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Electronics Australia WITH eti

May 1992

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

No film, no disks — just a row of DRAM chips

Dycam's new digital still camera is able to capture and store up to 32 images, in its internal DRAM memory. The images can then be downloaded to your computer (IBM compatible or Mac), via its serial interface. Barry Smith has been trying one out, and tells what he found in the story starting on page 20.

Amstrad's new 'double decker' VCR

Probably the most obvious use for a dual-deck VCR is in copying tapes (although not those that are copyright). But the Amstrad DD8904 can do much more than this — like making two different recordings at once, or making a new recording while viewing another. Jim Rowe explains, in his review starting on page 8.

On the cover

Federal staff member Fiona Robinson is pictured checking out the new Philips 28ML8916 'Widescreen' 71cm colour TV receiver, which provides a 16:9 aspect ratio and 100Hz display for better viewing of movies. See our review, starting on page 10. (Photo by Greg McBean)

Video and Audio

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Projects and Technical

Professional Electronics

Columns and Comments

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LETTERS TO THE EDITOR

Postage rates

I am on brief Christmas holidays in Australia and have seen your latest Editorial (*EA* January) complaining about rising postage costs and the possible demise of *Electronics Australia.* I regret I have no sympathy with your complaints.

When will you learn that Australia is a part of Asia and that Asia is not just a two day stopover on the way to the 'mother country' or a three day layover in Bangkok? Asia is NOT in recession; it is booming. In Hong Kong where I have my business there is also an unemployment problem — unemployment is around 1% (that is ONE %) and labour is so short that Filipina maids have now entered the general workforce.

The world is slowly but inexourably leaving Australia behind. The phone system is declining compared to that in Japan and Hong Kong; postage, taxation and government interference in business are ridiculously high. The price of electronic components here is just a joke. I am borrowing capital at 7.5%. Any regular traveller overseas or visitor to Australia knows this. I myself now doubt that I will ever return permanently.

The solution to your problems is to convert *Electronics Australia* to *Electronics Asia* based and printed in Asia and to become more attuned to the Asian region. The future of electronics for your magazine is in Asia; it is not in vintage radio or thinking back to the good old days. It is cheaper to print magazines like yours and post them into Australia from Asia than it is to print and post locally.

It is indicative of your current regard to Asia that your masthead only lists one Asian country and even then has had the telephone country code incorrect for all 1991 (852, not 862). Obviously you do not contact them often!

In 1967 I left Tasmania after graduating from University and moved to Melbourne. Tasmania was a good place to grow up but not to work. In the mid-1980's the same became true about Australia as a whole; after graduating any intelligent, thinking person had no choice but to go overseas if they wanted to do well for themselves. *EA* must do the same. The answer to your problems is not to exhort your readers to write to their local MP, but to recognise that your future lies in the Asian region. Do not look to others for your salvation; the choice to live or die lies squarely with you.

Peter Crowcroft PhD,
Hong Kong.

Terminology

I refer to the series of reports by Louis Challis on a range of new items of audio and video equipment. These are always extremely well put together and make very interesting reading. However, in the report on the Marantz PM-72 integrated amplified (*EA* February 1992), I am rather intrigued by the several references to signal-to-noise ratio, particularly with regard to the minus signs and the use of the suffix '(A)'.

When expressing a ratio, it is normally stated in dB with no arithmetical signs or other qualifications. When a number of dB is followed by the capital letter A, it is taken as a statement of the actual acoustic level in dB above the threshold of hearing (0dBA or a sound pressure level of 0.0002 microbar). For example, when reviewing the performance of motor vehicles, the NRMA gives the internal noise level under stated conditions as so many dBA (e.g., 70dBA).

In some instances, an A or a C in brackets, i.e., '(A)' or '(C)', has been used to denote the type of psophometric weighting applied to the measured sound levels. In this case, however, C-weighting is normally used for wide-range musical material while A-weighting is used for restricted range conditions; voice and telephone circuits etc.

Under these conditions, I am not entirely sure of the author's intent. I may have missed something along the way, but in any event, I would welcome some clarification of this matter.

Winston T. Muscio,
Lumeah, NSW

Louis replies:

Having read Mr Muscio's forthright letter I must acknowledge that his criticism of the use of negatives in front of signal to noise ratios is generally correct, and that somehow I have inadvertently perpetrated a minor misdemeanour for which I hope there will be no no fine.

Nothwithstanding that aspect of Mr

Muscio's criticism, his ongoing criticism in respect to reference to A-weighted signal to noise ratios in these circumstances is misguided.

It is now customary for most manufacturers to quote signal to noise performance in terms of either unweighted, or A-weighted levels.

The weighting used is the same as that used for conventional acoustical measurements, i.e., those associated with an input from a microphone, the only difference being that the input is electrical and not acoustical.

Mr Muscio's reference to psophometric weighting is appropriate for communication circuits, but not for measurements of signal to noise ratio on hi-fidelity equipment.

Having been chastised, I will be more careful next time.

Louis A. Challis,
Challis & Associates,
Kings Cross, NSW.

Article suggestions

There are three items that I am interested in knowing about, which I think other readers may also find interesting and could be published in a future edition of your magazine.

One is the operation of those low voltage lights. Some use a 12 volt transformer, while others use a small circuit. Perhaps you could explain the operation of this circuit and also print a circuit diagram so that we could make it.

Secondly, I would like to know the operation of those digital signs that are on the front of some of the government buses, giving the destination and other information.

I found the article 'Shake hands with the Devil' to be one of the most interesting and informative I have read for a long time, as it deals with something that we use and are exposed to every day but know very little of its danger.

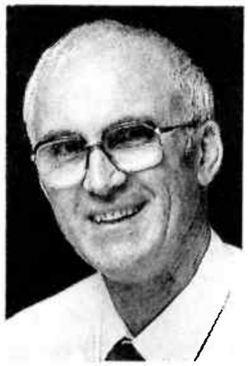
I would like to know how we can be electrocuted if we touch the active with one hand while we are insulated from earth by wearing rubber soled shoes, as the author mentions that the body has very little capacitance.

Glen Williams,
Heathcote, NSW.

DROP US A LINE!

Feel free to send us a letter to the Editor. If it's clearly expressed and on a topic of interest, chances are we'll publish it — but we reserve the right to edit those that are over long or potentially libellous.

EDITORIAL VIEWPOINT



A setback for Optus — but hopefully NOT for Pay TV

I'm writing this on an overcast Monday morning in late March. Last night, along with other media people and guests invited by Optus Communications, I was at the Hoyts Television studios in Sydney's North Ryde — expecting to see the long-planned launching of the first of Australia's new B-series satellites. A special satellite TV link had been established between Australia and the launch site in Xichang, South-West China, and after viewing some background videos we were switched through at about 8:40pm Sydney time to watch the final countdown and launching.

There was a bang, a roar and quite a bit of the usual flame and smoke. But then silence; and soon the smoke cleared to reveal the Long March LM-2E rocket still intact, but also firmly earthbound. It was all rather disappointing, especially for the Optus/Aussat people who had worked hard to make the launch a success. The Chinese were also very embarrassed, judging by the apology made by the president of the Great Wall Industrial Corporation (the launching contractor), just before the TV link was closed down.

At present little can be gleaned about the reason for the setback; Dick Johnston, director of Optus's satellite division, could only guess that one or more of the rocket's total of eight engines had somehow failed to ignite — forcing the launching to be aborted. The cause could take many days to find and rectify, and it may also take some time before the rocket can be made ready for another launch.

Still, the satellite itself doesn't seem to have been damaged — much worse things have happened in satellite launchings that 'went wrong', in the USA and elsewhere. Hopefully by the time you read this, satellite B1 finally will have been placed into orbit.

But disappointing though last night's events were, they should only be seen as a minor setback. There's every reason to believe that B1 and its sister B2 satellite will be in orbit by the end of the year, and by early in 1993 will have taken over from their trusty but now outdated predecessors A1 and A2. Australia will then have a greatly improved satellite communications system, with the ability not only to provide national direct TV broadcasting, but also to provide national satellite mobile/portable communications.

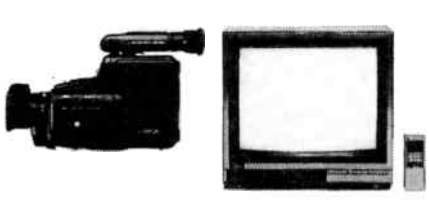
What concerns me more about B1's launch delay is the possibility that it could be used as an excuse to delay the introduction of Pay TV in Australia, by a much longer period.

Almost since the decision was announced last year that Pay TV would be allowed to commence late in 1992, we've seen a bewildering series of 'maybe/maybe not' announcements by the Minister for Transport and Communications, regarding not only its starting date but also its licensing and organisational details. It has become obvious that there are powerful commercial and political forces at work, complicating the whole situation.

It would be a great pity, I believe, if this latest and relatively minor technical hitch triggered yet another delay to Pay TV. Australia's viewers are surely entitled to have the same freedom of choice as those in other developed countries, and our electronics industry also needs the positive stimulus that this development will bring.

Jim Rowe

What's New in VIDEO and AUDIO



Sound Cube monitor speaker

The new Auratone 5PSC Primo-Sound-Cube is a high quality console mixdown and comparative reference monitor and powerful full-range extension speaker.

The sound is exceptionally clean, natural and undistorted — much better than the previous 'Cubes' released over 16 years ago. It is still however, a narrow band monitor so it will continue to fulfil its functions as a professional reference monitor for small speaker comparisons.

A new rubber surround and specially coated cone both contribute to the damping of internal break-up, which results in cleaner and more accurate sound.

The driver is a 5" (127mm) type with high temperature 1" (25mm) voice coil and a one pound (454g) magnet with 'Video-Shield'structure.

It has an impedance of 8 ohms; a power handling capacity of 35 watts nominal (70 watts music power); sensitivity of 88dB (1W/1m and a frequency response (anechoic on axis of 90-17,000Hz (100-12,500Hz +/-3dB).

The enclosure dimensions are 16.5 x 16.5 x 15.9cm.

The new Auratone Sound-Cubes are now available from Jacques Electronics, 268 Montague Road, West End 4101; phone (07) 844 1103.

DCC wins Japanese award

Philips has won the 1992 Technology Award from Japanese audio magazine publisher *Radio Gijyutsu* for developing the basic technologies of the Digital Compact Cassette system — particularly the PASC (Precision Adaptive Sub-band Coding) technique.

This is the third time that Philips has won the annual award — which is based on the view of a panel of judges drawn from the Japanese audio industry — having previously received it for Compact Disc and the Bitstream Conversion technique.

During a presentation ceremony in Tokyo, Radio Gijyutsu's president, Mr M. Kanai referred to the PASC coding system's many other application possibilities, including its suitability for the next generation of audio carrier, solid state memories.

Philips has signed DCC licence agreements with Samsung and Goldstar, Korea's two largest consumer electronics companies. As a result, both firms will be provided by Philips with the technical information required to design and manufacture DCC products.

Cassette deck has three heads, four motors

TEAC Australia has released the V-5000 three head, four motor cassette deck. Incorporating a number of new features, the V-5000 is part of TEAC's 'authentic' lineup that is designed to appeal to the more discerning audiophile or quality conscious purchaser.

TEAC have taken the route of employing a solid closed loop, dual-capstan transport drive system that offers very low wow and flutter characteristics. Additional benefits include improved transport stability over single transport system types.

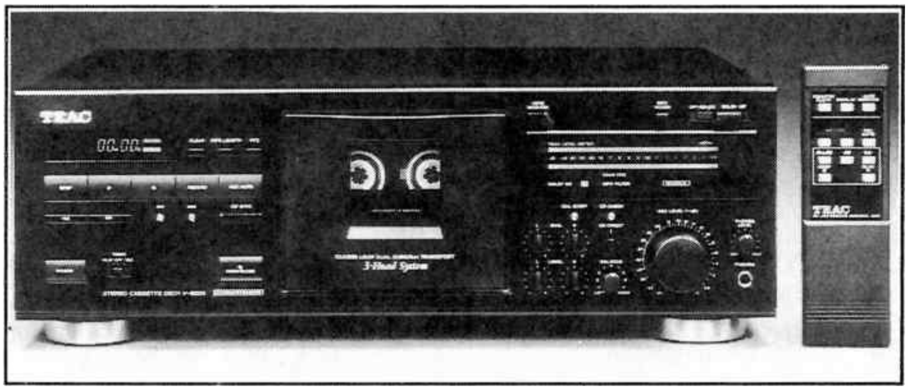
The V-5000 employs no fewer than four DC motors. The dual capstans use one as the servo motor, while the second motor drives the reel hubs.

A third motor operates the mechanism that pulls the tape head and pinch rollers into place, while a fourth motor provides power assistance for opening and closing the cassette well door. The V-5000 will automatically adjust for Normal, High and Metal position bias/equalisation. Although the centre detent positions of the bias and sensitivity controls will produce satisfactory results for most tapes, slight brand-to-brand differences between tapes can dictate user adjustments of these parameters.

Consequently TEAC have included a very comprehensive and yet straightforward calibration system to optimise all tape formulations.

Two 16-segment per channel fluorescent indicating displays are calibrated from -40 to +10dB with the 0dB reference making corresponding to the IEC recognised 0dB level of 250 nanowebers per metre.

An 11-button cordless infra-red remote controller enables armchair convenience. The V-5000 is covered by a five year warranty and is available at selected TEAC dealers. It has an RRP of $895.



100-minute Video-8 tapes

To meet the ever increasing demand for longer playing times in the Video-8 camcorder format, TDK has introduced a 100-minute recording time. TDK claims users can expect enhanced colour reproduction, owing to major improvements in metal particle formulation.

Namely, chroma output has been further improved over previous formulations and is responsible for the exceptional colour reproduction. TDK employs a proprietary 'Focused Magnetic Field Control technology', said to allow precise alignment and orientation of the pure iron Finavinx particles.

The HS-E100 has an RRP of $17.95 and is available at selected department stores and TDK dealers.

ABCTV buys Audiosound simulators

The picture shows part of a delivery of Audiosound Laboratories' unique SS-2 stereo simulators recently supplied to ABC television, which are to be installed around Australia.

The SS-2 which has been used by other broadcasters since stereo TV began, uses accurately controlled phase networks to achieve a spatial sound quality completely free of sibilance bounce and other odd effects which can occur with other types of simulators.

Further there is total compatibility with mono receivers as there is no change in frequency response to each change.

Further information is available from Audiosound Laboratories on (02) 938 2068.

Personal CD plays for 10 hours

Known as the SL-XPS900, the new Technics portable CD offers 10 hours of continuous play time, making it ideal for long distance travellers.

The extended play time is made possible by using two built-in thin rechargeable batteries combined with two AA-size alkaline batteries. The unit is also very slim and compact. In fact, it is smaller than two compact disc cases.

However, despite its compact size, the SL-XPS900 incorporates Technics' one bit digital/analog converter known as MASH. Previously incorporated only in full sized compact disc players, MASH is a high performance system enabling faithful small-signal reproduction and thus, crystal clear, detailed sound.

Remote control comes in two forms on the SL-XPS900. The first is as one-button operation on the stereo earphones, giving the ability to start, stop, skip, forward and replay, depending on how many times it is pressed.

The alternative card type 24-key remote is handy for when the player is hooked up to a home hi-fi system, allowing the listener 10-key direct track selection, music scan, repeat and program play among other functions.

Analog and optical digital output jacks mean the unit can also be used for editing onto a digital deck and will reproduce hi-fi sound via an amp and full sized speakers.

The SL-XPS900 comes in a soft case with all accessories including AC adaptor/recharger. Recommended retail price is $659.

New videotape lineup from TDK

TDK has introduced a new VHS videotape lineup, which is said to offer significant improvements in both picture and sound quality.

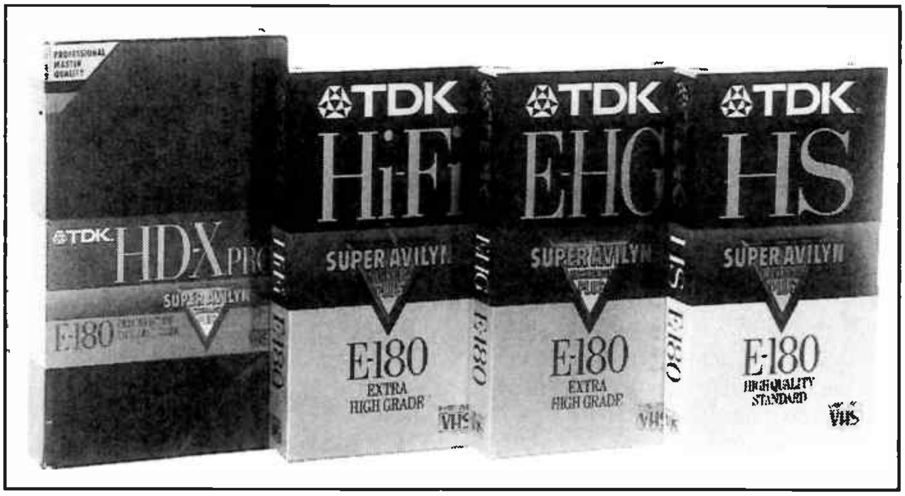
For the new tapes, TDK developed a totally new proprietary Super Avilyn technology, that is claimed to reproduce vivid and brilliant colour while producing superb sound quality.

There are four grades in the new VHS lineup including new HS (High Standards) which employs a newly developed base film to protect it against the vigors of high speed forward/reverse and repeat applications.

Then there is new E-HG (Extra High Grade) which offers almost twice the magnetic output of HS making it particularly well suited to produce the detail and resolution needed for large screen CTV's, or recording in LP mode.

New HiFi (High Fidelity) has been designed with a special finishing process that produces a mirror-like finish, for optimum contact between the tape surface and VCR heads. This process is said to culminate in the most detailed images and the smallest distinctions in hues being accurately expressed.

Finally, new HD-XPro (High Definition - Excellent Professional) uses a five layer tape construction. A High Adhesion (HA) treatment adheres the magnetic formulation to a three dimensional binder, which then adheres to a super smooth back coating. The HD-XPro is designed for all mastering and editing applications. Available in various playing times, TDK's new VHS line up is covered by a life time guarantee. ❖



Hands-on Test Report:

AMSTRAD'S DD8904 'DOUBLE DECKER' VCR

Previously well known for its value-for-money personal computers, Amstrad has recently created quite a controversy with its release of a new twin-deck domestic VCR. We were therefore quite interested to try out one of the new machines, to see what features it offers.

by JIM ROWE

Up until quite recently, the name Amstrad was mainly associated in Australia with personal computers — both IBM compatible and otherwise, but generally at the high volume, lower cost end of the market. The company was founded in the UK in 1968 by an astute and very forceful entrepreneur by the name of Alan Sugar, who is now the Chairman and MD. Under his guidance it has expanded internationally and is now active in over 50 countries, with 11 wholly owned subsidiaries (including the Australian firm). The parent company was listed on the London Stock Exchange in 1980.

But Amstrad is more than just a personal computer manufacturer. In the last few years in particular, the UK and Europe have seen Amstrad expanding into other sectors of consumer electronics. And this seems to have been a very successful move, because according to the firm's Australian MD Bordan Tkachuk half the parent company's international revenue now comes from consumer electronics.

One area where they've apparently been very successful is in the supply of domestic receiving packages for satellite TV. In a recent press release Mr Tkachuk said that Amstrad is now the leading European supplier of these, having sold over two million sets since 1989. So when Australia finally gets Pay TV, later this year or whenever our Government finally allows it to proceed, I wouldn't be at all surprised if we see Amstrad as an energetic and aggressive supplier of attractively-priced equipment.

In the meantime, the firm has already created quite a stir with a product it released late last year: the DD8904 'Double Decker' VCR. Almost as soon as the new VCR appeared, an organisation known as the Australian Film and Video Security Office promptly called for the new unit to be banned, on the grounds that it would encourage consumers to make illegal copies of copyright material. However Amstrad has continued to sell it, on the grounds that purchasers are provided with explicit warnings against illegal copying of copyright material.

Mr Tkachuk has commented recently that if the DD8904 were to be banned because of its possible use for illegal copying, it would logically also be necessary to ban ordinary VCR's — because they can be used to record copyright material broadcast by the TV stations. Not only that, but twin-deck audio cassette machines would presumably also need to be banned for similar reasons. In any case, as Mr Tkachuk has also noted, copying of videocassettes has been easily performed for years, merely by connecting two standard VCR's using readily available cables.

All that's new about the Amstrad 'Double Decker', in a sense, is that it combines most of the facilities of two standard domestic VHS machines neatly and conveniently inside a single case...

Incidentally the DD8904 contains no special circuitry or facilities to defeat or otherwise circumvent any copy-protection signals that may be present on commercial pre-recorded videotapes. In fact it incorporates circuitry to prevent copying tapes which use the CopyGuard system, so it will be just as incapable of copying such copy-protected tapes as a pair of standard machines. There's really no suggestion that it's some sort of 'pirate's special'.

Other advantages

Well then, if you can't use the Double Decker for making illegal copies of copyright material, why would you want one? What's the advantage of a twin-deck machine, over a conventional single-deck model?

For start, of course, you *can* use it for making 'dubs', or copies of your own home videos, for use by friends and relatives. This would be a handy feature if you've taken a video of your children's weddings or other special family events, for example. Not something many of us do all that often, to be sure, but it would be nice to be able to do it easily when we do.

Then there's the ability to make a recording on one tape, while you're simultaneously playing back another. So you don't have to miss out on watching last night's episode of that mini-series, because you have to record *tonight's* episode (or vice-versa). With an ordinary machine, you can either record a tape or play one back, but not both at the same time.

On the other hand, with the DD8904 you can also make two duplicate recordings of a program at the same time — handy when a friend or relative will be away and has asked you to make them a tape so they won't miss a show, but you also want one yourself...

Although the DD8904 contains only a single internal tuner, there's even the ability to record two *different* programmes at the same time, on the two decks. This is done using an external source for the second signal — such as a TV set with a SCART or other direct video/audio output connector.

It's also possible to play back a tape through up to three different TV's at the same time — one fed via the DD8904's UHF modulator output, and the other two via its dual SCART direct video/audio connectors. Or you can play back two separate tapes simultaneously to two different TVs, with one connected via the UHF output and the other via one SCART output. You can even flip back and forth between the two tapes, viewing them alternately on a single set.

Even *that* isn't the limit of the Double Decker's tricks, though. You can also use its two decks for continuous recording or

playback, with it automatically starting one deck when the other reaches the end of the tape, and so on. Since both decks are able to operate in half-speed 'LP' mode as well as standard 'SP' mode, this means that using E240 tapes the DD8904 can automatically record or play back for up to 16 hours at a stretch — without human intervention. If you're able to change tapes, it can operate indefinitely...

The ability to automatically changeover between decks can also be used for 'loop around' operation, where recording or playback cycles indefinitely between the two decks. This makes the DD8904 suitable for continuous playback in showrooms and exhibitions, and also for continuous recording in security monitoring and surveillance applications. If the machine is stopped following a significant event, the recording will provide a video log of the preceding period (up to 16 hours).

Quite apart from these 'special' features, the DD8904 offers most of the facilities you'd expect from a standard VCR. These include HQ picture technology, LP/SP dual speed operation with automatic sensing on replay, an IR remote control with LCD display and remote programming facility, an eight-event one month programmable timer, single-button 'quick timer' recording and two-speed picture search (3x and 5x) in both directions.

Additional controls

As you'd expect, the Double Decker has a few more controls than on a standard VCR. In addition to the usual set of control keys for each deck and the controls for setting up the tuner channels and clock/timer, hidden behind a lower flip-down panel, there's a button to select which deck's output you wish to use when both are operating (selection is automatic when there's only one in use).

Each deck also has its own set of controls for selection of its recording input source (Tuner, External or the other deck), reset and memory buttons for its tape counter, a tracking control and a tape speed control (SP/LP). The upper deck is also provided with the 'quick touch recording' (QTR) button. These controls are all hidden behind a small swing-out door to the right of the fluorescent displays.

There are also three additional controls in the lower control panel area, for selection between Normal, Continuous and Looping operation for recording or playback. And finally, there's a 'Synchro Start' button, for setting up and then starting the two decks in synchronism for tape copying (deck 2 > deck 1).

Apart from this, the rest of the DD8904 is much like a standard VHS machine. At the rear the only noticeable difference is that there are two SCART connectors for direct video and audio connections. These are in addition to the usual RF input and output connectors, but in place of the pairs of RCA and/or BNC connectors found on many machines of Asian origin. One SCART connector is used mainly for external signal sources, while the other is used mainly for connection to the user's TV receiver. By the way the RF output of the DD8904 is on UHF, around channel 36. As with many standard VCR's the machine has a switch at the rear which allows it to produce a test signal, for tuning your receiver accurately to its output. But inevitably the best results are obtained with direct video and audio signals from the SCART socket, assuming your set has the appropriate inputs.

Trying it out

Setting up the sample Double Decker turned out to be much the same as with a standard VCR. As usual there's a bit of fiddling around to set the clock/calendar and the various tuner channels, but the manual makes this relatively clear and straightforward. For a lot of the usual modes of operation, the DD8904 is also no more complex to drive than a single-deck machine. It's really only when you want to perform some of the machine's more unusual tricks that things get slightly more complicated; but even then the designers have made operation fairly intuitive. We were able to try out virtually all of the machine's facilities without any significant hassles.

A glimpse inside the case showed that the DD8904 uses two quite solid-looking decks, mounted one above the other in the main frame. The frame itself is of moulded plastic, but seems to be quite solid and well braced. Everything looks to be well designed and of similar quality to most respectable modern domestic VCRs.

In terms of performance, the Double Decker had no surprises. The basic replay and record/replay picture quality was of good 'HQ' quality, with a resolution of around 230 lines and a S/N ratio of close to 44dB. Copying from one deck to the other inevitably results in a small degradation in both resolution and S/N ratio, but in most cases this is barely noticeable.

The audio quality was also of good standard-VHS quality, so in terms of overall performable the DD8904 leaves little to be desired when judged in context.

As the technical spec for the DD8904 describes it as being fitted with CopyGuard protection, we tried making short test copies from commercial tapes. However we apparently didn't have any fitted with this protection system, because they copied reasonably well. Needless to say, we erased the copied segments at the end of this test. Presumably the machine would prevent copies being made from tapes using the CopyGuard process.

Summary

The Amstrad DD8904 Double Decker VCR is innovative in concept, and offers a lot more facilities than one expects. You can certainly use it for convenient copying of your own non-copyright video recordings, but it should also come in very handy for making two recordings at once, playing a tape through up to three TV's at once, recording one program while you're also playing back another, and so on.

The ability to make continuous and 'loop' recordings, and also play back in the same modes, should also make it of considerable interest for security, surveillance and sales demonstration applications.

The DD8904 carries a recommended retail price of $999, and is available from Amstrad dealers. If required further information is available from Amstrad, Building C, The Lakes Business Park, 11-13 Lord Street, Botany 2019; phone (02) 316 5289. ❖

PHILIPS' NEW 28" 'WIDESCREEN' COLOUR TV

This month, thanks to the people at Philips Australia, Louis Challis was able to check out an advance sample of that firm's new top of the line 16:9 aspect ratio TV receivers. The set is the 28ML8916, and after using it for a few days Louis says his existing sets now seem to have lost their appeal...

With all the space devoted to Philips products in last month's Winter CES review, you could be forgiven for thinking that I had covered all of the 'new pickings from the Philips Orchard'. But as it happens, Philips has been producing a veritable plethora of new goodies, including their new Matchline Series 28" and 36" 'Wide Screen' colour television sets.

Ever since the first 17" television sets hit the Australian market around 1956, we have seen a progressive market and public demand for larger TV screens. These progressively grew to 21", 24" and subsequently through 27" to the really big screens, whose prices tend to discourage all but the well heeled.

The new 28" Matchline TV set with which I was provided for this review epitomises the Pandora's Box of modern marketing. As I soon discovered, it contained just about every type of new technical feature or potential gimmick that you could possible think of or ask for. If it doesn't contain that 'wish function' or capability within the set, then it's on the cards that Philips have provided it in one of their optional units in the same Matchline collection.

The optional collection include a Laser Disc Combi Player, an S-VHS VCR and even more excitingly a new HD-MAC (High Definition) satellite receiver, which will satisfy your wildest dreams when the Olympic Games are transmitted with the new format later this year.

But then I am digressing, for it's the Matchline colour TV that we're really interested in. From the moment I opened its box and looked at its screen, whilst it wasn't quite 'love at first sight' I knew that this was a radical departure from past trends and accepted design philosophy. The most striking difference between the new Matchline colour TV's and their predecessors, with which you are no doubt familiar, is their unusually wide TV screen. These are 710mm (28") wide in the smaller set, and now less than 900mm (36") wide in the larger set. Both have a 16:9 aspect ratio, in place of the more conventional 4:3 aspect ratio which is currently the norm.

Why 16:9, I hear you ask? Well, as well as Cinerama and other modern wide screen films which have been produced for the cinema for many years, there have recently been a number of video recordings and laser disc films, which have been formatted with the 'letterbox' format, and recently a growing number of these have been transmitted by the TV stations with the wide screen format. If one displays or views such films with a conventional TV screen, you end up with noticeable black strips blanking out the top and bottom of your TV screen — hence the term 'letterbox'. The only alternative is to have a screen that is compatible with the wider aspect ratio.

The Matchline 16:9 aspect ratio screen is designed to resolve the problem, and give true wide format display of these transmissions or tapes/discs. But obviously there's a catch with normal TV transmissions, or replay of normal videos: when you select the 'Movie Expand' mode, to fill the screen, you have to accept the loss of the *top and bottom* of the transmitted picture. If you disable the expand mode to restore the top and bottom, you end up with blank strips at either side of the wide screen.

Initial reaction

Before I reviewed all of the special capabilities of the new Matchline TV set, I diverted from my planned procedure to assess the real benefits of its 16:9 aspect ratio. To do this I used Track 3 of Reference Recordings' *RA Video Standard Laser Video Disc*, LD101S, using a new Yamaha CDV-1700 NTSC combination laser disc player (which is currently competitively priced at $999).

Why would I choose to use NTSC you ask? Well, NTSC laser discs have been available for more than a decade, and test discs are readily available on NTSC format. By contrast, PAL laser discs have been available for a relatively short time, and regrettably appropriate test discs are virtually unknown. As it happens, the Reference Recordings LD101 NTSC test disc appears to be 'head and shoulders' in front of anything else I have yet seen, so I bought one on the West Coast of the USA.

The Reference Recordings wide screen demonstration material was filmed using two synchronised film cameras covering the left and right sides of the centre-line of the scene, using a helicopter flying through the Grand Canyon to produce a visually exciting wide 'Cinerama' view.

The video output is compatible with the 16:9 aspect ratio format when the Matchline's expand mode has been selected. The results were outstanding, and I regretted that the sound track was not of the same standard as the video content.

Many features

As I subsequently discovered, the Matchline set also incorporates innumerable other features. The first and most visually pleasing is its adoption of a 100Hz scanning frequency, which is flicker free and provides a visually superior picture when compared with the 25Hz line scan frame frequency, or the 50Hz interlaced line scan frequency with which you have become accustomed over the last 35 years.

Access to the multiple capabilities of the TV are, with few exceptions, controlled by a large and functional remote control (Model RC6411).

As well as controlling the reception of TV channels, external VCR's, laser disc players, CD, CDV or CDI players, it also allows you to connect satellite receivers

(which Philips have just released) as well as picture-in-picture (PIP) video control units (which have also been released, and which provide a useful on-screen double viewing capability for those that want it).

The remote control offers many functions, some of which are quite conventional, but some are relatively new and provide a comprehensive capability for home movies and also the latest Dolby Surround video and laser discs, with their multiple channel audio system requirements.

Thus for example, when the on-screen audio control functions are selected by pressing the 'green button', you are able to successively set the speaker balance, the treble and bass boost (or cut), and access the special speech circuit control capabilities — which include bilingual selection from laser discs, or bi-lingual TV transmissions (which are common in Europe but have not been adopted in Australia).

If you select the 'blue key' followed by the 'white key', you can activate a child lock, a sleep timer display, set the picture size, or even call up a demonstration program, which displays all of the special features contained within the Matchline TV.

You can view the details of the stored TV channels by pressing the menu button, followed by the white key to check what designations have been allocated — i.e. 'ABN 2' — and in which channel numbers these have been stored.

One of the unusual features which caught my eye was the 'picture freeze' capability, which allows you to instantaneously store any picture on the screen for as long as you like — at the expense of being able to view the on-going program. This is great for VCR's and laser discs, but is obviously of only limited value when viewing a live TV transmission.

Another unusual feature is the 'strobe' option, which sequentially stores discrete frames of video content with approximately a one-second delay between each successive frame. I have yet to work out why this facility has been provided.

When the TV channel you are watching broadcasts a Teletext signal, you can select the time button. This causes the time in hours, minutes and seconds to be displayed in a reasonably large blue rectangle at the upper right-hand corner of the screen.

As the Matchline set incorporates a Teletext decoder, with above average legibility in the normal display mode, I was surprised to find that the legibility of this display can be even further enhanced by expanding the screen so that the normal display fills the screen with either the upper or lower sections of the page, for unparalleled legibility.

The remote control also incorporates its own small LCD, through which you can check on your selection and on which signal inputs have been selected.

The rear of the Matchline set provides conventional TV aerial inputs, supplementary video outputs, inputs for optional TV tuners, as well as for inputs from conventional VCR video and audio connections. Two colour-coded SCART sockets are provided, for convenient direct connection of either a VCR or for a laser disc player, which is thereby achieved with minimal effort.

Audio outputs to the two mid-range/tweeter satellite speakers (which they describe as 'squeeter' boxes), are

The Challis Report

provided by means of a pair of DIN speaker sockets, whilst an additional array of four pairs of spring-loaded sockets are provided for two pairs of external speakers, to cater for full surround sound where the ultimate in sound fidelity is required.

An additional S-VHS VCR connector socket, together with conventional video and audio sockets suitable for VCR or laser disc players are provided on the front panel.

This is a particularly convenient and desirable ergonomic feature, especially if you wish to connect a PAL laser disc player and an NTSC laser disc player — as I did for both my subjective and my subsequent objective evaluation of the 28" Matchline TV.

Players, players

I felt a little self-conscious as I connected the Philips Matchline laser disc player through the rear SCART socket, and a separate Yamaha CDV-1700 NTSC laser disc combi player to the video and audio sockets on the front panel. My initial self-consciousness was soon dispelled and forgotten, though, as a result of the quality of the video and audio replay which the Matchline TV provided for me and my family.

The Matchline incorporates a single low frequency built-in bass speaker which covers the 50 to 700Hz region, and the two clip-on squeeters which cover the 700Hz to 16kHz range.

Although the built-in 2 x 40 watt amplifiers generally provide adequate 'grunt' (power output), I found that the satellite speakers are no match for larger external monitors if one wishes to provide audio quality on par with the best available video signals. As the clip-on speakers (and their leads) are plugged in, the change to larger and more efficient speakers involves minimum effort.

My objective assessment confirmed that the 28" Matchline TV has a genuine 400-line resolution, and a video frequency bandwidth which extends well past the 3.5MHz capability.

Its picture is exceptionally clean, extremely sharp, and is just one small step closer to the quality of high-definition television for which we all await, but which is still some distance in the future.

Summary

The Matchline TV with its new and exciting aspect ratio faces comparable problems to the consumer DAT player. Given the appropriate software and/or a willingness of the TV stations to transmit the appropriate signal, it offers unparalleled improvements in video viewing. Alas there is currently minimal software, and I am aware of only a few occasions on which the TV stations have transmitted appropriate programs.

The new Matchline sets are clearly a significant departure and evolutionary advance on previous TV design concepts, which have been the basis for TV sets for the last 25 years.

Whilst it took me some little time to reconcile myself to its different format, I acknowledge that following my audition of the Matchline TV, I have been converted to the view that this is the new wave, and all old TV sets (including those that I own) are now visually inferior.

By the time you read this, the 28ML8916 should be available from specialist Philips dealers. It measures 692mm wide by 512mm high by 515mm deep, and weighs 35kg. The recommended retail price is $5499.

Further information on both the Matchline Wide Screen sets, World Standard Laser Disc Player and the other new members of 'The Philips Collection' is also available from Philips dealers.

Our thanks to Philips Australia for the opportunity to try out an advance sample. ❖

In-flight phones, improved A-V entertainment:

Technology eases boredom on long flights

As aircraft design has advanced, international flight 'hops' have become longer and potentially even more taxing for passengers. But happily new aircraft like the Boeing 747-400's now being used by Singapore Airlines also take advantage of the latest technology to upgrade passenger entertainment and communications facilities.

by THOMAS E. KING

It wasn't too many years ago that Australian passengers on international flights to Europe were up and down more times than a yoyo. Fuel stops here, technical halts there — the long journey to Europe was a true test of endurance rather than a relaxing flight of fancy.

Over the decades technical advances and continual refinements both within and outside aircraft have not only shortened flying time between the distant continents, but significantly improved the travel experience as well.

The latest 'people mover' on this heavily travelled 'sky highway', the Boeing 747-400 — largest and fastest long-range 747 jet aircraft to date — has yet again pushed back the barriers of time and distance, while giving passengers an unprecedented level of luxury and comfort.

For aircraft buffs, a few 'jumbo' facts are in order. Built in the massive Boeing factory near Seattle, Washington, the 747-400 is the eleventh derivative on the original 'Jumbo' blueprint. Powered by four advanced Pratt & Whitney PW4056 engines providing 56,000 pounds of sea-level static thrust per engine, the 386,913kg (taxi weight) jet has a range of up to 8000 nautical miles or 13,000km.

The extended capability is due to more than just high efficiency engines, as the plane uses lightweight materials (namely aluminium alloys) to cover the plane's fuselage, tough graphite composite for the floor panels and carbon brakes. As well, advanced aerodynamics have resulted in a reduction in drag, ensuring better flight performance. For instance, the two metre high characteristic 'winglets' at the end of each wing provide a 3% savings in fuel consumption — or an extra 320km in range.

Beyond this the 747-400 can fly farther as it is able to carry an additional 12,500 litres of fuel. This is made possible by being the first ever aircraft to have fuel tanks installed in its tail section horizontal stabilisers.

At the aircraft's nose, engineers introduced advanced technology avionics to the 747-400 cockpit. As the first version of the 747 with an all digital 'glass cockpit', the 400's flight deck features six

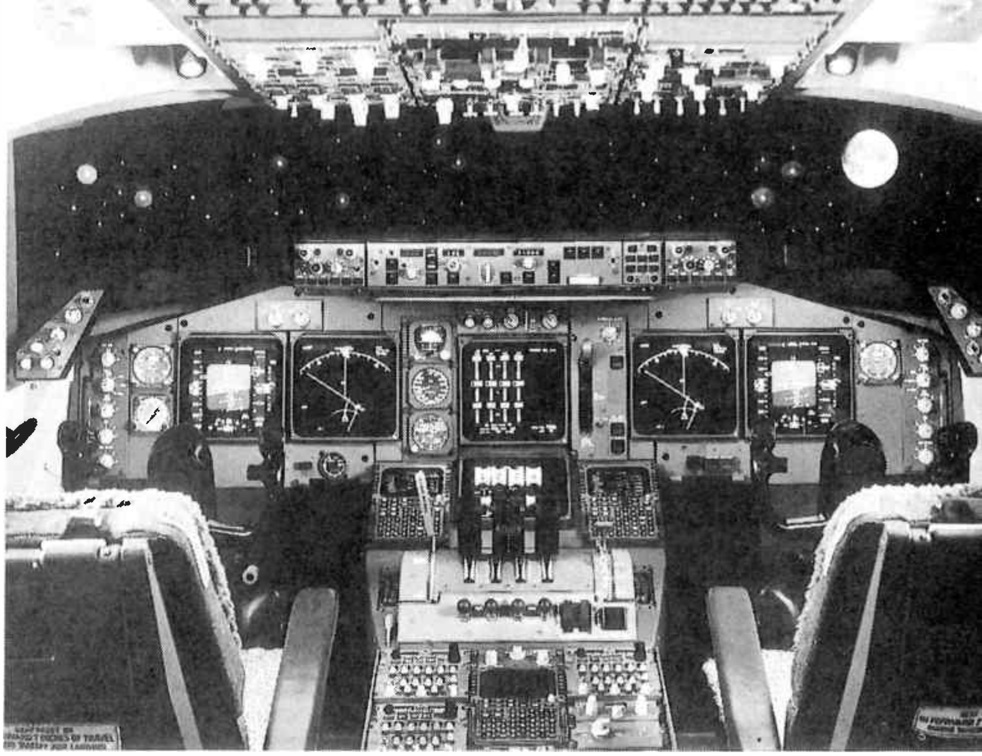
20 x 20cm cathode-ray tube displays which detail flight control, navigation and engine data. A 'Flight Management System' automatically monitors aircraft performance and assists in more efficient engine performance. Because the instrument panel has been streamlined, the pilot workload has been reduced considerably. This results in a two man crew — who are fully conversant with even the finest points of the 747-400 long before they ever enter its futuristic cockpit.

