up to 600V AC or 850V DC, and have an operating frequency range of DC to 400Hz.

For further information circle 238 on the reader service coupon or contact Westinghouse Industrial Products, Locked Bag 66, South Melbourne 3205; phone (03) 9676 8888.

Handheld GPS receiver

The Magellan GPS 2000 satellite navigator is a small handheld satellite

navigation tool which uses information from the 24 satellite US Dept of Defence system, providing users with positional information in latitude, longitude or UTM (map) coordinates, no matter where they are in the world. Used by US Military forces in operations such as Desert Storm, this form of navigation is highly sophisticated. Yet thanks to advances in technology, it is also extremely simple to use, and is now affordable.

The unit is about the same size as an average mobile phone and weighs 283 grams. It can be used to direct you from your current location to an area with known coordinates (e.g., a particular spot you've noticed on a map), or you can store up to 100 locations as you pass through them by recording these as 'way points' that are displayed on a clearly illuminated screen.

It also displays the distance travelled, the remaining distance to a selected way point, speed and course direction. By pressing a few buttons the GPS 2000 will also show you how to backtrack to reach a previously visited location, such as the camping ground or marina from which your journey commenced.

The GPS 2000 is available nationally for $595 at all Dick Smith Electronics Stores.

Harmonic generation and analysis system

California Instruments has introduced a new instrument which, when com-

NEW PRODUCTS

bined with an AC power source, becomes a sophisticated waveform generator, able to produce power test susceptibility waveforms specified by harmonic number, amplitude and phase angle. It also provides load current harmonic measurement and analysis capability. Called the harmonic generator analyser (HGA), the unit is ideal for testing power quality requirements.

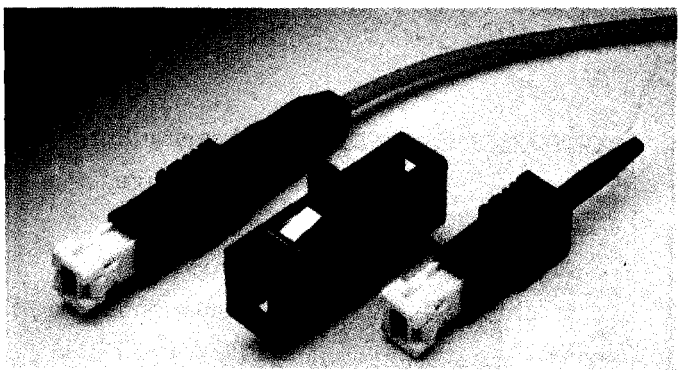
The primary component of the HGA is a true real-time arbitrary waveform generator (ARB) that allows waveforms to be generated immediately by directly programming the ARB, or from Windows based software running on a PC. The software allows access to all the generation and measurement functions including power source configuration, initialisation condition, basic measurement parameters, load current and voltage harmonic analysis, output harmonic distortion and defined transient parameters, and linking of events.

The HGA allows on-board storage of 18 custom waveforms in either single phase of three phase mode. PC waveform storage accessed via the software, however, is virtually unlimited. The software allows the display of such values as RMS voltage and current, phase angle and true power along with peak current, apparent power, power factor and total harmonic distortion of both voltage and current.

Computer control of the instrument is via IEEE-488.2 or RS232C, both fitted as standard. Available options including programmable single or three phase output, an output dropout switch and a high current measurement range for up to 160A RMS.

For further information circle 235 on the reader service coupon or contact Obiat, PO Box 37, Beaconsfield 2014; phone (02) 698 4111.

Fibre optic connectors



The Molex OptoClip connection system offers mechanical splice quality performance with the flexibility of a connector package. Featuring push-pull operation with a positive locking system that is similar to an SC connector, it also has a unique fibre alignment system to align fibres at tolerances comparable to the best performing ferrules.

A shutter swings into place when the end plugs are in the disconnected position, to protect fibre from contamination and to provide eye protection from laser radiation. Designed to fit in any standard SC mounting location, the Optoclip adaptor secures to the panel with screws or metal clips.

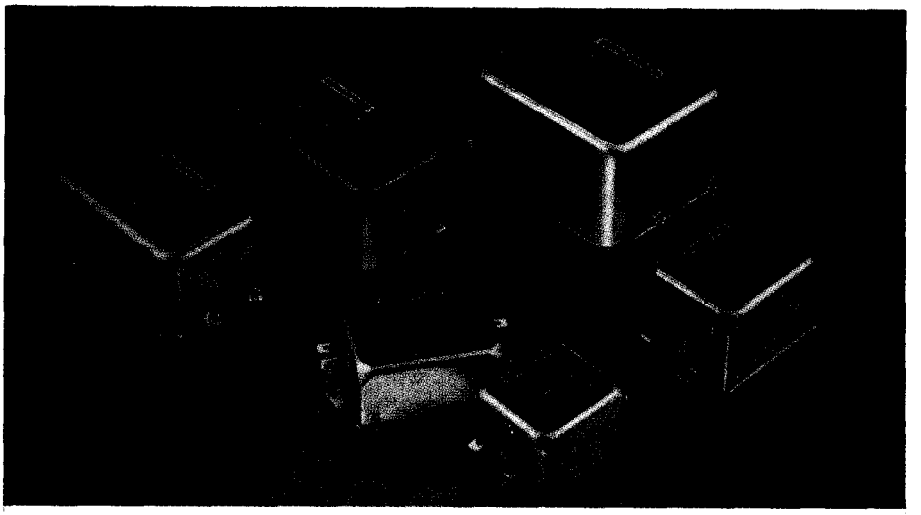
Applications for the OptoClip system includes data processing networks, telecommunication networks, broadband deployment, cross connects, CATV upgrades and locations using analog lasers.

The OptoClip system is easy to terminate in the field with two special hand tools; an easy to use crimp tool and a cleave tool. The cleave tool cleaves the fibre at an angle providing APC performance. The system accommodates all standard fibre types with a cladding of 125um and jacket size of 900um to 3mm, in either single mode or multimode versions.

For further information circle 249 on the reader service coupon or contact Utilux at PO Box 68, Kingsgrove 2208; phone (02) 50 0155.

Single phase mains filters

Schaffner has launched a new series of single phase chassis mounting filters that provide cost effective solutions for a wide range of general purpose filtering requirements. Known as the FN 2000 series, the filters have a very compact form factor — achieved through the use of high performance magnetic and capacitive components — which makes them suited for applications where space is at a premium. Excellent stop band attenuation characteristics and current carrying capabilities mean that the filters are particularly suitable for manufacturers, OEMs and system integrators seeking an inexpensive and easy to apply remedy for electrically noise equipment, such as motor drives and switch mode power supplies.