For the flight crew of Singapore Airlines this is possible because of an US$18 million (A$23 million) 747-400 flight simulator, located in the Flight Crew Training Centre at Singapore's Paya Lebar Airport. Designed to exacting specifications by the US Federal Aviation Authority, the earth-based aviation wonder is capable of duplicating almost exactly the motion, sounds and instrument indication of any condition on the 400.

A number of advancements distinguish the 747-400 simulator from previous models. Most notable is its rapid response time, which gives trainees a more realistic impression of actual cockpit situations. Instructors have greater control over training using the new touch sensitive CRT's, as they can make rapid changes in instrument readings.

Dubbed the 'Megatop' by Singapore Airlines pundits to distinguish it from their Boeing 747-300 'Big Top', SIA is not the only air carrier to take advantage of the new generation planes on the Australia/Singapore/Europe sector. However, with 14 Megatops in operation and with six more to enter service between April 1992 and March 1993, the aviation giant is a major player in the ever expanding travel game.

Singapore Airlines was not only the initial Asian airline to take delivery of Boeing's newest baby. The multi award-winning flag carrier was also the first international airline in the world to begin commercial flights using 747-400 aircraft, and the first with Megatop 'non-stop' flights between Singapore and London.



The flight deck of the 747-400 is 'user friendly', with touch-screen CRT's and advanced avionics — enabling the latest version of the Boeing aircraft to be piloted with a two person crew.

Passenger perks

SIA pilots propelled the inaugural Megatop into Australian skies in 1989. With the company's decision to dedicate 747-400 aircraft to the Australia-Singapore sector during the last quarter of 1991, many Australians have become acquainted with a new Singapore 'girl'. The perfect travelling companion for the 21st century, 'she' not only looks like a million dollars but she can woo even the most jaded passenger with a glittering array of space-age surprises, beginning with an ultra sophisticated audio system.

Three of the nine different audio channels on the Megatops are in stereo, as compared with two out of eight on other 747 types. Passengers flying in SIA's 'Raffles' (business class) and first class can also take advantage of European audio technology, as they are issued cushioned Sennheiser electronic stereo headphones for the duration of their air journey.

Flights using 747-400 aircraft are scheduled to maximise the aircraft's long range capabilities. To make certain passengers don't become bored by hearing the same audio programmes during the lengthy period aloft, the music system on Megatop is now located in the cabin — not in the plane's belly, as on other 747's — so flight crew can change cassettes easily and more frequently.

Incidently, the latest feature on the 747-400 aircraft audio systems is an auto pause facility, that allows the inflight programme to automatically stop at the commencement of crew announcements and automatically resume after their completion. This way you don't miss the punchline of a joke, or a favourite music passage...

Not content simply with the quantity of audio channels, the airline engaged professionals to maintain high standards in the quality of its inflight programming. The burgeoning California based World Airlines Entertainment Association, in conjunction with a panel of international media experts, recognised this commitment to quality with an award for 'Best Overall Entertainment Programming'. (Little known in Australia, WAEA — which represents over 200 airlines, airline suppliers and related industries — "is committed to excellence in inflight entertainment and services, and the continual improvement of the airline passenger environment".)

In addition, WAEA judges gave another accolade to the Singapore airlines publication *Silver Kris* as 'Best Inflight Magazine'. Within the monthly's section devoted to inflight entertainment are detailed listings for the many music channels and several pages on movies. Inflight movies are hardy a novelty these days but when there is a selection bigger than that of any cinema complex in Australia it's an entertaining advantage worth noting.

Since mid-1991, SIA has increased its compliment of inflight movies to 14 and introduced multi-language facilities. Non-English-speaking passengers are now catered for, because on all SIA 747 flights of more than five hours, movies are screened in English plus one of three other languages. A second soundtrack in French, German or Japanese can be heard on audio channels 2 or 4.

Movies precede the screening of *SIA World Vision News*, a 25 minute presentation of international and business news, plus reports of major world events originally televised by ITN in London. introduced in late 1989, and an innovation 'particularly well received by

Flight technology

A close up of an SIA Celestel sky phone. Using the system in conjunction with Inmarsat's global satellite network, flight crews can contact control towers worldwide.

Passengers on an increasing number of Singapore Airlines Megatop flights can now make airborne telephone calls to virtually anywhere in the world. Later this year the Celestel system will be expanded to accept fax and data traffic.

passengers', the daily programme is beamed by satellite from London to Singapore by the SPAFAX Airline Network where it is duplicated by the Singapore Broadcasting Corporation. It is then delivered to SIA for screening on all flights leaving Singapore, where flying time is at least three hours.

On selected flights from certain European cities the ITN news segment is duplicated in London and then couriered to awaiting aircraft.

On January 1, the British view of the world was supplemented with an American accent when news bulletins from Cable News Network were first shown on an SIA flight. Where time permits passengers can see what has happened with ITN — plus, as CNN prides itself, 'what is happening'.

While the bulletins are obviously video taped at present, 'live' TV broadcasts are a possibility within the not-too-distant future. And taped or 'live', from April, first class passengers can keep up to date in the comfort of their electrically operated seats while viewing individual high-resolution liquid crystal display screens.

LCD monitors will be a standard feature on all 747-400's delivered to SIA in the future, while existing aircraft will be progressively refitted with personal screens during regular periods of extensive maintenance. Following this, colour sets are scheduled to be introduced to Raffles Class passengers and, depending upon recommendations from the Singapore Airlines' Service Innovation Team, to the 316 seats in economy class.

Inflight phones

That advance in inflight entertainment will certainly be something to phone home about. And since late 1991, when SIA became the first airline in the world to offer global sky telephone facilities on a commercial international air service, passengers can do just that.

Widely promoted under the banner 'Celestel', SIA passengers are now able to communicate with virtually any point on the ground while inflight from virtually any place in the world, using a network of satellites.

Representing a major technological advancement in passenger telecommunication services, the development of Celestel is a joint achievement for the aviation and satellite communications industries.

The telecommunications network for Celestel is provided by a consortium of British, Norwegian and Singapore Telecoms. Each has provided dedicated ground stations at strategic points: British Telecom at Goonhilly in Southern England, Norwegian Telecom at Eik in Norway and Singapore on the resort island of Sentosa.

The Inmarsat satellite network — consisting of a dozen orbiting repeaters — relays the inflight telecommunications traffic (which later this year will include facsimile and data transmission) from airborne aircraft to ground stations.

From there is it sent to standard land-based telephone switching stations and on to the desired party. Calls are costed at US$8.80 per minute, payable by credit card.

While additionally offering uninterrupted communications between SIA flight crew and worldwide control towers from any point in flight, Celestel is a worthwhile although costly investment for the airline. Each system including avionics, antennae and telephones, costs about $830,000 per aircraft. SIA plans to fit Celestel systems on 20 Boeing 747s by 1994.

Because SIA technicians are totally preoccupied with installation of this revolutionary system and trials of new applications, it's understaandable that they may have overlooked on important issue.

No provision has been made for those exceptionally peckish travellers using Celestel to ring their favourite restaurant back home and actually have their pizza delivered inflight! ❖

You'll like the feeling of our new digital troubleshooting scope.

Now there's a 100 MHz digital scope that handles just like analog.

Digital oscilloscopes have certain advantages that are hard to overlook. But for troubleshooting, many engineers still prefer analog scopes. Simply because they like the way they handle.

The HP 54600 changes that. It *looks* like a 100 MHz analog scope. All primary functions are controlled directly with dedicated knobs. And it *feels* like one. The display responds instantly to the slightest control change.

But when it comes to troubleshooting, the HP 54600's digital performance leaves analog and hybrid scopes far behind. At millisecond sweep speeds, the display doesn't even flicker. Low-rep-rate signals are easy to see without a hood.

It has all the advantages that only a true digital scope can provide. Like storage, high accuracy, pretrigger viewing, hard copy output, and programming. And since it's one of HP's basic instruments the HP 54600 gives you all this performance at a very affordable price.

So if you like the feel of analog control, you'll like the way our new digital scope handles troubleshooting. To find out more call the Customer Information Centre on 008 033 821 or Melbourne 272 2555.

HEWLETT PACKARD

A Better Way.

JWT HTM125/A

Other CD Players spin the disc in mid-air.

Most CD players clamp an area of the disc not much larger than a 20 cent piece.

Unfortunately, this leaves the rest of the disc free to vibrate as it spins in mid-air, which is not a good idea.

Seeing as the laser in a CD player has to follow a path ten times narrower than a human hair.

Which is why Pioneer invented the Stable Platter CD mechanism. This supports the entire CD on a turntable, totally eliminating the vibration that plagues conventional CD players.

And because the stable platter mechanism has a greater rotating mass than conventional CD players, speed fluctuations and mechanical noise are virtually non-existent.

As is the problem of dust. It can't build up on the laser

and lenses for the simple reason they now face downwards.

All of which results in more natural, lifelike sound, that faithfully captures even the most subtle musical nuances.

In fact, the Pioneer Stable Platter CD will play exactly what was recorded.

Unlike other CD players that seem content merely to play Frisbee.

READER INFO NO. 5

PIONEER

The Art of Entertainment

Ball PIO 0050

DIGITAL CAMERA SAVES IMAGES IN DRAM CHIPS

Neither a still camera nor a video camera in the conventional sense, the new Dycam Digital Still Camera Model 1 is a hybrid of both technologies — and looks like neither. Yet it offers the ability to capture up to 32 images electronically, and then download them into either IBM-compatible or Apple Mac PC's. This makes it very suitable for low-cost desktop publishing applications.

by BARRIE SMITH

Having just spent parts of a tortuous year helping a Sydney school get on the road (if not on the page) with its Desk-Top Publishing system, I only wish that the Dycam Digital Still Camera had appeared a year earlier!

Like most schools keen to get into print, with flyers — and, of course, the school newspaper — the big goal is to get a grey scale photograph onto the printed page. Unfortunately, this often calls for one hapless teacher to do the D&P and somehow produce a bromide print that will survive the dot screen process — or emerge unsullied from the school photocopier (generally an impossible task).

Now, for all those 'little' newspaper proprietors — from schools to social clubs — your answer may well be here.

The Dycam is the first totally integrated (hardware and software) computer-orientated 'point and shoot' digital camera to arrive in Australia. The camera is sized — and shaped — exactly like the palm of the human hand. Neither a still, nor a video camera in the normal sense, the Dycam is a hybrid of both technologies — and looks like neither.

The hardware is basically two pieces: the camera itself and the host adaptor, which carries the power (for recharging) and serial port connections for accessing the pictures held in the camera's DRAM. A full charge — which takes about six hours — allows the shooting of 75-100 black and white pictures. However once the camera memory's 32-picture storage limit is reached you must dump the whole complement before shooting any more. The 32 shots will remain in memory — without a battery recharge — for about one day.

After charging, the host adaptor is removed and you can start shooting. The camera has comfortable finger grooves on both sides.

Above the lens is a flash source and direct viewfinder — the latter has reflective frame lines which indicate the field of view for three lenses — including the fixed standard 8mm. This covers the equivalent of a 70mm lens in a 35mm SLR. A wide-angle adaptor and both 1.5-times and 2-times tele adaptors are available. These screw into a 37mm thread.

A simple and large shutter button is placed in the centre front — suitable for either left- or right-handed operators. A shot taken is confirmed by an electronically generated 'click' — CCD image sensors are well known for their silence!

Ten seconds later another audible signal informs you that you can shoot again. Audible signals are used to notify the operator of other functions: low charge, no more memory space left for pictures, etc.

To preview your images you need access to a computer — either an IBM compatible (with or without Windows) or a Mac (preferably with 8-bit display). The host adaptor is reconnected and an 8-pin communications cable (supplied) is plugged into the host adaptor, with the other end inserted into your computer's serial port.

Software is supplied and you install

The base of the camera mates with the host adaptor, for charging the internal NiCad cells and also downloading the stored images to the computer via a serial port.

same onto your hard drive. Once all this has been done you work from your computer screen. I am a confirmed Mac user, so a data rate of 57,600 baud was selected from the software menu; with some complex images it is advised that this rate may need to be lowered. In my own experience with the camera I had no need to change. This done I simply opened the Dycam software — and up came a screen full of 32 thumbnail pictures — 24 x 36mm in size — from the camera's RAM. Each was neatly labelled with the time and date.

Open any one, and the image fills the screen — with minimal fuss. In my case I connected the Dycam to a Macintosh SE and was looking at a picture within one minute of taking it. Using a Macintosh II at 57k baud the image comes up in 12 seconds.

All available pictures stored in the camera can be unloaded and saved as TIFF files in one simple operation. Because the CCD captures the images with off-square pixels it is necessary to rescale the TIFF files by increasing the vertical proportion by 18%.

The images are stored in compressed form, so decompression takes place every time you open an image. In compressed form each picture occupies about 30K bytes; when decompressed a single image can take up between 80-100K. For lots of pictures you need lots of disk space. Saving the picture will see it stored as a TIFF (Tagged Image File Format) file, a common format for graphics software.

DOS software is supplied on both 5-1/4" and 3-1/2" disks. On installation you are asked to choose between DOS or Windows paths. If using a VGA driver you can select the 320 x 200 pixel resolution, displaying up to 128 levels of grey; alternatively a high res — 640 x 480 pixels — option is also available, showing up to 16 levels of grey. The connection is made via the COM1 or COM2 serial ports. IBM data rate: it is suggested the 115,200 baud speed will suit a 386DX or 486 computer, while 57,600 baud is recommended for a 286AT or SX and 38,400 for XT models. If using Windows you can save images in BMP format.

The Dycam is impressive — not only by way of the camera's ergonomic styling, but by the elegance and simplicity of the software. Using it you can check on the camera's battery health, the number of shots taken, or even switch the camera to tripod mode (for time exposures minus flash).

With an IBM compatible computer you gain one advantage over a Mac connection: you can discover the exposure time taken with each shot — if that sort of information is crucial to you.

Company background

Seeking further information from the Dycam people in Chatsworth, California, I learnt that development of the Model 1 began in September, 1988 with a six-member team. The company's VP Engineering, George Ismael confessed to me that "as usual with new technology, development took a bit longer than anticipated..."

The first factory-built units shipped in November 1990, for the US domestic market. When setting the specs for the new camera the initial intention was not to supplant film photography, but to 'make images as useful to business as words'.

Demand was expected not from the DTP area, but from insurance firms, real estate firms, inventory specialists and a variety of non-publishing businesses.

George Ismael explained that "Since most data processing environments are not able to easily handle colour, it seemed to us that gray-scale images would be most productive."

"They take less storage, are easier to print and much faster to process than colour pictures."

"Colour is possible at a modest cost

increase in the camera, but with terrible impact on the performance of the host systems. We know how to build colour cameras, but getting them to market is not yet a high priority for us. Our current efforts are instead directed at making the gray scale camera faster, cheaper and more useful."

Disarmingly, Mr Ismael confessed one of the team's design goals not reached was that 'every picture taken with the camera should be a good one'. He feels that, for a picture to qualify as a 'good' one it should be properly exposed, in focus and accurately framed. While unable to do much about the latter he admits the Model 1 is deficient in flash exposure control and has less dynamic range than he would like. This has lead to the company developing what he described as "some innovative techniques to improve the camera's performance in 1992".

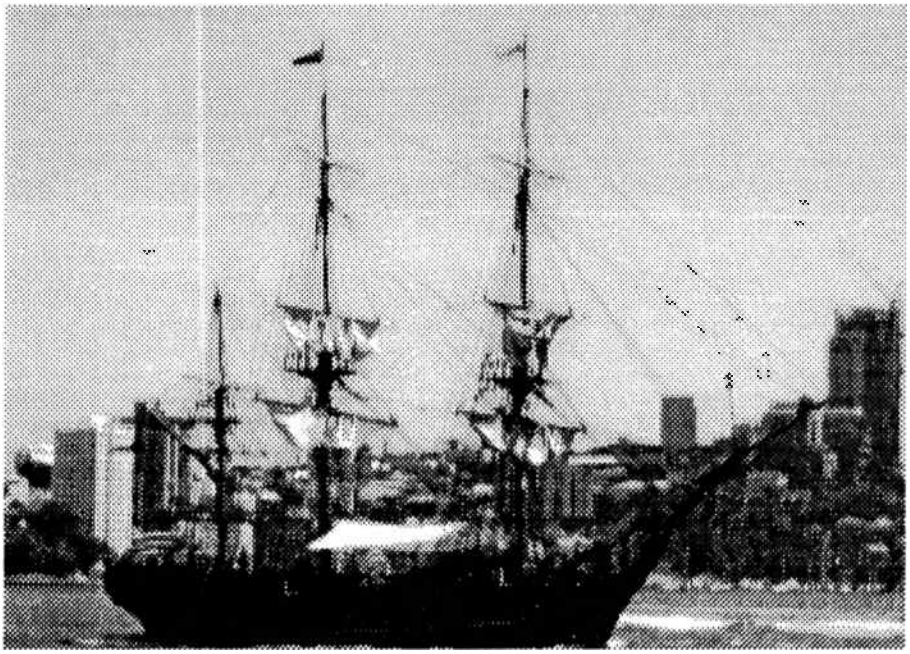
He continued: "Don't think of digital photography as a replacement for film. Neither the Model 1 Dycam nor the $US20,000+ digital film back from Kodak can match film for resolution and dynamic range. But this camera (the Dycam) can take an unlimited number of pictures, for the same cost as about 100 Polaroid film packs."

Focus is fixed, so the camera holds subjects sharp from one metre to infinity. For closer shots you need to attach 'dioptres' or close-up lenses — a '+4' for 25cm, or a '+2' for 50cm.

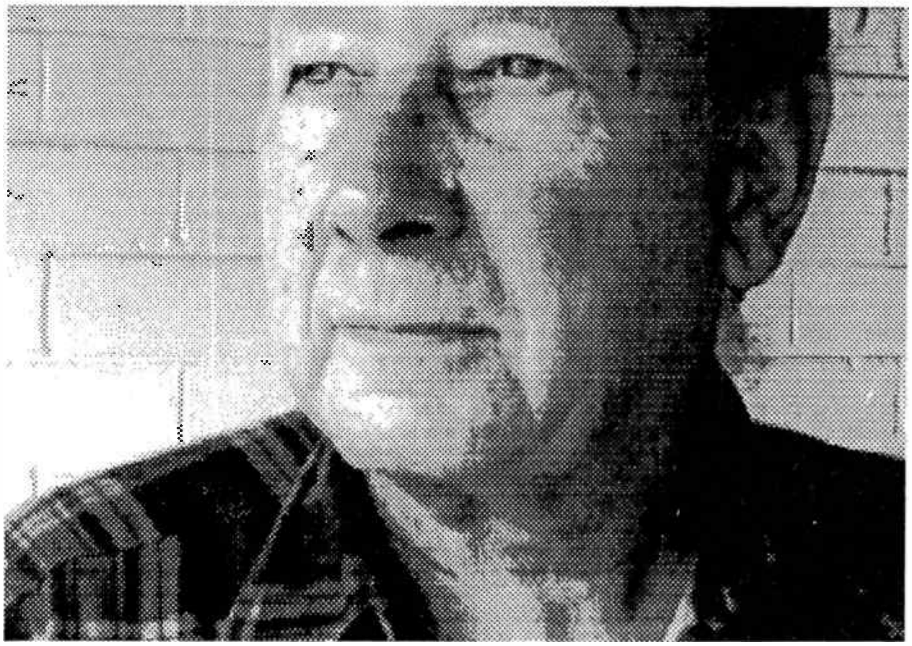
You'll also need to cross your fingers, and hope that you've allowed for the effects of viewfinder/lens parallax. The latter is one area the makers could address — the Dycam could well be a 'cute and quick' stand-in for a graphics scanner.

The camera has an onboard image processor that compresses images and saves them in ordinary DRAM chips. There is 768KB of this type of memory in the camera for image storage, while other special purpose memory on board adds up to a total of over 7MB.

Accessories either provided with the Dycam or available separately include a stepping ring, a neutral density filter, a host adaptor, two serial I/O cables, one cable adaptor and three software disks. Also in the kit is *Picture Publisher*, the company's own image editor software.



Two shots taken with the Dycam — one of a 'tall ship' on Sydney Harbour, the other a portrait. Both were printed out from an Apple Macintosh using a LaserWriter IINT 300dpi laser printer.



Trying it out

While 256 shades of grey are claimed, you have to be careful in your shooting and take pains in the computer manipulation of the image. The resolution is 376 x 240 pixels — possibly the equal of a '110' film photograph.

But an immensely useful camera it is, due to its fuss-free computer interface. Once a Dycam picture exists as a computer file it can be printed out on any output device: from inkjets through laser printers to imagesetters.

The flash does tend to wash out 'people' subjects, and the system doesn't like excessive contrast. I found that diffused, directional light was the best.

Although the maximum shutter speed is 1/1000, even this may not be enough for very bright conditions and Dycam recommend the use of a neutral density filter (supplied). My test locations included the beach and I found no trouble with overexposure — however, snow conditions could give trouble.

Dycam shots are only the starting point. I was able to dump some of my test shots into another Mac with a grey scale monitor and *Digital Darkroom* software installed. Here I adjusted brightness and contrast. The illustrations shown here were made this way and printed out on a LaserWriter IINT 300dpi laser printer.

The big advantage of the Dycam used

SPECIFICATIONS
Dycam Digital Still Camera Model 1

Format:	Internal Dynamic RAM
Memory:	7.5M bytes total
Image sensor:	1/3" CCD: 90,240 pixels
Grey levels:	256
Capacity:	32 compressed mono images
Lens focal length:	8mm
Focus:	Fixed: from 1m to infinity
Exposure:	Program AE
Shutter:	1/30 — 1/1000s electronic
Battery:	NiCad rechargeable
Dimensions:	171 x 83 x 28mm (H x W x D)
Weight:	283g

in this way is that you are supplied with a printout complete with a dot screen of (approximately) 70 lines per inch. In other words the Dycam can, with the appropriate printing device, output a grey scale image complete with half-tone screen — onto paper or film negative.

Growing uses

The Queensland State Forestry Service is apparently interested in one to record tree canopies and graph the light areas on the forest floor; Telecom Australia has already acquired one; the University of Sydney has one for its Veterinary Department; a number of high schools have also purchased examples for art and photography classes.

The Dycam would be ideal for any school publishing a newspaper — image capture and retrieval is rapid, and there is no need for darkroom expertise, the picture remaining within the computer's digital domain. I can predict the second model of this innovative product will take its talents further, and I understand a colour version is on its way — it should be here around late in the year.

In Australia, the Dycam Digital Still Camera Model 1 is distributed by Sprinter Products, of Suite 1/22 Darley Road, Manly 2095. You can also contact them on (02) 977 8155, or fax (02) 976 2442.

Recommended retail price for the camera itself is $1705 ($1495 ex tax); for schools it's available at $1316.

A closeup lens kit with 1, 2 and 4 dioptre lenses is available for $145 ex tax, while a wide-angle (x0.5), and x1.5 and x2.0 tele lens adaptors are available for $114 each, again ex tax.

Further information is available from Sprinter Products, at the above address. ❖

Moffat's Madhouse...

by TOM MOFFAT

Being first to solve problems

In Jim Rowe's editorial a few months back, he bemoaned the fact that so few young people are planning careers in science and engineering. He mentioned the fact that many young people saw technical subjects as 'boring'. Well, let's be honest — maybe some of them are.

I remember during my own early engineering training I was forced to take a technical drawing course, and I HATED it. I am basically a messy person, and I just couldn't cut it making all those neat little lines on pristine white paper. For me it was always smudge, smudge, smudge, tear it up and do it again.

I guess a lot of the problem is the same today is it was then. We engineering students seemed to spend all our time with our noses to the grindstone, studying rules and formulas and power factors and Smith charts. All the while, our colleagues in less demanding faculties were out there whooping it up with the ladies and partying day and night. We did all the work; they got all the goodies.

To improve our self-image, we engineering types used to strut around with slide rules slung from our belts. We didn't know it at the time but to non-engineering people, and to all those yummy university women, we looked like *nerds*.

They didn't even have nerds back then, but the fact remains — from today's viewpoint, we were nerds. I finally broke free of the stigma when I started playing in a band in a pub, an activity I still indulge in to this very day. Later I got my radio engineering ticket via the Bell Telephone Company's technical college in Denver, Colorado. A lot of what we were taught were techniques used in the 1920's, such as measuring frequencies using Lecher wires.

Mother Bell was a very conservative outfit: they would build something to last and then use it for 40 years or so. We got the impression that there was nothing new; we were just doing the same old stuff of our predecessors a generation earlier.

But when you get to a certain point in all this, you start to think — did they do that right? Surely there must be an easier way to get a signal from point A to point B. With our nice new engineering tickets we abandoned the communications gear of the 1920's and got our hands on Real Radios!

The hot stuff back then in the 1960's was travelling wave tubes, gadgets that could churn out a healthy microwave signal with an absolutely enormous bandwidth. But TWT's needed almost daily attention, and they were pigs of things to work on. One slip of the hand when tuning one and you'd blow it up, no fear.

You'd sit there with fuses popping everywhere and alarm bells ringing and think: surely something must be better than this! And that's the point — there's always a better way, always a new answer. It was Bell Telephone guys who sat there swearing at valves and came up with the transistor to replace them.

So, students-to-be out there, take note of the fact that the further along you move in this electronics game, the more fascinating it becomes.

. Everything I learned at uni and the Bell Telephone college is now obsolete — totally replaced by new ideas, most of which were cooked up by people who suffered some struggle and boredom in the early days.

I won't mention any specifics for fear of stirring up a hornet's nest, but I can think of plenty of people who had a real good time at uni but are now doing the same boring jobs they fell into 20 years ago. The next big deal in their lives is retirement; the next big deal in my life is — a new design!

Problems to solve? Things to do? There are plenty, waiting for you to finish your course and get into it. Perhaps a doctor's thesis?

When I was new in the game, back with Mother Bell, I used to travel around working in various far-flung telecom installations in the state of Nevada. I was usually alone, and I carried a portable FM radio around for company. The only station it could pick up, out there in the country, was transmitted from the top of a 9000-foot mountain outside Reno.

One morning I hooked up the radio and then for some reason moved the tuning dial. And it was full of FM stations coming in from such places as Chicago, Pittsburgh, Kansas City and Calgary in Canada. They were streaming in, from thousands of kilometres away in every direction — on a VHF band that was supposed to be line-of-sight only, according to my formal training.

It wasn't long before I went for an amateur licence, so I could play around with this VHF myself. I read all the magazines, studied the books, talked to people, and before long I knew 'everything there was' about skip reception. I knew what caused it, which atmospheric layers were involved, how temperature affected it, everything! Oh yeah? Consider this:

I have been spending a lot of time with weather satellites lately, working on a new project for *EA*. These satellites transmit on VHF at around 137MHz, and we all know that once the satellite goes over the horizon its signal must disappear.

This happens, right on cue — but then it sometimes comes right back for another go, and you might spend five more minutes receiving signals from a satellite that's long disappeared from your 'line of sight'.

How can this happen? Apparently, nobody knows. From my own observations the effect seems to occur only when the satellite is to the south, over the Antarctic. Does temperature have anything to do with it?

The satellite is in space, temperature should be meaningless. Does the ice below have some effect? Is it the earth's magnetic field, converging in the south? Nobody knows.

Here for you, my future scientist friends, on a silver platter, is a question that needs some answers. Care to work on it?

I mentioned this effect to some people in the Weather Bureau, and they said they had noticed it too, but nobody knew why it occurred. But mention of the subject unearthed something even more interesting.

Reproduced herein is a rather scruffy satellite picture, received by Weather Bureau Senior Technical Officer Colin van den Hoff, during a voyage of the *Icebird* along the Antarctic coast. The satellite photo clearly shows the polar region, but there's one problem — it's the wrong pole. If you study the picture you can make out Canada, Siberia, Greenland, and you can see right over the North Pole to the other side.

Now it's unlikely this was a mistake. The picture was received on a computerized automatic satellite receiver, which carefully logs all conditions at the time of reception.

Logged data shows that the *Icebird* was at 64° 9' South, 76° 22' East, between the Davis and Mawson Stations. The time was 15:02:56 on Christmas Eve, 1991. The computer says the satellite involved was NOAA 11, one that's become an old friend during my own satellite experiments.

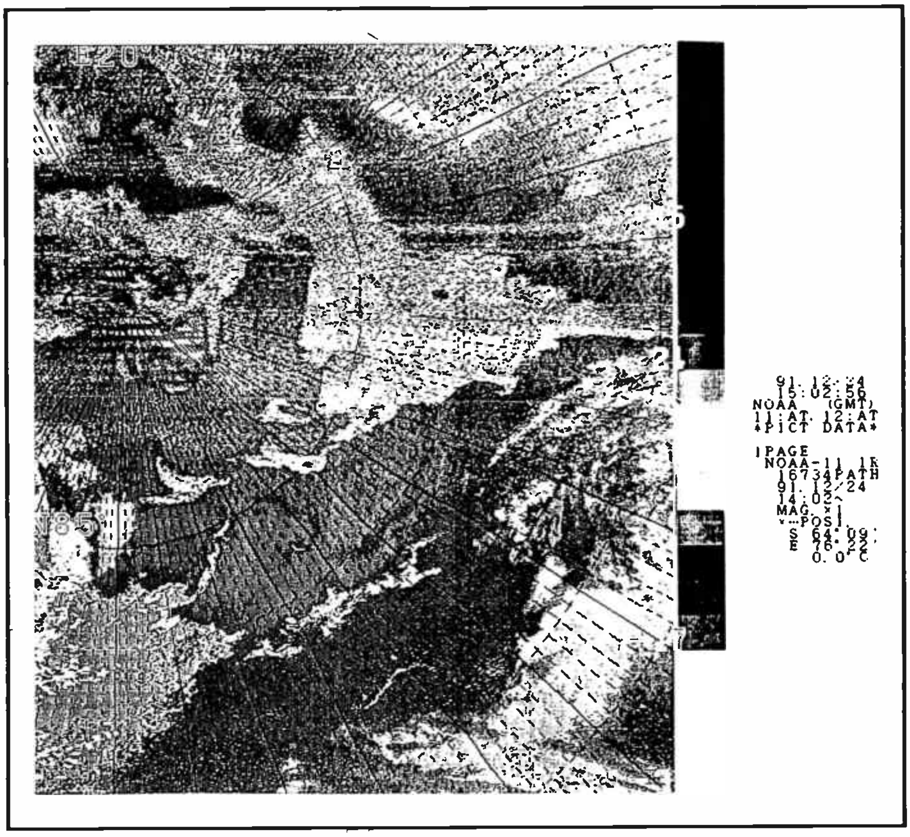
This computerized receiver on *Icebird* contains its own satellite tracking program, so once is acquires a satellite signal it can use known orbital elements to work out where the satellite is and draw the appropriate lines of latitude and longitude onto the picture.

The only thing that doesn't quite tally is the coverage of the picture itself, which appears much wider than what normally comes from NOAA 11.

But the fact remains — even if it's the wrong satellite, the image shown in the picture can only be from the northern hemisphere. Here we have a signal from a five watt transmitter, on 137MHz, travelling half way around the globe. Atmospheric skip? Probably not — remember that the signal is originating *above* the atmosphere, not below it.

My own guess is that the effect has something to do with the Earth's magnetic lines of force, possibly travelling along them somehow, but it's only a guess. One of you future science graduates might like to take this one up; you'll probably score a trip to the Antarctic!

In my amateur radio activities I've also come across some occasional surprises. On HF, particularly the 14MHz band, long-distance skip is very common. One day I was operating from our beach house, about 60km from Hobart, and I heard a Hobart station working Morse Code.



His signal could be heard twice, very weakly in the first instance, and then a fraction of a second later, very strong. The weak signal was coming direct from Hobart, probably via backscatter, but the strong signal was skipping all the way around the world. That's what you call long skip!

Now consider this story, told to me by a member of the United States Navy during his ship's visit to Hobart. Prior to going to sea, this fellow was an air traffic controller at the big US Navy base at San Diego, California. Many pilots are trained here, and it's not unusual for things to go wrong.

One day this operator picked up a 'Mayday' call from a student pilot, who gave his call sign and position and then said his engine had cut out and he was going to ditch into the sea.

The ATC operator followed the normal procedure and launched a search-and-rescue operation into the pilot's reported area. It was no big deal — pilots ditched from time to time, and they were usually rescued with no problems.

But within a few minutes of calling out the SAR team, the controller found himself in the hands of Naval Intelligence — undergoing intense questioning. Are you SURE of the callsign? You're absolutely certain of the position? Yes, yes, said the controller.

Why all the doubt? He was eventually told that the callsign and position were indeed correct, but — that Mayday message had been transmitted from a training flight during World War II — 20 years earlier.

When I heard that one my skin crawled. It isn't often you hear a ghost story from someone who was personally involved in it.

I don't think this fellow was having me on. He was cold sober, in fact a teetotaller. There were other US Navy personnel present at the time the story was told, and there were other Hobart people there as well. Everyone was quite serious.

Now forget about ghosts for a moment, and consider this possibility: Could a radio signal be transmitted, and then get stuck in some kind of 'closed skip' situation, where it just keeps going round and round — even for 20 years?

This has been suggested before, but no real evidence has ever been collected to back up the theory.

So there's something *else* that needs study by a future science or engineering graduate. Whoever proves this effect will go down in history right next to Marconi. ❖

20

'WORLD RAD

SANGEAN
ATS 818CS
FM STEREO/MW/LW/SHORT WAVE/CASSETTE PLL SYNTHESIZED WORLD RECEIVER
FULL AUTO STOP
TAPE
LIGHT
FM 87.5-108 MHz / MW 520-1620 kHz / LW 150-519 kHz / SW 1621-29999 kHz
FM
MW
LW
SW
MANUAL
DIRECT ACCESS
METER
FREQ
STANDBY
120m
1
90m
2
75m
3
60m
4
49m
5
41m
6
31m
7
25m
8
21m
9
19m
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16m
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13m
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11m
M
ENTER
STANDBY
BUZZER
RADIO
TONE
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HIGH
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A WORLD
VALUED AT
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EACH

10S' TO BE WON!

The Sangean ATS-818CS is available from all Dick Smith Electronics stores. Please phone (02) 888 3200 for details on your nearest outlet.

There's a special bonus for anyone subscribing to Electronics Australia with ETI, or renewing/extending their existing subscription over the next three months: by arrangement with Dick Smith Electronics, we have no less than 20 of these exciting new Sangean ATS-818CS multi-band digital tuning radios to be won! Each radio has a normal retail price of $399 – giving a total prize value of $7980.

Who is eligible to win one of these excellent receivers? Anyone who subscribes, or extends/renews their subscription to Electronics Australia with ETI, between March 25 and June 25, 1992.

The Sangean ATS-818CS is a compact portable unit which combines a multi-band digitally tuned communications receiver with a high quality cassette tape recorder. The radio section has full PLL synthesised tuning, and operates over the following frequency bands:

LONG WAVE: 150 – 519kHz
MEDIUM WAVE: 520 – 1620kHz
SHORT WAVE: 1.621 – 29.999MHz
VHF FM: 87.5 – 108MHz

The ATS-818CS includes a built-in dual time clock, allowing display of both local and universal time; direct-access keypad to permit instant tuning of any desired frequency; 45 programmable memory channels; built-in scanning facilities; a rotary tuning knob, with selectable fast or slow action; adjustable IF bandwidth; a BFO for Morse and SSB reception; a manual RF gain control; a tone control; and a large LCD panel which provides fast and clear display of operating frequency (14mm high numerals), time, memory channel and signal strength. The LCD panel also has a back light which can be disabled when not required.

Other features are a 'key lock' switch, to prevent accidental flattening of the batteries; a connector for external antenna input, as well as a built-in telescopic rod antenna; a headphone jack; and a 'dial lock' switch to prevent accidental detuning from a critical frequency. The receiver also features both a built-in carrying handle and a tilting bail, to allow convenient table top operation.

Despite all of these features, the Sangean ATS-818CS measures only 296 x 192 x 68mm (L x H x D), and weighs only 2kg. It is fully microprocessor controlled, and uses 15 integrated circuits, 61 transistors, 8 FETs, 53 diodes and two LEDs. Operation is from either four 'D' size alkaline cells and three 'AA' size cells, or an external 6V DC power supply.

And YOU can win one of these exciting new receivers, simply by subscribing or renewing your subscription to Electronics Australia with ETI, before June 25, 1992!

PLUS everyone who subscribes or extends/renews their subscription will receive two of these Project Electronics magazines valued at $3.25 each. YOURS FREE !

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Simply phone our toll free number 008 800 933 and have your credit card details ready. If you do not have a credit card then fill out the coupon attached and post. If the coupon is missing, send your name, address, phone number and cheque to: Federal Publishing Company Reply Paid No. 3, P.O. Box 199, Alexandria, NSW 2015. Any enquiries can be made by phoning (02) 693 6666. Unsigned orders can not be accepted.

CONDITIONS OF ENTRY

1. The competition is only open to Australian residents authorising a new or renewal subscription to Electronics Australia magazine before last mail on 25.06.92. Entries received after closing date will not be included. Employees of the Federal Publishing Company Pty. Ltd., Dick Smith Electronics, their subsidiaries and families are not eligible to enter. 2. South Australian residents need not purchase a subscription to enter, but may enter once by submitting their name, address and a hand drawn facsimile of any coupons to the Federal Publishing Company Pty. Ltd., P.O Box 199 Alexandria, NSW 2015. 3. Prizes are not transferable or exchangeable and may not be converted to cash. 4. The judge's decision is final and no correspondence will be entered into. 5. Description of the competition and instructions on how to enter form a part of the competition. 6. The competition commences 25.03.92 and closes last mail on 25.06.92. 7. The draw will take place in Sydney on 29.06.92 and will be announced in a later edition of Electronics Australia. 8. The prizes are: 20 x Sangean ATS-818CS radios, valued at $399 each. Total Prize valued at $7980. 9. The promoter is the Federal Publishing Company Pty. Ltd., 180 Bourke Rd, Alexandria NSW 2015. Permit No. TC92/0000 issued under the lotteries and Art Union Act 1901; Raffles and Bingo Permit Board No. 92/0000 issued on 00/00/92; ACT permit no. TP92/0000 issued under the Lotteries Act 1964; NT permit No. 92/000.

When I Think Back...

by Neville Williams

Vintage Radio Design: A smorgasbord of readers' comments, questions — and answers

Reader response to the 'Think Back' series has been very gratifying, particularly in respect to the articles to do with vintage receiver design. Some respondents have been most helpful with personal recollections and photostats; others have raised questions, a selection of which form the substance of this present article.

For example, I had just rounded off the article on 3/4-valve superhets when the postman delivered a letter from Keith Walters of Lane Cove, NSW. From past experience, I fully expected a dissertation on video recording, wide-screen TV and satellite links — his pet subjects, with which I can only envy his familiarity.

But no! Behind the contemporary facade of video systems and digital signal processing lurks a vintage radio enthusiast. The same Keith Walters who has taken public potshots at the decision makers and intelligentsia of the video scene penned the following paragraphs:

My original enthusiasm for 'ancient' radios was sparked while I was still at school in the late 1960's, by an early Airzone chassis found in a pile of electronic junk that I purchased at an auction for $2. Despite its very 'original' condition, the old warrior worked remarkably well, particularly with a 100-foot (30m) aerial strung up to a backyard mango tree.

With its valve RF amplifier and its 175kHz IF, for gain and selectivity it beat the pants off any transistor radio I had access to at the time. (An often overlooked virtue of even the most humble valve receiver is that you can connect a much larger outside aerial to them than is possible with a transistor set, giving interstate reception without filling the band with chirps and whistles).

Keith says that the set has since become the victim of transformer failure — not readily replaceable because types with 2.5V heater windings are few and far between. Since then he has accumulated a small collection of vintage radios, with cabinets, but none able to match what he remembers as the performance of the old Airzone.

Possible solutions

I can well imagine veteran collectors asking why he doesn't grab the first available 6.3V transformer and see whether he can trade his old 2.5V valves for plug-in equivalents with 6.3V heaters. Or maybe he could dismantle the replacement transformer and substitute a new heater winding, with fewer turns of thicker wire.

Another possible option would be to re-jig the heater wiring so that the 2.5V valves operate in series-parallel from the 5V rectifier winding, with the rectifier running from the 6.3V winding through a dropping resistor.

Then again, if the 6.3V winding is centre-tapped, earthing this would provide two 3.15V windings which could conceivably power the 2.5V valves through dropping resistors.

> **Super-regen receivers:**
>
> Thank you for your magazine and the excellent series 'When I Think Back'.
>
> How the super-regen detector works has always been a mystery. My version is this: (Please correct me if I'm wrong).
>
> *A super-regenerative detector breaks in and out of oscillation at a repetition rate determined by the frequency of the quench voltage.*
>
> In his article in the December 1991 issue, Neville Williams mentions the use of super-regen recevers in aircraft during World War II. I would like to add that, to conserve space, they were also used in American submarines. Unfortunately they would radiate a signal 'up the stick', which could be picked up by enemy ships. Some bright spark(?) solved the problem by placing an RF amplifier stage between the detector and the aerial.
>
> (D.C.B., Alderley Qld).

This is all secondary, however, to the main thrust of Keith's letter:

Your present series of articles have given excellent in-depth explanations of various aspects of early valve receiver design and herein lies a great irony:

I once had a collection of EA/Radio & Hobbies going back to the 1940's and I can't recall any technical articles that provided quite the same attention to detail that your present ones have. Now, two decades on, in the era of compact discs, cellular phones, computers and 16M RAM chips, we have the series I was looking for 20 years ago.

A case in point is the January 1992 article, in particular the part concerning the headaches involved in developing AGC systems.

Keith Walters says that he repaired and passed on to friends three of his not-so-vintage receivers. Duly grateful, they all praised their 'superior tone', which surprised him because the sets all suffered detector-induced distortion, both audible and visible on the oscilloscope. I quote:

Matter of opinion:

No matter what I did at the time, I could not correct it. It was exactly as your article describes — with the various loads removed from the detector, the distortion disappeared.

At the time, I reasoned that the circuit must have worked properly once, so there had to be a faulty component. I replaced all the resistors and capacitors, and even tried wiring a separate 6AL5 *diode under the chassis in place of the existing diodes. I also checked the IF transformer, looking for leakage current but there was no sign of that either. So I simply left things as they were.*

I no longer have access to the particular radios, but I'm pretty sure that all three sets used simple AGC with the diodes tied together. They must have been real cheapskates in those days, seeing that a proper AGC system would have required only a couple more components. But I do wonder whether the reason they were able to get away with simple AGC in those days had something to do with the programs that were broadcast then. When I was working on the sets, I would almost certainly have been tuned to a 'Top 40' type station, most of which use compression techniques to increase their 'talk power', thereby operating close to 100% modulation for most of the time. Perhaps in the old days the average modulation depth tended to be much lower than now.

Responding first to the last couple of pars, I will endorse both propositions. In the period we are talking about, most of the music came from 78rpm records, which suffered high distortion arising from the geometry and dynamics of the system, and high noise from the texture of the pressings.

Licensed Announcers

The licences for announcers referred to in the December 1991 article would probably have been those issued by the Ministry of Information — certainly from 1941 (perhaps earlier) to the end of the War.

Announcers who read or commented on news or did outside broadcasts of news events were regarded as journalists. They had to be careful that, in the course of such a broadcast, they did not convey useful tactical information to the enemy — hence the official intervention.

It was actually more of a problem in the UK than in Australia.

(Adrian Dunne, Melbourne)

Why all the fuss?

With a source signal of that ilk, and against a background of 1920's-style reproduction, extra detector distortion may not have attracted much attention.

And, yes, diode distortion due to adverse loading rises rapidly with the modulation percentage, and artificially high modulation with an otherwise clean signal would inevitably highlight the problem.

As for publishing a design series 20 years too late, I am not sure whether to plead guilty or to suggest that Keith walters simply didn't arrange to be born soon enough!

The fact is that most of the R&D on which the articles were based was done in the 1930's and published concurrently in company literature and industry publications. It was also the subject of periodic lectures to members of the IRE and WIA and to radio service groups.

It didn't make it into *R&H* because the magazine, as such, didn't appear until April 1939, on the eve of World War II.

By the time civilian radio had returned to normal in the late 1940's, the appropriate course was seemingly to adopt proven techniques without elaboration, and to focus the articles on the practicalities of completing successful projects.

By the 1950's and 60's, reader interest in valve radio receivers was being crowded out by audio systems, test instruments and electronic gadgetry, by TV sets and solid-state technology. While many found the technological rate of change bewildering, they nevertheless expected a 'plain English' coverage from the technical press — and this is primarily what we gave them.

Since then, technological progress has not slowed but, ironically, its bewildering present-day rate has spawned renewed interest in the humble, hand made equipment of yesteryear — which remains sufficiently comprehensible and accessible

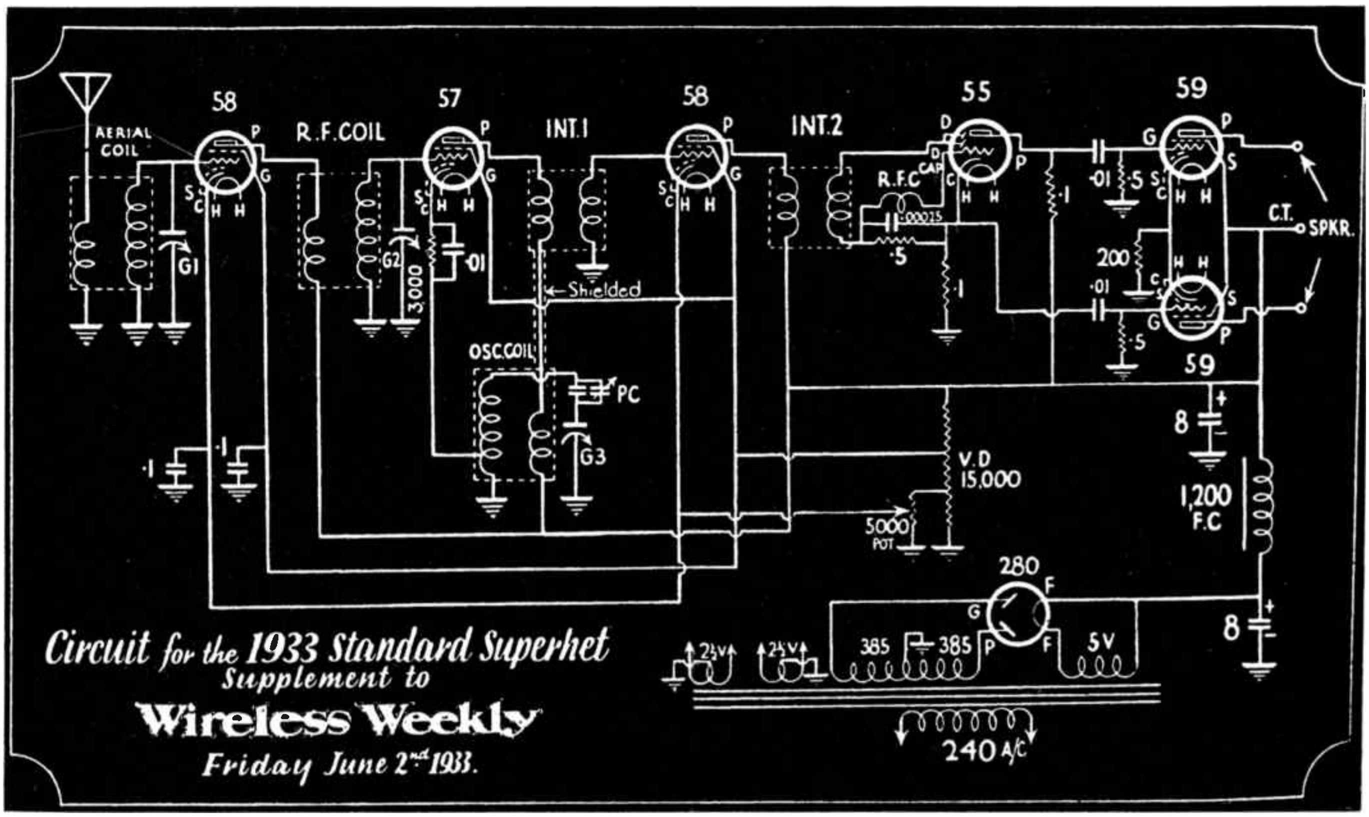

Fig.1: Inserted as a large blueprint into 'Wireless Weekly', the circuit of the 1933 Standard Superhet created enormous interest by its use of a simple resistance-coupled phase splitter to drive push-pull output valves.

to encourage its acquisition and restoration as a hobby.

What prompted the recent series on vintage receiver design was the realisation that many such hobbyists were clearly unaware of considerations which had featured in industry literature of the 1930's. Most of it has long since been discarded, but I was fortunately able to resurrect a precis of it, with prompting from *Radiotronics*, assorted valve manuals and odd technical journals.

Also on hand were copies of the *Radiotron Designer's Handbook* (third and fourth editions) the latter being a huge 1500-page tome on valve-based technology, complete with more references than you're likely to find anywhere else. Had Keith Walters been presented with a copy 20 years ago, he might have found less time, since then, to study solid-state video!

All the same, I'm encouraged by his letter and glad that he found the series helpful, even if somewhat belated.

One other point I almost overlooked was Keith's implication that some designers must have been 'cheapskates'. I quoted the remark to one retiree, who used to be a receiver designer for a major manufacturer. I quote: "Keith's obviously never had to work with the kind of accountants I had to cope with. You'd have thought that they had to meet the cost of every extra component out of their own pocket!"

Super-regen receivers

In the panel carrying the above heading, a reader whose name I couldn't quite decipher from his signature invites me to comment on his explanation of how a superregenerative detector works.

To be frank, it's a bit like defining a horse as a four-legged animal. It's true as far as it goes, but it doesn't go far enough; the definition would need to be expanded considerably if the reader was ever to differentiate between a horse and scores of other quadripeds!

It was, in fact, the inadequacy of most such definitions/explanations that prompted the debate, as summarised in the December 1991 issue. If D.C.B.'s 'version' is to give some clue as to how a super-regen. detector really works, he would have to add a further paragraph along these lines:

However, the exact timing, duration and/or amplitude of the oscillatory 'packets' is affected by possible audio signal components on the grid, be they a by-product of system noise or a modulated carrier. In turn, the variations so introduced cause audio-related variations in the mean value of the anode current, which in practice can have an energy level many thousands of times greater than that of the tiny 'samples' that created them in the first place. It is for this reason that a super-regenerative circuit can offer an exceptionally high order of detection gain.

It's possible that the above par could be better expressed, but if D.C.B. can't at least appreciate the point I'm trying to make, I can only suggest that he goes back over the relevant issues, where the matter is discussed at greater length.

In the meantime, thanks for the information about use of superegen receivers on submarines. When lying doggo beneath the waves, about the last thing one would need would be an errant radio signal to attract the attention of enemy destroyers!

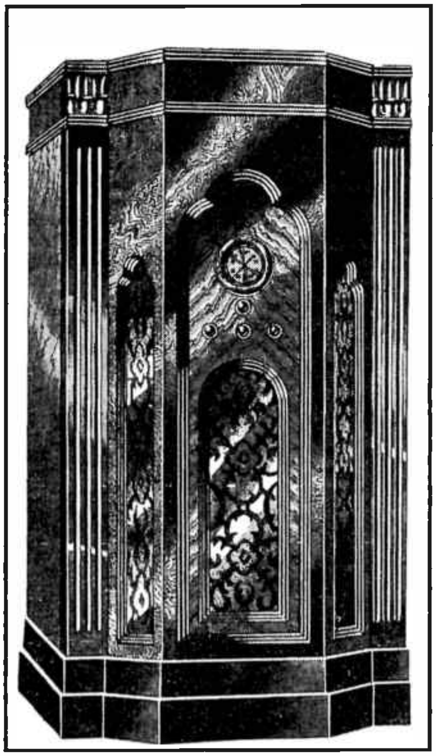

Fig.2: In the style of the period, the 1934 Reliance York was housed in an ornate upright console, with lift-up lid giving access to the phono player. Cabinet construction and finish was of exceptional quality.

In that same wartime context, I must also acknowledge a letter from Adrian Dunne of Melbourne, as reproduced in the panel headed 'Licenced Announcers'. It is largely self-explanatory.

According to my Macquarie Book of Events, under legislation enacted following the outbreak of war in 1939, the Department of Information assumed responsibility for the classification of news and other wartime information. Although as a magazine editor I had to observe their directives in regard to restricted information, I did not connect this fact with mention in the December issue of an 'announcer's licence'.

My thanks to you also, Adrian, for jogging our collective memory!

Domestic radio again

From Bathurst NSW, Mr E.G.(Ted) Baker also expresses his gratitude for the 'Think Back' series and adds: "The information in the series is invaluable for the serious radio restorer". He continues:

I wonder if you can comment on the circuit of the '1933 Standard Superhet' (circuit enclosed). I am especially puzzled by the circuit around the 55 diode detector and phase inverter.

Depending on the strength of the received signal, a voltage will be developed across the 0.5meg diode load resistor which will be negative with respect to the cathode. This voltage will be applied directly to the grid of the 55, and one wonders what effect this might have on its operation as a phase inverter.

Did you have any experience with the set? Presumably it operated satisfactorily.

As will be apparent from the circuit (Fig.1,) the receiver in question was unveiled on June 2, 1933 — by which time I had been employed in the radio industry for less than six months, for the princely sum of one pound ($2) per week. As such, I was in no position either to evaluate the design or to invest in a kit of parts to build one. My reactions to the circuit are therefore all of the hindsight variety.

With an RF stage ahead of an autodyne frequency changer, IF amplifier and diode detector, the front-end gain and selectivity would have been well ahead of the ordinary 4/5-valve domestic superhets of the day. While this would have set the receiver apart, the real point of interest was in the push-pull output stage — offering double the usual audio power.

Push-pull output stages were not new in 1933, but most relied on push-pull grid drive transformers, which were either very costly or characterised by an indifferent frequency response. Moreover, in mains powered equipment, they were prone to hum pick-up from the magnetic field of the power transformer.

The 1933 Standard sidestepped such problems by using a 'phase-splitter' stage, with its effective output load being formed by two identical resistors, one in the anode/HT+ circuit, the other in the HT-/cathode return.

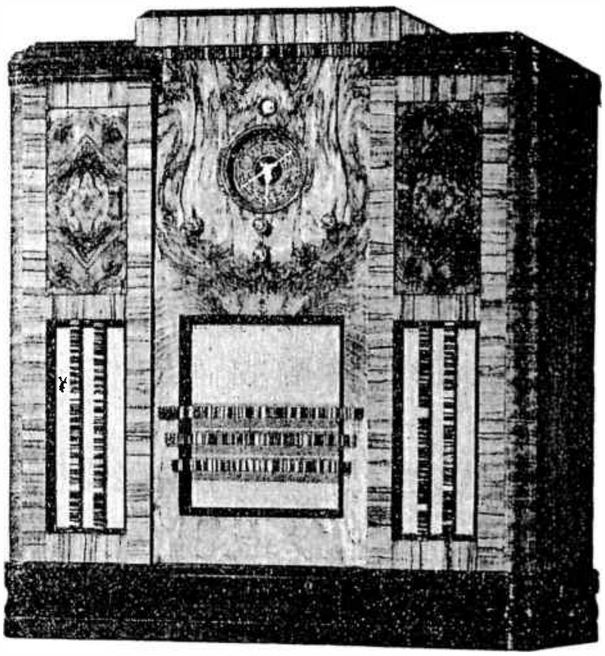

Fig.3: Still in keeping with the industry trend, the 1936 'York' was housed in a loughboy-style cabinet. It featured automatic volume expansion and, unlike other receivers, retained a push-pull triode output stage.

Suppose, in Fig.1, that a positive-going signal at the grid of the 55 caused the anode current to cycle through an upward excursion of 0.1mA. This would produce a resultant voltage drop at the anode of 10V, representing a negative-going 10V pulse at the grid of the upper output valve.

Meanwhile, the same upward excursion in anode current would cause a positive-going 10V pulse at the cathode of the 55, and therefore at the grid of the lower output valve. In short, by sharing its load equally between anode and cathode, output from the 55 was separated into two signals of opposite phase.

I have forgotten who first devised the above phase splitting circuit, or when, but for most readers in 1933, the idea was both novel and intriguing. The end result was a receiver that was sensitive, selective and unusually powerful, without being unduly complicated or costly.

As such, it rewarded the *Wireless Weekly* initiative, boosted the do-it-yourself market and posed an implicit challenge to the manufacturers of routine 4/5-valve superhets. If you come across one, it could certainly be worth restoring.

The Standard did have certain in-built limitations, however. Because half the output signal appeared across the cathode circuit, normal stage gain could only be realised if the audio input signal was injected between grid and cathode of the 55 triode.

In respect to radio signals, this was achieved quite simply in the 1933 Standard by processing the IF signal and the recovered audio directly between the diodes, cathode and grid, independently of earth.

Unfortunately, the arrangement rendererd the circuit unsuitable for use with a phono pickup — because in the normal way, a pickup signal would have had to be injected between grid and earth. In this mode, the output signal present across the unbypassed cathode resistor would result in a high level of negative feedback, reducing the effective per-channel gain of the 55 triode to less that unity, instead of something over three.

Again, because the entire diode/cathode circuit was pegged above earth by 50 volts or so, the system was not available for automatic gain control.

Fortunately for promoters of the 1933 Standard Superhet, prospective constructors in 1933 were not particularly concerned by these restrictions and it was equally too early in the scheme of things to question the lack of negative feedback around the output stage. It would not have been practical, anyway.

What then about the point raised by Ted Baker: direct application of the diode voltage to the grid of the 55?

First off, the diode voltage did not depend, as Ted has assumed, on the strength of the received signal — because of the manual RF/IF gain control. To work out why becomes an exercise in thinking backwards from the loudspeaker end.

In everyday use, the RF/IF gain control would be set so that the volume from the loudspeaker would be at normal listening level. The drive signal to the 59 output valves would therefore be maintained at a similarly 'normal' level, as also would be the signal fed through the 55 from the diodes.

In short, whether the incoming carrier was strong or weak, the manual gain control would be so set as to feed a substantially uniform IF signal to the diodes.

The question therefore becomes simply a matter of whether the voltage generated by the diodes would be an appropriate bias for the 55, with the detector/audio system operating at a normal listening level.

Without getting bogged down in theory, the 55 had a very low amplification factor (8.3) and was fairly accommodating in respect to the applied bias — especially when operating into a high value load from a high voltage source. All the evidence suggests that, in the 1933 Standard circuit, direct coupling worked well and there was no point in complicating matters by inserting a coupling capacitor and a grid return back to a tapping on the cathode load.

It was/is of no account that the 55 triode happened to be working into a split load. In terms of grid/anode dynamics, the valve was simply operating as a voltage amplifier into a nett load of 0.2meg (200k), with a supply voltage of around 300 and a (hopefully) acceptable external bias.

Valve 'monstrosity'?

Some time back, I received a letter from Darryl Kasch, then working with 2GZ in Orange, NSW. Caught up with vintage radio, he had assembled a collection of 1930's-style receivers. Darryl had also worked through the files of *Wireless Weekly* for the same decade, in Sydney's Mitchell Library and extracted a wad of relevant photostats.

In the process, he had come across references to the 'York' receiver, manufactured by Reliance Radio of Sydney — variously located in Clarence St, then York St and finally Barrack St, City, alongside the Lottery Office.

His first reaction to the York was that it was an expensive, over-designed 'monstrosity', inspired by the American, chrome-plated E.H. Scott receiver. He had heard (wrongly) that I had originally designed it and was seeking further information.

In more recent correspondence from Maryborough, where he is now associated with 4MB, Darryl says that his collection of vintage receivers topped the hundred before he 'cut back', but he had still not managed to locate a Reliance York. In the meantime, based on what he had heard and read about it, he had decided that the York must have been an impressive receiver in terms of tonal quality. Indeed, he suggests, it could conceivably qualify Reliance as the birthplace of 'custom-built hifi' in Australia.

That Darryl hasn't come across a York receiver is not surprising because, for the most part, they were manufactured as one-off specials to meet specific needs. Whether this would confer pioneer 'custom' status is another matter.

Apart from a personal interest in hifi equipment, the management of Reliance saw merit in displaying a deluxe receiver, where practicable, at shows and exhibitions. They attracted attention and generated publicity in the press. And after the show, some well-heeled business executive would usually be waiting, cheque in hand, with the further possibility that one or other of his/her friends would line up for 'the next one you produce'. It certainly helped confer a quality image on what was essentially a small family company.

'Leading edge' design

Described as 'Australia's Outstanding Achievement in Radio', the first Reliance 'York' advertisement pinpointed by Darryl Kasch appeared in *Wireless Weekly* for December 8, 1933. Editorial coverage in the same issue indicated that it was available with or without in-built record player, in a 'massive' but modestly embellished upright console cabinet.

The chassis and all exposed metalwork appeared to be chromium plated, accommodating a 9-valve circuit, a 4-gang tuning capacitor and drum dial, with preselector and RF stages ahead of the frequency changer. The audio system featured an almost legendary Ferranti transformer feeding push-pull 45 triodes and driving an imported Jensen D8, 10-1/2" (27cm) 'concert' loudspeaker.

In fact, during 1933, the newly established Reliance factory had problems enough coping with the production of standard models and, curiously, I have no recollection whatever of the above-mentioned York. Either my memory has slipped a cog, or the requisite few Yorks were assembled privately elsewhere.

I do, however, remember the model that followed it. Described as 'Australia's Most Luxurious Radio Reproducer', it was featured in *Wireless Weekly* for December 14, 1934 (Fig.2).

The advert showed an ornate, upright console, of piano-finished burr walnut,

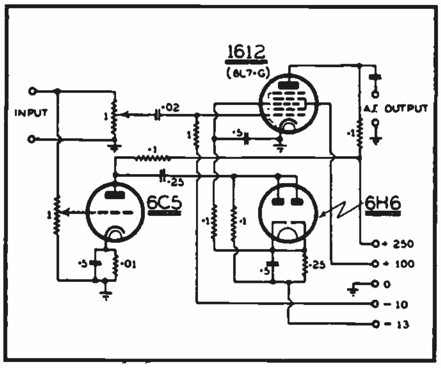

Fig.4: Basic automatic volume expansion circuit from the 'Radiotron Designer's Handbook', 3rd edition, p.74

with sculptured cathedral-like panels to frame the controls and serve as 'diffused' sound outlets. I well remember the fuss when the cabinets were delivered by Ricketts and Thorpe, the detailed inspections by Reliance executives and the apprehension when cabinet fitter Vic Inkster — a husky Harbord lifesaver — took to them with handtools to accommodate the equipment.

For a model produced in 1934, the basic design would have been the work of Norman Martin, my immediate senior and mentor in the Reliance factory. My subsequent contribution would have been to the assembly and wiring routines and, later, final adjustment.

At the time, Ray Tonks, mentioned some time back as a 'build your own Hammond' organ buff, was also working at Reliance, initially in the factory and later on field delivery, installation and service. For transport, he and his cohorts used the 1934 equivalent of a 'ute': a Harley-Davidson motor cycle with a large box sidecar. (By observation, riding a big Harley around Sydney on wintery, wet days was a much overrated pastime!)

Ray Tonks, after a subsequent stint in AWA Special Products at Ashfield, is now retired on the NSW mid-coast. He still has a clear, mental picture of me aligning and final checking the York receivers which he had later to install.

My own most vivid recollection of the 1934 'Yorks' involved a stack of gold-sprayed metalwork which, when laboriously assembled, enclosed the receiver proper in a largish steel box. It was described in advertisements as:

A totally enclosed, triple shielded, tuner/audio chassis with full floating valve panels. Separate power chassis — two heavy duty power transformers — two rectifiers, elaborate filtering.

Advanced circuitry

The 10-valve circuit specifications also suggest a 'nothing but the latest' approach.

In 1934, the York was offering a triple-wave tuner, with automatic gain control and a rare feature which I have not previously mentioned: automatic muting. Between stations, when an AGC equipped tuner might ordinarily reproduce loud static or electrical interference, the audio end was automatically muted so that otherwise rude noises were silenced. The system 'un-muted' immediately a regular signal was tuned, to permit normal reproduction.

Again, at a time when most other manufacturers had traded sound quality for the extra gain offered by power pentodes, the Reliance York was one of the

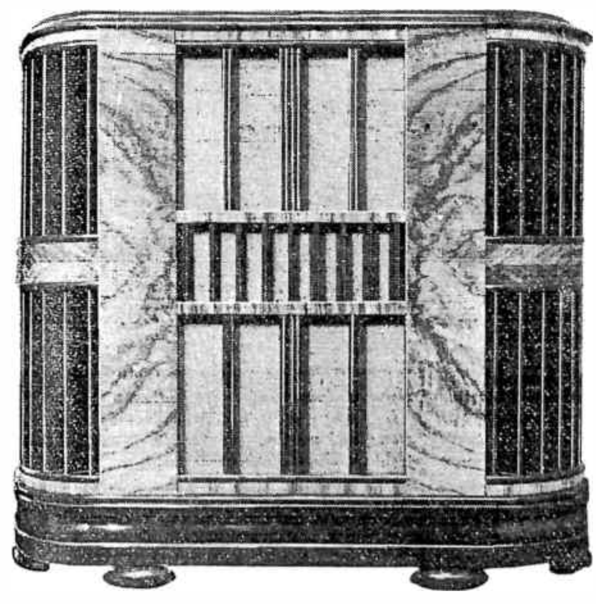

Fig.5: A prime example of elaborate cabinet work housing twin permag. auditorium loudspeakers, for the 1937 Reliance York. It was connected to the equipment cabinet via a 200-ohm line.

very few commercial receivers which retained power triodes, in the form of push-pull 45's. The power available would have been in the range 5 to 10W, depending on the operating conditions — which I have long since forgotten.

Their output was fed to a top quality American 29cm auditorium loudspeaker, from Jensen or Magnavox, which offered high sensitivity, extended frequency response and smooth, powerful bass.

To those of us who worked on them, the 1934 'Yorks' were totally 'over the top' for ordinary families. I still remember the amazement of the Reliance sales staff when a very humble old lady from a very humble address walked into the showroom and ordered a York — for no other reason than she wanted to own in her lifetime at least one thing that was 'the best'!

Re-reading the advertisement through 1992 bi-focals, the wholesale price for 'this magnificent instrument', direct from the manufacturers, doesn't seem all that steep: £49/16/8. In truth, for an average family man in those days, 'fifty quid' could have meant 10 weeks' wages — around $4000-5000 in today's currency. It was, undoubtedly, a radio for the rich; a wireless for the well-to-do!

Later model Yorks

An advert in *Wireless Weekly* for July 3, 1936 illustrates a still later model York — presented in a completely new, rectangular 'loughboy'-style cabinet in piano-finished 'Italian burr walnut and mocasser ebony'. The price had risen to 75 guineas (£78.15.0), with Reliance conceding that it was 'admittedly not for the average home'.

The chassis is/was described in precisely the same terms — totally enclosed, triple shielded, floating valve panels, two heavy duty transformers, etc. — but it carried two extra valves plus a magic eye. A similar audio system was retained, with an imported loudspeaker, but this time around, it featured automatic volume expansion as well as automatic muting netween stations.

As I recall, the automatic volume expansion was based on an arrangement which had been devised by RCA and published in their early application data for the 6L7 pentagrid mixer/amplifier. The circuit was subsequently reproduced in the third edition of the *Radiotron Designer's Handbook* (Fig.4).

It involved using the 6L7 (or its low-noise equivalent 1612) as the first stage in the audio amplifier. At the same time, some of the input was diverted to a 6C5 triode and fed thence to a 6H6 diode, which converted the audio signal to a resultant DC voltage. This was fed to grid-3 of the 6L7, such that the stage gain of the 6L7 would increase progressively with a louder signal.

The prime purpose of so doing was to expand the dynamic range of 78rpm discs, which had customarily been compressed at the recording stage as a precaution against system overload.

For acceptable results, the user had to exercise discretion regarding when to activate the expansion and how far to advance the expansion control.

Used to excess or on programs which did not warrant its use, the result could be disconcerting, with louder passages surging in volume in a quite artificial way.

We soon learned at Reliance that the most tractable music for an introductory demonstration was a theatre organ recital, by the likes of Reginald Dixon. By their very nature, such recitals relied on gentle, romantic passages and dramatic crescendos — with volume expansion, working into a generous loudspeaker system, adding predictably to the effect.

Meanwhile, around 1936, we had been pursuing developments aimed at increasing the power capability of the York amplifier, extending to the possible use of 2A3's or 6L6's instead of the existing 45's.

I well remember a conference on the subject with the late Fritz Langford-Smith of the AWV Co., which saw the big triodes installed in the developmental prototype. Unfortunately, about that same time, Reliance was hit with a liquidity crisis and both Norm Martin and I accepted other positions.

What happened after that I'm not sure, but a feature on the 1937 Reliance York in *Wireless Weekly* for December 17, 1937 revealed an extension of the earlier circuitry to 19 valves — including twin rectifiers and four 2A3's in push-pull parallel driving twin imported permagnetic loudspeakers.

A four-band tuner was provided, with a measure of bandspread at the highest frequencies. The set was housed in two separate cabinets with the 'works', once again chromium-plated, in a solid, richly veneered chest. The loudspeakers were in a separate, massive sculptured enclosure with tapestry-backed apertures at the front and sides.

While this was before the era of mathematically derived systems, by any standards (and especially by those of 1937) two large concert loudspeakers in a massive cabinet, driven by four 2A3's could only sound very impressive.

I'm sure Darryl Kasch would love to get hold of one — assuming that he could find somewhere to put it! ❖

Automotive Engine Control - 4

Continuing our look at the way electronics is becoming an integral part of the modern motor car, this month we look at fault-finding and servicing. Inevitably the techniques used to track down the cause of problems in an electronic engine control system are rather different from those used in the past, and require somewhat more sophisticated instruments.

by TONY MERCER

So something has obviously gone wrong. The new love of your life, not to mention your bank manager's financial salvation, won't start? Or idles a bit roughly, does it? Perhaps it has the performance of a pregnant water buffalo, but with petrol consumption that would make the sheiks of Arabia smile with delight?

You have gone and checked all the usual items: spark plug leads, hose connections; nothing mechanical fallen off. Guess the only thing left is the little black box that obviously controls all of this...

Could be, but not likely. Chances are that one of the connections to the myriad of sensors that feed data to the aforementioned beastie is kaput, or at least very sick. Perhaps an actuator like a fuel injection solenoid is playing up. The oxygen exhaust sensor is usually good for a laugh, but not if you have to pay for one. So how do you go about fault-finding the system?

Well, you would need to start with an understanding of the said system, some electrical measuring equipment (a CRO is a good idea, but not used often enough in the motor servicing industry), and the maintenance manual that covers this particular vehicle. This should enable you to find perhaps 20% of the faults.

Only 20%? Yes, that's right. The problem is that there is very little you can actually test or get access to, or obtain readings that make any sort of sense. The manual may tell you to measure the output from the inductive pickup with a voltmeter, in the area that you feel is at fault, and that the meter should read 0.3V at a certain point in the engine cycle, and 1.5V at another. You do this and sure enough, it is correct. You continue on down other paths, getting hopelessly lost, more confused and generally frustrated. You still suspect the inductive pickup, but at $150 a throw you are not inclined to replace it on suspicion. The motor wreckers are of no help, as they have not seen too many of these devices and anyway they also know how much they cost — and will charge accordingly.

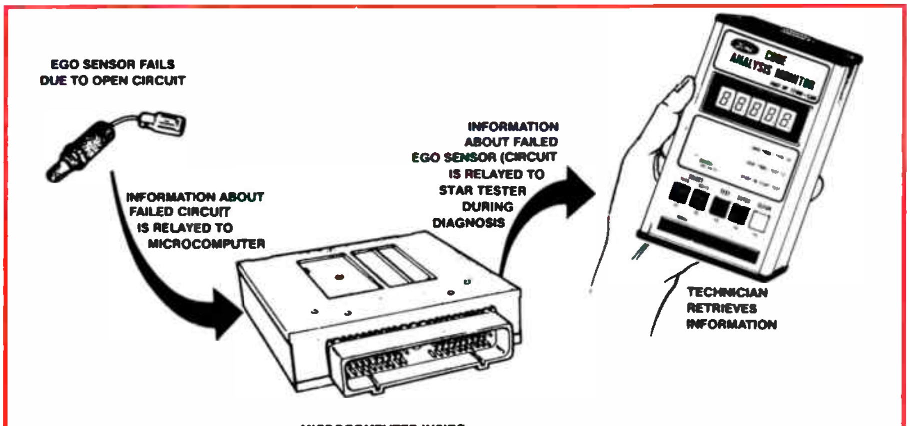

Fig.1

What to do? Well, with an understanding of the system and a CRO, you examine the pickup output and sure enough there is the problem. There is certainly 0.3V and 1.5V as suggested, but nothing else. No AC, or insufficient in order to reliably provide a sensor input to the controller. While accepting this, you wonder aloud why there is not a more detailed and accurate description of this in the manual when looking for the fault. The problem is that the manual is designed for service personnel who generally lack both electronics knowledge and also a decent service CRO, as against the special purpose instruments

Code	Test	Code Description
11	All tests	System Pass
12	E.R.	High RPM idle check fail
13	E.R. & Cont.	Low RPM idle check fail
14	E.R.	Unsteady pip signal during idle test
15	E.R. & Cont	Bad ROM/KAM data
16.	E.R.	RPM loo low to run fuel test
21	K.O.E.O & E.R.	ECT out of range
22	All tests	Map sensor is out of range
23	K.O.E.O & E.R.	TP sensor reads out of range
24	K.O.E.O & E.R.	ACT sensor reads out of range
41	E.R	HEGO always lean during fuel test
42	E.R.	HEGO always rich during fuel test
51	K.O.E.O & Cont.	ECT voltage too high
52	K.O.E.O.	Power steering switch open
53	K.O.E.O & Cont	TP voltage too high
54	K.O.E.O & Cont	ACT voltage too high
55	E.R.	Internal EEC-IV power too low
58	E.R.	Idle tracking switch not tracking
61	K.O.E.O & Cont	ECT voltage too low
63	K.O.E.O & Cont	TP voltage too low
64	K.O.E.O & Cont	ACT voltage too low
67	K.O.E.O	NDS or ACC is on
68	K.O.E.O	Idle tracking switch always tracking
78	Cont.	Interruption to the keypower circuit
85	K.O.E.O	CANP output circuit check fail
87	K.O.E.O	Fuel pump output circuit fail
99	E.R.	Idle speed corrections not learnt

Fig.2

that are usually tailored for a particular job with easy to use controls. This means that if you try to use this kind of gear outside its particular service domain, then it is generally useless.

The writers of the manual know that the general mechanic will have access to a multimeter and will know how to use it, so they figure that if they measure the DC voltage produced this will at least confirm a 90% state functionality for the component, without confusing him too much.

This may sound a bit harsh on a body of men who in the main do yeoman service, keeping vehicles alive — many of whom have done post-trade electronics courses. It is just that the manual writers don't seem to bear them in mind.

On-board diagnostics

In the workshop, the first port of call for obtaining symptoms to the fault (apart from customer statements) is the on-board diagnostic facility. Usually there will be some form of indication on the ECU, a flashing light or digit that conveys error or status condition codes (Fig.1).

Fig.2 is an example of the sort of information one might get if all is not well. As was mentioned earlier, the computer within the controller has the facility to monitor past events and to flag errors — be they permanent or intermittent.

The computer could deduce that, as an example, the fuel consumption is too high. This would be based on past histories and the data implanted in its memory when new. It might suspect that the oxygen exhaust sensor was faulty, given how hard it is working in order to keep the air/fuel ratio at the correct point.

Unfortunately the computer has no way of knowing whether the air intake duct is blocked, for example, which can result in it making a wrong diagnosis. One mechanic out west found a complete shirt sleeve in the intake of a farmer's car, which was brought in for just such a problem. Fortunately there was no evidence of there being an arm in it. (Oh well — computers are only human!)

The next step is to insert what is known as a 'breakout box' (Fig.3), in between the controller and the wiring harness. This breakout box enables the serviceman to simulate all the sensor signals such as the distributor signal, engine temperature, etc., and test the outputs. This simulation is usually done in conjunction with the engine running, and is designed to give the serviceman more details about the operational state of the vehicle.

The usefulness of these tools is of course dependant on their complexity, cost and ease of use. The diagnostic tool can be the greatest thing for servicing since sliced bread, but if you need an electronics engineering degree to operate it then there will not be much chance of it being used.

At one extreme there could be a diagnostic tool capable of simulating all the sensor inputs and monitoring the outputs, without the engine running. If this proved satisfactory then the serviceman could deduce that the controller and its interconnections were OK. Next the engine is started and extremes of operating environment are simulated and the effects tested.

At the other end of the range there are devices that are little more than convenient methods for checking voltage, current and resistance readings with a multimeter. These breakout boxes are usually part of a suite of diagnostic equipment, designed to be compatible with the complete offerings of a particular auto manufacturer. As a result they often can't be used for other vehicles.

Because these devices are manufactured by the same people who make the vehicle, or their agents, they are usually conservative and will not allow you to obtain intimate vehicle specifications — such as the controller's program listing or details about vehicle performance. Generally they will also not allow you to modify the ROM in order to increase vehicle performance, so all of you 'petrol heads' out there hoping to soup up your vehicle will have to travel a different path.

What this leads to is immense difficulty in obtaining anything else than a rather superficial understanding of the workings of the vehicle. If the serviceman is working for a specialist repair organization whose money is made by only repairing vehicles, then high grade, very versatile equipment is needed. This would probably involve desktop computers, logic analysers, CRO's etc., and be accompanied by a great deal of operator training.

The serviceman who has no understanding of the system and is being pressured to get the vehicle out will, out of necessity, replace the device that the diagnostic equipment has lead him to believe is at fault. Some 'native cunning' helps some service personnel to arrive at a correct diagnosis, as well as having seen the problem before.

The difficulty here is that there is such a plethora of new vehicles hitting the market, accompanied by some general common failures starting to occur later in the life of various models, that fewer faults are being found in this manner than one might suppose.

As well, the auto electronics is as reli-

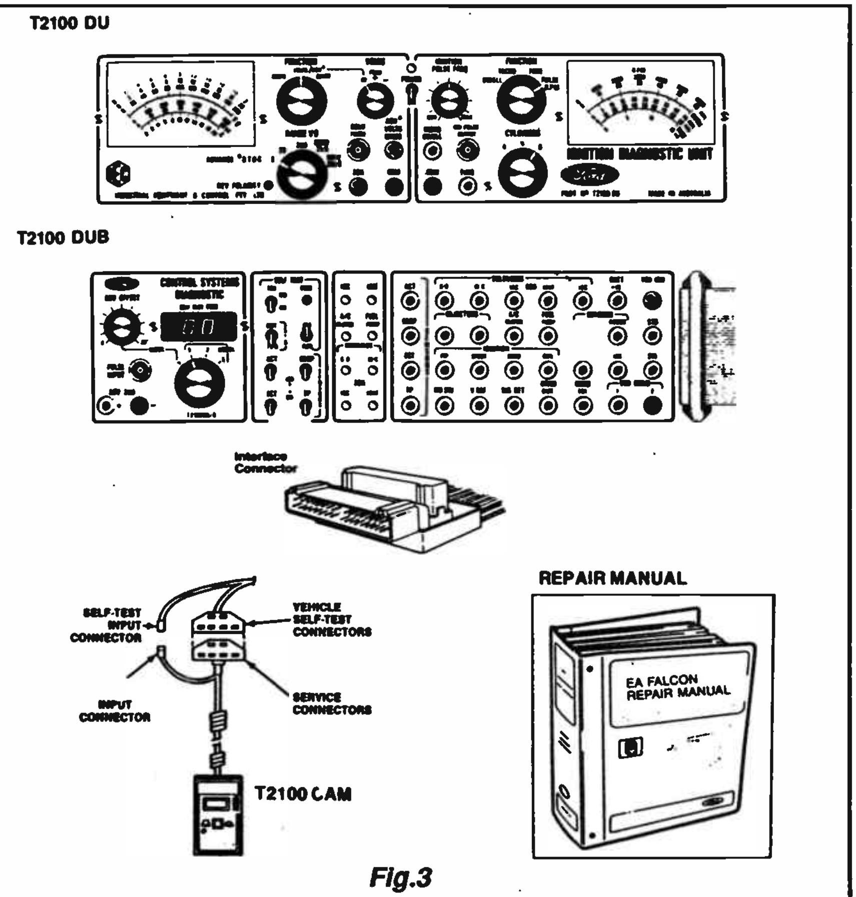

Fig.3

able as other sections of the industry and the failure rate in the pure electronics is usually rare. Rare to the extent that the auto serviceman is not getting sufficient practice at genuine fault finding, as against component replacement.

Repair vs replacement

Once a black box has been deemed to be faulty, usually by temporary substitution with a good one, then the auto manufacturers will often specify renewal with a new one. They claim that the faulty one can't be repaired, at least to their high standards — but if their standards are so high, why did the computer fail in the first place?

They maintain that if the box is repaired it needs to go back through the arduous heat/cold/vibration/-humidity/high/low voltage and random-clock-speed tests again, in order to regain its dependability rating.

One man who thinks this is not so is Tim Sheather of Automotive Electronics in Epping, Victoria. In spite of monumental difficulties his firm repairs these modules, and he claims to a higher standard — because they upgrade commonly failing components. I say monumental difficulties, because they get no help whatsoever from the auto manufacturers. No drawings for the controllers, no decoding of funny inhouse numbers on the components, etc.

The Automotive Electronics strategy is to take an electronic control unit (ECU) that they have had no experience with, and build a simulator to test it out — something like the breakout boxes that I described earlier. The lid is removed from the unit and some good old-fashioned detective work is used to form a sort of database about it. There is apparently an organization that will cross-match the funny type number components if it is possible, or similar devices will be installed even if it means some PCB alteration to make it work.