The series comprises 72 standard versions, covering current ranges from one to 30A, each of which is optionally available in medical (B type) or safety (A type) configurations.

Furthermore, the internal design is based on modular architecture, which enables Schaffner to produce custom version of the filters very efficiently.

Each filter is contained within a chassis mounting metal housing, and offers a choice of fast-on, wire or screw fee-through connectors for ease of system integration.

The filters are all designed for operation at up to 250V AC, and can handle supply frequencies from DC to 400Hz.

For further information circle 248 on the reader service card or contact Westinghouse Industrial Products, Locked Bag 66, South Melbourne 3205; phone (03) 9676 8888. ❖

Silicon Valley NEWSLETTER

Cold War technology foils phone thieves

In one of Silicon Valley's most remarkable defence conversion stories, ESL, the ultra top secret Pentagon subcontractor in Sunnyvale has become the nucleus of a hot high-tech startup in the market to combat cellular telephone fraud.

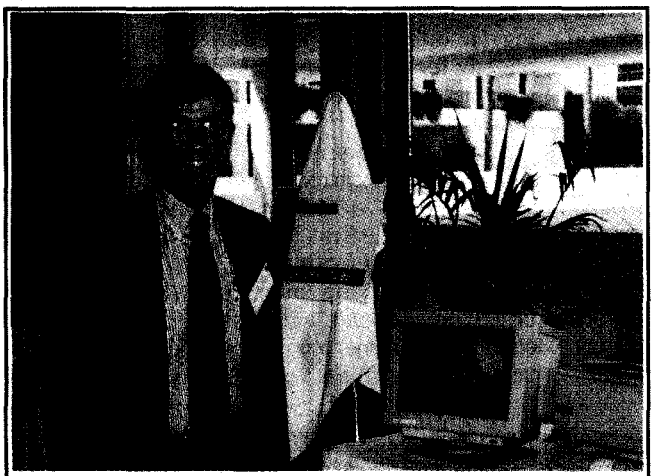
Using sophisticated technology originally developed to keep tabs on the communications from Soviet submarines and ships, Corsair Communications' 'RF fingerprinting' system has become a major problem for cellphone thieves in Los Angeles, its first major test market. The results have been so good that telecommunications experts say the system represents the communications industry's best defence in the war against 'cloned phones', a multi-billion dollar annual scam as well as the biggest growth industry in the underground economy.

Corsair's 'PhonePrint' is aimed at ending cellphone theft by taking advantage of a simple technical insight. In the same way that individual people will have slightly different handwriting or fingerprints, any two radio transmitters will send out a radio frequency or 'RF' signal in slightly different ways. If you can learn the 'fingerprints' of all the different transmitters used by your opponent, something both Americans and Soviets tried as part of their Cold War espionage arsenal, you can tell whether a given transmission is from the massive aircraft carrier or small supply ship.

ESL worked on RF fingerprinting for the Pentagon for decades. Now, the same techniques that were applied against the Soviet Navy is being used against big-city cellphone fraud.

Any two cellphones that roll off the same assembly line will have enough subtle differences — such as in the tolerances of their various resistors and capacitors — that the signals they emit will be completely distinguishable from each other, as long as you know what to look for.

In normal cellular operations, a phone trying to call someone first sends two numbers to the receiver at the nearest cell site: its own telephone number, and a special electronic serial number that's hard-wired into it.



At the recent Semiconductor 95 Conference, former Intel executive William Davidow — now a partner in high tech venture capital firm Mohr and Davidow Ventures — predicted that chip manufacturers will in the future use far more subcontracting of chip design, packaging and other functions, in order to control rapidly escalating costs. This will create "tremendous business opportunities", said Davidow.

Because the current (AMPS) cellular system was designed years ago without any apparent regard for either privacy or security matters, those numbers are transmitted unencrypted over open airwaves. Thus, it's a simple matter to grab them out of the air and reprogram them into a second phone. The equipment to do both, though illegal, is sold in a booming gray market.

The second phone can then be used freely and for free — at least until the rightful owner of the pair of numbers gets a monthly statement and notices all the calls that he or she never made. At that point, the cell carrier cuts off service, forcing the owner to get a new phone number.

TRW, realising the commercial potential of its ESL subsidiary's technology for the cell phone business, created a new business unit called TRW Wireless Communications in 1993. Later it was renamed Corsair.

Corsair's system puts the equivalent of a 486 computer with 20MB of RAM and a 540MB hard drive into each cell site. The system builds a database of the fingerprints for each phone, through normal usage. Then, when it notices a mismatch between an RF fingerprint and pair of numbers, it assumes the pair of numbers have been illegally entered into a second phone. The call is simply not put through.

The system has been fully operational since summer in more than 100 of the Los Angeles cell sites with the highest fraud rate. Melissa May, a spokeswoman for cell carrier Airtouch, said the company is "impressed with the results. We think both the company and our customers have benefited".

Corsair's computers prepare daily reports about its effectiveness, and while the company doesn't want the exact numbers publicised, they show it blocking tens of thousands of clone calls a day — on a daily caller volume of well over 500,000.

New CVD tools allow 4Gb DRAMs

During the last half decade, chip makers have been able to create new generations of advanced memory and microprocessors at a breakneck pace, as equipment companies were able to extend the use of critical lithography, etch, and chemical vapour deposition (CVD) technology to handle ever smaller geometries. Today's advanced 16 megabit DRAMs and Pentium processors are built using 0.7-0.5 micron tech-

nology. But unless the equipment industry is able to quickly develop new leapfrog process technologies, the chip industry will hit a wall at about 0.35um — where existing technologies, particularly in etch and CVD, are running out of steam.

However Lam Research in Fremont claims to be the first tool maker to offer production-ready CVD tools for chip fabs that target initial 0.35um production and are scheduled to migrate to the 0.18um and even 0.1um level over the next five to seven years. These geometries are small enough to manufacture four-gigabit DRAMs.

Lam, which controls about 60% of the market for high-density (0.35um and below) etch tools, said its Deep SubMicron (DSM) 9800 and 9900 CVD systems will provide most of the dielectric CVD requirements for devices starting with 64Mb and 256Mb DRAMs and beyond.

Lam senior vice president Ray Degner told a press conference in San Jose that although Lam has not been a player in the CVD market, the requirements for new technologies in CVD enable new players with innovative technologies to compete with CVD market leaders such as Novellus, Watkins-Johnson, and Applied Materials. "At 0.35 micron, it doesn't matter what you did before. There is a total 'Reset to Zero' in the market, and we believe we have an 18-month lead over the competition in bringing manufacturing-ready deep submicron CVD systems to market."