Tim Sheather suggests that many of the failing components could be bought at a Tandy or a Dick Smith store. But of course some of the components are especially made for the controller.

The actual microcontroller or signal data processor chip can be a bit harder to come by — often being made especially for this task by Intersil, Hitachi, Toshiba *et al* — but Automotive Electronics either rat one from another unit or purchase the original component from the supplier, usually at great expense if they are even available.

Repairing these devices is not cheap, but then considering the amount of research work that goes into the database and the cost of an original manufacturer's replacement, not that expensive. Indeed some of their clients have come to them after receiving a whopping quote for repairs, from the dealer who sold them the vehicle in the first place.

There have been units sent to AE for repair that have not been faulty at all. Tim says that this is probably brought about because the fault is somewhere else in the system and is likely to be intermittent. If you guys in the general electronics industry thought you had seen some hairy intermittent faults, try having a go at fault finding an electronic system on a motor car!

Tim Sheather feels that a lot of the problems are in the wiring harness — particularly around the connectors. Apparently few of these connections are soldered, but use instead a unique cable connection system.

Again with no disrespect to the auto servicing industry, if one has spent a lifetime using reasonably heavy physical work practices to perform one's job functions, it is a bit hard to accommodate the more gentler and precise practices needed when dealing with electronic components. You can imagine the problems this can lead to when a vehicle has undergone crash repairs — particularly when someone has casually sliced through a wiring loom with an oxy torch.

This leads me to the introduction to the next and last in the series of these articles. If you have ever crawled in under the dashboard of your car and been amazed at the wiring in there, you may be wondering what will happen when all the new and prophesied 'electronic wonders' are eventually installed.

In Europe there is a project called PROMETHEUS (Program for European Traffic with the Highest Efficiency and Unprecedented Safety) under way. This is to establish a system that will enable vehicles to 'talk' to each other and various traffic control systems, in order to increase vehicle and occupant safety. Just image the wiring loom when this arrives!

Will it be so large that there will be little room for anything else, including driver and passengers? Will the aforementioned problems with wiring looms mean the vehicle will be so unreliable as to be unusable?

Fear not, good readers, because help for the auto industry is at hand. In the next article I will be having something to say about multiplexing, where the wiring loom is replaced with a single command/data line and a power bus that has the potential to render these problems a thing of the past.

(To be continued) ❖

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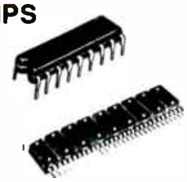

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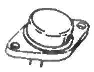

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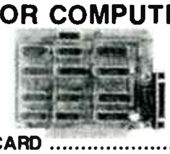

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FORUM

Conducted by Jim Rowe

Toroidal transformers ARE just as safe as the E-I type — or are they?

No sooner had the February issue been published, than I started to get phone calls and faxes from manufacturers and suppliers of toroidal power transformers — responding to the critical comments made in that month's Forum by S. Calder, of Hycal Electronics. One representative came close to demanding that we publish material from himself in the next available issue, to correct what he claimed were 'serious and misleading inaccuracies'. But there were also a few calls from manufacturers of the other types of transformer, at least partly *in support* of what Mr Calder had written...

Mr Calder's letter with its criticisms of toroidal power transformers certainly produced a response, suggesting that if nothing else he may have touched on something of a 'sensitive spot' as far as toroidal transformer makers are concerned. And not just in Australia, but overseas as well.

Not that a response from the people concerned isn't welcome, of course. In fact I actually invited this myself, in the February column, with this comment:

But perhaps there's more safety built into a modern toroidal transformer than we think, and if this is so I hope one of their designers or manufacturers will let us know and set the record straight.

I guess after giving them an invitation like that, I shouldn't be surprised that they responded. Perhaps it would have been more surprising if they hadn't, because their silence would almost have been an admission that their products were less safe than other types of transformer...

Be that as it may, let's give the toroidal people the opportunity to present their side of the case without further ado.

The first comments to arrive came in the form of a fax from Mr Michael Larkin, a director of Sydney-based toroidal transformer maker Tortech Pty Ltd. Here's what Mr Larkin had to say:

With regard to the comments by S. Calder, we would like to explain the design and safety aspects of the toroidal transformer, to counter the criticisms expressed.

Transformers designed to AS3108-1990 must pass a stringent set of constructional and electrical tests. This standard is the same standard that E-core transformers should be tested to.

The insulation between the primary winding and the secondary winding for the toroidal transformer consists of a minimum of three (3) lapped layers of insulation, with a minimum thickness of 0.3mm. This insulation must be capable of withstanding 3.5kV AC for a period of one (1) minute. The insulation is normally a polyester tape. The continuous temperature rating of this material is 130°C, with a melting point of 250°C. The final insulation is one layer of this same lapped polyester. This provides very safe protection of the secondary winding and is capable of withstanding greater than 1kV testing levels. (Note: the primary winding is on the inside, with the low voltage secondary winding on the outside.)

We have found this polyester tape to be highly successful in preventing contact between the primary and secondary windings, when applied correctly.

Tortech Pty Ltd's transformers use winding wire with an enamel insulation which has a temperature rating of 180°C continuous. This is a double coat enamel, to ensure that the turn-to-turn insulation is maintained. Prior to winding every roll of wire is quality tested for size and high volt testing of the wire's enamel.

Special techniques...

Tortech transformers incorporate special winding techniques in the primary windings to minimise the voltages between layers, such that the voltages from layer to layer are no higher than the turn to turn voltages.

Short circuit or overload failure is a function of the overload protection provided in the circuit for the transformer. This is a relevant comment to all transformers, so to say toroidal transformers are more susceptible to an overload heating situation is a misconception.

Winding compression with Tortech's toroidal transformers is controlled by tightening the mounting kit to the published recommended pressures, which are supplied to our customers. The neoprene padding material, which is sandwiched between the mounting plate and the transformer as well as between the transformer and the base, has a continuous rating of greater than 100°C and is made of a flame retardant material. This material is capable of withstanding 5kV AC testing voltages.

Other advantages

What has been explained in this article is the design safety aspects of the currently designed Tortech toroidal transformer. The advantage of the toroidal construction is that it can give much better magnetic coupling between primary and secondary windings. This cannot be achieved with a centre-divided bobbin contruction as discussed in Calder's article. This is particularly relevant to transformers used in amplifiers.

When the toroidal transformer overheats, the insulation between the primary and secondary windings must melt and the wire enamel must melt to allow the primary to come into contact with the secondary. If the correct insulation materials are used and the correct insulation thickness and winding techniques are applied, then the danger of this happening is minimised.

Also, it may be pointed out that the overload protection design is paramount to eliminating the overloading of any

transformer. When an E-core transformer is overloaded the centre divided bobbin can melt, just as the polyester tape might melt in the toroidal transformer.

In summing up, toroidal transformers are very safe and if designed and used correctly, they provide a better alternative to conventional transformers by offering a lower size, lower magnetising current and lower impedeance between primary and secondary windings.

Tortech design and stock a range of toroidal transformers which have been fully tested by a N.A.T.A. laboratory to AS 3108-1990 specifications. They are also fully approved by the NSW Office of Energy.

Thank you for those comments, Mr Larkin. It was interesting to learn the materials that are used, and the precautions taken to ensure that your toroidal transformers do provide a high level of safety. I confess I'm intrigued by that reference to special winding techniques for the primary windings, though — how you're able to keep the layer-to-layer voltages down to the same value as that between turns, I can't imagine. It sound like a pretty neat trick.

I was particularly interested to read Mr Larkin's comments about the overload failure performance of toroidal transformers, because this was of course the specific aspect referred to by Mr Calder. Perhaps I'm wrong, but it seems to me that the points Mr Larkin makes in reply amount to these:

1. Overload protection is ultimately provided by the external circuit, for both kinds of transformers. It's provided by things like fuses, circuit breakers or thermal cut-outs.

2. Yes, the layers of tape separating the primary and secondary of a toroidal transformer can melt under overload conditions, but so too can the bobbin and its centre divider, in a conventional E-I cored transformer.

3. In any case, toroidal transformers must pass exactly the same safety tests as the E-I type, in order to meet the requirements of AS 3108-1990.

Different categories

All of which seem fair enough, at least at first sight. The only complication is that as far as I can see, from a reasonably thorough attempt to understand the specification for AS 3108, the standard actually provides *a number of categories* regarding 'short-circuit and overload protection' — not just one.

I find the specification remarkably confusing, both in this area and others, and from the comments I've heard around the industry, I gather I'm not alone (more about that later). But it seems that AS 3108 provides for at least two main kinds of transformer: those that are 'inherently short-circuit protected' and/or 'fail-safe', and those that are not. The latter kind are those that rely upon protection by the external circuit — in the form of fuses, thermal cut-outs and circuit breakers — while the former do not rely on any such protective devices.

From Mr Larkin's fax, with its reference to overload protection provided by the external circuit, it seems as if he was considering only transformers which meet the AS 3108 requirements for 'non fail-safe' or 'not inherently short-circuit protected' units. And presumably toroidal transformers are just as capable of meeting the requirements for this category of device as E-I transformers, providing they use the right materials and the right design methods and manufacturing techniques.

But I gather that with the core bobbin materials which have been available for the last few years, it has become possible to produce E-I type transformers which meet the more stringent requirements for classification as a 'fail-safe' or 'inherently short-circuit protected' device. In other words, to produce a transformer that doesn't rely upon *any* overload protection from the external circuitry, but meets the AS 3108 specifications for failing in an inherently safe manner.

I gather that quite a few of the 'safety isolating transformers' currently manufactured both in Australia and overseas meet this rather stiffer requirement. But I also gather that virtually all of these transformers are of the conventional E-I cored type, generally with the 'divided bobbin' construction.

Could toroidal transformers meet the AS 3108 requirements for classification as a 'fail-safe' or 'inherently short-circuit protected' transformer? It would probably not be impossible, although the comments I've received from people with lots of experience in transformer design have generally been along the lines "This would be extremely hard for anyone to achieve".

Other comments

More about this later. For the moment, let's move on to consider the comments from other defenders of toroidal transformers. The other main response in this regard was a 'double header' fax, which effectively came both from a local firm and their overseas principals. The local firm in question is Harbuch Electronics, of Hornsby in NSW, and the fax was sent by Harbuch's Mr Peter Buchtmann. Here's what he had to say:

The response among reputable transformer manufacturers to the comments made by Mr Calder in your February '92 issue concerning the safety of toroidal power transformers has been swift and predictable. Please find attached a letter faxed to us to pass on to you, from Terry Monaghan, Design Engineer with our principals Antrim Transformers Ltd of the UK.

Michael Faraday got it right, when he made the first transformer. However it took quite a while before the correct wire, steel, insulation and machinery made it possible for the rest of us to make a safe, efficient power toroid economically.

Unfortunately, there are still some in the industry who still haven't got it right, and these people and their products have resulted in a few unfortunate instances such as those experienced by Mr Calder.

As the whole subject of toroidal transformers, including the production process and safety aspects, seems to be misunderstood even by professionals in the industry, I would welcome the opportunity to assist your editorial staff in any way I can, in the production of a future article on this subject.

Thanks for those comments, Mr Buchtmann. I liked your reminder about Michael Faraday having used the toroidal construction when he made the first transformer, too.

As you can see, Mr Buchtmann's note also acts as an introduction to the second part of his fax, which relays that from Mr Terry Monaghan the designer at Antrim Transformers. And here's what Mr Monaghan has to say:

Regarding Mr S. Calder's comments on the safety aspect of using toroidal power transformers in kits, we have the following comments.

It is unfortunate that some constructors of electronic equipment have a tendency to have cheapness, rather than safety as their main criterion for choosing a particular power transformer. Like Mr Calder, we too have seen a fair share of badly constructed power transformers over the years (E & I types included).

At Antrim Transformers even our bulk standard toroids are double insulated; some are even triple insulated. At the crossover point, where the primary windings pass through the secondary, not only are the leads double insulated, but a high creepage distance is maintained between the windings.

There are several options available to further improve the safety aspect of the transformers if deemed necessary. These include:

1. Triple insulation between primary and secondary, to comply with AS 3108 requirements.

2. Thermal cutouts or thermal fuses to limit temperature rise under fault conditions.

3. Copper foil earth safety screens between the primary and secondary windings.

Regarding mounting: a large dished steel washer is used to spread the pressure on the windings, plus neoprene washers and polymeric insulation are used to absorb any stress that could damage the windings. We use grade 2 winding wire, which is extremely robust under adverse conditions.

Again, alternative mounting arrangements are available — e.g., potted inserts in the centre or totally potted construction. It must be said, however, that thus far we have not seen any evidence of transformers damaged due to the mounting arrangements!

Thanks for your comments and information too, Mr Monaghan. I didn't realise that it was possible to provide triple insulation between primary and secondary, and also to maintain adequate 'creepage' distances between them. But then, I guess it must be possible to do this, if the transformers are able to meet a fairly tight safety spec such as that to AS 3108.

Another point I note from Mr Monaghan's fax is that it's apparently also possible nowadays to provide a copper foil earthed safety screen between primary and secondary. This is also good news, not just from a safety point of view, but because such a foil screen would obviously be able to act as an electrostatic shield, and reduce RFI/EMI transfer. Traditionally the difficulty in providing such a shield was seen as a functional shortcoming of toroidal power transformers.

Helpful article

By the way, Mr Buchtmann also very kindly sent me a copy of an article written by Mr Monaghan in the well-known English magazine *Electronics & Wireless World*, describing the evolution of modern toroidal transformers and their advantages over conventional E-I types. This I found very interesting and informative. For example it explains why toroidal transformers are more efficient, with lower iron and copper losses, and why they have a lower stray field. It also explains why they can be made smaller than the E-I type, for a given power level.

Mr Monaghan is certainly very able in explaining the many advantages of the toroidal approach. He leaves little if any doubt that when well designed and made, this type of transformer is to be preferred in quite a few applications.

But has he shown that they are just as *safe* as the E-I type? I notice that in his fax he talks about double and triple insulation between primary and secondary — presumably using the same polyester films discussed by Mr Larkin, and with much the same techniques of overlapping, etc. Obviously such materials and techniques allow Antrim transformers to meet the basic specs for a standard like AS 3108, in much the same way as this is done by Tortech's transformers.

But like Mr Larkin, Mr Monaghan also brings in the need for devices such as 'thermal cutouts or thermal fuses to limit temperature rise under fault conditions'. Again there is no suggestion that Antrim's transformers are able to qualify in the 'fail-safe' or 'inherently short-circuit protected' category.

So while noting the many points that Mr Larkin, Mr Buchtmann and Mr Monaghan have made, I think we can probably conclude that currently it *isn't* feasible to produce toroidal power transformers that are 'fail-safe', or 'inherently short-circuit protected', as defined in a standard like AS 3108. At least not on a commercial basis, I suspect.

But does this mean that Mr Calder was right, when he wrote that toroidal power transformers are 'fairly dangerous', and have 'basically no protection against failure'? And does it also mean that a piece of equipment which uses a toroidal power transformer is intrinsically 'unsafe'?

Sorry folks, I don't think so. It isn't a simple black-and-white situation; like so many things in the real world, it's one where there are shades of grey.

For a start, the simple fact that one kind of transformer may not be easily made *inherently* fail-safe doesn't mean that it can't be *rendered* completely safe (from a practical point of view) when fitted into a piece of equipment — by the provision of suitable auxiliary components such as thermal fuses or cutouts. Transformers usually operate as part of a system, and it's a bit unrealistic to act as if they are operated in stark isolation, away from any support devices.

The mere fact that a standard like AS 3108 (and no doubt there's a similar IEC standard) provides for the safety certification of *both* 'inherently fail-safe' and 'non inherently fail-safe' transformers shows that the experts who formulate such standards recognise that in principle both kinds of device can be used to achieve whatever levels of safety are deemed necessary.

So that providing a toroidal power transformer is properly designed and made, using the right materials, in accordance with a standard such as AS 3108, and then provided with the correct components to ensure that its temperature rise will be limited in the event of an overload situation, I think the manufacturers have every right to claim that it will be just as safe in operation as a conventional E-I cored type.

Note, though, that because toroidal transformers seem to be essentially 'non inherently fail-safe', their ability to provide full electrical safety in the event of an overload can only be maintained if they *are* provided with the appropriate protection components — such as a thermal fuse or cutout. But this requirement is exactly the same as with an E-I cored transformer of the same 'non inherently fail-safe' variety. In both cases the transformer may well become UNSAFE if it is asked to withstand a serious overload, but has not been provided with the right protection component(s).

Which, I suppose, could bring us back to Mr Calder's original argument, at least in slightly re-worded form. Perhaps you can argue that toroidal transformers are *less* suitable as components for use in kits and hobby projects, on the basis that their safety level is more dependent upon things like the correct fitting of thermal protection devices, applying the correct amount of mounting tension, etc.

There may well be some validity in this argument, I suspect. If a kit or project builder doesn't fit the correct thermal fuse or cutout correctly, and/or overtightens the mounting bolt/nuts for a toroidal power transformer, it could conceivably become unsafe and dangerous in the event of a serious overload. But you could argue that a 'non inherently fail-safe' E-I transformer could almost as easily become dangerous, in the same kind of situation.

I guess the conclusion which we can draw here is that ideally the best kind of power transformer to use in kits and hobby projects is the 'fail-safe' or 'inherently short-circuit protected' kind. After all, it's only this kind that are specified as remaining safe even when they fail in an overload situation — and without relying on 'external help'. For this reason alone, then, Mr Calder is perhaps justified in believing that power toroidals are not the preferred type for use in kits and hobby projects.

Different complaint

Moving right along, one of the other people who contacted me soon after the February issue was published was Mr Doug Evans, of Sydney-based transformer manufacturer Telectran. Doug has been in the transformer business for many years, and used to visit the *EA* office regularly in the past when he was with Ferguson Transformers.

Doug wasn't one of the people who rang up to complain about our criticism of toroidals. However he did want to chide me about something else that I had written in the same column, about E-I transformer construction. This was my reference to:

...the modern approach of two separate high-temperature rating bobbins side by side, with a 'washer' of fire-proof insulation between them.

Doug's reaction to this was to ask "How long is it since you saw how these transformers are made? That technique went out with the Ark!"

He explained that nowadays, thanks to the development of even better materials for E-I bobbins, it is possible to achieve all of the requirements for classification under the AS 3108-1990 'inherently fail-safe' specification, using a one-piece moulded bobbin which uses a central divider to separate primary and secondary windings. By using bobbin material with a very high melting and ignition temperature, combined with similarly rated covering tapes, etc., the transformer is made so that even if it is destroyed due to massive overload, there is still no risk of a conductive path forming between primary and secondary.

At Doug's invitation, I went out to Teletran's factory in the northern Sydney suburb of Terrey Hills, and spent an interesting morning seeing this type of transformer being made.

By the way, Doug Evans also pointed out that it isn't strictly correct to describe a power transformer itself as being *approved* by the various state safety authorities, even though it may be manufactured in accordance with the relevant sections of AS 3108, etc., and passed the appropriate tests. As a transformer is essentially a component, for building into a piece of equipment, it would be inappropriate for a safety authority to issue it with a full 'Certificate of Approval'.

It's really only a complete appliance or other piece of equipment that can be approved, so that true safety approval can only be given to a transformer that is fully enclosed, and sold as a finished appliance in its own right.

But all that manufacturers can do, in the case of a transformer that is to be sold as a component, is have it certified by the safety authorities as *suitable for use* in appliances — on the basis of it's having been made in accordance with the relevant sections of AS 3108. This is generally known as a 'Certificate of Suitability'.

So a 'component transformer' cannot correctly be described or advertised as 'approved' by the safety authorities, only as being 'certified as suitable' in accordance with AS 3108. It's a point worth remembering.

That standard

And finally, a further comment about Australian Standard AS 3108-1990, the one that we've been trying to use as a reference in considering transformer safety. As I said before, I found it quite difficult to follow, and I gather I'm by no means alone.

Talking with various people in the industry — even those who are regularly involved in getting both component transformers and/or appliances tested and certified — there seems to be generally agreement that various aspects of the standard are either confusing and/or hard to follow.

I don't know whether this is due to standards like AS 3108 having been developed by a committee of experts, or from a perceived need to 'cross every T and dot every I' from a legal point of view, or what. But the result seems to be that this kind of standard seems to end up like the worst kind of abstruse legal document — almost undecipherable by anyone except those who wrote it.

To me it's particularly unfortunate that a standard dealing with the electrical safety of transformers, with so wide an application, should be so difficult to understand and interpret. Surely this sort of standard should be so clear and unambiguous that almost *anyone* can follow it, if the full potential benefit of the standard is to be achieved. Don't you agree?

Perhaps Standards Australia needs to get in a few people to make 'plain English' translations of standards like AS 3108, in the same way that various insurance companies produced translations of their policy documents... ❖

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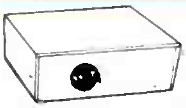

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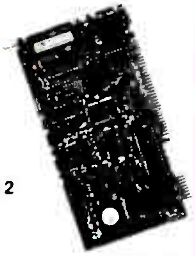

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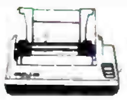

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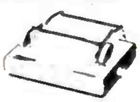

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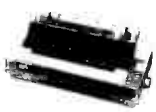

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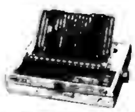

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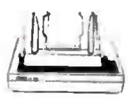

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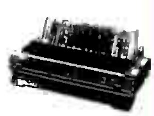

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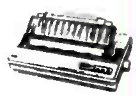

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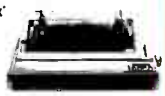

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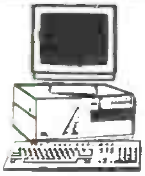

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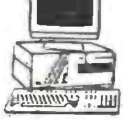

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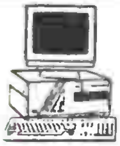

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57Mhz LANDMARK SPEED TEST
85 MEG HARD DISK
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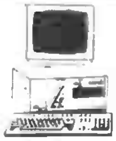

80386-40 CPU 64K CACHE ON BOARD MEMORY
1 MEG RAM EXP TO 16 MEG
65 Mhz LANDMARK SPEED TEST
126 MEG HARD DISK 12ms ACCESS TIME
1.2M JAPANESE BRAND F.D.D
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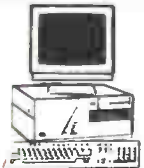

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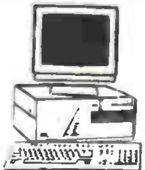

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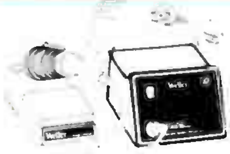

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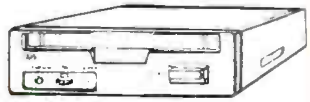

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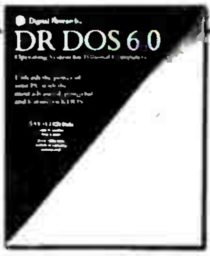

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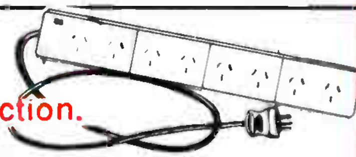

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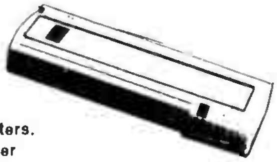

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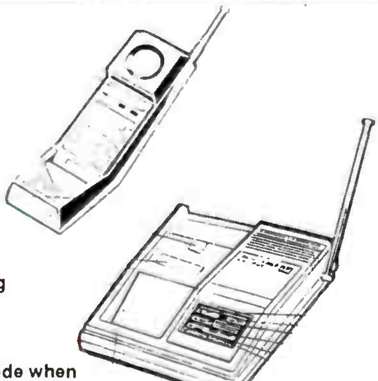

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World Radio History

THE SERVICEMAN

VCR's that still need 50Hz, and the TV that kept on blowing fuses

This month is going to be 'Contributor's Month', mainly because very little has happened in my workshop over recent weeks. One story concerns faultfinding in a not-too-common amplifier, and another a colour TV that kept on blowing fuses — but could easily have killed someone.

I must admit, it's very satisfying to have a run of straightforward jobs that pay well, without any of the hassles that so often provide material for these pages.

But without hassles there is nothing to write about in this column, which means I am grateful to our readers for their stories. So, on with the letters...

Our first contributor refers back to a story about an AWA video recorder with a faulty timer. It was told on these pages in the November issue.

If you remember, the clock could be set but would not advance the time, and the timer record function seemed to be permanently ON. I modified the board to get the machine going, and later replaced the whole board. But I never did find out what the real problem was.

Well, reader K.W. of Lane Cove has written in with what he felt may have been the answer.

I can probably help you with your problems with the Mitsubishi VCR's clock/timer microprocessor (EA November '91). In many of these circuits, even when the microprocessor uses a crystal oscillator for its internal clock functions, it still uses the mains 50Hz for the clock reference.

This is not as silly as it seems, because the electrical authorities guarantee that, barring power failures, there will always be an exact number of mains cycles in a year. So theoretically, a mains-synced digital clock should always show the correct time, year in and year out.

If you look at the Mitsubishi circuit, you will see that pins 1 and 25 of the fluorescent display, (marked 'F' for filament) connect to a 3.1V AC source. The display is actually made up of a collection of triode valves, with fluorescent anodes!

You will note that the transistor Q8A0 is also driven from this source via R8A3, providing a 50Hz clock drive signal to pin 5 of IC8A0. If this was somehow being lost, it would produce the symptoms you have described.

How do I know all this? Well, I work for a large company that rents film equipment (16mm and 35mm cameras, lights, etc.) to movie makers, as well as making custom electronic equipment for use as props.

One of the tasks I was given was modifying a Hitachi M728 mains VCR to operate from a 12V battery (the industry standard in the film world).

This turned out to be something of an engineering nightmare, requiring all sorts of weird and wonderful power supply rails, as well as the 3V AC for the display filament. I eventually managed to build a switch-mode power supply that could do all this, without excessive power consumption.

The real nightmare was in the clock circuit! This proved to be most extraordinary. The clock reference IS derived from the microprocessor crystal, but it still insists on the presence of the 50Hz signal to make it activate the display. Without the 50Hz it thinks there's a power failure and apparently goes into a low current standby mode, running off a 47,000uF 'supercap'. This only lasts about a minute, so I had to add two alkaline cells to the system so that the users wouldn't have to keep resetting the clock.

It was easy enough to build a 50Hz multivibrator to fool the micro into thinking that the mains was present. But I assumed that it would have to be a precise 50Hz and I wasted a lot of time mucking about with crystal references and so on. Imagine my surprise when I found that a one minute display increment still took precisely one minute, even with a 30Hz input!

Nonetheless, I got it all working sucessfully. The only trouble was, the production company that wanted it decided not to use it after all — so it's still sitting on my bench!

Thanks for your letter, K.W. It explains quite a few points about the clock and timer on the old AWA machines. Unfortunately, it explains nothing about the problem that faced me.

On reading back over my original story, I realise that I had omitted the part about the 50Hz pulse. At the time I was puzzled about that pulse, because the microprocessor obviously had a crystal oscillator — which logically would be used to drive the clock. I didn't appreciate that the pulse could be used to confirm the presence of AC mains power.

Yes, K.W., I had checked the pulse and found it all present and correct. That wasn't the reason for the failure.

So the great AWA VCR mystery is a mystery still. The faulty board is on the shelf, just waiting to be repaired if ever the solution to the problem can be found.

A barter deal?

Now on to our second contributor. He is N.W., of Sydney. N.W. is not new to these pages, having appeared recently as a teacher of electronic servicing to a colleague with a CB power supply problem.

Once again N.W. is working for no (cash) pay. Instead, he's become one of the growing number of people who trade goods for services, without the need for cash money. Indeed, with the economic situation as it is, all of us have to indulge occasionally in, as N.W. puts it, 'a barter deal':

A Local Backyard Printer is a handy person to know when one, needs a small printing job done. Recently, when I approached my own LBP about running off a few leaflets, he said: "What say we do a barter deal on these?"

"How do you mean?" I asked.

"Well, I'll do this job in my spare time, on left-over paper, if you'll take a look at that old amplifier in your spare time and see if it can be fixed. If it can, fine! If it can't, I'll shove it in the bin."

He explained that he'd been using it with a small tape player to provide music while he worked. But lately, it had developed noise and hum problems.

I leaned over to have a look, half expecting to find an old valve job, but under the dust was a 'PHODIS Silicon Solid State' system, with a BSR 3-speed record changer on top and provision for auxiliary and tape inputs. It also had volume, bass, treble and balance knobs, and filter switches for loudness and noise.

"Okay," I said, "but no promises. If it's something simple, we've got a deal. If it looks like a heap of trouble, I reserve the right to change my mind". On that basis, I took it back to the shop to await the hypothetical spare time.

When I finally did couple the amp to the test loudspeakers, I was greeted by a faint hum plus the odd scratching noise that one almost expects from a neglected amplifier. I was still wondering why it would be such a hassle in a workshop situation, when the hum suddenly became very audible indeed — only to disappear again within about 10 seconds.

Mutterings of disgust! Faults are one thing; intermittents are quite another!

Gaining access to the PHODIS wasn't exactly a cinch. The works were mounted in a rigid wooden case, and held partially captive by internal leads. I certainly didn't want to have to dismantle it and have a spare-time job spread all over the bench. Fortunately, however, I managed to slide the amplifier forward just enough to have a poke around.

That someone else had been there before me was evident, from replacement resistors feeding the tone and balance controls, and a substitute main filter capacitor wired clumsily into circuit with scraps of lamp flex.

It was also apparent that the plug-in pickup leads were not making proper contact. And while the PU didn't appear to have been used in recent times, faulty input connections could well be contributing to stray hum and noise problems.

The plugs turned out to be real 'lazyman' devices. The hot lead had been soldered into the central pin in the normal way, but the earth braid had just been wrapped around a groove in the outer shell, to be held in place by the push-on moulded shroud. Inevitably, in withdrawing the plugs to slide the amplifier forward, the shrouds and earth braids had long since been dislodged, leaving only the active pickup leads connected. This time around I soldered the earth returns.

Rather than trust the old pickup as a source of signal, I fed the audio generator into the mono AUX socket at the back. But I wasn't very impressed by what I heard: poor channel balance, noisy controls, sundry background scratchings and intermittent loud bursts of hum. I had the horrible feeling that I'd inherited a no-win job!

Poking around, however, I noticed that the bursts of hum appeared to be sensitive to movement in the lamp-flex leads to the replacement filter capacitor. At least I could check that out. Inspection showed that where they joined the rectifier, a loose strand from the DC-minus lug appeared to be resting on the chassis. It may not have mattered, because it was probably at earth potential anyway — but in an audio amplifier, earth connections should be deliberate, not accidental. That was easily fixed.

Next, I loosened the metal clip and slipped the capacitor out, intending both to verify the value and wiggle the individual lugs. Ah yes, 5000uF — and wiggling the lugs provoked no protest from the loudspeakers. While I had it in my hand, I reached for the multimeter to check for any voltage on the metal case. And yes, it was at virtually the same 24V as the DC supply line — an apparent leakage path from the internal foil.

Maybe it was an original fault; on the other hand, maybe my predecessor had been a bit too willing in tightening the mounting clip. But that was not all. Part of the clip, I noticed, was touching the earthy copper pattern on the amplifier board alongside — another accidental earth path.

But this time, it was one that might involve steady (or intermittent) leakage current from the main filter capacitor.

It looked like a pretty good score: three possible boo-boo's in replacing one capacitor! I would have replaced the capacitor myself at that juncture, except that I didn't have a suitable one on hand at that time. So I wrapped it in adhesive tape, re- soldered the connections for good measure and slipped it back into the clip, at the same time bending the clip clear of the board pattern.

When I switched the amplifier back on again, it was agreeably quiet. And that's the way it remained, while I checked for any other obvious faults and quietened the controls with a few squirts of CRC 2-26. The apparently poor channel balance, by the way, was due to someone having replaced the original A-taper balance pot with a C-taper, shifting the balance setting way off centre — in itself no great hassle.

When the owner called to drop in the leaflets and pick up the system, I suggested that the old PHODIS would be a good subject for restoration by a hobbyist, but probably not by a serviceman on a per-hour basis.

In the meantime, what I had done might give it a new lease of life. The suspect capacitor might last for years, or it might start acting up tomorrow. Just in case, I handed him a spare, which I'd come across. As a handyman, he's quite capable of installing it himself — although so far, he hasn't had to.

Thanks, N.W. It's interesting to read about repairs to unusual, or uncommon, equipment such as the PHODIS amp. Still, I'm glad it was you that came across the unusual brand. Odd names like that worry the life out of me — where will I get a manual? Where will I get parts?

Actually that particular brand sounds more like it should come in a packet from the chemist's!

Of course as N.W. shows, there is often no reason to panic. The faults are mostly straightforward, obvious, and easy enough to solve without a service manual.

Blow that fuse!

Our next contributor is a newcomer to these pages. He is J.N., of Gayndah NSW, and he tells a story of frustration and comedy that could well have ended in tragedy:

I have always been interested in electronics, and when I moved to this town I started to fix the odd appliance for acquaintances. This led to four years of part-time repair work, until it got too big for me to handle as a hobby, so I started a full-time business from my home.

> ### Fault of the Month
>
> **Sharp DV-4884 colour TV**
>
> **SYMPTOM:** No go. The set is completely inoperative and the Standby pilot lamp is not alight. The fuses are OK and there is no fault with the power cord or mains switch.
>
> **CURE:** The primary winding of T2001 is open circuit. This small mains transformer supplies power to keep the remote control receiver 'awake'. As it is energised continuously, it can suffer premature burnout.
>
> *This information is supplied by courtesy of the Tasmanian Branch of The Electronics Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.*

This only lasted for a year before it grew so big that it was either get out of the house and into a shop, or face a divorce. So I have been running a successful shop for nearly a year, with sales as well as service.

Now to my story, which concerns a Sharp model CX2032 colour TV. The set was quite dead when it came into the shop. However, all I could find wrong with it was a blown mains fuse, and replacing this restored the set to full working order.

The set was returned to the owners, but it was not long before it was back again, with exactly the same fault. This sequence was repeated quite a few times. Sometimes the fuse would last only a couple of days, yet at other times it would survive for several weeks.

Strangely though, the fuse would only blow in the customer's home. On one occasion I used it at my home as the family set for two months, without any trouble. But it blew the fuse within two days of going back to the owner.. In desperation, to find the short I replaced the two-amp fuse with a 10-amp one, but this only led to a blown up rectifier. The set still blew its mains fuses intermittently.

All of this went on at home, during the eight months before I went into the shop. But it wasn't long after I moved that the set was back again for the same reason.

I replaced the fuse and switched on. Everything seemed to be OK, so I attached the workshop antenna — and the fuse blew. It then dawned on my that it was something to do with the antenna that was causing the fuses to blow. And it turned out to be the antenna socket itself.

At some time in the past, the socket had been replaced with a wrong type. The set is a live chassis type, and must have an isolated socket. The one in this set was an ordinary, straight through type. In detail, it was fitted with a socket number QTANJ0156CEZZ, instead of a QTANJ0118CEZZ.

The socket was directly connected to the earth shield of the lead from the tuner, instead of being decoupled by 2 x 390pF capacitors as in the correct part. Because the set has a live chassis, the tuner is at half mains voltage — and of course with the wrong socket, so too was the antenna system.

At my home the antenna was a simple VHF dipole, so there was no problem (although there would have been if I'd plugged in the antenna while touching something that was effectively earthed!) But at the shop it was quite different. That system used a correctly installed distribution amplifer, which was properly earthed. So it blew the fuse in the problem set. However, this didn't explain why the fuses blew only occasionally at the customer's home. The reason was eventually found, and was most amusing one, in a deadly sort of way!

It seems that their young son had found an old Beta VCR on the tip. Whenever the parents went out, he would connect up the old video and try to run it. How-

ever, the machine was not double insulated, so it would blow the fuse by linking the antenna socket back to the mains earth. Of course it was very difficult for anyone to trace the cause of the trouble, because the son would always deny touching the television. To the parents, it seemed that the set was going one night, and not the next.

The cure was quite easy. I had only to fit a 10nF mains rated capacitor in series with the earth lead between the tuner and the socket. It would seem that there was already such a cap in the active lead.

After I had solved this particular problem, I was reminded of a similar occurrence with a former customer of mine. He had been thrown off his iron roof and badly injured after touching the TV antenna. I could remember his set. It too was a Sharp, although I don't know the model. I now wonder if that set was also fitted with a wrong part, thus making the antenna live. He would have completed a circuit to ground through the roof.

Unfortunately he has moved away now, so I can't check back. Because the set seemed to work normally, both before and after the accident, it was probably attributed to static electricity and not to what may have been the true cause — a wrong antenna socket.

Thanks for that cautionary tale, J.N. I can't recall ever coming across a Sharp with a faulty antenna socket, but after your story I will be doubly careful. I hope you will, too, because dead readers do nothing for the circulation of our magazine.

Part numbers

While on that subject, I feel I must say a word or two about those Sharp part numbers. Look at them again — QTANJ0156CEZZ and QTANJ0118-CEZZ. Both numbers are 13 characters long, but only two of those characters are different. No doubt Sharp has a reason for such unwieldly part numbers — every one of their parts has a similar number — but other manufacturers don't find it necessary to use such a complicated system.

The problem with 13-character part numbers is that you have to read every character carefully and slowly, and compare them equally carefully, to ensure that you are not making a mistake. And often, Sharp parts do not carry the whole letter complement that is given in the manual, leaving one to wonder if the missing letters on the new part are the same as the missing letters on the old.

It's not good enough! And it's one reason why Sharp sets don't enjoy great popularity with busy servicemen.

Faulty computers

And now just a brief note to end this month's column. It's about someone else's problem, although I had more than a bit to do with it because in this case I was the customer.

I recently bought a new Amiga 500 computer, complete with a video titling package comprising a 500K memory upgrade, a genlock, and the necessary software to produce video titles. It all went together easily and I was soon happily editing and titling some home movies.

Then the trouble started. The 'caps lock' LED started flashing and the keyboard refused to accept any more keystrokes. I was able to reboot the system using the mouse, but still the keyboard remained unusable.

Things were back to normal an hour or so later, but the fault returned next day, and again the following day. So I complained to the people who had sold me the machine. To their credit, they were most apologetic and asked me to return the machine for an immediate replacement.

I returned the computer, minus the video pack, the next day and received in its place the first of a batch of 10 latest-model machines the company had just taken into stock. Back home, I reassembled the memory and genlock, then inserted the boot disc and waited. And waited. Nothing happened. The disc drive, a 3.5" minifloppy built in to the computer, refused to do anything. It wouldn't even rotate the disc. So back to the shop it went.

Computer number three was another of the new ones, which had been carefully checked out by their staff when they heard that I was on my way back to the shop.

Number three worked perfectly, with the only problem being an occasional crash which I put down to my unfamiliarity with the operating system and software. I had no doubt that that problem would go away when I had more experience. However, two corrupted discs later I began to wonder if number three really was up to scratch.

Then I noticed what I should have seen earlier. The disc drive LED was not coming on when the drive was active. I had probably corrupted the discs by removing them while the drive was still working.

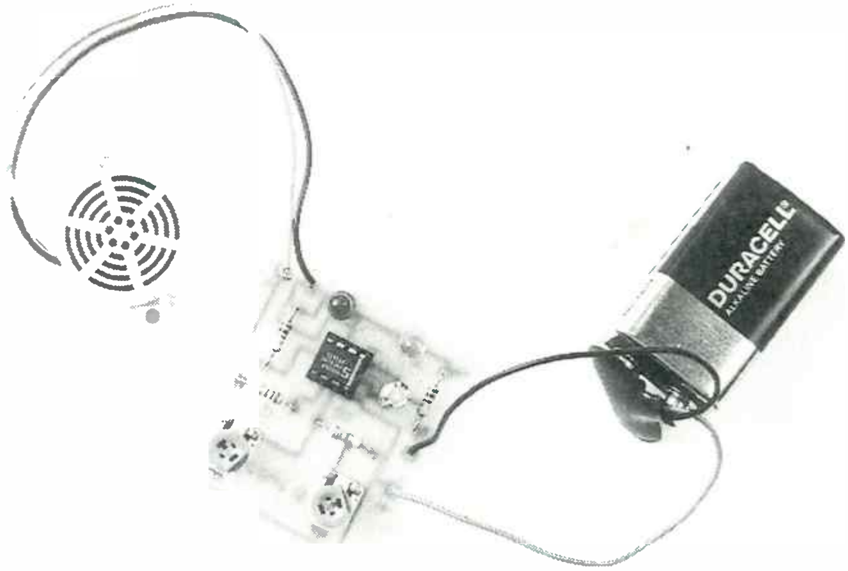
So back went number three, and I found the shop staff tearing their hair

Continued on page 99

Timer Circuits

In this chapter we look at multivibrator circuits and the 555 timer IC. And to put words into action, we've included a small construction project based on the 555.

by PETER PHILLIPS



In Part 14, we looked at the resistor-capacitor combination, and the effect an RC circuit has on an AC signal. Now it's time to examine the role of the RC circuit in timer applications. Generating a time delay is often required in electronics, and delays of anything from a few microseconds to several hours can be achieved with RC circuits, in combination with other components.