Both DSM systems have shown to be capable of depositing highly uniform film for devices with structures as small as 0.18um, allowing chip makers to use the tools for at least three generations of devices.

Fab plant maker's sales top US$3B

The boom for chip equipment continued to be reflected in stunning sales and earnings by leaders in the industry, most notably Applied Materials of Santa Clara. Applied said it achieved record results for its fiscal 1995 year with net sales of US$3.1 billion, up 84.5% from fiscal 1994 net sales of $1.7 billion. The company's net income (profit) increased 112.5% to US$454.1 million from $213.7 million in fiscal 1994. New orders in fiscal 1995 totalled US$3.9 billion, an increase of over 90% from 1994. Applied's backlog of orders rose to $1.5 billion.

Applied Materials chairman James Morgan said the record sales reflect continued strong demand for the company's advanced wafer processing systems and global installed base support services. For fiscal 1995, all geographic regions reported record sales, reflecting the increased globalisation of semiconductor manufacturing.

"1995 has been the greatest year in Applied Materials' history", said Morgan. "We have successfully ramped our manufacturing capabilities to meet the tremendous surge in demand, while continuing to improve profitability, launch many new products and enter several new markets that will provide a basis for continued future growth."

HP & Intel to integrate PCs, TV

Hewlett-Packard and Intel have announced a series of new technologies that could make it easier for TV viewers to pick and choose what they want to see, and how they see it — on a PC or TV.

HP said it will be supplying America's third-largest cable operator, Comcast, with low cost set-top boxes and cable modems, a move that will allow high-speed transmissions of voice, data and video into the home through both televisions and PCs.

Meanwhile, Intel and Cable News Network said people who use the newest enhancements on the 'CNN at Work' service will be able to pick and choose the information they receive on their desktop PCs. CNN at Work is a live feed of the cable news channel into PCs, most commonly used by stockbrokers and other financial companies. With a new database system Intel is adding to CNN at Work, users will be able to filter out news that isn't of interest to them, while at the same time get flagged when news is announced that is relevant. This system relies on high-speed phone lines rather than a cable hookup.

HP and Intel also announced a joint venture with AT&T Network Systems and Hybrid Networks, to develop compatible cable modems and products in an effort to push the cable industry to conform to a single standard. Unless cable providers and manufacturers agree on a single type of cable modem, consumers could find that the system they used in one city won't work in another.

To overcome consumer price barriers to set-top boxes costing up to US$700, HP said it would rent the cable modems out to local cable systems at about $7 to $10 per month, allowing cable operators to begin a mass deployment of the modems in early to mid 1996.

TCI, the nation's largest cable operator, along with Cox Cable and Comcast has agreed to purchase one million of HP's set-top box, called Kayak, in 1996 — according to William Hahn, operations manager of interactive broadband products for HP.

Intel, which is developing its own cable modem, called CablePort, will also offer its cable modems at a discounted rate to cable operators when they are released sometime this year.

Sony to enter the PC market

Sony has announced that it plans to enter the US market for Intel/Microsoft-based desktop and laptop personal computers, next fall.

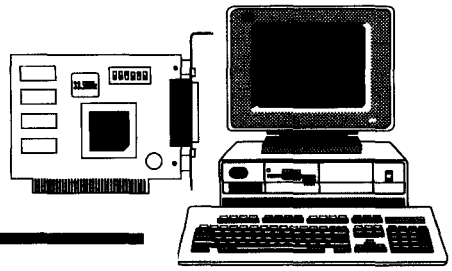
Sony's new chairman, Nobuyuki Idei, explained that his company, which relies on distributors and outside service firms, sees the entry into the PC market as a way to learn to deal directly with end users — something that will become increasingly important in the future consumer electronics markets Sony wants to play a major role in.

Personal computers as we know them won't be used around the world on the scale of televisions or telephones, Nobuyuki said, because they are too difficult to use for most people. But computing power for the consumer market will not be limited to the PC; it will also be added to products such as eyeglasses and televisions. "The intelligent television idea and PC idea coexist", Idei said. "But what is bigger? I think the more simplified, intelligent type of television should be a much, much bigger market." Idei also said that selling personal computers would also help the company sell more monitors, a core business for Sony.

Idei also listed several of Sony's other major market strategies, including:

- Sony is not interested in buying a US television network, particularly while broadcasting changes from analog to digital signals that permit far more choices for programs and services.
- The new high-capacity compact disc will take three to five years to become a mainstream item. The disc, for which a design compromise was reached by Sony/Philips and Toshiba last September, will have nearly 10 times the capacity of current CDs — enough to hold a movie. Some manufacturers aim to have their first new CD players out by fall. ❖

Computer News and New Products



Multimedia Pentium system

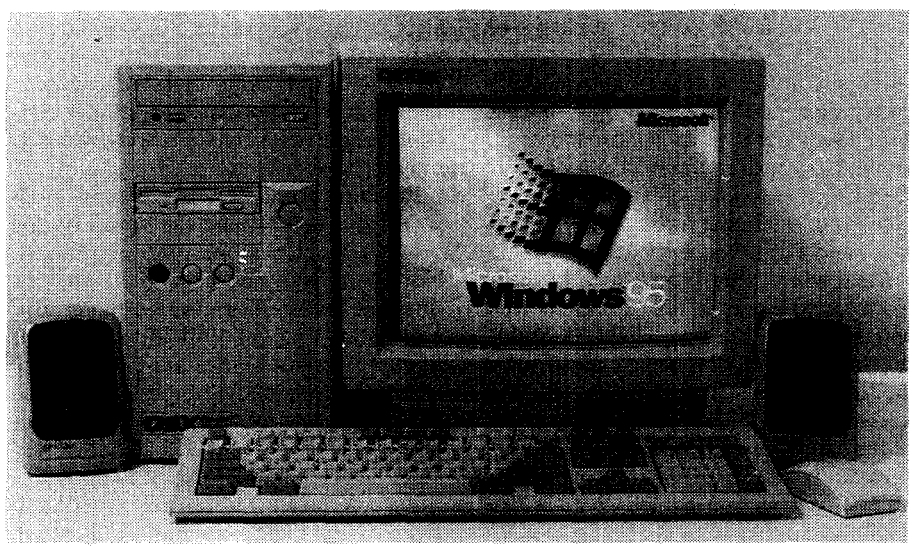
Dick Smith Electronics has recently launched the third generation of its DSX Power Series housebrand PC, the DSX Multimedia Pentium 75PC.

The system comes with a Pentium processor, 8MB of RAM, 850MB hard drive, 16-bit sound card and quad speed CD-ROM drive and is priced at $2999. It includes a 14" non-interlaced digital monitor.

Fully assembled in Australia to high quality control standards, each system is also fully tested by the Dick Smith Electronics quality control team, and is claimed as a quality alternative to international brands.

Other features include a 3.5" floppy disk drive, plug and play motherboard, PCI 1MB video card, expandable to 2MB, stereo speakers, Microsoft Windows '95, Works and Encarta '95.

For further information contact your nearest Dick Smith Electronics outlet.



Industrial quality active matrix LCD

The LCDh102t-31 active matrix LCD module recently introduced by flat panel display (a joint venture between Philips, Thomson, Segem and Merck) features a new integrated meander backlighting system that dramatically increases screen brightness. This makes it suitable for use in bright surroundings. It can also be dimmed for use in darkened conditions.

The module has VGA resolution (640 x 480 pixels) on a 10.4" (diagonal) screen. A 24-bit driver circuit allows it to display up to 16.7 million colours.

The module electronics enables easy interfacing with commercially available VGA chipsets such as those from Cirrus Logic, Western Digital and Chips & Technologies.

With its bright (250cd/m^2), high contrast screen and 40,000 hour operational life, the display is suited for use in industrial PCs and terminals, automatic teller machines, electronic point of sale and test and measurement equipment, multimedia systems and workstations in areas of high ambient lighting.

For further information circle 164 on the reader service coupon or contact

TFT LCDs offer XGA resolution

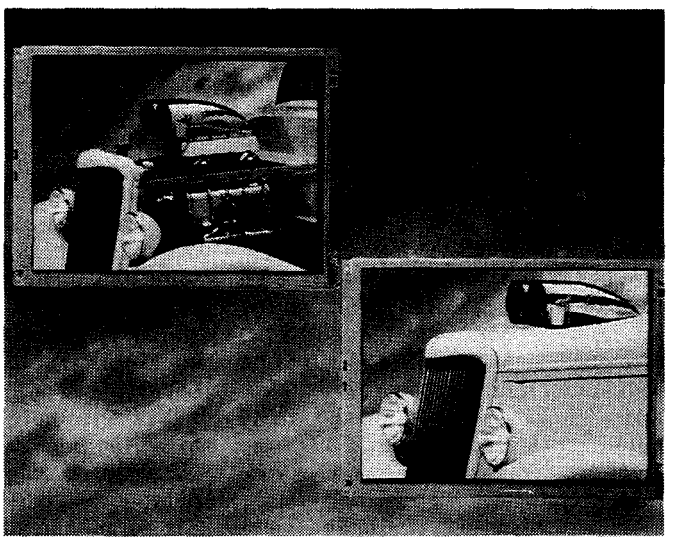
Mitsubishi has launched its new active matrix colour TFT line of products, called Angleview — a broad family of SVGA, VGA and XGA displays designed for both notebook and high resolution applications. Mitsubishi has invested more than $400 million to bring total production capacity to the equivalent of 100,000 10" panels per month in 1996.

The products are available in two lines: a notebook line of 10.4" SVGA and VGA displays and a high resolution line that includes a 12.1" XGA display and 13" EWS display.

All members of the family feature fast response and a wide viewing angle without any image reversal.

As the next generation of Angleview colour TFT LCDs come on line, they will feature thinner glass, lighter weight and lower power displays, according to Mitsubishi.

For further information circle 161 on the reader service coupon or contact the Mitsubishi Electric Australia Semiconductor Department on (02) 684 7777. You can also write to 348 Victoria Road, Rydalmere 2115.



Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 805 4479.

EPROM emulators speed development

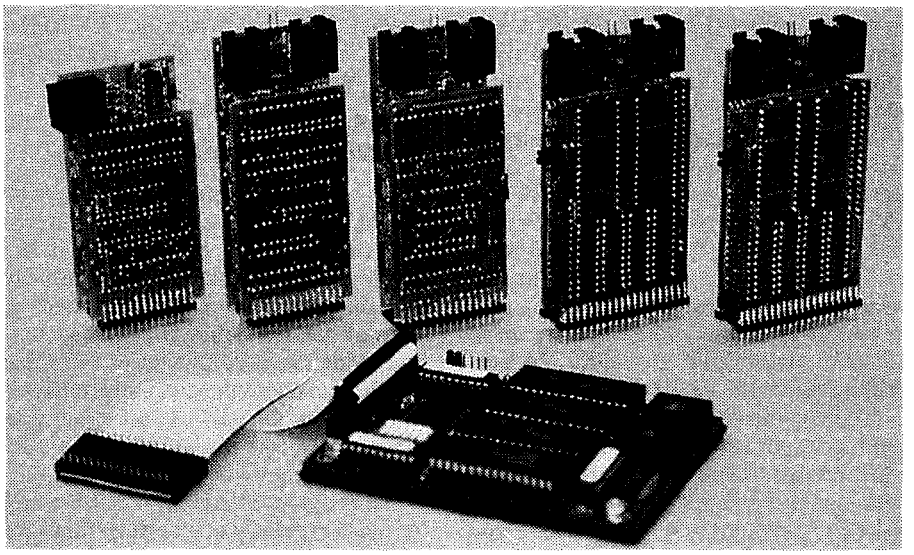
The TechTools range of EPROM emulators includes the low cost EconoROM series and the advanced FlexROM series, both designed to significantly reduce software development and debugging time.

The EconoROM series accelerates the software development process by eliminating the need to remove, erase, program and re-install EPROMs for every software change. They plug directly into the EPROM socket on a target board and emulate the EPROM throughout the development process.

EconoROMs connect to a standard PC or notebook computer parallel port, and are supplied with PC software which allows fast downloading of the target program into the EPROM emulator.

The FlexROM series provide all the advantages of the EconoROM series plus a host of more advanced features. In addition to basic EPROM emulation, the FlexROM series support Flash memory emulation, target write-back, arbitration support, memory upgradability and advanced host software. The target write back facility allows the target to write to its EPROM, eliminating the need for overlay memory when using a debug monitor or in-circuit emulator.

For further information circle 163 on the reader service coupon or contact Technology Affair, 57 Wessex Street, Carina 6020, phone (09) 246 4810.