While there are many other ways, perhaps the most popular method of producing time delays is with the 555 timer. In fact, the 555 timer is such a useful IC, that we'll devote most of this chapter to it. The simple construction project we've included uses the 555 and you might like to build it to learn how this IC can be used to flash lights and sound a buzzer.

Apart from the 555 timer, there are numerous ways to generate time delays, and we'll start by describing circuits that are called *multivibrators*.

Multivibrators

The term 'multivibrator' applies to a range of switching circuits that have some form of feedback to make the circuit switch from one state to the other. There are three types of multivibrators, and all of these can be constructed using transistors. The simplest is the *bistable* multivibrator, also known as a *flipflop*, shown in Fig.1. This circuit has two stable states and requires a pulse at either one or the other of its inputs to make it change state.

In Fig.1, if we assume that Q1 is on, then because its collector voltage is virtually zero, Q2 will be off. The voltage at the collector of Q2 will therefore be close to the supply voltage, holding Q1 on by supplying it with base current via R5.

If a positive pulse is applied to the SET input, Q2 will be momentarily turned on by the pulse. As a result, its collector voltage will drop, turning off Q1. The rising collector voltage at Q1 will now allow base current for Q2 to flow via R2.

In other words, the whole circuit rapidly changes state and Q1 turns off, causing Q2 to turn on. When the trigger pulse is removed, the circuit will remain in the new state. To make it change state again, a trigger pulse needs to be applied to the RESET input.

The monostable

The monostable multivibrator or *one shot* is shown in Fig.2. This circuit has only one stable state, hence the term *mono*stable. The stable state for Fig.2 is with Q2 on and Q1 off, as Q2 will be biased on by R2. If a negative trigger pulse is applied via C2, Q2 will be turned off and its collector voltage will rise to the supply voltage. This will cause base current for Q1 to flow via R3, turning on Q1.

However, while the transistors are able to switch quickly from one state to the other, the charge that was originally on C1 cannot instantly disappear.

Before the trigger pulse, the voltage across C1 was virtually equal to the supply voltage — positive on the left, negative on the right. When Q1 is turned on, the left terminal of C1 is connected to ground, via Q1, leaving the right terminal negative with respect to ground. This negative voltage will hold Q2 off, and the trigger pulse now has no further effect.

Under this condition, C1 will charge in the opposite direction via R2 and Q1. When the voltage across C1 equals about 0.6V, Q2 will turn on and its collector voltage will fall to zero. This removes the bias for Q1 and the circuit quickly switches back to its stable state.

So in summary, a short duration negative-going trigger pulse causes the monostable circuit to switch to the unstable state.

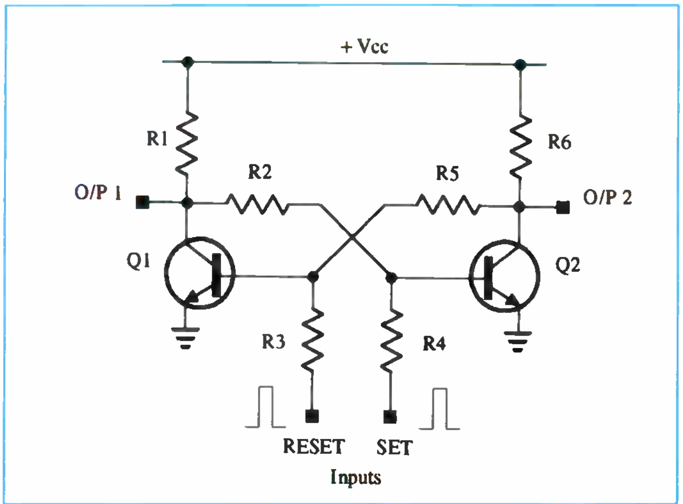


Fig.1: The bistable multivibrator, commonly called a flipflop, has two stable states, two inputs and two outputs. It is often used in digital circuits.

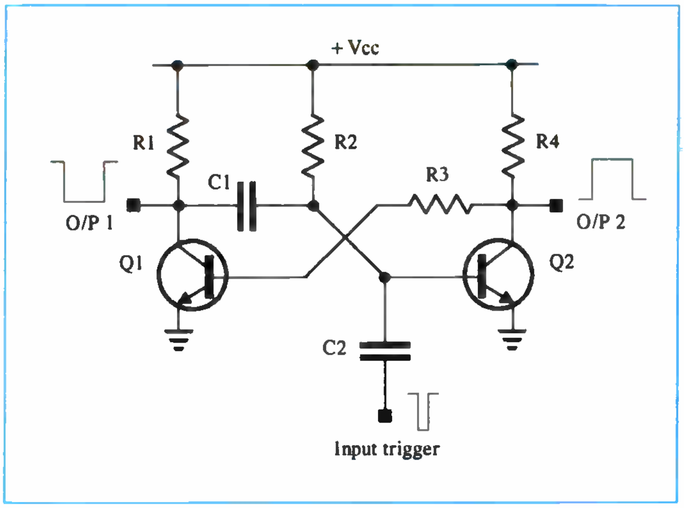


Fig.2: This circuit shows the monostable multivibrator. When a trigger pulse is applied to the input, the circuit will change state or a time determined by C1 and R2.

The circuit remains in this state for a time determined by R2 and C1. The monostable multivibrator is therefore a timer circuit, in which a pulse triggers the timer into action. The period (T) of the unstable state can be calculated with the equation:

T = 0.7 x R2 x C1 seconds.

The astable

The third type of multivibrator is the *astable*, shown in Fig.3. This circuit has no stable states and continually changes from one state to the other at a rate determined by C1-R2 and C2-R3. This circuit is rather similar in operation to the monostable multivibrator already described, except that each half of the circuit triggers the other.

It therefore has no input and simply spends its life oscillating. The output waveform is a squarewave, and by making the time constant of C1-R2 different to that of C2-R3, the mark-space ratio (high-low times) of the waveform can be anything you like.

In the circuit of Fig.3, the time Q1 is on equals 0.7 x R2 x C1 and the time it is off equals 0.7 x R3 x C2. The period of the waveform is therefore the sum of the individual times. The frequency (as always) equals the reciprocal of the period. This circuit is therefore an oscillator, and is often used in a digital circuit.

The circuit of Fig.4 shows a simple LED flasher based on a transistorised astable multivibrator. The LEDs will flash on and off every 0.7 seconds. If the supply voltage is increased to 12V, the value of R1 and R4 will need to be increased to 1k to limit the LED current to around 10mA.

The 555 timer

When the 555 timer IC was first released in the early 1970's, it made the circuits just described virtually obsolete. This simple IC probably represents a landmark in electronics and has been the subject of numerous books and magazine articles. Most literature on the 555 tends to use the 'cookbook' approach, in which an endless array of applications are given.

This method has many advantages, as uses rather than theory are usually preferred by readers. For this reason, we'll do something similar, although we need to start with a description of how the IC works before getting into circuits.

The block diagram of Fig.5 shows the internals of the 555. The IC has eight pins, named as shown, and it contains two comparators, three resistors, a bistable multivibrator (flipflop) and a transistor. This setup may seem too simple to do much, but as you'll see, it's a winning combination.

We've already described the flipflop, but the term 'comparator' is new. Basically, a comparator is a very high gain

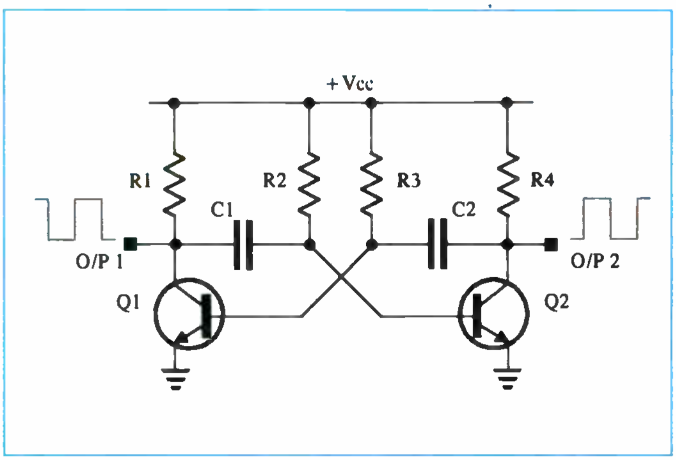


Fig.3: The astable multivibrator has no inputs, because it has no stable states. While power is applied, the circuit changes states at a rate determined by C1-R2 and C2-R3.

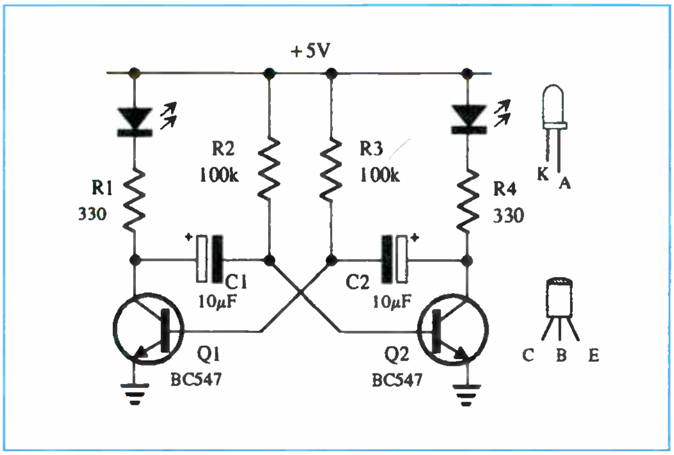


Fig.4: In this circuit the LEDs will flash on and off every 0.7 seconds or so. Build it and see the transistorised astable multivibrator in action.

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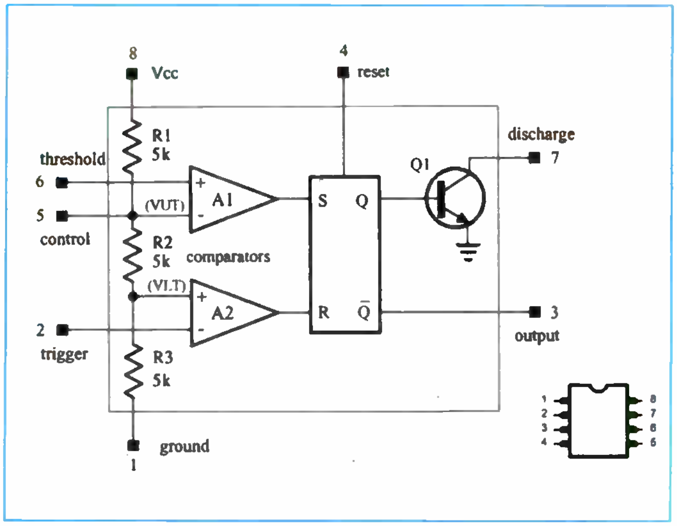


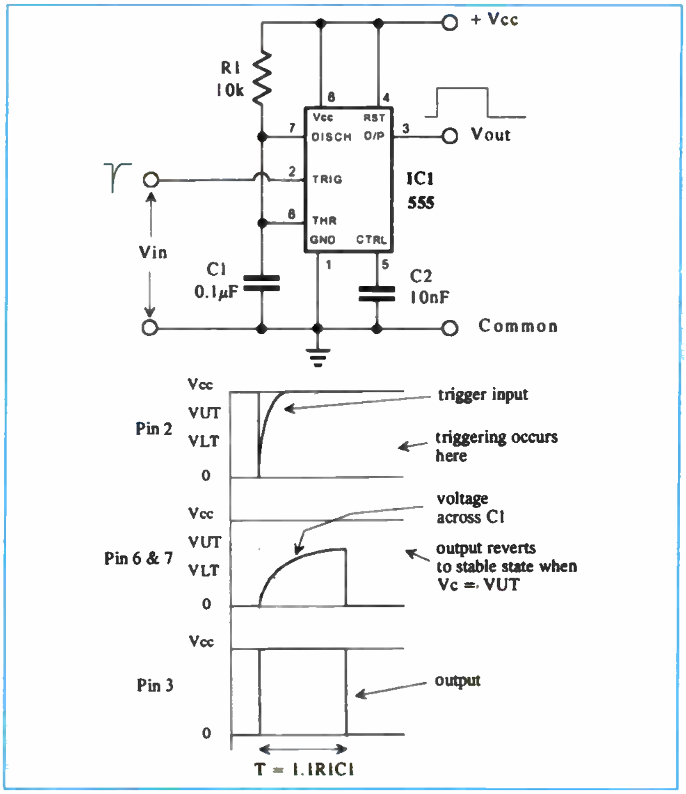


Fig.5 (above): This diagram shows the internal block diagram of the 555 timer. Voltage VUT equals 2/3 the supply voltage, and VLT equals 1/3 the supply voltage as resistors R1, 2 and 3 are all equal.

Fin.6 (right): The 555 monostable. When the trigger input causes the voltage at pin 2 to fall below 1/3Vcc, the output goes high. The timing capacitor (C1) can now charge via R1, and when the capacitor voltage reaches 2/3cc, the timer resets and the output returns to zero.

amplifier with two inputs and one output. Because of its high gain, a comparator doesn't work like a conventional amplifier, as the smallest signal will cause the output to be either fully on or fully off. If the voltage at the positive input is slightly more positive than that at the negative input, the output of the comparator will be fully positive.

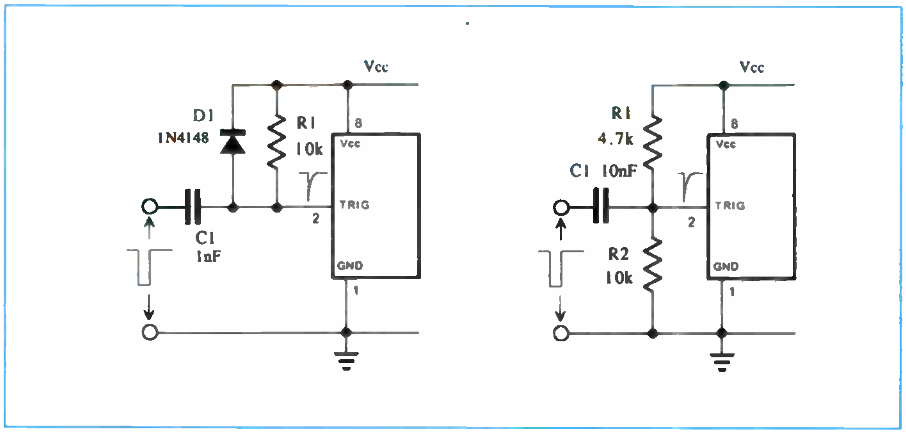
If these polarities are reversed, the output will be at zero volts. In other words, a comparator has two output conditions — maximum or minimum (high or low).

When the 555 is connected to a supply voltage, (positive to pin 8, ground to pin 1), voltages will be established at the inputs of the comparators by the resistor network. Because these resistors are all equal, the voltage (VUT) at the negative input of comparator A1 will equal 2/3 of the supply voltage.

Similarly the voltage at the positive input of A2 (VLT) will be 1/3 of the supply voltage. Obviously then, the output of the comparators will depend on the voltage applied to the other terminals (pins 6 and 2 of the IC).

Fortunately, we don't need to know what the outputs of the comparators are, rather we're more interested in the state of the transistor Q1 and the output terminal at pin 3.

Because the transistor is driven by one output of the flipflop and the output of the 555 comes from the other (which has the opposite output level), the transistor will be on (conducting) whenever pin 3 is low. This means that pin 7 is at zero volts (low) when pin 3 is low. If pin 3 is high (or at Vcc), the transistor will be off, and pin 7 an open-circuit.



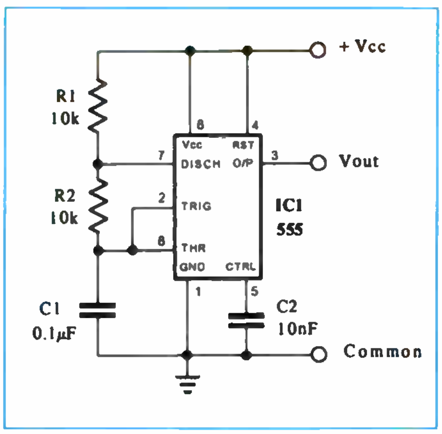


Fig.7: Either of these circuits can be used to produce a short, sharp trigger input at pin 2 of the 555. The time constant of the RC circuits should be less than 1/20th the period of the output pulse.

Fig.8 (right): The 555 astable requires two resistors and a single capacitor. The trigger input is connected to pin 6, and the circuit switches states at capacitor voltages of 2/3Vcc and 1/3Vcc.

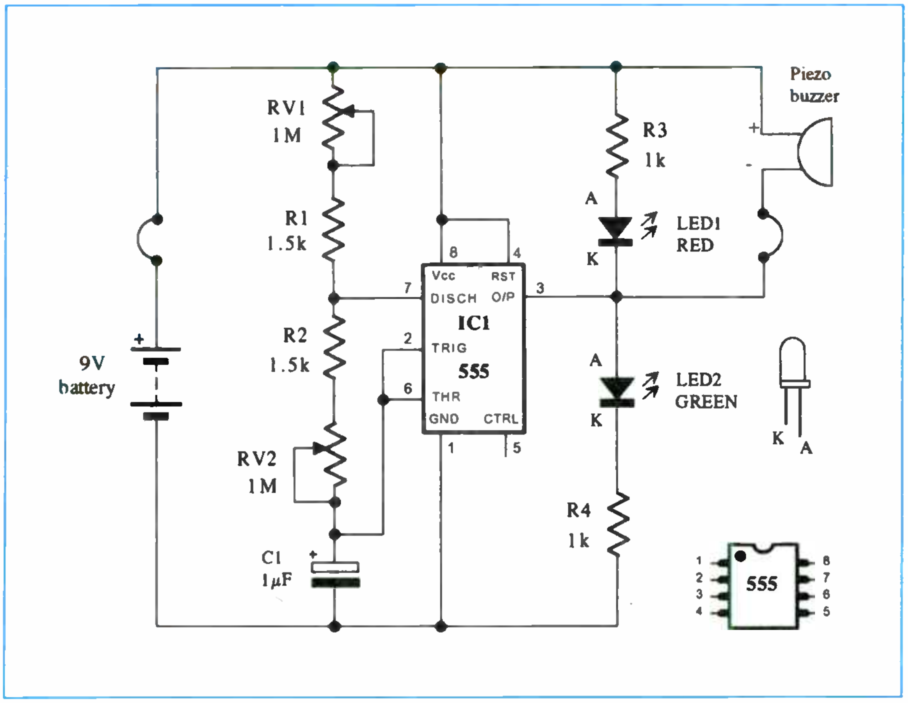


Fig.9: The circuit of the project has two adjustments that control the times the LEDs are on. When one LED is one, the other is off, and a wide range of adjustment is available.

Now that we've looked at some basics, the best way to show how all this works is to examine the 555 in its simplest function, a monostable multivibrator.

555 monostable

The 555 monostable is shown in Fig.6. As you can see, there are not many components required, although all pins are connected to something. The supply terminals (pins 1 and 8) are fairly obvious and supply voltages up to 16V are connected to these terminals.

Pin 4 is called the RESET terminal and is usually connected to the supply voltage. If this pin is momentarily connected to ground, it will reset the output at pin 3 to a low. If the reset pin is held low, it will prevent the IC from operating.

Pin 5 is called the CONTROL terminal and has several specialised uses. As shown in Fig.5, this terminal connects directly to the resistor network and a voltage applied to pin 5 will alter the values of VUT and VLT. It can therefore control the time delays produced by the timer. When not used, pin 5 is generally connected to ground with a 10nF capacitor C2.

The timing components for the circuit of Fig.6 are R1 and C1. The trigger input is a negative-going pulse applied to pin 2. Before the trigger pulse is applied, the circuit will be in its stable state, with the output and pin 7 both at zero volts. Therefore the internal transistor is conducting and the voltage across capacitor C1 is zero.

As soon as the trigger pulse at pin 2 causes its voltage to drop below VLT, the internal flipflop will change state; the output (pin 3) will go high and the internal transistor will be turned off. This allows capacitor C1 to charge, at a rate determined by the values of R1 and C1. When the capacitor voltage reaches VUT, the internal flipflop is toggled back to its original state.

The circuit is now back to its stable state, ready for another trigger pulse. The sequence is shown in the waveforms and the time the output is high can be calculated using the equation:

T = 1.1 x R1 x C1

For the circuit values shown the output pulse width is 1.1 milliseconds.

The value of C1 can be anything from about 500pF up to any maximum value, although electrolytic capacitors need to have a low value of leakage current, particularly if R1 is over 100k or so. The usual range for R1 is somewhere between 1k to 10M.

Trigger pulse

An important requirement for this circuit is the trigger pulse. While the voltage at the trigger input (pin 2) is less than VLT, the output will remain high, so it's important that the trigger pulse be short and sharp. There are various ways of achieving this, and two possible circuits are shown in Fig.7.

In both of these, the input pulse is coupled to pin 2 with a *differentiating* network. This circuit consists of a capacitor (C1) connected to a load resistor (R1), and the input pulse causes a charging current to flow in the capacitor via the load resistor.

A load resistor is required, as for practical purposes, pin 2 of the 555 can be regarded as an open-circuit. This resistor actually serves three purposes — to provide a charging path for the capacitor, to convert the charge current to a voltage and to bias the trigger input above VLT.

In the first circuit, a 10k resistor is connected from the trigger input to the supply rail. When the input pulse is applied, current flows from the supply rail, through R1 and C1, then to ground via the trigger source.

The voltage developed at pin 2 is shown on the diagram, which as you can see has the short duration, sharp transition properties required. The diode prevents the voltage at pin 2 rising *above* the supply voltage, and acts as a protection device.

In the second circuit, two resistors are used. In this arrangement, the quiescent voltage at pin 2 will be around 2/3 of the supply voltage. In the first circuit, this voltage will equal the supply voltage. The advantage of the second circuit is that the trigger pulse doesn't need to be as strong, as there is a smaller voltage change required for triggering to occur.

In both circuits, the values of C1 and the resistors are important. As a rough guide, the time constant of the differentiating network (R1-C1 in the first circuit, C1-R1//R2 in the second) needs to be less than 1/20th the period of the output pulse.

For example, say the output pulse is to last 1ms. Therefore the time constant of the differentiating network needs to be 50us (1ms/20). Remember that the time constant of an RC network equals the product of the resistor and the capacitor values, therefore if a capacitor value of 1nF is chosen, the resistor value should be less than 50k (50us/1nF).

In the first circuit, making R1 less than 50k will give the required time constant. In the second circuit, the *parallel combination* of R1 and R2 should be less than 50k. As well, their values should give a quiescent voltage around 2/3Vcc at pin 2.

555 astable

The astable configuration of the 555 is shown in Fig.8. As we've already explained, the astable is an oscillator and

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there is no input. At switch on, the capacitor will be discharged — giving a trigger condition to pin 2, as the voltage is less than 1/3Vcc. This sends the output high and holds the internal transistor off. The capacitor then charges through the series-connected resistors R1 and R2.

When the capacitor voltage rises to 2/3Vcc, the output of the 555 will go low, and the discharge transistor turns on. The capacitor now discharges through R2 and when its voltage falls below 1/3Vcc, the circuit retriggers and the cycle continues.

Because the resistance of the charge and discharge paths for the capacitor have different values, the high and low times of the output are different.

The time the output is high is found with the equation

$TH = 0.69 \times (R1 + R2) \times C1$

On the other hand the low time is calculated with:

$TL = 0.69 \times R2 \times C1$.

The total period is the sum of TL and TH, and again the frequency is the reciprocal of the period. For the circuit shown in Fig.8, the high time is 1.38ms, the low time 0.69ms, the period is 2.07ms and hence the frequency is 483.1Hz.

To make the output waveform symmetrical, a diode can be connected across R2, with the anode to pin 7. The charge path for the capacitor is now R1 and the diode, while the discharge path is R2. Because R2 is no longer in the charge path, the charge and discharge paths have the same resistance. The effect of the voltage drop across the diode can be compensated for by varying the value of the resistors.

Practicalities

We don't have space to discuss all the many and varied applications of the 555 timer. However a few words about its limitations are important, as not all references to the IC describe them.

The first point to make is that not all 555 timer ICs are the same, although in theory they should be. This IC is made by most semiconductor manufacturers and for reasons best known to the manufacturers, there are subtle differences between the various brands.

For example, one brand of 555 will be better than another at driving a load. Ideally, the output voltage should be either the supply voltage or zero. However, you'll find that while each brand of IC will be within its specifications, some will be closer to the ideal values than others. This is important in some applications (especially in digital circuits) and is a point worth remembering.

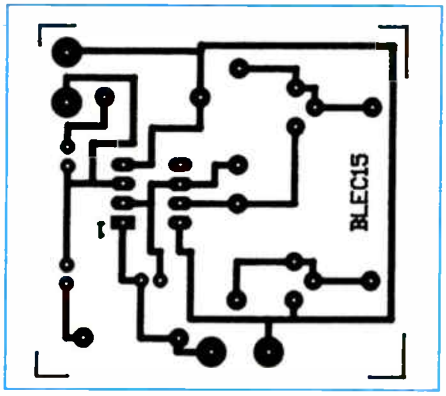
Incidentally, some brands of 555 will *latch-down* to zero if the output voltage is even momentarily brought negative by as little as 0.6V. This can happen if the 555 is driving an inductive load, and the usual protection diode will not prevent this happening.

An important consideration with any switching device is the effect on the power supply when the device actually changes states. The 555 timer (like many digital ICs) becomes a virtual short-circuit across the supply rails, during the short time it is changing states.

The effect is a high value of load current for a very brief instance. Even in the best of power supplies, this will cause a spike on the supply which can affect other devices in the circuit.

To prevent this, a *bypass* capacitor (0.1uF, ceramic) should be connected as close to the IC as possible. In some cases, it is even necessary to connect a 10-ohm resistor in series with the supply and pin 8 of the 555. A bypass capacitor from pin 8 to ground then cleans up the spikes.

The drive capability of the 555 is

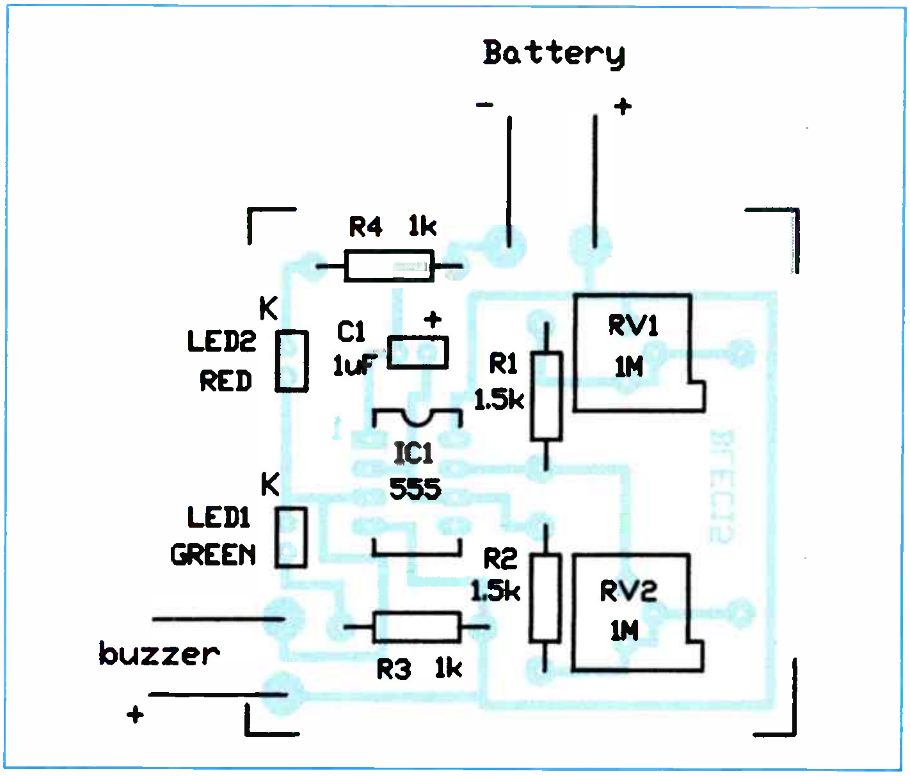


Here's the PCB artwork so you can make your own board, if you wish.

usually specified at 200mA. This means that the load current in either direction (into or out of the IC) should not exceed 200mA. However, a point rarely made is the amount of current the internal discharge transistor at pin 7 can handle.

As a rule, this current is also 200mA and it is important that the discharge path of the timing capacitor have sufficient resistance to prevent this value being exceeded. For this reason, it is usual to specify a minimum timing resistance value of 1k, although lower values of supply voltage and small value timing capacitors may allow a resistor value less than 1k.

There is so much more that can be said



Use this layout diagram to locate all the bits on the circuit board. Make sure the LEDs are mounted the right way around, as otherwise they won't light. C1 and IC1 must also be orientated as shown, to work correctly.

about this IC, and if your appetite is now awakened, be assured there is no shortage of literature about the 555.

We'll end here by describing a simple construction project that you might like to build, to learn more about this fascinating device.

555 LED flasher

This project is one I developed some time ago, and it was fully described in *EA* for March 1990. I'm including it here as it fits in nicely with the topic.

Basically, the circuit is a 555 astable that drives two LEDs and an optional buzzer. The two variable resistors allow the on-off times of the LEDs to be adjusted over a considerable range. The adjustments also provide a wide range of sounds from the buzzer. In other words it flashes and buzzes over an almost infinite range of settings.

The circuit diagram is shown in Fig.9, and as you can see it operates from a 9V battery. The buzzer can be anything that operates from either 6V or 9V, and in the original version was a type of mechanical buzzer with an inbuilt transistor driving circuit. If you want to use one of these try Oatley Electronics, as they supplied the buzzers used in the original project. A piezo buzzer will also work, although the sounds are not quite as interesting.

PARTS LIST

Resistors

All 1/4W, 5%:
R1,2 1.5k
R3,4 1k
RV1,2 1M trimpot

Capacitors

C1 1uF electrolytic

Semiconductors

IC1 555 timer IC
LED1,2 5mm LEDs, red, green

Miscellaneous

PCB coded BLEC15, 49mm x 46mm;
6V or 9V buzzer;
9V battery and battery clip.

The printed circuit board artwork allows two types of trimpots to be fitted, those originally supplied by Oatley Electronics and those available from most parts suppliers. Everything mounts on the circuit board except the battery and the buzzer. When these components are connected, solder one lead only, so the other leads can be used as the 'on-off' switches.

To build the project, simply follow the layout diagram. Watch the polarity of the LEDs, the timing capacitor (C1) and the IC. You needn't fit an IC socket, although this might be a good idea if you need to faultfind the circuit.

Of course, you don't have to use a printed circuit board. The circuit can be built on anything that can hold electronic components. You might use 'strip-board' (Veroboard), or perhaps matrix board.

While I don't advocate it as a general practice, it's even possible to build the circuit on a piece of cardboard. To do this, poke the components into the cardboard and connect them with insulated telephone wire.

The important thing is to try and build it, in whatever way you can. This way you'll have the fun of making an electronic gadget and also learn while you do it. For example, you might like to calculate the maximum and minimum times that both LEDs are on.

Try other values for the timing capacitor, and see what happens if pin 4 is connected to ground. Perhaps even try applying a voltage (no greater than 9V) to the control terminal at pin 5, from either an AC or a DC source. In short, experiment and learn as you go. The worst that can happen is a burnt out 555, and by shopping around you should be able to pick one these up for 50 cents or so. ❖

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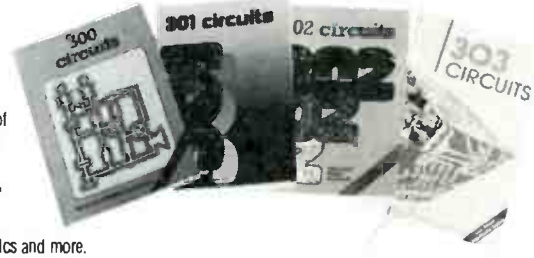

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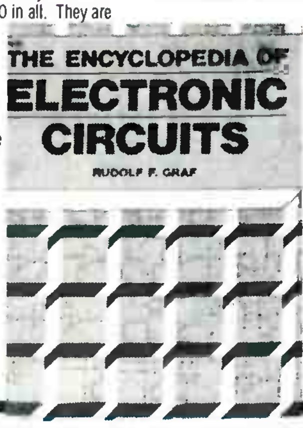

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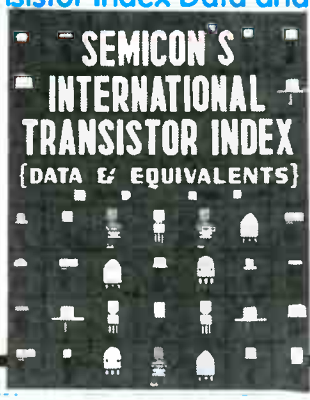

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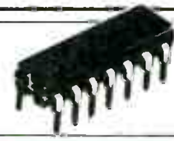

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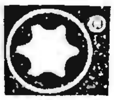

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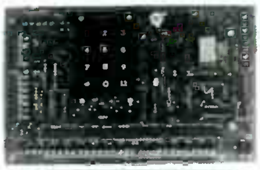

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Ref: Silicon Chip February 1992

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Dolby Surround Sound Decoder Kit

Ref: EA January 1992. Experience cinema sound in your own lounge room. The Dolby "Surround Sound" process increases the sensation of "being there" by producing an effects channel to create surround sounds which a conventionals stereo system can't produce. Hook this simple kit in conjunction with your Hi Fi VCR or stereo TV and take full advantage of movies recorded with Dolby encoding. Short form kit - includes PCB, and all on board components. Cat. KA-1741 **$39.95**

TV Transmitter for VHF VCRs

Ref Silicon Chip March 1992

How many times have you wanted to watch something from your VCR on another TV set located in another room of your house? Up until now you had to run along cables through the walls or through the ceiling. Want to fix that? Our new transmitter does away with all those cable and simply connects into your VCR, and transmits a signal to your second TV set. THe Jaycar kit is supplied with Jiffy box, front panel labels and the VHF modulator, plus all specified components except the antenna assembly and connecting VCR cables.

Cat KC-5114

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240V Power Relay Kit

Ref: EA January 1992

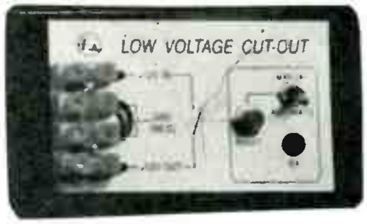
This kit will monitor the power drawn from a "master" power point socket, and automatically switch on a slave socket. It's very versatile because it can monitor one or several appliances plugged into the "master" and switch one or several devices plugged into the "slave". An ideal use for this project would be to switch on your Hi Fi system. With a four outlet board plugged into the slave socket, turning on your amplifier (in master) will switch on your tuner, tape deck, CD player and turntable etc. The kit includes PC board, box, 240 volt sockets, lead and plug and all specified components.

Cat. KA-1740 **$49.50**

Low Voltage Cutout Kit for Cars and Boats

Ref: EA January 1992

Build this simple kit and avoid getting caught out with a flat battery. It simply connects into a 12 volt accessories power line and shuts off the flow if the batteries voltage drops to a dangerously low level, where it won't start the vehicle. The shut off voltage is adjustable over a nominal range of 10.9V to 11.9V and the unit will restore power to the load automatically when the battery voltage has returned to around 12.6V. An extremely useful and practical kit. The kit includes PC board, box, relay and all specified components.



Cat. KA-1739 **$22.95**

Studio Twin Fifty Stereo Amplifier

Ref Silicon Chip Feb, March, April 1992

FEATURES OF THE TWIN 50

• 50 watts per channel with both channels driven into 9 ohm loads • Very low noise on phone and line level inputs - comparable with many DC players • Up to seven stereo program sources can be connected • Tape monitor loop • Separate ultra-low distortion stereo headphone amplifier • Stereo/mono switch • tone defeat switch • Straight forward construction.

BEGINNER CONSTRUCTORS CAN BUILD THIS AMP - If you can use simple hand tools and a soldering iron you can build this project. virtually everything is board mounted making construction incredibly simple, allowing you to complete this project in a couple of nights.

PERFORMANCE SPECIFICATION • Power output (one channel) - 4 ohms 80 watts, 8 ohms 55 watts • Power output (both channels) - 4 ohms 70 watts, 8 ohms 47 watts • harmonic distortion less than 0.05% 20Hz to 20kHz at rated output level for any input or output.

See catalogue for full specifications.

The new Studio Twin Fifty is housed in a midi-sized case and comes as a complete kit including punched and screened front panel; black anodised knobs, all specified components and high quality pre-tinned printed circuit boards.

Cat KC-5110 **$299**

Karaoke Box Kit (Vocal Canceller)

Ref: EA November 1991. Karaoke is a lot of fun. With this kit you can remove the lead vocal from almost any recording, and replace it with your own via a standard microphone. It's a great way to liven up a party. Complete kit includes PC board, box, front panel and all components.

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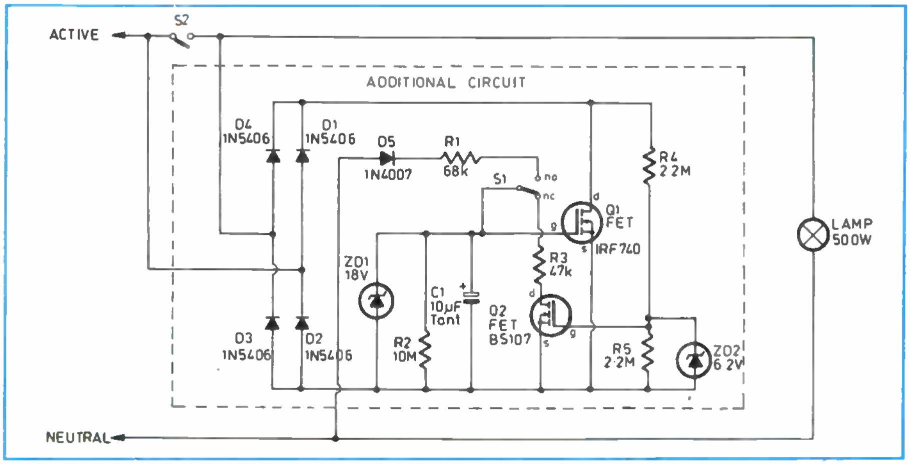
Circuit & Design Ideas

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 responsibility, enter into correspondence or provide further information.

Mains-powered light delay



This circuit is a mains powered timer which will switch off a light or other device, after a fixed delay. It is very useful for lighting up the path leading to the garage, then turning itself off after about two minutes.

Several good features of the circuit include: it is very easy to construct because it has only a handful of parts; it is easy to install because it requires no modification to the existing wiring, apart from three connections; and it can control a large load (500W is conservative — with suitably rated diodes 2kW is possible).

The circuit is also very economical. It draws virtually no current when active, and a minute 100uA when on standby. The standby cost for its 0.21kWh of energy used per year is about two cents!

Diodes D1-D4 rectify the incoming mains current for use in the rest of the circuit. The lamp is in series with the supply, and in standby mode, the idle current is 100uA. The for the positive (or negative) half cycles, this current flows between active and neutral via D1 (or D2), R4, R5 and ZD2, D3 (or D4), and the lamp. This is the only current pathway, as FET Q1 is off at this point, and very little current flows since R4 is 2.2M.

FET Q1 is off because the idle current through R5 produces the gate voltage to keep FET Q2 turned on (ZD2 limits this gate voltage to 6.2V). A fairly low resistance path exists between the gate of Q1 and ground, via switch S1, R3 and the drain-source of conducting Q2 — so the gate of Q1 is pulled low, keeping Q1 switched off.

If switch S1 is now pushed (S1 is a momentary-action pushbutton), then Q2 will be disconnected, and capacitor C1 will be charged via D5, R1 and S1 on the negative half-cycles. The voltage on C1, and hence on the gate of Q1, is limited to 18V by ZD1. With 18V on its gate, Q1 will be turned on, giving a low resistance path between its drain and source. The current flow is now limited only by the lamp — in effect, Q1 forms a virtual 'short' across switch S2. When S1 is released, C1 will slowly discharge through R2, which will take about eight minutes to complete if left to discharge unhindered.

However, once the voltage on C1 reaches the threshold voltage of Q1 (about 4V), Q1 will start to turn off. As Q1 turns off, the gate voltage on Q2 starts to rise, and, when high enough, Q2 will start on turn on.

With Q2 conducting, C1 will discharge more rapidly, which results in Q1 turning off harder, and Q2 turning on. The effect is that there is no fading — the lamp just switches off.

Because of this, the heat dissipation in Q1 is kept to a minimum, so for low wattage applications, no heatsink is necessary. For example, with an 'on resistance' of 0.55 ohm, the power dissipated in Q1 for a 100W bulb is only 0.1W.