ISA bus 486 SBC with cache

The SBC-455 from AAEON Technology is a half length ISA bus format computer board that includes all standard I/Os with high speed UARTS on the serial ports, watchdog timer and power management. A C&T65545 chipset provides support for both CRTs and flat panel displays, including the new generation active matrix LCDs from FPD in Holland. Two 72-pin SIMM sockets can take up to 64MB of RAM, and a PC104 expansion socket enables extremely rugged systems to be

built up. It can take a range of processors from 486SX-25 to Pentium P24 and includes 128KB of cache.

Maximum current drain is 2.5A from a single 5V supply. Power pass through of +/-12V is available to drive peripheral cards. Manuals and a comprehensive cable adaptor set are included.

For further information circle 162 on the reader service coupon or contact Amtex Electronics, 13 Avon Road, North Ryde, 2113; phone (02) 805 0844.

Monitor has 89cm screen

According to Mitsubishi, board room meetings need never be dull again with the launch of its new large screen colour computer monitor, the Diamond Pro 37 (model number XC3730C), featuring an 89cm viewing area. The monitor is also designed for use at trade shows and exhibitions, public areas, in control rooms and teaching and training venues.

The high light output of its large cathode ray tube means it can be seen under ordinary room lighting conditions. Competing projection systems usually require a darkened room. Suitable for connection to most types of computers and video systems, the monitor can display PAL, NTSC and SECAM video signals as well as computer graphics. It has a wide horizontal scanning range of 15 - 85kHz and is compatible with PC, Macintosh and Workstation systems. It has two RGB, two video and S-video inputs and a vertical scanning range of 40 to 120Hz.

The large Mitsubishi CRT uses an Invar shadow mask to reduce image distortion while dual dynamic beam forming enhances focus at the screen's periphery.

The monitor includes an infra-red remote control and a built in audio amplifier for stereo sound and easy connection to multimedia computers. The RRP is $16,655 (inc. tax).

For further information circle 165 on the reader service coupon or contact Mitsubishi Electronic Australia, 348 Victoria Road, Rydalmere 2115; phone (02) 684 7262.

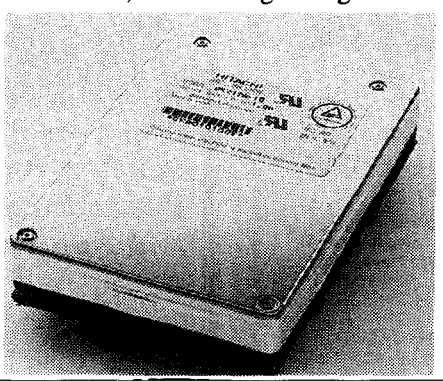
2.5" 1.3GB HD drive

A new family of 2.5" hard disk drives has been released by Hitachi Australia. Based on Hitachi's thin film head technology and high density disks, the new drives offer a density of 99,000 bits/in — a 50% increase over the density of Hitachi's previous 2.5" drives. They have an average seek time of 12ms and ATA-2 interface (supporting PIO Mode-3 data transfer rates up to 11.1MB/sec).

The new drives are available in two form factors — the DK212A series with a height of 19mm and a capacity up to 1.08GB, and the 12.5mm DK222A providing up to 1.3GB capacity.

To meet the demands of portable computing applications the drives have an operating shock resistance of 150G and non-operating shock resistance of 250G. Power consumption (for seek and read/write operations) is 2W.

The new drives have a common mechanical design, read/write heads and electronics, allowing significant economies of scale in manufacturing. Hitachi has also expanded its production capacity to support anticipated demand, with a new US$200M manufacturing plant now online in the Philippines.



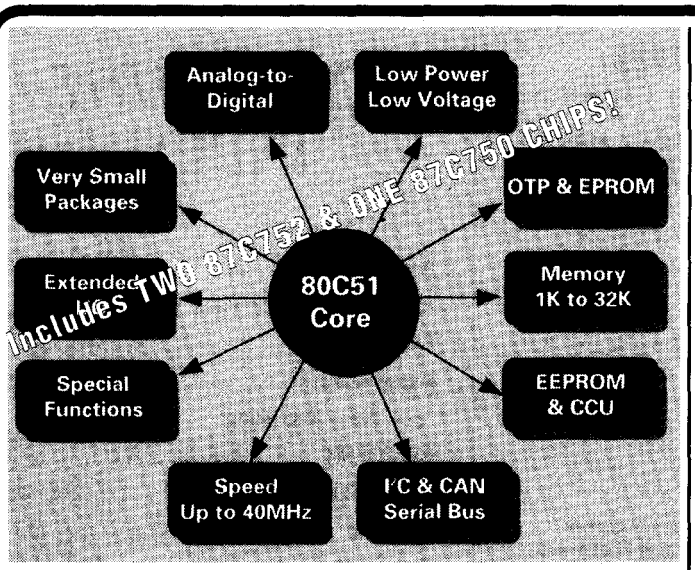
The drives have a 300,000 hour MTBF rating and are sold through distributor DCS Australasia on (03) 9878 0344. For further information circle 166 on the reader service coupon or contact Hitachi Australia, 73 Miller Street, North Sydney 2060; phone (02) 929 8799.

Measurement conversion software

A new computer program RiadaConvert — The Conversion Encyclopaedia has been designed and developed in Australia. The software lets you convert more than 2000 units of measure and is a definitive guide to units for a wide range of categories including length, mass, volume and temperature as well as more unusual categories such as clothing sizes, monetary rates and selected foreign words and phrases.

The program is a comprehensive tool for those regularly converting values for work or study. It can convert unusual units, like spats to sagenes or barads to pascals as well as common units like centimetres to inches. A feature of the software is the informative text associated with many of the units, giving historical and cultural perspectives. It also allows the user to define units and categories. The program is a true 32-bit application written and designed for Windows 95 and Window NT, but also runs on Windows 3.x. The product is priced at $65.

For further information circle 170 on the reader service coupon or contact Riada, PO Box 1141, Windsor 3181; phone (03) 9510 9685. ❖



Ever wanted to try out the new generation of microcontrollers?

Well here's the low cost way to do it with the DS-750 Development Kit from Philips for only $159.90!!

It has the following features:

- **Emulates 87C750 Microcontrollers in Real-Time**
- **Programmable Clock up to 40MHz**
- **Built-in Programmer for 87C750/1/2**
- **High-speed Hardware Simulator**
- **Source-Level Debugger for C, PLM and Assembler**
- **24-pin DIP Emulation Header**
- **Serially linked to IBM PC at 115 kBaud**

APPLICATIONS

The main applications of the DS-750 Kit are: -

Evaluation of Philips microcontrollers
Demonstration of microcontroller capabilities
Development of microprocessor based systems
Hardware and software debugging purposes
Training in the field of microprocessors
Programming of Philips microcontrollers

The Ceibo DS-750 supports 87C750 Philips microcontrollers at any frequency allowed by the devices. It is serially linked to a PC/XT/AT or compatible systems and can emulate the microcontrollers using either the built-in clock oscillator or any other clock source connected to the microcontroller.

The clock oscillator generates 40MHz, 20MHz, 16MHz, 10MHz and 5MHz. Emulation is carried out by programming an 87C752 microcontroller with the user software and an embedded monitor program. The DS-750 provides the on-board programming capabilities and locates the monitor in the upper 1K that is not available for the 87C750.

Three working modes are available: real-time, simulator and simulator plus. In the real-time mode the user software is executed transparently and without interfering with the microcontroller speed. Breakpoints can be added to stop program execution at a specific address. in the simulator modes, an additional microprocessor is used to take control of the 87C750 lines and to simulate its operation but not in real-time.

This operating mode allows access to all the microcontroller functions (I/O, timers, etc.) and interacts with the hardware according to the user software execution or directly by means of emulator commands sent from the host computer. The combination of the two available working modes allows an easy way to debug hardware and software functions. The software includes C, PLM and Assembler Source Level Debugger, On-line Assembler and Disassembler, Software Trace, Conditional Breakpoints and many other features.

EXPERIMENTS

Five experiments demonstrate the capabilities and advantages of the 80C51 device and its derivatives. Completing each of the experiments will provide the user with more knowledge and experience.

1: Getting to know the DS-750
This experiment carries out several exercises to describe the functions of DS-750.

2: Data Transfer Instructions
This experiment helps you to understand the different addressing modes of the devices, writing programs that use the data transfer instructions, and transfer data and code to and from different memory types.

3: Input/Output Ports
This experiment shows how to manipulate Boolean variables, use the input/output capabilities of the microcontrollers, and how to assemble programs that use the ports of a microcontroller.

4: Arithmetic& Logic Functions
This experiment will help to make calculations with the microcontroller, replace logic circuits by microcontroller functions, and to write programs that use arithmetic and logic instructions.

5: Control Transfer Operations
After completing this experiment the user should be able to understand the stack operations, write programs that use the control transfer instructions and pass control to subroutines.

The DS-750 system is supplied with a User's Manual, debugger and application software (including Cross Assembler), microcontroller documentation (huge databooks!), two samples of the 87C752 and one of the 87C750 (all windowed EPROM microcontrollers), RS-232 and interfacing cables and a power supply.
All you need to get up and running for just **$159.90**

Degauss Wand

Every TV technician needs one and our's is locally made. 240V, 2A with 10 minutes continuous rating **$99.95**

Plug Packs

All for 240Vac operation.

PP-300MV	3/4.5/6/7.5/9/12Vdc @ 300mA	**23.20**
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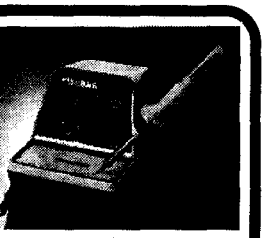
PP-1000MV	6/7.5/9/12Vdc @ 1A	**35.95**
PP-9138	13.8Vdc @ 800mA	**35.95**
PP-09V-AC-300MA	9Vac@ 300mA	**20.95**
PP-10VAC-1A	10Vac @ 1A w/- 2.1mm Plug	**28.60**
PP-12V-AC-300MA	12Vac @ 300mA	**13.95**
RPP250*	Regulated 1/3/4.5V @ 250mA	**30.95**
RPP500*	Regulated 6/9/12V @ 500mA	**40.80**

** Ideal for Walkmans etc*

Hakko 926 Soldering Station



The Hakko 926 is a super-quick heat-up (3 sec cycle) and fast recovery iron. The built-in ceramic heater maintains temperature to within 0.5°C of the setting. Yes this is an ADJUSTABLE temperature iron covering the range from 200°C to 480°C using a full wave zero-crossing switching system. Meets MIL-STD-2000 and operates at safe 24V.
Some people are asking $250!

Our's are only **$222.60**

We keep 18 Hakko Tips in stock plus spare parts, solder etc. You won't find a better range of soldering/desoldering tools! Here's the complete list of irons, tips, spares etc!

HKO-470	Desoldering Tool	**1349.30**
HKO-470-SPONGE	Sponge	**4.80**
HKO-802-ELEMENT	802 24V/50W Heater Elmt	**91.10**
HKO-802-EL-COVER	Element Cover for 805	**4.75**
HKO-802-EL-NUT	Nut for 802 Element Cvr	**6.10**
HKO-802-NZL-0.8S	802 0.8mm Slim Nozzle	**29.00**
HKO-802-NZL-1.0S	802 1.0mm Slim Nozzle	**29.00**
HKO-802-NZL-0.8	802 0.8mm Nozzle	**29.00**
HKO-802-NZL-1.0	802 1.0mm Nozzle	**29.00**
HKO-802-NZL-1.3	802 1.3mm Nozzle	**29.00**
HKO-802-NZL-1.6	802 1.6mm Nozzle	**29.00**
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HKO-802-FILT-SM	802 Small Ceramic Paper	**13.60**
HKO-802-FLTR-SPR	802 Spring Filter	**20.35**
HKO-802-REAR-HLD	Holder Assembly for 802	**12.65**
HKO-PIN-0.8	0.8mm Clng Pin 802/483	**4.65**
HKO-PIN-1.0	1.0mm Clng Pin 802/483	**4.65**
HKO-PIN-1.3	1.3mm Clng Pin 802/483	**4.65**
HKO-PIN-1.6	1.6mm Clng Pin 802/483	**4.65**
HKO-802-FILT-LG	Large Crmc Ppr 802/483	**13.25**
HKO-O-RING	O-Ring for 802/483	**15.25**
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HKO-481-T-1.3	481 1.3mm Tip	**33.95**
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HKO-483-T-1.0	483 1.0mm Tip	**36.20**
HKO-483-T-1.0S	483 1.0mm Slim Tip	**36.20**
HKO-483-T-1.3	483 1.3mm Tip	**36.20**
HKO-483-T-1.6	483 1.6mm Tip	**36.20**
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HKO-483-PIN	483 Heater Core Pin	**7.45**
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HKO-900M-NUT	Small Nut	**4.30**
HKO-900M-NIPPLE	Small Nipple,Pipe&Fitt	**8.30**
HKO-900M-NUT-ENC	900M Small Enc. & Nut	**8.60**
HKO-900M-HEATER	Heater for 926	**35.70**
HKO-900M-T-LB	0.2mm Conical Tip	**15.40**
HKO-900M-T-B	0.5mm Conical	**11.05**
HKO-900M-T-K	Knife tip	**23.25**
HKO-900M-T-I	Tip for 900M Iron	**11.05**
HKO-900M-T-1.6D	1.6mm Dual Flat Tip	**11.05**
HKO-900M-T-1.6H	1.8mm Offset Tip	**18.40**
HKO-900M-T-1C	1.0mm Single Flat	**15.40**
HKO-900M-T-1CF	Offer 900M-T-1C	**15.40**
HKO-900M-T-2.4D	2.4mm Dual Flat Tip	**11.05**
HKO-900M-T-2C	2.0mm Single Flat	**11.05**
HKO-900M-T-2CF	Offer 900M-T-2C	**11.05**
HKO-900M-T-3.2D	3.2mm Dual Flat Tip	**11.05**
HKO-900M-T-3C	3.0mm Single Flat	**11.05**
HKO-900M-T-3CF	Offer 900M-T-3C	**11.05**
HKO-900M-T-4C	4.0mm Single Flat	**11.05**
HKO-900M-T-4CF	Offer 900M-T-4C	**11.05**
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HKO-900M-T-RT	SMD Tip	**22.90**
HKO-900S	Small Iron for 926	**90.25**
HKO-900S-HEATER	Heater for 900S	**40.60**
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HKO-900S-T-1.2D	Tip for 900S Iron	**14.35**
HKO-900S-T-1.6D	Tip for 900S Iron	**14.35**
HKO-900S-T-1C	Tip for 900S Iron	**18.40**
HKO-900S-T-2C	Tip for 900S Iron	**14.35**
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HKO-926	Adjustable 200C - 480C	**222.60**
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HKO-926/924-ADPT	926 to 924 Tip Adaptor	**32.05**
HKO-926-HOLDER	Complete 926 Iron Hldr	**16.95**
HKO-926-PCB	926 PCB	**76.90**
HKO-926-RCPTCL	Insulator for 926 Holdr	**5.10**