If you wish to vary the time delay, vary C1 and/or R2. With the values shown, the delay is about 2-1/2 minutes, but this may vary by a minute or so, depending on the threshold voltage of the particular IRF740 that is used. But for the same FET, the delay time is fairly repeatable — my tests showed only a two second spread over my 2-1/2 minute delay.

For normal continuous operation, the original light switch S2 is used; for delayed switch-off operation, switch S1 is momentarily toggled. To restart the delay (even before it has timed out) simply toggle S1 again.

My toggle switch was a standard modular type, with the word 'press' on it. By using a faceplate with two holes, I was able to mount it alongside the original switch. The circuit board was housed in a plastic soap box, and tucked into the wall recess behind the faceplate.

Harry Velthuizen,
Upper Hutt, NZ. **$40**

DREAMED UP A GREAT IDEA?

If you have developed an interesting circuit or design idea, like those we publish in this column, why not send us in the details? As you can see, we pay for those we publish — not a fortune, but surely enough to pay for the effort of drawing out your circuit, jotting down some brief notes and popping the lot in the post (together with your name and address) and send them to Jim Rowe at -

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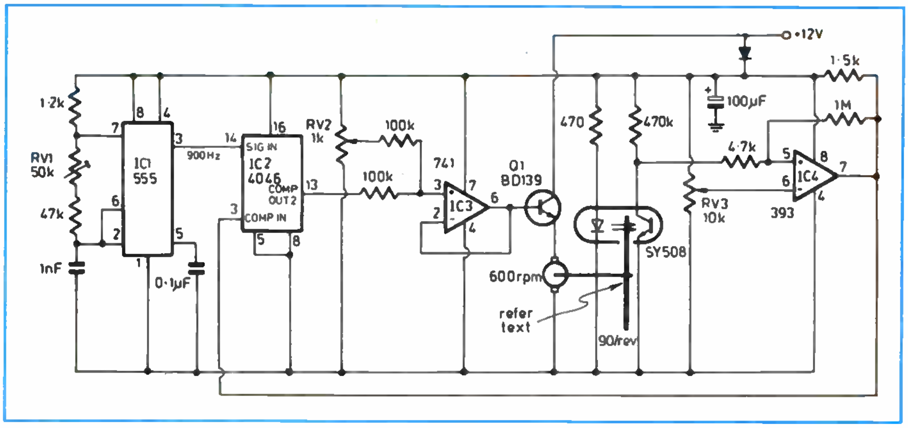
DC motor speed controller



This circuit arose from the need to run a DC motor at a very constant speed for long periods of time, from an unregulated supply. The motor load is almost constant. Since a DC motor, fitted with an incremental shaft encoder, is essentially a voltage-controlled oscillator, it can perform that function in a Phase Locked Loop (PLL). This is the principle upon which this circuit operates.

A 555 timer (IC1) is used in astable mode to generate a reference frequency of 900Hz. This signal is fed into IC2, which is a 4046 CMOS PLL.

A feedback signal, generated by the shaft encoder and photo-interrupter, is also fed into the 4046. This signal is first squared up by IC4 before being fed into the phase comparator input.

The shaft encoder consists of a circular disk attached to the disk drive of the motor. There is a series of holes around the edge of the disk, which spins in the slot of the SY508 photo-interrupter.

The phase comparator inside IC2 produces a pulsed DC signal at pin 13, which, with a little buffering from IC3, drives the motor through a power transistor Q1.

RV2 provides some damping of the phase comparator signal, and also allows the DC level to be adjusted to suit different motors. No loop filtering is necessary, owing to the rotational inertia of the motor and encoder.

The shaft encoder which I used has 90 holes, so it produces 90 pulses per revolution. Because the reference frequency is 900Hz, this results in a rotational speed of 600rpm. This speed is as constant as the frequency stability of the 555. If greater stability is required, a crystal oscillator could be used. 12V motors taken from discarded car cassette players are ideal for this application.

Peter Stuart,
Carlingford, NSW. **$45**

Constant-current transistor tester

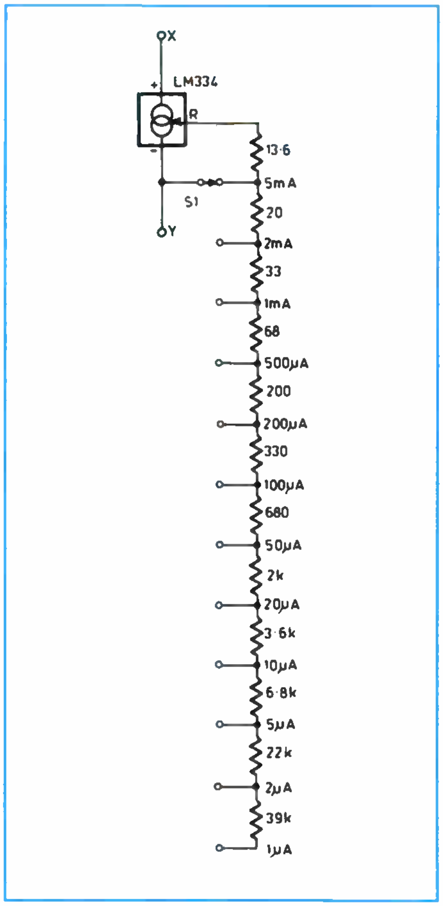
This unit provides a constant current source/sink which can be used with an ammeter and a bench power supply to test both NPN and PNP transistors, at up to twelve different switch-selectable base currents. The V_{CB} values varied from 2-30V. At the heart of the circuit is a National LM334 three terminal adjustable current source whose current I_{SET} is determined from:

$I_{SET} = 68mV/R_{SET}$

My circuit was housed in a UB5 plastic box, with an economy one pole 12-position switch (S1) and two banana plugs.

Transistors I have tested ranged from a BC548C (base current=1uA) to an AD149 germanium power transistor (base current=1mA).

In both cases, the base current stayed constant (+/-10%) over the 2-20V range. On the 5mA setting, self heating of the LM334 caused the current to increase slowly, but it still remained with 10% of the initial calibrated setting. Reverse voltage connections were checked to 18V (I=9uA) with no failure.



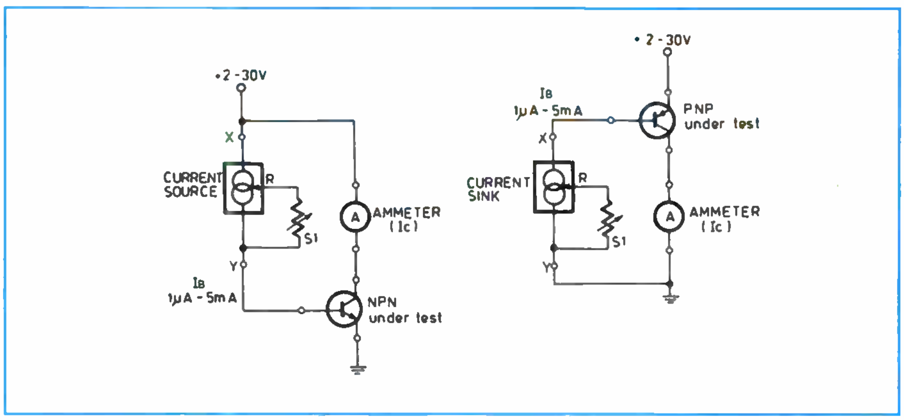
I have also used the unit to compare brightness of LEDs and to supply a constant current to zeners when measuring their breakdown voltage.

The resistance values which I have given on the diagram were for my prototype and should be used as a guide only, as the voltage across R_{SET} will vary with different devices.

Correct resistance values can be established using a digital ammeter, beginning with the 5mA setting and working back towards the 1uA value. The unit can be used in the current-source or current-sink mode, for NPN and PNP devices respectively.

To test a transistor for its static parameters, simply connect the appropriate terminal, X or Y, to the base of the transistor under test (see diagrams), and vary the base current with switch S1.

David Astin,
St Kilda, Vic. **$35**



Construction Project:

The 'Miracle' Active TV Antenna

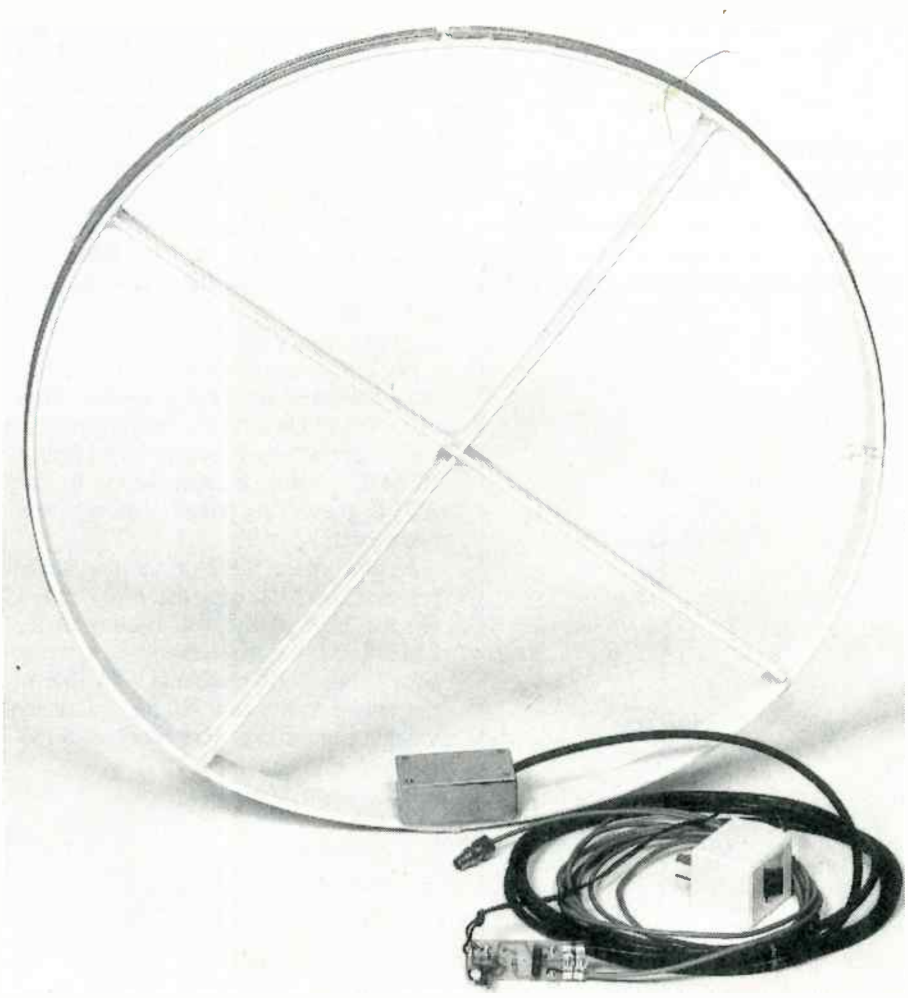
We describe here an all-new TV masthead amplifier that uses an unconditionally stable low noise 2GHz amplifier IC. Use the amplifier with the omnidirectional circular antenna also described, with an existing antenna or as a distribution amplifier. The complete active antenna is ideal for boats, caravans as well as in the home. The whole concept is innovative and the cost for the lot is less than $25.

by PETER PHILLIPS

This project comes from Oatley Electronics, in response to requests and suggestions from readers, especially Peter King — skipper of the yacht 'Miracle'. We therefore decided to call the project the Miracle Antenna, as apart from the association with Peter King, the project really is a rather miraculous design. After all, $25 these days is not much to pay for an antenna that can be built by anyone, especially when this includes a masthead amplifier and the power supply regulator.

The only other cost is a power source which can be either AC or DC, with a current capability of around 25mA. In many cases, it should be possible to obtain this supply from an existing source, but if not, the specified plug-pack is only another $12.

As we said in the introduction, the masthead amplifier can be built separately and even used with a 'rabbit's-ears' type antenna for much improved performance. It's also suitable as a TV distribution amplifier or, as its name implies, as a masthead amplifier for an existing external antenna. But before we describe the amplifier, first a look at the circular antenna.



The antenna

These days, a TV set is as much a part of life as a radio. Portable TV's are now found in most caravans, boats, buses or in virtually anything that moves. However a problem of watching TV 'on the move' is that reception varies as the direction of the antenna changes. Most TV antennas are directional, with high gain antennas being the most directional.

A basic dipole antenna has the lowest gain but the widest reception lobes, with equally shaped front and rear lobes. Reception drops off to a minimum as the dipole is moved 90° off axis, giving virtually no signal pickup. This effect therefore makes a basic dipole virtually useless for mobile reception, as you only have to turn the corner and off goes the picture.

However, if the dipoles are formed

into a circle, the antenna becomes almost omnidirectional — making it more suited to mobile use. The gain of the antenna is still low, but given reasonable signal strengths, reception on a yacht or a bus becomes more consistent.

A problem with this type of antenna is its construction. The conventional method is to form aluminium rods into the required circular shape, with supports to hold the structure together. The dimensions are also important, with a compromise required to get the best overall bandwidth for the frequency range of the TV spectrum.

These days circular antennas are installed in most interstate coaches, usually under a dome fitted to the roof of the coach. To improve the gain, a masthead amplifier like that described here is generally included.

To give you an idea of what can be achieved, here's what Peter King has to say about the reception he has from a circular antenna similar to that described in this article and fitted with a masthead amplifier that uses the OM350 IC:

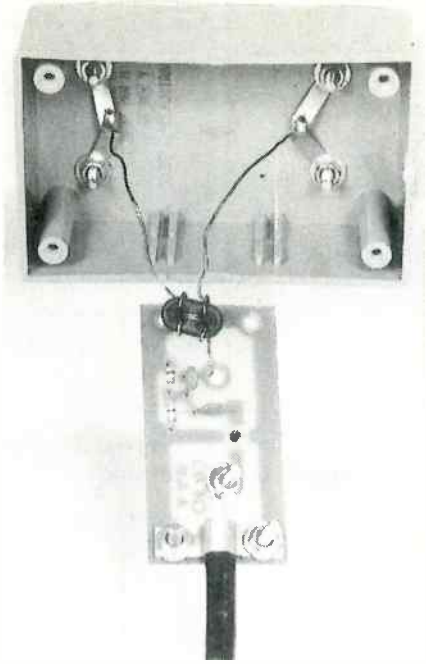
'Here's a design for a circular TV antenna that actually started out from an old crab trap I originally bent up to make my first antenna. On the VHF channels with the two gaps in the ring, it is non-directional on long distance reception when combined with the masthead amplifier. For example, when in Pittwater, I get good reception from Newcastle TV and when in Port Stephens I can watch Sydney TV. In fact, since adding the masthead amplifier, I have good TV reception all the way from Sydney to Airlie Beach in Queensland. Before the amplifier, there were quite a few anchorages that had no TV reception.'

So obviously the masthead amplifier makes the circular antenna a much better proposition. The gap referred to by Peter is the distance between the ends of the folded dipoles, and for VHF is around 8mm to 10mm. For UHF reception, no gap is required, as we'll explain.

Antenna design

While circular antennas have been in use for some time, Oatley Electronics have come up with a construction design that makes it very cheap and easy to build. As the lead photo shows, the structure looks rather like a wheel with four spokes. The material is a plastic cover strip used to join fibro sheets. This material is readily available from building suppliers and the antenna requires a 3m length. The construction diagram shows the dimensions of each section.

As shown in Fig.1, the circular section is formed from a 179cm length and the spokes from two 57cm lengths. You'll have very little material left over from the 3m length after the antenna is built. A jiffy box joins the circular section and the masthead amplifier fits inside the jiffy box.



This shot shows how the masthead amplifier PCB is connected into the terminal box on the circular antenna, via a small balun. Winding details for the balun are given later in this article.

The spokes are held in place with silicone glue. You'll find the circular section will form an almost perfect circle, and the finished unit is light and robust.

This structure is then used to support the dipoles, which are lengths of coaxial cable. The prototype has two dipoles, spaced about 20mm apart, held in place with blobs of silicone glue. For VHF use, run each dipole about half-way around the outside of the ring, with a gap between the dipoles of about 8mm. In other words, there are four equal lengths of cable fitted to the outside of the ring.

For UHF use, run the cable right around the ring. That is, the dipoles are effectively joined, without a gap as for VHF use. Incidentally, for VHF-UHF use, you could try having one pair of dipoles with the 8mm gap and the other joined.

The two dipoles are connected in parallel inside the jiffy box as shown in Fig.2. The terminals serve to connect the dipoles and also to hold the jiffy box to the circular section. The earth braid and the inner core of the coaxial cable for each dipole are joined, with the earth braid the active surface for the dipoles.

The amplifier

The masthead amplifier uses an IC with the type number MAR6. This IC has a bandwidth of 2GHz, a gain of about 20dB, excellent stability and a noise figure of 2.8dB. These specifications are better than the popular OM350,

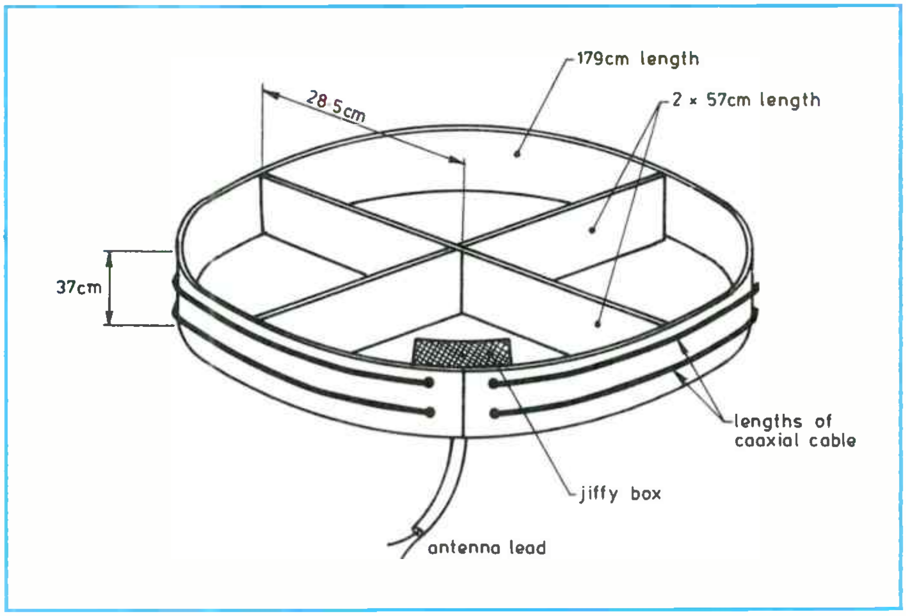


Fig.1: The antenna frame is constructed from a 3m length of plastic strip, normally used to join sheets of fibro. The circular section is formed from a 179cm length and the spokes from two 57cm lengths. The jiffy box joins the circle and silicone glue holds the spokes in place. The dipoles are lengths of coaxial cable, with both the inner cone and the earth shield joined.

particularly the noise figure. The IC requires a DC supply current of around 25mA. As you can see, the circuit of the complete amplifier is extremely simple and includes overvoltage protection provided by diodes D1 and D2, with isolation given by C1 and C2.

The power supply-signal combiner section is constructed on a separate PCB and is based around a 7805, 3-terminal regulator. Inductor L1 isolates the RF signal from the DC supply, with the ferrite bead taking care of the very high frequencies associated with UHF reception. The supply voltage to the amplifier is about 3.5V, giving a supply current of 22mA.

The power source can be either DC or AC, as D1 and C1 form a half-wave rectifier for AC and polarity protection/filtering for DC. The DC input voltage range is between 7 to 20V, and 6 to 15V for AC. Capacitor C3 isolates the DC supply from the signal sent to the TV set.

Construction

The amplifier circuit is built on the printed circuit board coded OE 92, AA/A. Start by fitting the metal thread nuts and bolts used to terminate the input and output coaxial cables. Each bolt is held to the board with a nut, then the cable is connected by fitting a second nut, with the inner core of the coaxial lead clamped between the two nuts. Fit washers as required.

Clamps are used at both ends of the board to hold the cables and to connect the earth braid of the cables to the earth of the PCB.

With the cable mounting hardware in place, fit and solder the two capacitors and the two diodes. The IC is surface mounted, with the body of the IC fitted inside the clearance hole drilled between the four mounting tracks.

You should be able to see the white dot when looking at the component side of the board. This dot identifies the input terminal of the IC.

The power supply PCB is coded OE 92 AA/B. Again the cables are terminated with clamps for the earth braid and metal thread nuts and bolts for the inner core. If required, the power supply input leads can also be terminated with nuts and bolts. The ferrite bead fits over a wire link as shown in the layout diagram. As before, fit the cable mounting hardware then fit and solder the various components. There is no need to attach a heatsink to the regulator, as the power dissipation is less than 0.4W.

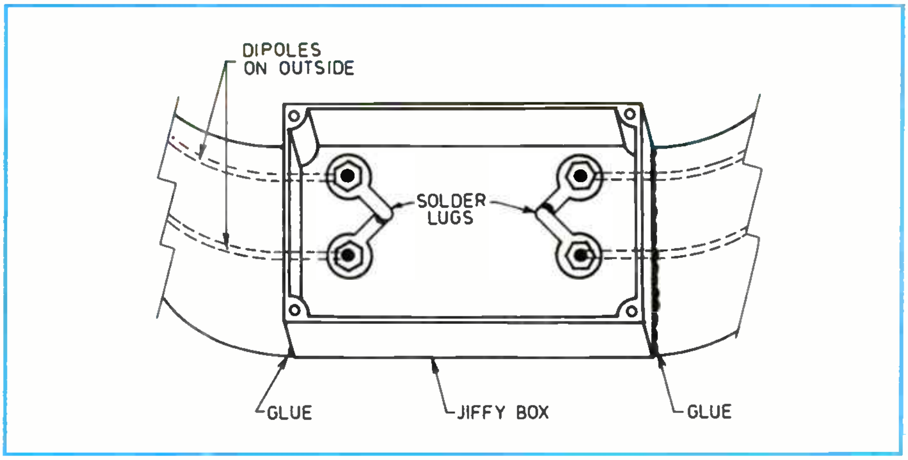


Fig.2: This drawing shows the internal connections for the dipoles. The amplifier fits inside the box, connected with a balun to the antenna terminals.

Incidentally the designs for both PC boards used in this project are copyright to Oatley Electronics, and as a result the PCB's will not be available from any other firms. However as noted in the parts list, complete kits for the project are available from Oatley Electronics, at a very attractive price.

Active antenna

Although both the circular antenna and the masthead amplifier can be used independently, the intention is to combine them to give a high performance, omnidirectional antenna.

As the photo of Fig.3 shows, the antenna is connected to the amplifier with a balun. The details of the balun used in the prototype are shown in Fig.4, in which both windings comprise three turns, threaded as shown. For clarity, only one winding is shown in the diagram. The other winding is identical, but wound from the other end of the core.

A conventional 300:75 ohm balun can

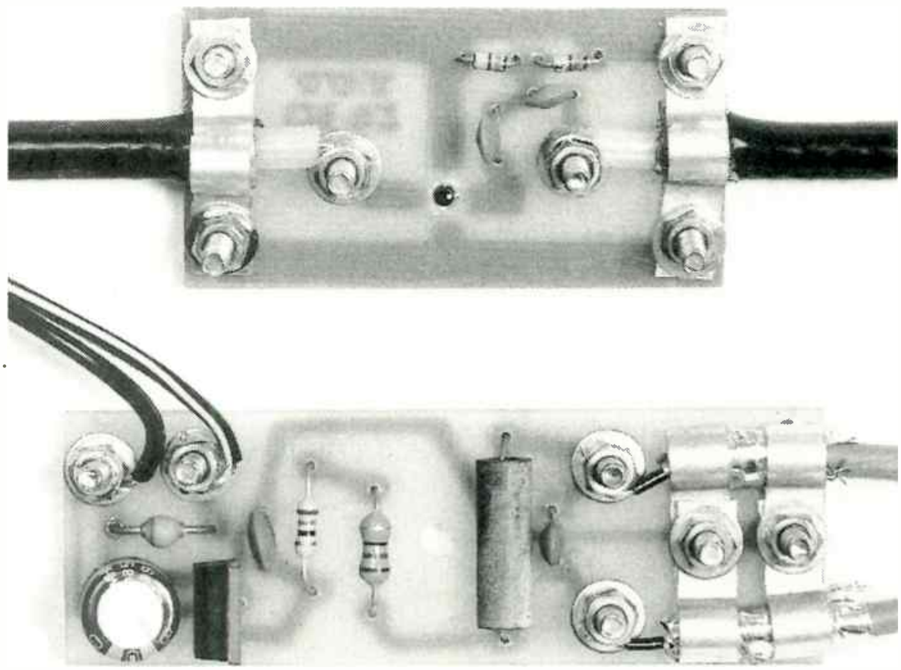
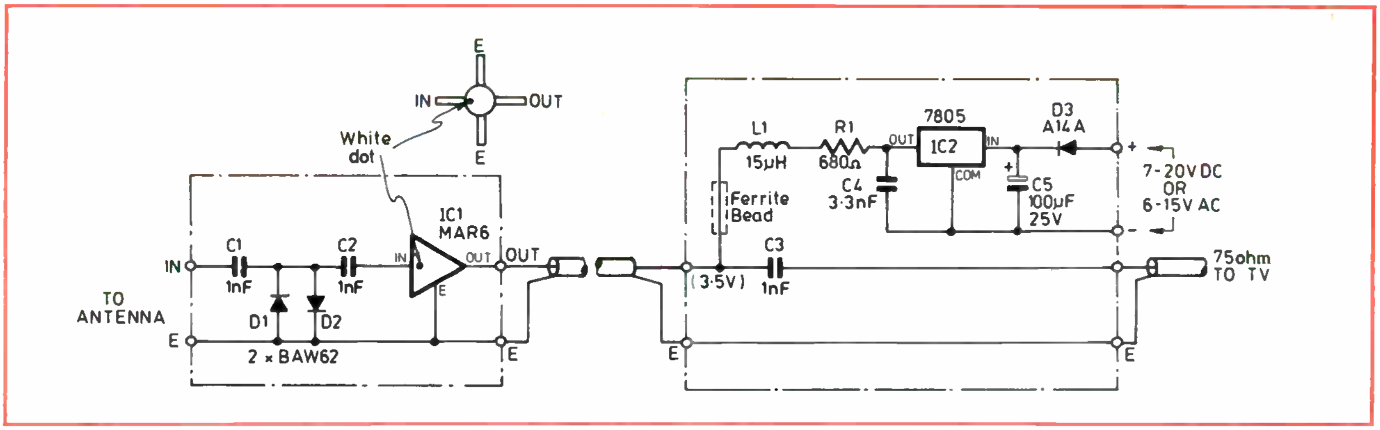


Fig.3: This shot shows both printed circuit boards. The boards are connected with a length of 75-ohm coaxial cable. Clamps are used to connect the earth braid of the cables to the PCBs.The amplifier IC fits into a hole drilled between four mounting tracks and solders directly to the trackside of the amplifier board. The white dot identifying the input terminal should be visible when viewed from the component side, and faces the antenna lead connection.



The circuit of the amplifier is contained on two PCBs. The input of the MAR6 amplifier IC is protected with diodes D1 and D2. The voltage regulator/signal combiner section uses a 5V, 3-terminal regulator, isolated from the RF signal by L1 and the ferrite bead around a wire link. The supply voltage to the amplifier IC should be around 3.5V, indicating a current consumption of 22mA.

also be used. This type of balun has a 2:1 turns ratio and you could either wind your own or use a ready made one.

This type of balun is slightly more complicated to wind, hence our simpler design. The interesting point is that the turns ratio of the balun seems to have little effect on the performance of the system, as the amplifier stabilises the impedance and makes impedance matching far less critical.

The amplifier and the balun are then installed inside the jiffy box, which should be made waterproof if the antenna is to be used outside. Make sure the PCB is positioned so it doesn't touch the dipole connection terminals.

A piece of insulation could be placed between the board and the terminals to make sure.

The amplifier PCB is connected to the power supply PCB with a length of 75-ohm coaxial cable. This cable carries the signal and also supplies the DC power to the amplifier. The TV set is connected to the power supply board with a suitable length of 75-ohm coaxial cable. The power source for the regulator is connected to the regulator PCB with twin core flex. The length of the flex doesn't matter and the power source can be located anywhere that suits your installation. We used a 12V DC, 300mA plugpack.

Other aerials

As already mentioned, the amplifier can be used with any TV aerial, such as the popular 'rabbit's-ears' type. The reception with this type of antenna is usually very directional, and you'll find an effective improvement in the directional characteristics if it is used with the amplifier.

Apart from increased gain, the amplifier maintains a constant resistive load for the antenna. While this could be done by a resistor across the antenna terminals, this would cause a loss. The amplifier provides both a terminating resistance and gain to make up the loss, giving a more stable performance.

As for any balanced antenna, a balun is required to connect the antenna to the amplifier. You can use either a 300:75 ohm balun or the 1:1 type used in the active antenna.

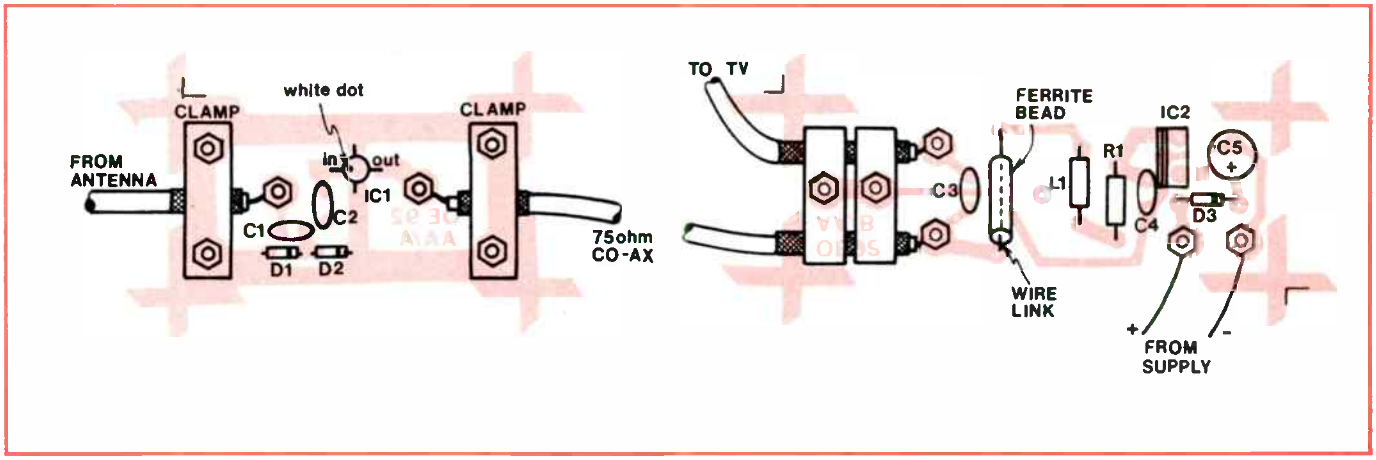
The antenna can also be an unbalanced type, such as a telescopic type. In this case, the antenna is connected to the amplifier directly with 75 ohm coaxial cable.

The amplifier can also be used with an external TV aerial, by mounting it in a waterproof enclosure as close as possible to the antenna terminals. Again a balun will be needed, although some antennas have a balun already fitted. Either of the baluns already described will do.

Masthead amplifier

The main reason for using a masthead amplifier is to improve the signal to noise (S/N) ratio at the antenna terminals of the TV set, and counteract transmission losses in the cable/distribution system.

To understand this, you need to know



The layout for both PCBs. The inner core of each cable is connected to the PCB with metal thread screws and nuts. The ferrite core is placed over the wire link on the power supply board.

Active TV Antenna

that in VHF and UHF receivers, most of the noise that degrades signal reception (causing 'snow', in the case of TV signals) actually comes from the first amplifier stage in the receiver itself. If the signal induced into the antenna is attenuated by the cable, or things like splitters, etc., before it reaches the set, the ratio of signal to noise will therefore be considerably poorer than if the signal was able to be fed directly to the set at full strength.

It's not practical to move the set up to the antenna, so the next best thing is to place a low-noise amplifier up there instead — to boost the antenna's signals *before* they (and the masthead amplifier's own noise) are attenuated by the cable and/or splitters. An example will hopefully make this clearer.

Consider an antenna that produces 200uV of signal, and a set whose tuner generates say 20uV of noise, referred to the input. If the set was directly connected to the antenna terminals, the S/N ratio would be 10 times or 20dB. However if we connect the two with a cable and/or splitter system with a loss of 6dB, the signal that reaches the set will now only be 100uV, making the S/N ratio only 5 times or 14dB.

Now let's say we connect a 20dB masthead amplifier to the antenna terminals. This will boost our signals from 200uV to 2mV, and even if the amplifier were no better than our TV set's own input stage, the S/N ratio at the input of the cable will be 20dB (i.e., 200uV of noise). So if our transmission line still has a loss of 6dB, the signals reaching the set will now be 1mV, accompanied by 100uV of noise.

When we add this noise to the 20uV generated in the set's input stage (which must be done by RMS addition, since they're both random signals), we get 102uV of noise, giving a final S/N ratio of 1000/102, or very close to 20dB.

This is obviously much better than without the masthead amplifier, and virtually the same as if we'd taken the set itself right up to the antenna. (With our MAR6 chip, the improvement will actually be much better than this again, because the masthead amp has a much better noise figure.)

The other reason for using a masthead amplifier is to increase the signal level applied to the TV set, to a value that allows the AGC system in the TV to operate. This tends to reduce the noise generated within the RF circuitry in the set.

However, remember that all signals picked up by the antenna are amplified, including 'ghost' signals.

As well, strong signals may cause overloading. Sometimes it is necessary to 'trap out' strong or unwanted signals by using tuned filters connected between the antenna and the amplifier. However, this is beyond the scope of this article.

A distribution amplifier

A distribution amplifier is generally used to compensate for the losses that occur in a system where a number of TV sets are connected via splitters to a common antenna. In this instance, the amplifier is usually connected before the first splitter. However, if this causes overload to the receivers supplied by the first splitter, the amplifier might be positioned further along the system. Sometimes, rather than go to all the work of fitting (and waterproofing) a masthead amplifier, it is practical to fit the amplifier at the point where the antenna lead enters the building.

While the S/N ratio will be lower than having the amplifier at the antenna terminals, in many cases the difference won't be noticeable. For best results, use low-loss coaxial cable (-2dB/10m) to connect the antenna to the amplifier.

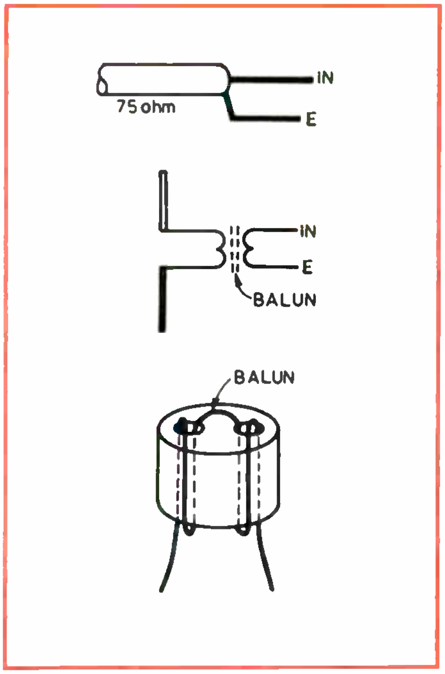


***Fig.4:** An unbalanced antenna, such as a telescopic type is connected directly to the amplifier with 75-ohm coax. Balanced aerials are connected with a balun. Only one winding is shown for clarity; the other winding is identical, but wound from the other end of the core.*

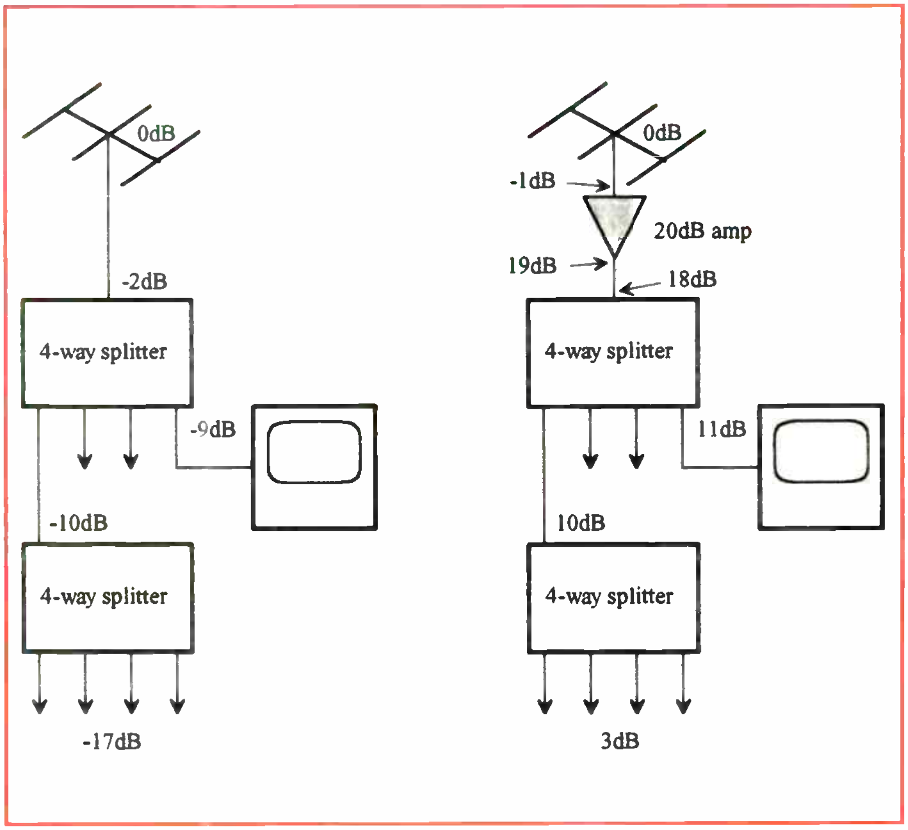


***Fig.5:** This diagram illustrates the effect of adding an amplifier to a TV signal distribution system. The diagram assumes a loss of 7dB in the splitters, a loss of 2dB in the antenna cable and a loss of 1dB in the cable connecting the splitters.*

PARTS LIST

Resistors
R1 68 ohm, 1/4W, 5%

Capacitors
C1-3 1nF ceramic
C4 3.3nF ceramic
C5 100uF, 25V electrolytic

Semiconductors
D1,2 BAW62 signal diode
D3 A14A, 1A diode
IC1 MAR6, 2GHz RF amplifier
IC2 7805, 5V regulator

Inductors
L1 15uH inductor
FB Ferrite bead
FC Ferrite balun core

Miscellaneous - amplifier
PCB coded OE 92 AA/A, 55mm x 28mm;
PCB coded 0E 92 AA/B, 80mm x 25mm;
cable clamps;
nuts and bolts;
75 ohm coaxial cable;
AC or DC, 25mA power source (7-20V DC, 6-15V AC).

Miscellaneous - antenna
3m length of plastic (fibro sheet joining strip), available from building suppliers, approx cost $3.60;
small jiffy box, 28 x 54 x 83mm;
coaxial cable for dipoles, 4m length;
nuts and bolts;
solder lugs;
silicone glue;
75 ohm coaxial cable as antenna lead.

Kits of parts for this project are available from:
Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985
Postal address (mail orders):
PO Box 89, Oatley West NSW 2223.

Masthead amplifier kit, both PCBs and all on-board components	$19.90
As above but including jiffy box, able for antenna dipoles, screws, clamps, solder lugs	$24.90
9V DC, 200mA plug pack	$12.00

To give you an idea of the improvements, let's say the distribution system has two 4-way splitters to supply seven TV outlets as shown in Fig.5. If the splitters have a loss of 7dB, the loss will be at least 14dB at the outputs of the second splitter. When combined with the losses in the transmission lines, you will probably be down by 17dB or more. A typical output at the first splitter will be probably 9dB less than the signal at the antenna terminals. Adding an amplifier with a gain of 20dB will improve the signal by this amount, giving a signal level at the final outlets that will be 3dB higher than the signal at the antenna terminals. The output at the first splitter will be increased by about 11dB.

Summary

As you can see, this whole project has many options. The circular antenna-amplifier combination gives an active omnidirectional antenna with a performance equal to a conventional high gain, multi-element TV aerial. However, it's much smaller and better suited to mobile use. As already described, it's ideal for caravans and boats, especially for those who want the luxury of TV while on the move. It could also be used as the main antenna in the home, as its wide bandwidth allows reception of both VHF and UHF signals. Because of its small size, the antenna can be more readily installed in the roof cavity. Naturally, as for any antenna, the higher the installation the better. The amplifier has a performance better than any similar design previously presented, due mainly to its improved S/N figure and its stability.