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Australian designed and made and programs most popular EPROM's and FLASH proms. Just connect to the parallel/printer (Centronics) port of any IBM compatible computer using a DB25 connector and you can program 28 and 32 pin devices ranging from 2764 to 27080 and their derivatives. Ideal for use with lap-tops – no plug-in cards or complications. Programmer is completely hand-free. All controls are via the attached computer. Support software gives feedback of progress. Functions available include Blank check, verify EPROM to disk file, Auto ID, Read and Write EPROM to disk. EPROM contents can be viewed and single hex bytes altered. Operation can be either manual or automatic using the built-in ID mode of the EPROM to match the most efficient programming algorithm to the device. Requires only minimal memory as programming is done in "chunks".
Support the local product!

Excellent value **$363.00**

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At last an affordable EPROM eraser for the hobbyist or individual engineer.

- ***Erases up to 9 chips simultaneously***
- ***Erasure times from 15 minutes***
- ***Double insulated case***
- ***Long life 7mW/cm² tube***
- ***Presettable timer 15-40 minutes***

$151.25

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How many times have you struggled to get a spring out of a piece of equipment and then spent what seems like eternity trying to get it back?!!
Well we've found the answer a special Spring Puller – again from Italy!. Made in chrome vanadium steel and 210 mm long it has a hook shaped tip at one end and a fork-shaped tip at the other. Value at **$18.50**

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Solder masked and silk screened PCB and software on 3.5" disk only (See EA July 95) **$10** (cat K47)

SPEAKER SIREN
Uses driver circuit from our Protect Anything Alarm kit, gives 95dB sound pressure of irritating sound. BARGAIN **$12**. (cat K71)

PLASMA EFFECTS SPECIAL
Ref: EA Jan 94. This kit produces a fascinating colourful changing high voltage discharge in a standard domestic light bulb, or light up any old fluorescent tube or any gas filled bulb. Fascinating! The EHT circuit is powered from a 12V to 15V supply and draws a low 0.7A. Output is about 10kV AC peak. PCB: 130 x 32mm. PCB and all on-board components (flyback transformer included), and instructions: **$28** (cat K16) Hint: connect the AC output to one of the pins of a non-functional but gassed laser tube, amazing results! The special? We supply a non-functional laser tube for an additional **$5**, but only when purchased with the plasma kit. Total price: **$33**

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HELIUM-NEON LASERS
633nm red laser tubes from new and near new equipment. Suitable for light shows: Output power in the range of 2.5 to 7.5mW. Includes our 12V Universal Laser power supply MkIV. (No problems with our new transformers.) *ON SPECIAL* at a reduced price of **$80** for a 2.5-4mW tube and supply (cat L01). **$130** for a 40-7.5mW tube and supply (cat L02). WARNING: involves high voltage operation at a dangerous energy level! Needs a source of 12V at 2A (at least). A 12V gel battery or car battery is suitable, or for 240V operation, our Wang computer power supply (cat P01) is ideal. SPECIAL PRICE for this supply, when purchased with matching laser head/inverter kit is an additional **$10**

MASTHEAD AMPLIFIER
High performance low-noise masthead amplifier covers VHF-FM-UHF and is based on a MAR-6 IC. Includes two PCBs, all on-board components. For a limited time we will include a suitable plugpack to power the amplifier from mains for a total price of: **$25**

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VISIBLE LASER DIODE KIT
5mW 670nm visible laser diode and collimating lens, with housing and APC driver kit EA 9/94 SPECIAL **$40** Suitable case and battery holder (as in EA 11/95): **$5**

AIR-COOLED ARGON-ION HEAD Used 30-100mW argon-ion head blue/green output. Includes details of power supply and other information: head only. **$180 to $350** (Depends on hours of use, but these have heaps of life left as they were used at very low currents.) One year guarantee, size 35x16x16cm.

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See February *SILICON CHIP* for some extremely low priced IR-UHF remote controls: 1-ch UHF remote control with additional central locking **$53** for 1 Tx & 1 Rx, 2-ch UHF remote control (from **$30**) for 1 Tx & 1 Rx, and an 8-ch remote control which includes 1 Tx & 1 Rx at **$36**!!

CYCLE-VEHICLE COMPUTER
NEW SOLAR POWERED MODEL
Originally for bicycles, these suit any moving vehicle with wheels! 9-function computer with speed, average speed, maximum speed, distance, odometer, timer, scan, freeze frame memory, and a clock. Microprocessor circuitry can be adapted to work with almost any wheel diameter. Divide the wheel diameter in millimetres by 6.8232, and program the result into the computer. **$32** (cat G16)

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Parts to make a 3-stage first generation night scope that gives good vision in starlight! Includes a 3-stage fibre optically-coupled image intensifier tube, EHT power supply kit which operates from 6 to 12V, and sufficient plastics to make a monocular 'scope. 25mm version **$270.** (cat N04), 40mm version **$300** (cat N05) Also available, a quality Peak brand 10x 'plalupe' as an eyepiece **$18.** See SC Sept. 94.