It's therefore ideal as either a masthead amplifier, a TV distribution amplifier or simply to improve the performance of a basic dipole antenna. The amplifier has a kit price of less than $20, making it not only the best one we've so far presented, but the cheapest. ❖

Construction Project:

STROBOSCOPE MK2

Although kits for it may still be available, our July 1988 design for a Stroboscopic Music Tuner is now strictly obsolete — because its top-octave synthesiser chip has been replaced. Here's a modified design, which uses the new M208B synthesiser chip. It has an additional octave, sinewave output and can be built in either a general-purpose chromatic version, or a version tailored specifically for guitar tuning.

by IAN CLOUGH

Stroboscope 2 is basically an updated version of Mark Cheeseman's Stroboscopic Tuner for Musicians, published in the July 1988 issue of *EA*, and comes with a few improvements. The first of these is the addition of the top octave, while secondly it provides a sinewave output instead of a square wave.

Any acoustic instrument will benefit from using a sinewave as your tuning reference, because most of these naturally produce sinewaves.

Squarewaves, however, are produced by the addition of odd harmonics, in inverse proportion, to the fundamental frequency and as such they can trick your ear when tuning by this method.

As with the original design, Stroboscope 2 has a visual tuning indicator which will help considerably when fine tuning — so those of you with Roseanne Barr's sense of pitch will not be left out.

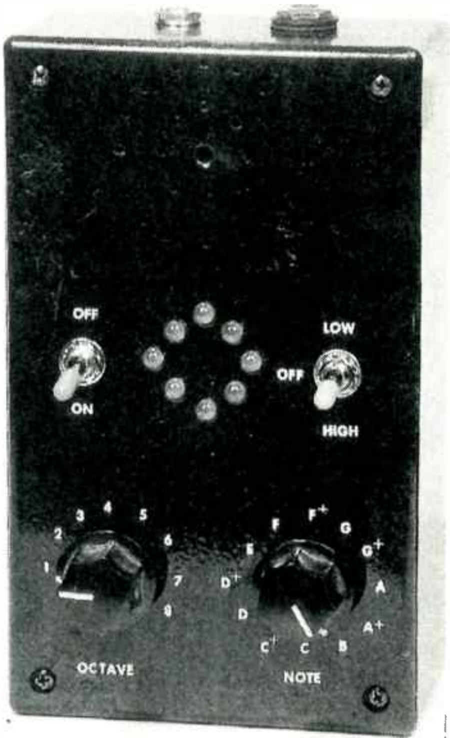
There are actually two different versions of Stroboscope 2. The first is the chromatic version, described first, and the second is the guitar version — described later.

Chromatic Version

As in the July 1988 version, the reference frequency and the unknown frequency are both fed directly to the LEDS. A circular display of eight LEDs is used for the visual comparison.

The anodes of the LEDs are driven one at a time, in sequence, by a counter running at eight times the reference frequency of the note to which the instrument is to be tuned. In this way the lights appear to chase in a circle once every cycle of the selected reference frequency. This function alone is not very informative, but it comes into play with the rest of the circuit and becomes very useful.

Now for the clever part. The cathodes of all the LEDs are connected together,



and driven by a buffered version of the incoming 'unknown' signal — from the instrument you're tuning, either directly or via a mike.

The difference between the two frequencies, known as the *beat frequency*, is accordingly displayed on the LEDs. If the frequencies are exactly the same then the display will appear to be stationary, and the same LED or LEDs will remain lighted continuously.

The LEDs are actually being pulsed at the selected frequency, but persistence-of-vision convinces us that each LED is continuously lit. If the frequencies are slightly different, then the display will appear to rotate in one direction or the other, depending on which frequency is higher. This is similar to 'Them wagon wheels a'spinnin' backwards', in old western movies.

Very low frequencies, which are not musically useful, will produce a variation on this display. But the effect is similar enough to be interpreted in the same way...

The tuner covers the full chromatic scale and has a range of eight octaves.

The circuit

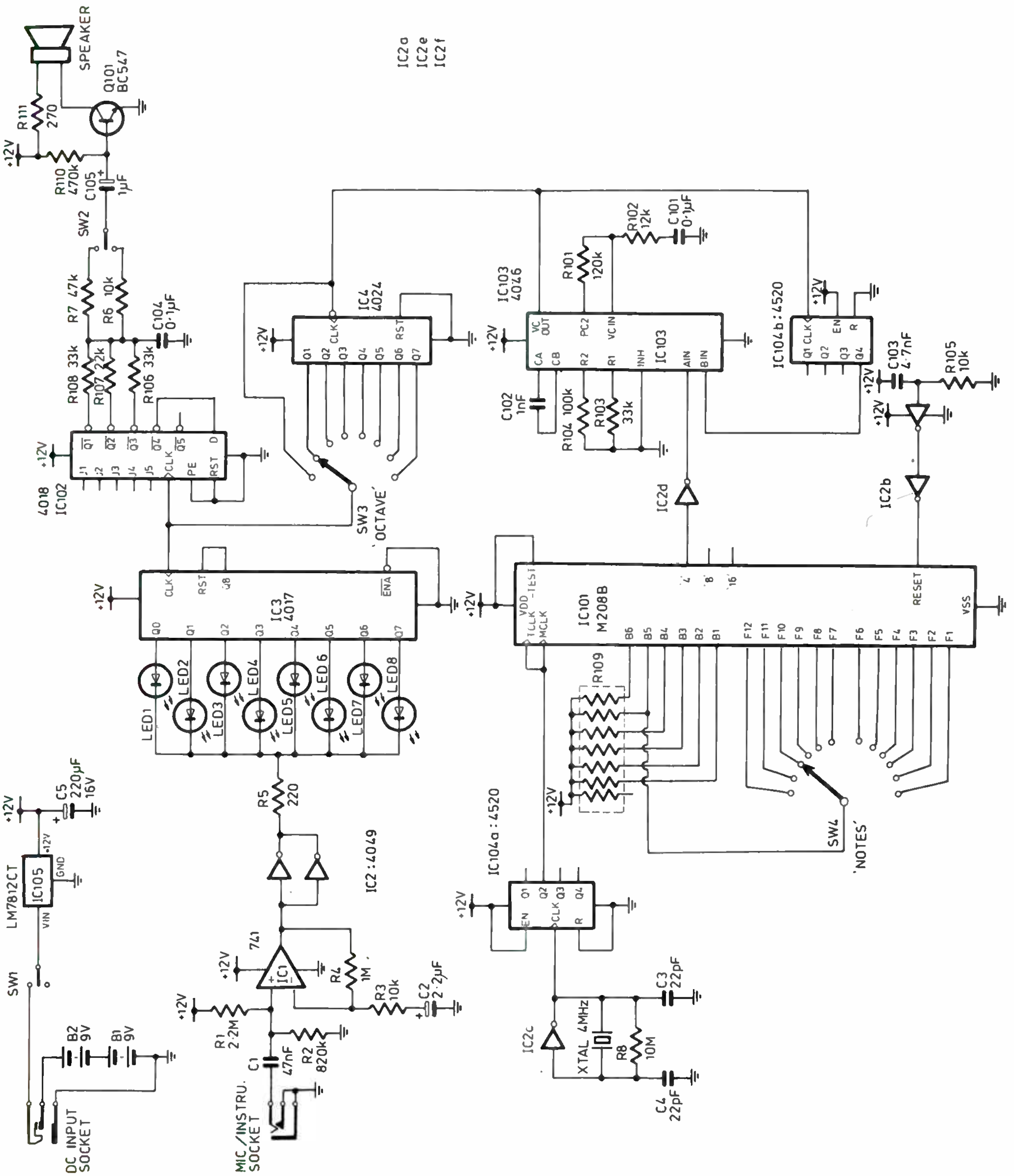
The circuit is based around seven digital ICs, a regulator, a transistor, and a single op-amp. The input signal (from a microphone, or direct from an electronic instrument) is capacitively coupled to the non-inverting input of IC1 by C1.

R1 and R2 bias the input to the op-amp to a voltage of around 3V. This ensures that the LEDs remain off in the absence of an input signal. These resistors also set the input impedance to about 500k, which is sufficient for just about any input device. R3 and R4 set the gain of the input pre-amplifier to 100, to ensure sufficient gain for low signal levels.

(Incidentally, plugging a lead in and touching the end with your finger is sufficient to get a response, as the front end amplifies induced AC hum quite nicely, and this is a quick test for the display — but it does depend on the strength of the hum.

You can also lean the lead against an insulated power cable. For a test of this, select octave 1, and you will get a slow beat between G and G#.)

High signal levels are likely to cause the input stage to go into clipping, but this is advantageous, as the brightness of the display is a function of the duty cycle of the drive to the LEDs. IC2e and f buffer and invert the output from the input



Here's the schematic for the chromatic version of the author's modified stroboscopic tuner, which uses the new M208B organ chip to generate the desired reference note frequencies. This chip replaces that in the original tuner, which is no longer available.

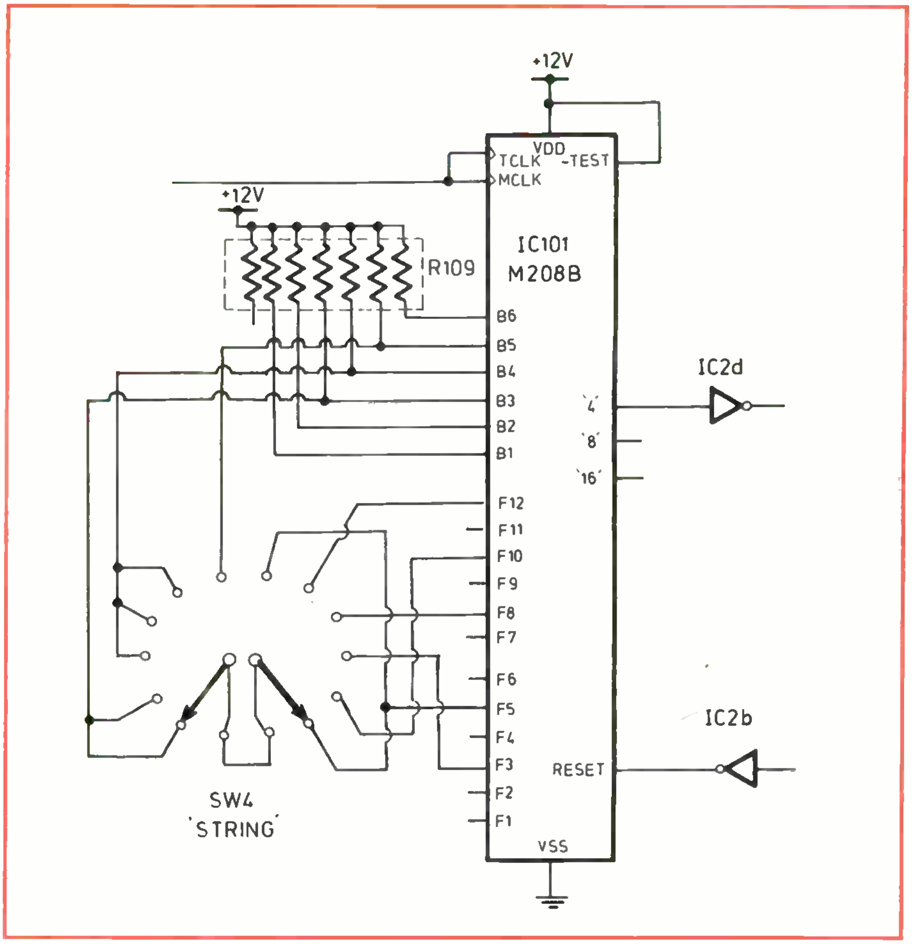
stage, and drive the cathodes of the LED display.

A crystal oscillator based around IC2c provides a stable 4.000MHz frequency reference for the circuit. R8 biases the inverter into its linear region, and C3 and C4 stabilise the system. The 4.000MHz signal is then divided by four, through IC104a, to produce a 1.000MHz reference. This is fed to IC101, which is an SGS M208B single 'electronic organ' chip — the successor to the top-octave synthesiser used in the previous tuner, which is no longer being produced.

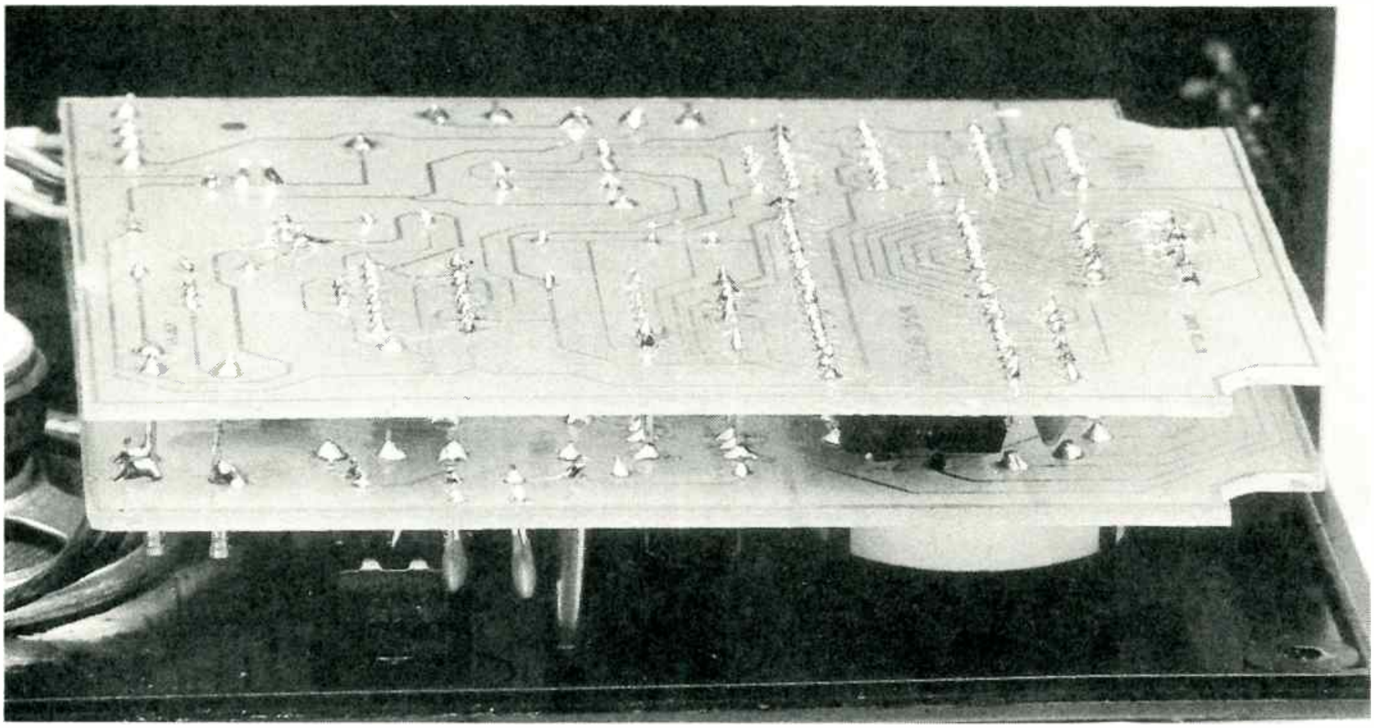
The M208B is actually capable of much more than the present circuit demands. It can produce 61 notes simultaneously and in three 'footages', plus a whole host of other functions which are beyond the scope of this article.

The notes are selected by SW4, and the 4' output of the chip is then inverted and buffered by IC2d. It is then fed to the signal input (pin 14) on IC103, which multiplies it by 16. This signal is in turn fed to IC4, where SW3 selects the particular octave required. It is also fed back to pin 3 of IC103, which is a phase comparator.

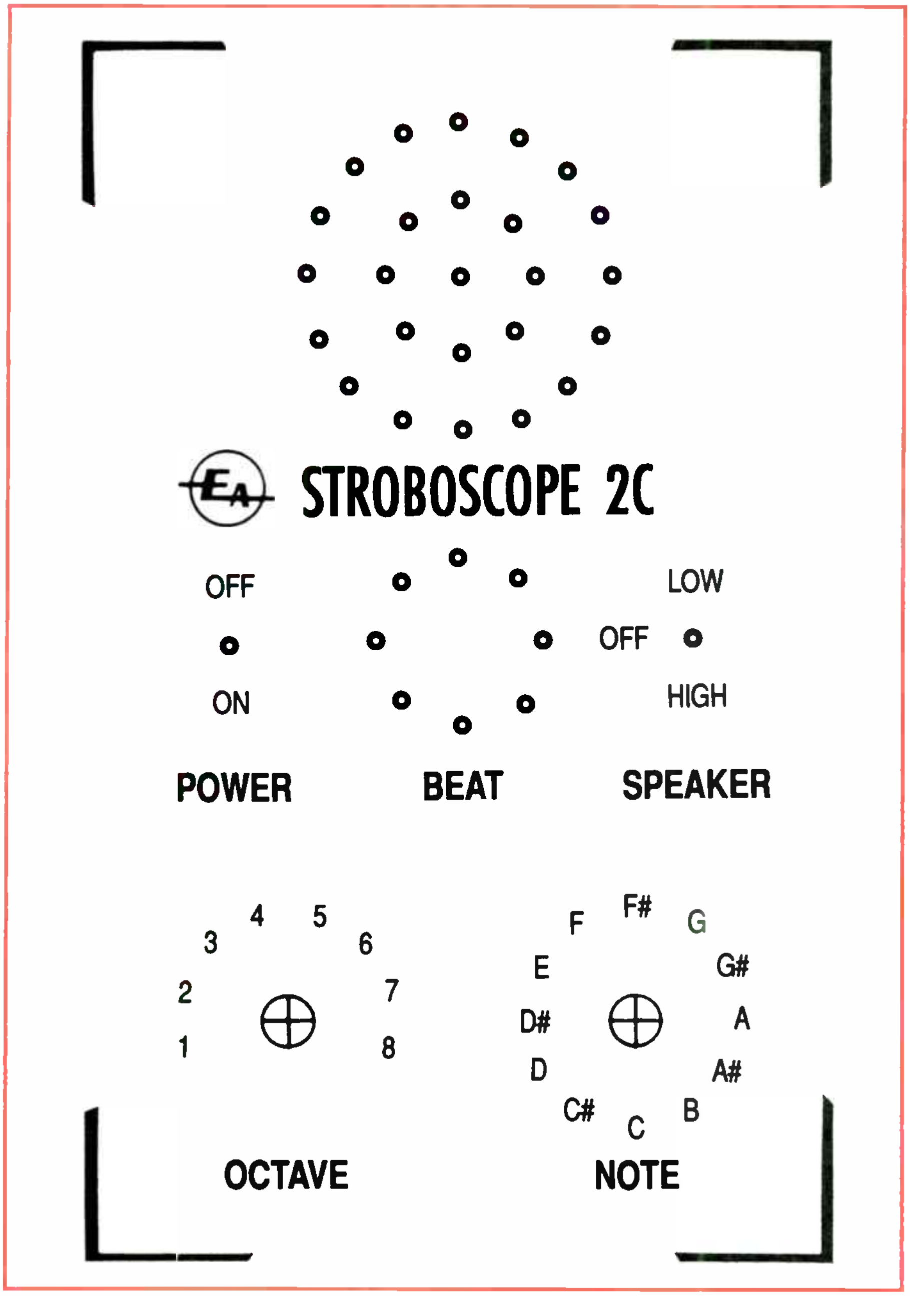
IC4 is seven-stage binary ripple counter. This means that the frequency appearing on each output is half the frequency on the previous output. The frequency appearing on the first output is half the input frequency to the IC. SW3



The guitar version of the new tuner uses a slightly modified circuit, with SW4 connected so that it effectively selects the reference frequencies on the basis of the standard guitar strings.



A view inside the author's prototype, showing the two stacked PC boards. The board nearest the front panel mounts the control switches and most of the original circuitry, while the second board mounts the additional circuitry.



Here is the front panel pattern for the chromatic version of the author's tuner, reproduced here actual size for the benefit of those who would like to make their own.

selects the desired octave by selecting one of these outputs (or the undivided input) to become the reference frequency. This reference frequency becomes the clock input to IC3 and IC102.

IC3 is a Johnson decade counter, which is programmed to decode only eight outputs by tying its reset pin to output 9. When the 9th output is decoded, this resets the chip and forces it to decode output 1 again.

A difference here, compared with the 1988 design, is that the carry-out function is not used in this version. This function is replaced by IC102, which is a walking-ring counter whose output frequency has been programmed to be the input frequency divided by eight. The low-active outputs Q1, Q2 and Q3 are summed by resistors to form a simple DAC, and produce an output which approximates a sinewave. This waveform is filtered by C104 and fed to the output stage via R6 or R7.

The output signal amplitude is determined by the position of SW2, whose common is capacitively coupled to Q101 by C105. R110 provides some biasing, while R111 limits the current provided to the speaker. Please note that the optimum value of R111 depends on Q101. A value of 220 ohms works better for BC549's, but other transistors may require adjustment of R111 for best results.

The signal produced at the speaker is the same as the cycle time of IC3, thus the audible frequency is the same as the selected reference frequency. The output is not very loud, due to the power rating of the speaker, but is quite sufficient for normal tuning of most instruments. If you need more output, though, the unit can be fitted with an audio output socket, fed from the base of Q101, which can be used to drive an audio amplifier.

IC103 is a 4046 phase-locked-loop, which has been set up as a frequency multiplier. This not a hard concept to grasp, but requires a little explanation. Basically the chip is two parts, the VCO (voltage-controlled oscillator) and the phase comparator loop.

The frequency of the VCO is determined by R103, R104, C102 and the voltage on pin 9. R103 sets the maximum frequency (determined with pin 9 at VCC), while R104 sets the minimum frequency (with pin 9 at GND), both in combination with C102. R101, R102 and C101 form the integration section of the comparator loop. The frequency of the VCO is set to be 16 times the input frequency (this provides the top octave); this is then divided by 16 by IC104b and fed into the comparator.

The comparator outputs a signal which is proportional to the difference in phase and frequency between the divided VCO signal and the input signal from IC101, via IC2d. This signal is integrated by the loop components and the resultant voltage is fed to pin 9 (VCO in). Any variation in either signal produces a corrective signal from the loop and forces the VCO to follow the signal in (pin 14).

The VCO is only pulled over one octave, a 2:1 frequency range (the other octaves are produced by IC3), but R103 and R104 allow about 3:1 due to the variations between chips. In identical circuits (without a reference signal), two different 4046 VCOs differed by 30% for the same values of components and voltages.

IC101 requires a positive-level power-on reset signal of 500us, which is produced by C103 and R105, and then buffered by IC2a and 2b.

The notes are selected by SW4 from octave 7. This produces frequencies in the range of 2093Hz to 3951Hz. When these are multiplied by 16 (a shift up of four octaves), the range becomes notes from octave 11. When divided by eight (a shift down of three octaves) at the outputs, this allows selection of notes up to octave 8. The range of frequencies is then 31Hz to 7902Hz.

Stroboscope

Last but not least is the power supply. The recommended supply voltage for IC101 is 11.4 to 12.6V DC. Testing showed that voltages below 10V DC produce disappointing results, hence the 12 volt supply.

This consists of two 9V batteries in series to provide about 18V (new alkalines will provide about 21V on no-load). This in turn is regulated by IC105, a 7812 12V regulator, and smoothed by C5. Unregulated power from a plug pack or similar, in the range of 14 to 37V DC, can be applied to the DC input socket.

Construction

The circuit is mounted on two boards measuring 88 x 102mm, coded 92strb2a and 91strb2b, which are sandwiched together with two 16-pin sockets and 7 separate pins. These provide both signal paths and structural support.

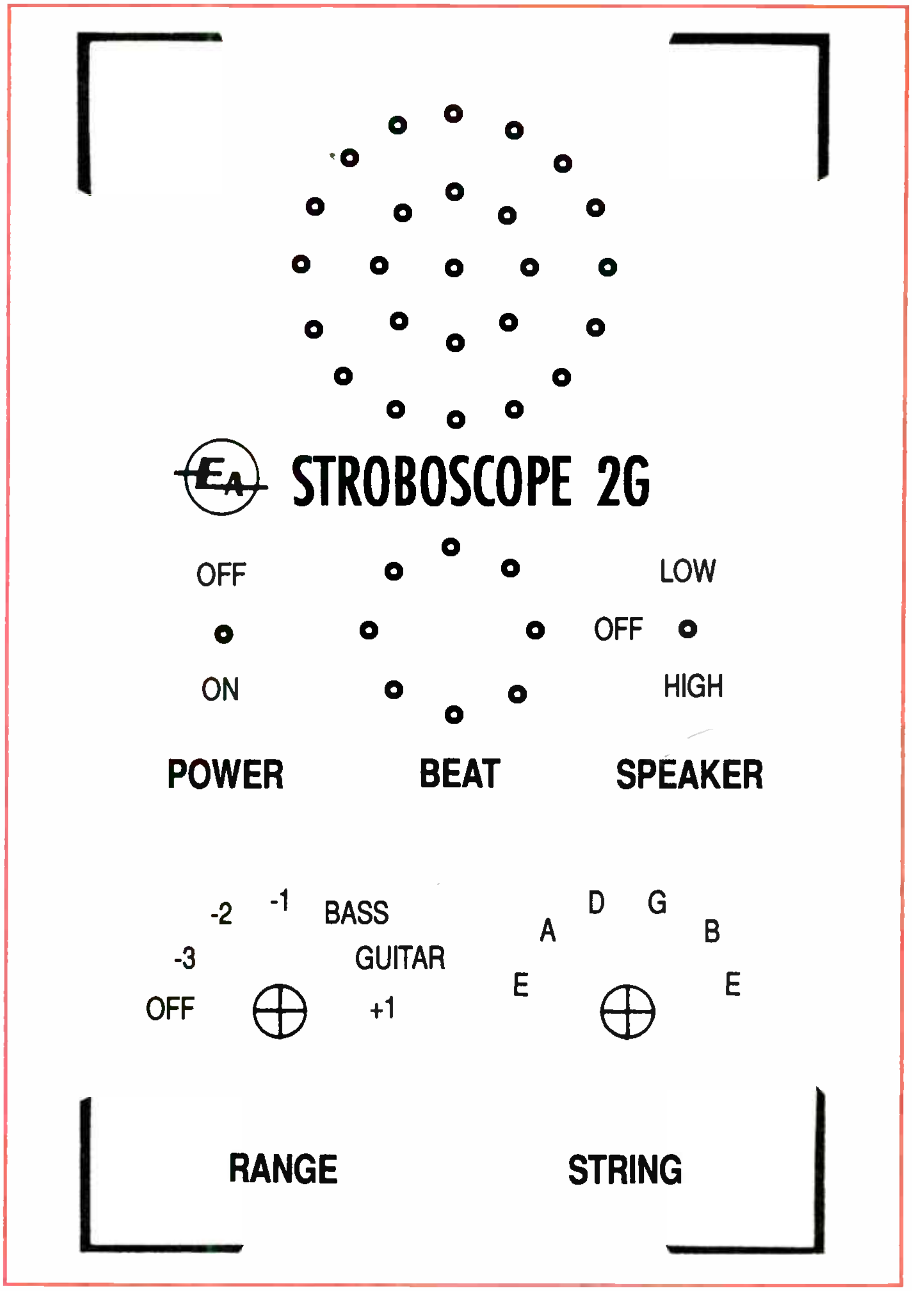
Begin by checking the boards for shorted tracks or hairline fractures. Do it before you start soldering, because they become very hard to find afterwards.

Using a round file of about 10mm in diameter, file out the bottom corners of the boards — being careful not to break the track that runs around the boards. Before mounting any components, check that the holes for the four switches and the wire wrap sockets are the correct diameter, and enlarge them if necessary. All component lead holes should be 0.7mm (30 thou), while the rotary switch holes should be 2.5mm (100 thou) and the between-board pin holes should be 1.0mm (40 thou). I would recommend using 0.7mm wire solder, as there are a few areas of fine detail, and the smaller diameter solder reduces your chances of solder bridging. Assembly of the PCB's is straightforward and is best accomplished if you complete one board before assembling the other.

Most importantly, **check the component list before you begin construction**, and if you have any components missing, get them before proceeding.

There is nothing more frustrating than discovering a missing component five minutes after the shops have shut on Saturday afternoon, and then having to wait until Monday for the part.

Starting with the bottom board (the one where IC101 goes), and keeping all standing components low profile, place the resistors and capacitors (make sure the caps are lying on their side). Next place IC105 (12V regulator) with its back on the top of the board. Place Q101 (NOT IC101!), taking care that its orientation is correct. Due to variations in pinouts between manufacturers, you may have to bend leads to make it fit.



And here's the front panel artwork for the guitar version.

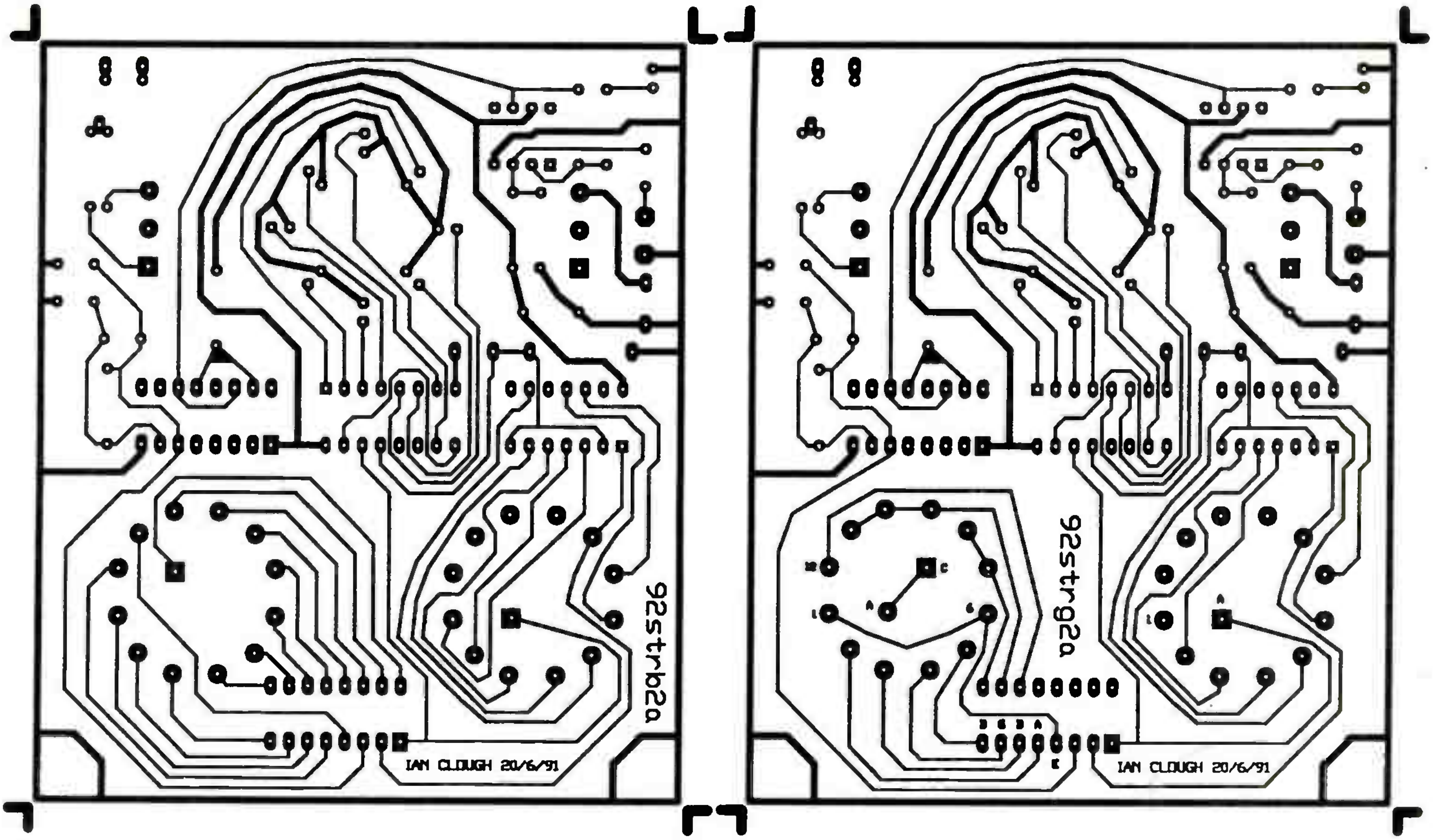
There is one link on the bottom board, located near R102. Next, taking careful notice of orientation (i.e., IC102), place all ICs except IC101. This is an expensive device, and due to space limitations, cannot be socketed. Therefore keep it in its conductive foam until it is needed. Place the 9V battery snaps, paying attention to polarity.

Now comes the top board. Place the two wire links near IC4, then the resistors and capacitors, again noting polarity. Make sure R3 and R4 are in the right positions, or you will get no gain from the op-amp.

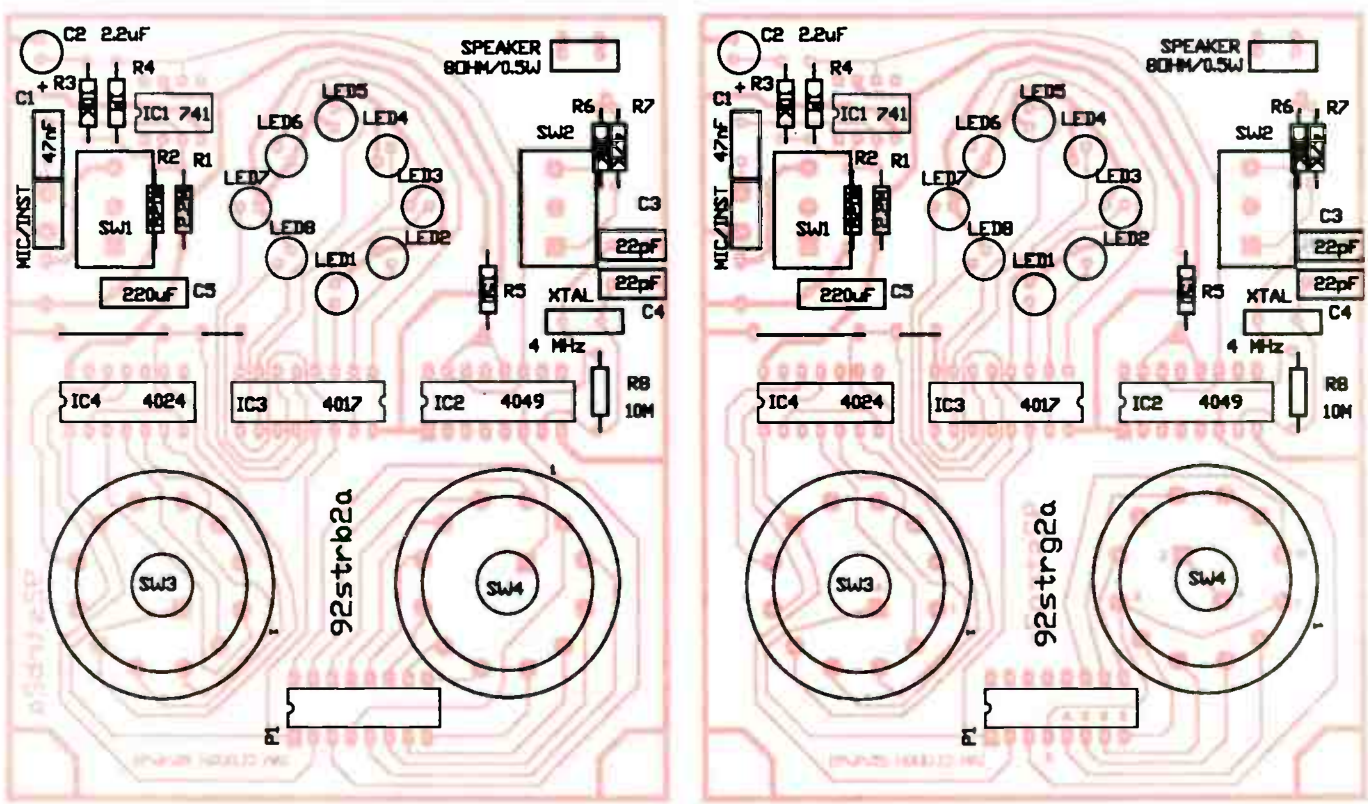
If you are going to use sockets (other than the wire wrap type supplied), on the top board, then place them now. But **do not place the two wire wrap sockets** yet. You risk bending them while inserting other components, and this will make life very difficult when it comes to joining the boards.

Place IC1, IC3 and IC4, taking note of IC3's orientation. Note that IC2 is not fitted yet — one of the wire-wrap sockets goes in this position, and it ultimately plugs into the socket. The second wire-wrap socket goes in position P1, between the rotary switches.

Do not place the LEDs yet (do you get the feeling we're anticipating your every move?). Place the crystal, then solder



Here are the two PCB patterns for the top board of both the chromatic version (left) and the guitar version (right) of the author's tuner. Note that both versions use two boards, both of which are customised for each version.



And here are the wiring overlay diagrams for each of the above boards. note that 16-pin wire wrap sockets are fitted in both cases in the P1 and IC2 positions. The long pins of these sockets are used to perform many of the interconnections between these upper boards and their mating lower boards.

wire links on to SW1 and SW2. The centre links have to be long enough to pass through to the bottom board. The toggle switch with the centre-off position goes on the right hand side of the board. Don't forget to solder all the switch connections under the top board, as these provide a signal path from top to bottom.

Next insert the two rotary switches. Both are the single-pole, twelve-position type, but the Octave switch should have its special washer fitted so as to restrict its movement to eight positions. The Note switch should not have its washer in place at all, to allow the full 12 positions of movement. The mounting of the LEDs should be left until the mechanical details are completed.

The housing used for the prototype is a plastic jiffy box, measuring 150 x 90 x 50mm. The top PCB is supported below the lid of the box by the four switches.

The 6.5mm signal input socket and the DC input connector are mounted on the top end of the base of the box. A line about 20mm from the bottom of the box is a good guide, as this leaves space inside the box for the magnet part of the speaker — which protrudes below it. It would be advantageous to drill the mounting holes before you attach any wires to these two sockets. You will soon get to join the boards together, but first comes the lid.

Using a *photocopy* of the front-panel artwork, drill all the holes on the front panel. There are quite a lot of these, due to the presence of the speaker on the panel. It is best to drill small pilot holes first, and then enlarge them to the correct sizes afterwards. You will need a 5mm hole for the LEDs, a 1/4" hole for the toggle switches, and holes of about 9mm for the rotary switches.

When all the holes are the correct size, and you are satisfied with the fit of the lid, carefully align the Dynamark front panel and stick it on. (For those of you familiar with the 1988 version, please note the extra octave and the shifting of the notes one position clockwise.) Using a sharp scalpel or art knife, cut out all the holes for the switches, LEDs and speaker.

The easiest way to mount the speaker is to use a strong adhesive and glue it to the back of the front panel. Next, insert the eight LEDs into their holes in the PCB, taking note of polarity — but do not solder them in place yet. Remove the nuts from the four switches and attach the top board to the front panel. Now line up all the LEDs with their respective holes and solder them in place one by one, so that they all protrude through the front panel by the same distance.

When you are satisfied with this stage, remove the top board from the panel, check it for shorts and proceed with the rest of the construction.

Now insert the wires that go to the signal input and DC input sockets, and the speaker, but don't connect the other ends yet.

At this point you should insert all the between-board pins, which go on the top board. It is best to use pins from an 8-pin wire wrap socket for these. Using the 8-pin wire wrap socket, carefully cut individual pins out of it. You will only need five of them. **(Do not cut pins out of the 16-pin wire-wrap sockets!)**

There are three pins near the speaker connector, and two of them near the DC input socket. The other two between-board connections are made by the long wires on the centres of the toggle switches.

NOW you can place the two 16-pin wire wrap sockets, in the TOP board. Polarity is electrically unimportant, but remember that IC2 (4049) is placed in one of them, and has its PIN 1 pointing towards SW4. The next thing is to *carefully* place IC101 on the bottom board. Do not be afraid to make a good solder joint on this IC. Simply 'waving your soldering iron near the pins' results in a bad joint, and is worse than holding the iron on the pins for the full 10 seconds recommended maximum.

You are now about to embark on an engineering feat second only to joining the two halves of the Sydney Harbour Bridge. That's right — joining the boards!

But first, make a final check that all the components are placed on the boards and all the wires to the external components are connected. Check that you have 39 wires protruding from the top board. That's two 16-pin wire wrap sockets (32), five individual wire wrap pins (37), and two long wires from the centre of the toggle switches (39).

If all is well, bring the two boards together, placing the top board directly over the bottom board. Align the pins carefully, and press the boards until about 1-2mm of pin is protruding through the bottom board. When you are satisfied that there is an even spacing around the boards, solder away.

Again when you have finished, check the bottom board for shorts. (You already checked the top board, didn't you?)

Now plug IC2 carefully into its socket, fit the completed board sandwich into the front panel, put on all the nuts, and connect the wires to the external components. Then fit the two sockets into the case, and attach the two batteries.

You may want to attach a piece of stiff card to the underside of the bottom board with blu-tack, to prevent the metal cases of the batteries from shorting connections on the bottom board. All that remains is to screw the lid on the box, and *Voila — C'est fini!*

Tuning up

There are basically two ways to use this tuner. How you do it depends on your own ability to accurately tune one tone to the frequency of another.