NEW CATALOG AT OUR WEBSITE
We have combined efforts with DIY ELECTRONICS (a Hong Kong based company) in producing a WEB site on the Internet. Here you can view and download a text version of both of our latest catalogs and other up to date information. Email orders can also be placed here. The combined effort means you are offered an extensive range of over 300 high quality, good valued kits, and many more interesting components and items. The range of kits includes simple to more advanced kits, covering a very wide field of applications: educational, EPROM, experimental, gas and diode lasers, microprocessor, computer, remote control, high voltage, night vision etc. We'll leave it to you to do the exploring at:
http://www.hk.super.net/~diykit

12V-2.5W SOLAR PANEL
US amorphous glass solar panels only need terminating and weather proofing. Includes clips and backing glass. Very easy to complete. Size: 305x228mm, Voc 18-20V, Isc 250mA. SPECIAL **$20 ea, 4 for $60.**

Efficient switching regulator kit also available: suits 12-24V batteries, 0.1-16A panels, **$27**. Also available, simple, efficient shunt regulator kit **$5**

MINI CAR FOR CHILDREN NEW
Battery powered car supplied with a 6V 8Ah battery and a suitable charger. Has headlights and direction lights, and is coloured red. Overall size is 1010 x 620 x 412mm (large!) Our introductory price is limited to orders placed between Feb-April. Introductory quantity is LIMITED at a SPECIAL PRICE of **$350.** Suitable speed control kit an extra **$10**.

400x128 LCD MODULE
New Hitachi LM215 400 X 128 dot matrix LCDs in an attractive housing. Driver ICs fitted but needs external controller. Effective display size 65 x 235mm. **$25 ea. or 3 for $60**

PASSIVE TUBE - SUPPLY SPECIAL
Russian passive tube plus supply combination at an unbelievable SPECIAL REDUCED PRICE: **$70** for the pair! Ring or fax for more information.

3.5 DIGIT LCD METER
Panel meter, 200mV, 1999 count, 9-12V @ 1mA, 0.5% accuracy, auto polarity & over-range indication, 13mm char height. 100MΩ I/P, 68 x 44mm. **$27**

CCD CAMERA - TIME LAPSE VCR RECORDING SYSTEM
Ready made PIR detector module and learning remote control combination can trigger any domestic IR remote controlled VCR to *RECORD* human activity within a 6m range with an 180² view. Starts VCR recording at first movement and ceases recording a few minutes after the last movement has stopped. Just like commercial CCD-video recording systems costing $1000's!! No connection needed to your existing VCR. IR detector module, control kit, IR learning remote control and instructions **$90** or **$65** when purchased with our CCD camera. Previous CCD camera purchasers can claim reduced price with proof of purchase.

TINY PCB CCD CAMERA with auto iris lens, 0.1lux 320k pixels, IR responsive, has 6 IR LEDs on PCB, almost matchbox size! **$180**

IR ILLUMINATOR Has 42 high-output 880nm IR LEDs (30mW @ 100mA ea). Operates from 10-15V DC, current adj range 5-600mA. Suits our CCD camera: **$40**

VHF MODULATOR for CH7-11, to connect CCD camera to a TV set. Operates TV if modulator within 50cm of the antenna. No wires! **$12**

SOUND FOR CCD CAMERA High gain audio amp, electret mic, speaker **$10**

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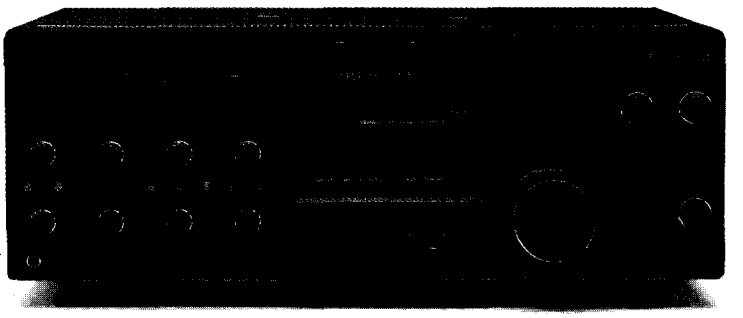


IC-R9000

With an Icom receiver, the world is as wide as your band

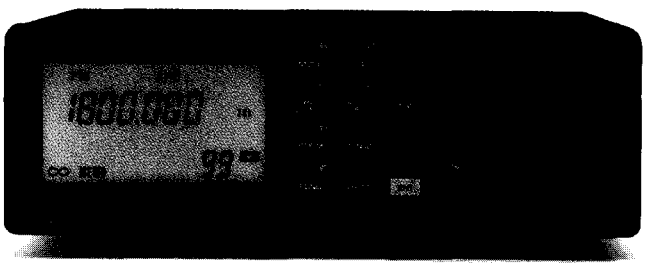
The mobile IC-R100 is packed with powerful features, and covers the 100kHz - 1800 MHz (500 kHz ~ 1800 MHz guaranteed) range in AM, FM, wide FM modes with multi-function scanning and 100 memories with 20 scan edge channels.

While the IC-R7100 covers from 25 ~ 2000 MHz in SSB, AM, FM, wide FM modes, optional TV and FM stereo adaptor, with 900 memory channels, sophisticated timer functions and multiple scan functions.

The top of the range IC-R9000 expands your listening horizons, covering 100 kHz ~ 1999.8 MHz in all modes and featuring Icom's unique CRT display, intelligent scan functions and an amazing 1000 memory channels, in a unit that delivers superb high frequency stability, even in the GHz range.

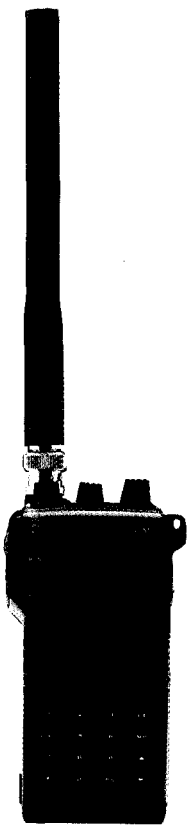
So tune in to the ones that professional listeners use, from the wide range of Icom wide band receivers.

IC-R7100



IC-R100

IC-R72



IC-R1

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