The first way is to use Stroboscope 2 as a tuning fork and tune the instrument by ear — though you eventually develop musclebound earlobes, from turning those heavy tuning pegs(!). If you choose this method, then you won't need the microphone input. But if you are trying this method in the presence of other noise, then it is very hard to be accurate.

The other method is to plug a microphone into the input jack and place the microphone as close as possible to the instrument to be tuned. If it is an electric guitar or keyboard etc., then you can connect the instrument's output directly to the tuner input.

Adjust the controls on the tuner to select the note to which the instrument is to be tuned, and play the corresponding note on the instrument while watching the LED display.

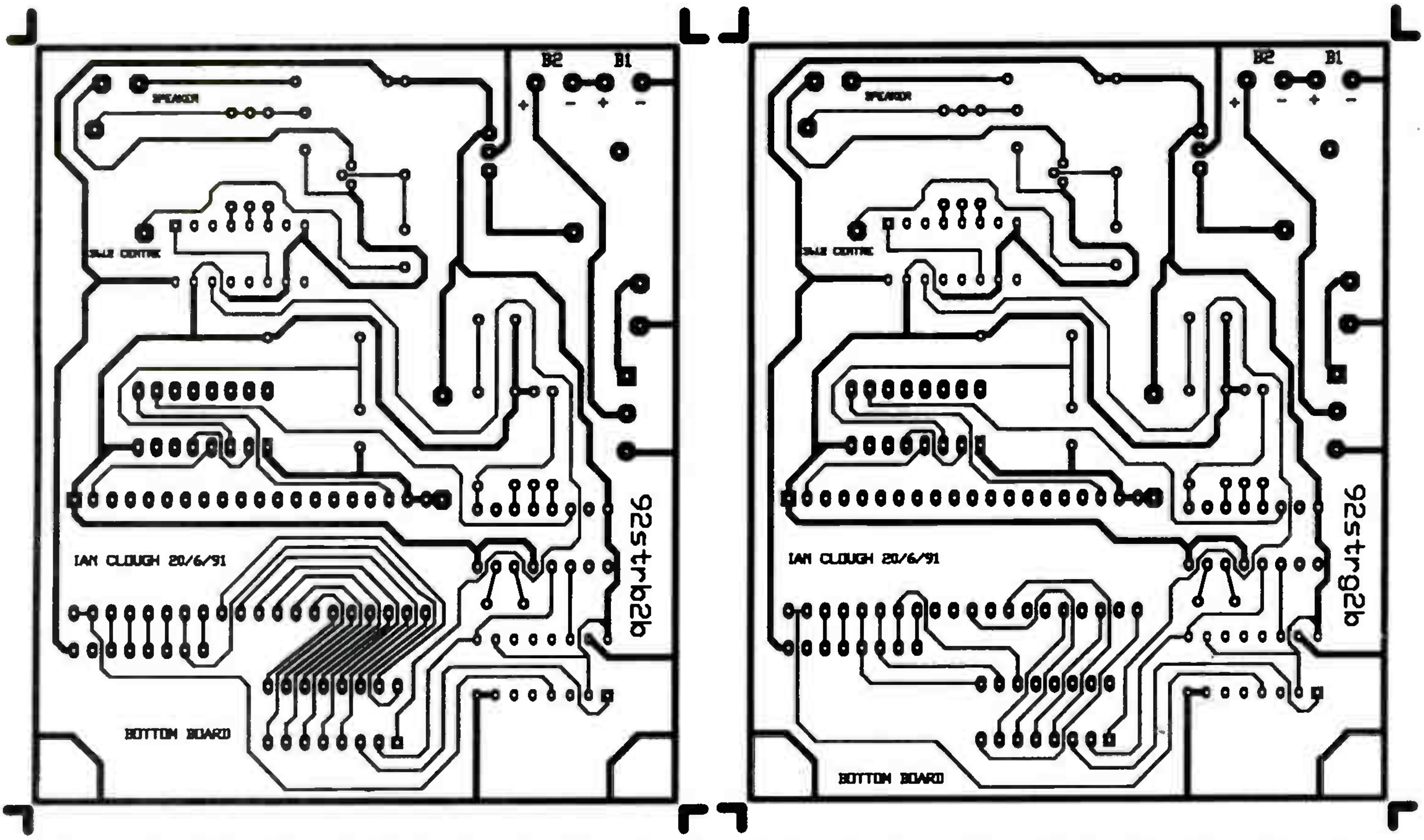
The LED display will appear to rotate either clockwise or counter-clockwise, depending on whether the instrument is high (sharp, #) or low (flat, *b*) in frequency (pitch). Now all you do is adjust the tuning on the instrument until the pattern remains stationary, or very close to it. If the signal is too low in level, then the LEDs won't light at all.

You may note that the display rotates quite fast on very low notes, even when they sound the same. In these cases, the best way to tune the instrument is to tune by ear first, and then adjust the last bit using the LEDs. Bear in mind that even if the LED display is rotating a few times per second here, the relative difference is quite low.

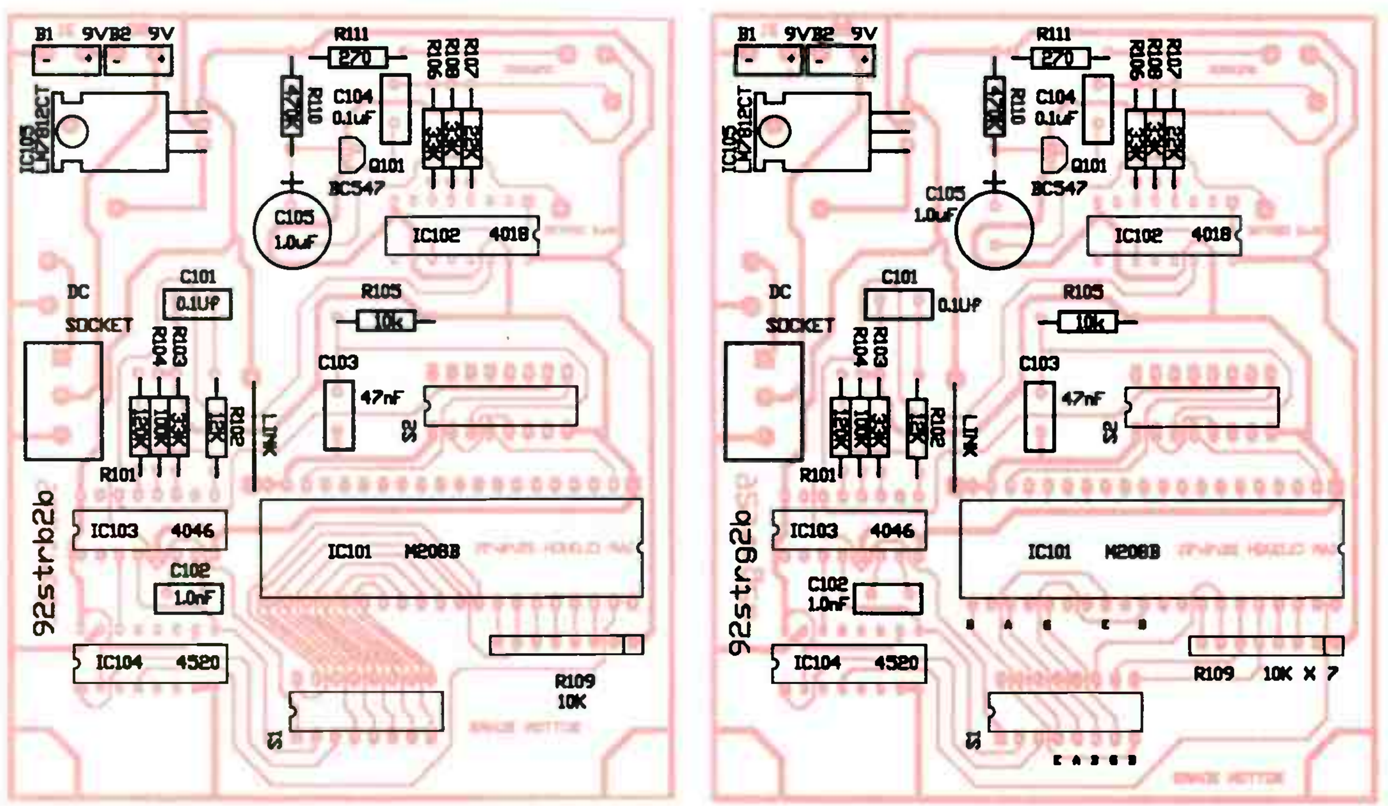
That's it!

Guitar version

During the design of Stroboscope 2, a friend of mine suggested a version of the tuner to suit guitarists — because a chromatic tuner required too much fiddling with selecting octaves as you changed strings. This version therefore allows you to select the correct note and octave with just one switch, while the



Here are the PCB patterns for the two lower boards, actual size as before. The chromatic version is on the left and the guitar version is on the right.



And finally, here are the overlay/wiring diagrams for the two lower boards. Again, the chromatic version is on the left and the guitar version on the right. Note that R109 is an in-line resistor network with seven 10k pull-up resistors.

other one is used to select between instrument ranges.

If you are building the guitar tuner option, then you will need to take note of a few differences between the two circuits, and the construction details. Basically, the differences entail different component values, and different circuit board layouts.

Firstly, the component values:

- SW3 is now a single pole, 7-position rotary switch, instead of an 8-position switch;
- SW4 is now a two pole, 6-position rotary switch, instead of a single pole 12-position; and
- R104 changes from 100k to 680k.

R104 is changed to the larger value to allow for the lower frequencies required by the guitar version. Ideally, the VCO should only be pulled over the desired octave range, but variations between devices require broader component values.

If the VCO was only pulled over the desired range, it would be less susceptible to noise in the control voltage.

In theory, the guitar version would only need to produce the notes for a Bass Guitar and a conventional guitar, but it was decided to leave the other octaves selectable for those who felt they wanted them. The very bottom octave has been deleted because very few guitars are required to shake the cobwebs out of sub- woofers. But all in all, there shouldn't be too many complaints about the range available.

Next, the construction details. Obviously you will need to get the correct pair of circuit boards for the guitar version, but there are no big surprises here. Just follow the instructions for the chromatic version, but keep in mind that SW4 is now a 2-pole 6-position rotary switch, and SW3 will only select seven positions.

The front panel is obviously different, but beyond that there are no differences in operation except the automatic selection of octave with note.

If in the unlikely situation, you find that you cannot select some notes, you may have to experiment with R104 and R103. If you have to increase the upper frequency range, place a resistor in parallel with R103. If you have to decrease the lower frequency range, place a capacitor in parallel with C102.

This is most unlikely as the values given allow for a 30% variation, but 'some mothers do 'ave em'. Above all, follow the construction details closely, make sure you have the correct components, and be patient.

Happy tuning! ❖

PARTS LIST

Semiconductors

IC1	741 or similar op amp
IC2	4049 hex CMOS inverter
IC3	4017 CMOS Johnson counter
IC4	4024 CMOS counter/divider
IC101	M208B NMOS organ chip
IC102	4018 CMOS walking-ring counter
IC103	4046 CMOS phase-locked loop
IC104	4520 CMOS dual counter
IC105	LM7812CT 12V regulator
Q101	BC547 or similar NPN transistor
LED1-8	Red LEDs, 6mm diameter

Resistors

(All 1/4W 5%)

R1	2.2M
R2	820k
R3,R6,R105	10k
R4	1M
R5	150 ohms
R7	47k
R8	10M
R101	120k
R102	12k
R103,R106,R108	33k
R104	100k
R107	22k
R109	10k x 7 SIL network (8 pin)
R110	470k
R111	270 ohms

Capacitors

C1,C103	47nF metallised polyester
C2	2.2uF 10VW electrolytic
C3,C4	22pF ceramic
C5	220uF 16VW electrolytic
C101,C104	0.1uF ceramic
C102	1.0nF ceramic
C105	1.0uF 16VW electrolytic

Hardware and Miscellaneous

2 PC boards, 88 x 102mm, coded 92strb2a, b
1 Plastic jiffy box, 150 x 90 x 50mm
1 Dynamark or similar front dress panel
1 Single pole 12-position rotary switch
1 Single pole 8-position rotary switch
2 Knobs for rotary switches
1 Miniature SPDT toggle switch (SW1)
1 Miniature centre-off SPDT toggle switch (SW2)
1 Panel mounting 6.5mm phono socket
1 Panel mounting 2.5mm power socket
1 4.000MHz quartz crystal
1 57mm speaker
2 9V battery snap leads
2 9V batteries (216 type)
2 16-pin wire-wrap sockets
1 8-pin wire-wrap socket
Assorted lengths of hookup wire, 0.7mm solder, etc.

Guitar Version:

For this version, the two PCB boards are coded 92strg2a/b (same sizes).
Also the following parts are changed:

R104	Now 680k 1/4W 5%
SW3	Now a single pole 7 position switch
SW4	Now a two pole, 6 position rotary switch

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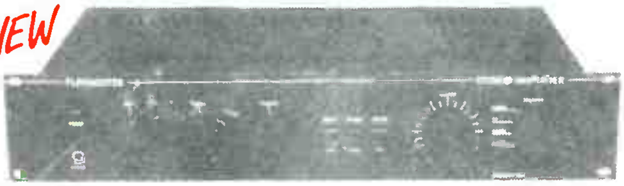

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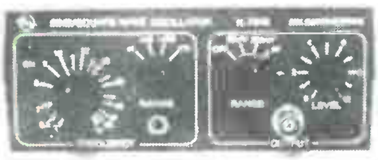

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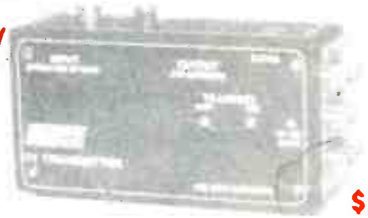

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ACTIVE CROSSOVER FOR 2 WAY SPEAKER SYSTEMS

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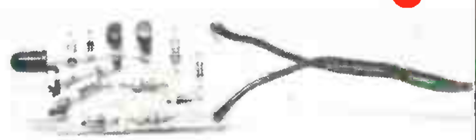

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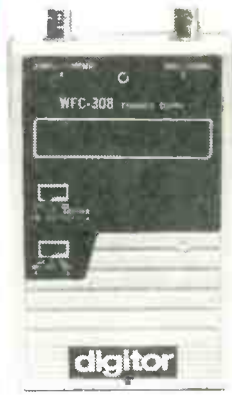

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Gate Time:	2s, 0.02s, 0.002s Switch Selectable
Read Out:	KHz or MHz
Power:	8.4V rechargeable battery or optional 12V/500mA adaptor, Cat M-9627

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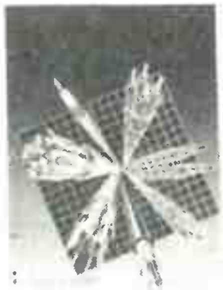

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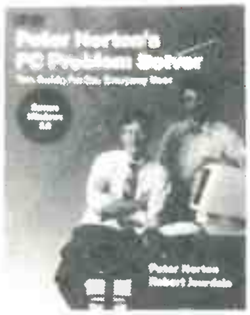

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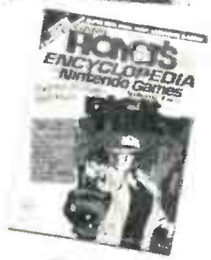

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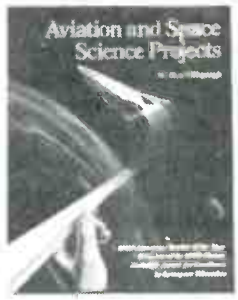

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ACTIVE CROSSOVER FOR 2-WAY SPEAKER SYSTEMS

Active crossovers have been described in many articles in the past as a means of improving loudspeaker performance. To provide worthwhile improvement over conventional crossovers, an understanding of their operation and performance goals is necessary. Some features of the crossover described here are not seen in speakers costing many thousands of dollars.

by MICHAEL M. VAUGHAN

For high fidelity sound reproduction, it is not possible to design a speaker driver which will faithfully reproduce all frequencies. Drivers are designed to cover certain sections of the audio spectrum — woofers covering low frequencies and tweeters covering high frequencies. In a three-way speaker there is also a midrange speaker, which covers a range of frequencies in the middle of the spectrum.

Unfortunately feeding all the drivers of a multi-way system with the entire audio spectrum leads to poor results. Woofers suffer from cone break-up when driven with high frequency signals. This results in distortion as well as a gradual rolling off in frequency response. Tweeters suffer from an inability to cope with the high energy signals which are present at lower frequencies. The tweeter will not be able to reproduce the lower frequency material and will be damaged by both cone over-excursion and overheating of the voice coil.

To overcome these problems, a circuit is placed between the amplifier and the speaker drivers which separates out the low and high frequency signals. Such a circuit is known as a *crossover*. For a two-way loudspeaker it consists of a high-pass and low-pass filter as shown in Fig.1. The traditional crossover uses LCR filter networks to provide the crossover function. Since no energy is added to the system this is called a *passive* crossover. The R component is considered to be the speaker voice coil, an assumption which simplifies design.

Different filter responses can be made by changing the order of the filter. In technical terms this is defined by the number of poles, but it can be determined quickly by counting the number of components in an LCR filter.

A second order high-pass filter will have one capacitor and one inductor, while a third order will have two capacitors and one inductor. The higher the order of the filter, the faster will be the roll-off of unwanted frequencies and the greater will be the complexity. A typical second order crossover is shown in Fig.2.

Such a crossover exhibits a frequency response as shown in Fig.3. For a Butterworth filter the crossover point occurs where both the high pass filter and the low pass filter are 3dB below unity. The maximum roll-off for this filter is 12dB per octave, which is adequate for most driver combinations.

Another important parameter for any crossover system is the *phase* response. An examination of the phase response for the second order crossover shows that at the crossover frequency the outputs are 180° out of phase. Thus at the crossover frequency the sum of the speakers' output is zero.

This is obviously an undesirable feature which is usually cured by reversing the polarity of one of the drivers. The hole in the frequency response is removed, but is replaced by a 3dB rise in response at the crossover point. The poor phase characteristics of the second order crossover provide a good reason for avoiding its use. Further parameters worth consideration are:

- The variability of the load. Since the impedance of a driver varies with the frequency of the signal, particularly around resonance, the load applied to the filter section is not always optimal.
- The radiation pattern produced by the speaker is frequency dependant. Unless a linear phase crossover is used, the output of the crossover

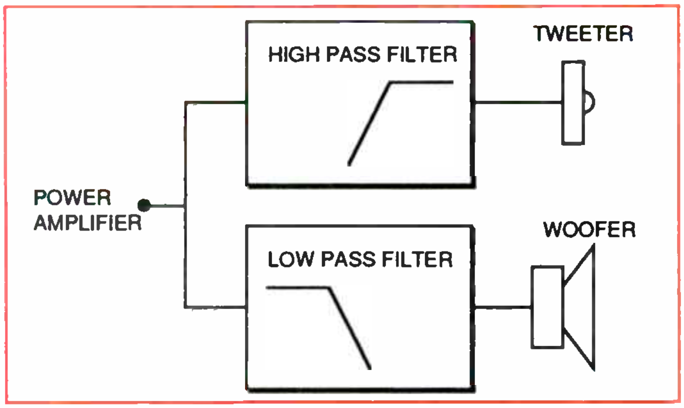


Fig.1: The signal from the power amplifier is split into two frequency bands which suit the speaker drivers being employed.

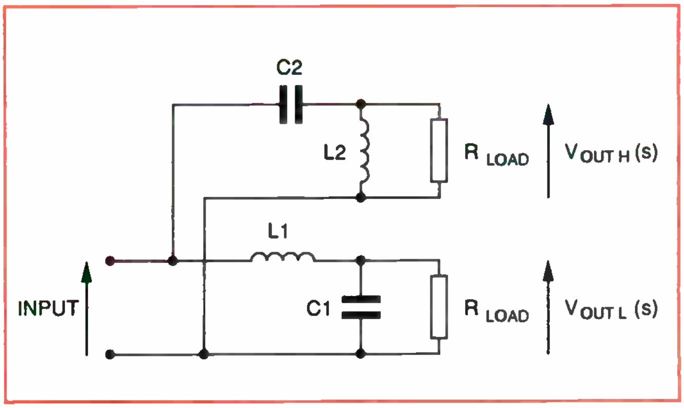


Fig.2: A passive second order crossover. The filter components are chosen as a trade off between roll-off slope and flatness of frequency response.

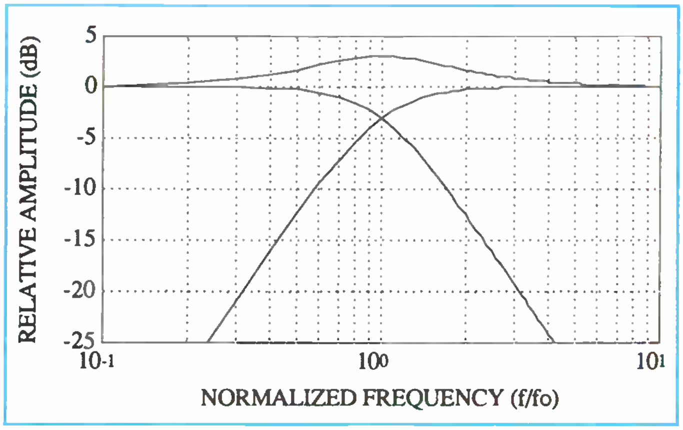


Fig.3: The frequency response of a second order Butterworth crossover. To prevent cancellation at the crossover point, the phase of one of the drivers is reversed. This results in the total response shown at the top.

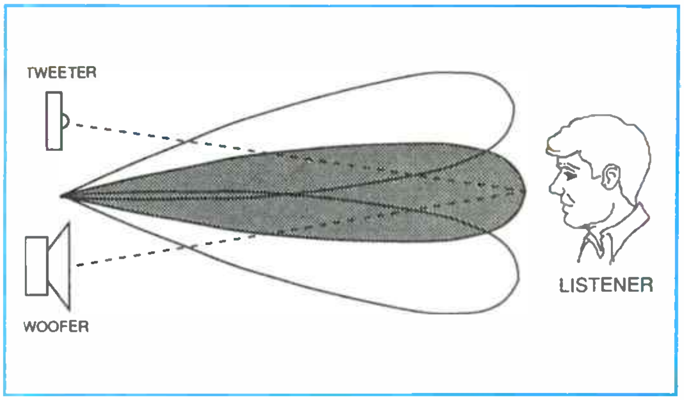


Fig.4: The signals from the tweeter and woofer add together where they are in phase, to produce a lobe. Outside of this lobe the phase shifts result in cancellation of the signal. A varying phase shift between the drivers will tilt the lobe, adversely affecting the performance of the system.

will exhibit phase errors outside of the immediate crossover region. These errors lead to the signals from the two sections partially cancelling one another.

- Transient performance. In general the steeper the slope of the crossover, the more degraded will be the transient response. A first order filter provides the best transient response performance, but provides inadequate roll-off for all but the most expensive drivers. The performance of higher order filters is determined by the Q of the filter.

An active crossover

To overcome many of the limitations associated with passive crossovers, the filter network is shifted so that it precedes the power amplifier. The crossover no longer carries the high power signals required by the drivers, which allows the use of active components such as operational amplifiers. Fig.5 demonstrates the idea.

The advantages of this topology are many:

- The active crossover works into ideal high impedance loads, rather than unpredictable reactive loads. With no unwanted interaction with the speaker drivers, the filter responses are reproduced with textbook accuracy.
- Discrepancies in speaker driver efficiencies can be compensated for without effecting any other parameters. Where one driver is more efficient than the other, the attenuation can be done at the output of the relevant filter.
- The speaker drivers are connected directly to the power amplifiers. This results in very little resistance between the voice coil and the amplifier, which dramatically improves the damping factor. An improved damping factor smooths the frequency response and improves transient performance. Anyone who has experimented with designing ported speaker enclosures will know that the resistance between the speaker and the amplifier is an important consideration when optimising the bass response.
- Complex filters can be used without being overly expensive. The requirement for large inductors and bipolar capacitors in passive crossovers makes most speaker designers opt for the simplest designs. Small signal components are relatively cheap and make active crossovers attractive for experimenting with high performance designs.

Given the freedom available with active filters, it is important to keep in mind the design goals:

- Freedom from phase shift
- Flat overall frequency response
- Optimum transient or step performance
- Adequately steep filter slopes for the drivers

The work done by Stanley Lipshitz and John Vanderkooy has shown that a class of filters exist whose output shows identical phase responses for the low and high pass sections. This is a most desirable property, as the main lobe of the loudspeakers output then shows no tilt through the crossover region. Using this configuration guarantees the first and second goals.

Essentially the phase linear network

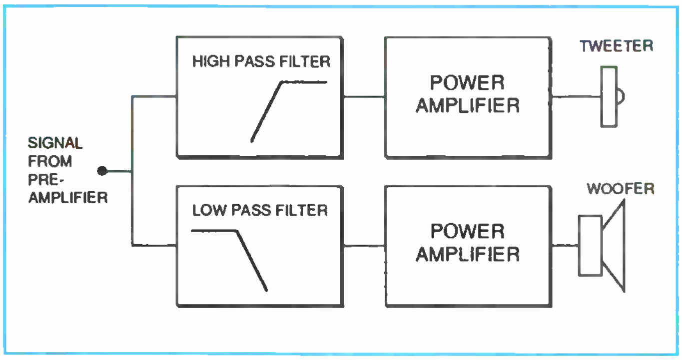


Fig.5: An active loudspeaker system has the crossover filters before the power amplifiers. Obviously the topology requires more power amplifiers, but provides substantial performance advantages.

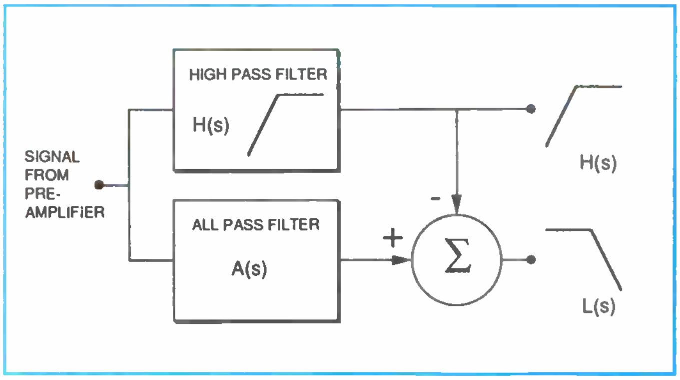


Fig.6: The low pass filter is synthesised from the high pass response. Such a design offers a flat frequency response and in-phase outputs.

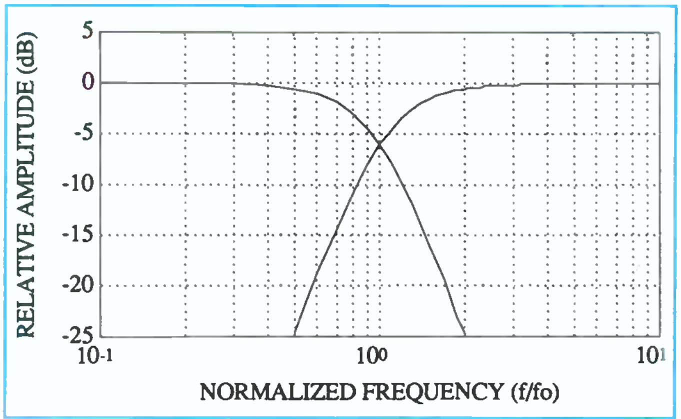


Fig.7: A fourth-order Linkwitz-Riley crossover provides slopes of 24dB per octave. The low pass filter is synthesised from the high pass.

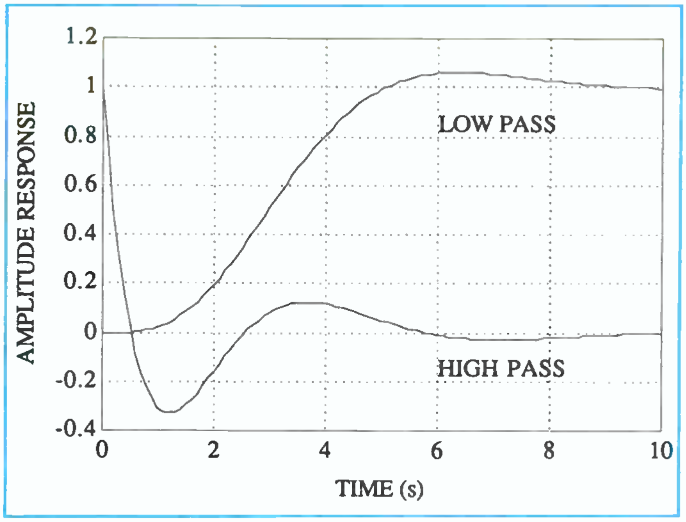


Fig.8: The step response of the fourth-order Linkwitz-Riley crossover.

uses a pair of cascaded second order high-pass filters to provide the high pass output. An all-pass filter is used to mimic the phase response of the high pass filters and then, by means of a subtraction circuit, the low pass output is derived. Fig.6 demonstrates the idea.

The most suitable filter types for this configuration are the Bessel and the Butterworth. Butterworth filters have a steeper slope than the Bessel, at the expense of a poorer step response.

The Butterworth filter is known as a *maximally flat response* filter, which means that the response in the pass band is as close to flat as any filter type can achieve. This is why it is so common in audio applications.

When two second order Butterworth filters are cascaded, the resultant filter is called a Linkwitz-Riley filter.

A Linkwitz-Riley crossover using the subtractive scheme has high and low pass filter slopes of 24dB per octave, which are steep enough for any drivers.

The frequency response is shown in Fig.7. Note that the response at the crossover point is 6dB below zero rather than 3dB. A fourth order Butterworth filter is 3dB below zero at this point, which distinguishes it from the Linkwitz-Riley filter.

The Linkwitz-Riley crossover is a popular choice with active sound systems for live bands. Adding the low and high filter outputs results in a flat frequency response and excellent polar response.

'High slopes maximise the power handling of the drivers, which is important when very high sound levels must be achieved. For those interested in making such a crossover, the component values have been included in Table 1. The step response of a Linkwitz-Riley crossover is shown in Fig.8.

For optimum performance in a home sound system, the Bessel filter is difficult to better. Some readers may know that the Bessel filter provides very good transient response at the expense of a slow roll-off rate. For this topology, where a fourth order filter is required, the slow roll-off rate is not such a problem. The slopes better those of a second order Butterworth filter and approach those of a third order Butterworth.An interesting point about Bessel filters is that the high-pass and low-pass filters do not add to give a unity response. This problem is overcome by the subtractive configuration, because the summation of the output responses will always be the same as the response of the all-pass filter.

The derived low-pass output is not that of cascaded Bessel filters, but much more closely resembles a second order Butterworth. It is however phase aligned to the fourth order high-pass. Fig.9 shows the frequency response, and Fig.10 the step response.

The high pass section has a slope of around 18dB per octave, while the low pass section is closer to 12dB per octave. Since the crossover point is 1.272 times the expected point, some juggling of the crossover frequency is necessary.

Circuit description

The circuit in Fig.11 closely follows the block diagram in Fig.6. Note that Fig.11 shows the circuitry for one stereo channel; this is duplicated for the second channel. To provide a low impedance input to the filters a buffer stage has been incorporated, using an op-amp as a voltage follower. The input impedance has been set at 10k by R1, but may be adjusted to suit different pre-amplifiers. IC2a and IC3a are configured as Sallen

CROSSOVER FREQUENCY	R2-R4	R5-R7	R8-R10
2043Hz	39kΩ	47kΩ	4k7
2415Hz	33kΩ	22kΩ	22kΩ
2952Hz	27kΩ	18kΩ	18kΩ
3622Hz	22kΩ	27kΩ	2k2

Table 1.

CROSSOVER FREQUENCY	R2-R4	R5-R7	R8-R10
1895Hz	27kΩ	27kΩ	27kΩ
2325Hz	22kΩ	22kΩ	22kΩ
2842Hz	18kΩ	18kΩ	18kΩ
3410Hz	15kΩ	15kΩ	15kΩ

Table 2.

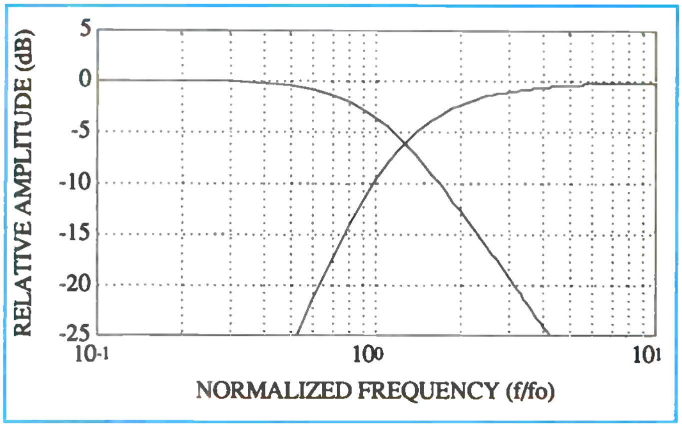


Fig.9: The crossover frequency response using two cascaded Bessel high-pass filters and a synthesised low-pass filter. Note the lack of symmetry and that the curves do not cross in the middle. The outputs do however add to give a flat response, are always in phase and have good transient performance.

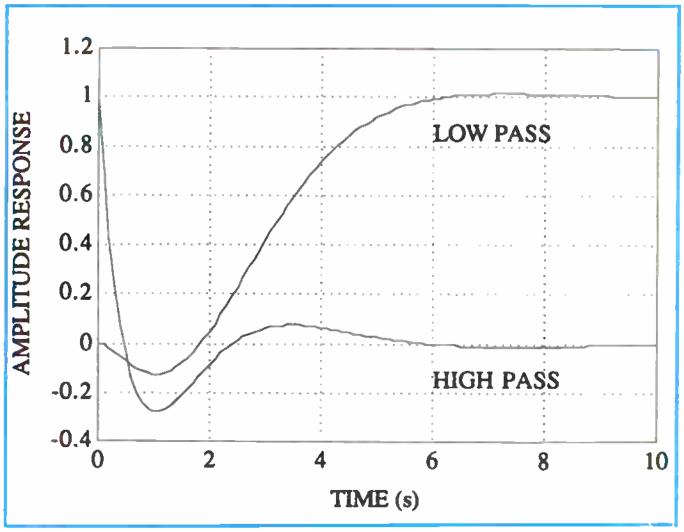


Fig.10: The step response using Bessel filters. Note how damped the outputs are for a fourth order system.

and Key high-pass filters. Since close tolerance component values are required, some resistors are made up of series pairs.

IC2b is configured as a second order all-pass active filter. A second order all-pass provides the same phase response as two second order filter sections. It should also be noted that the all-pass filter does not provide unity gain, but rather a gain of 0.25. This value depends on the Q of the filter and is 0.33 for the Butterworth case.

Correction for this gain mismatch occurs in the subtraction stage IC3b. On the output of both the high-pass and low-pass sections are potential dividers R18/R19 and R20/R21 respectively. These are used for matching the sensitivities of the speaker drivers.

By attenuating the output which will be driving the more efficient speaker driver, the overall frequency response can be made flat.

Division ratio

As an example assume that the chosen woofer has a sensitivity of 90dB for 1 watt at 1 metre, while the chosen tweeter has a sensitivity of 93dB for 1 watt at 1

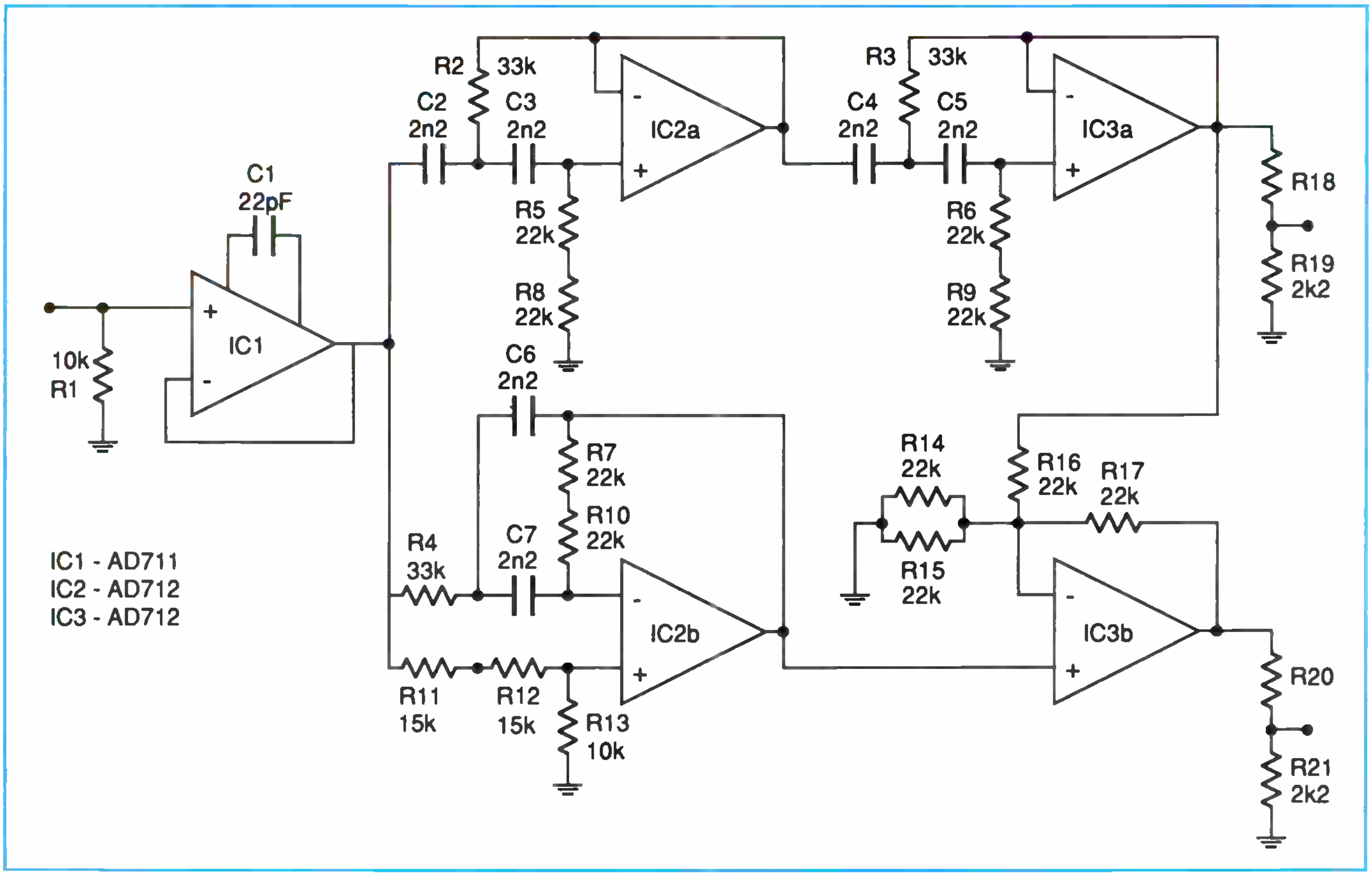


Fig.11: The schematic for one channel of the author's active crossover circuit. The high-pass output appears across R19, and the low-pass output across R21.

metre. The 3dB attenuation needs to be converted to a ratio using the following equation:

$d = 10^{(\text{-signal drop in dB}/20)}$

$d = 10^{(-3/20)}$

$d = 0.7079$

Hence the voltage going to the tweeter needs to be 0.7079 times that which is being fed to the woofer.

Another parameter is the impedance of the voice coils. For example assume that the woofer has a 6-ohm voice coil, while the tweeter has an 8-ohm voice coil. Since we are calculating the attenuation for the tweeter, the following equation is used:

$k = \sqrt{(\text{Tweeter impedance/Woofer impedance})}$

$k = \sqrt{(8/6)}$

$k = 1.1547$

The total attenuation factor is then calculated by multiplying these two constants together:

$m = d \times k$

$m = 0.82$

If this factor comes out greater than one, then it is the other driver which needs attenuation. Using the value m the resistor values can be calculated for the output attenuator. The attenuator circuit is shown in Fig.12, and as shown the upper resistor R is easily calculated:

R = (2200 - m.2200)/m, so

R = 480 ohms for this example

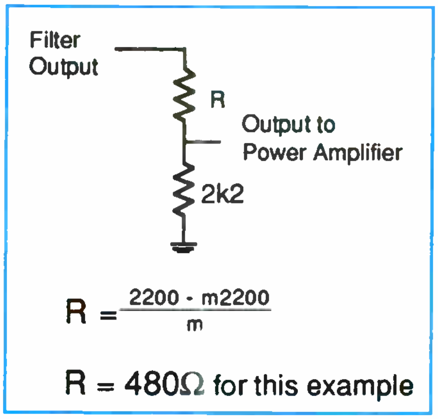


Fig.12: The value of the top resistor for each output divider is calculated knowing the desired attenuation factor 'm' (see text).

It should be noted that the output resistance of this circuit is R in parallel with 2.2k. This should be sufficiently low to make any loading by the power amplifier insignificant.

Critical components

There is little point in going to the trouble of building an active system if it is going to degrade the overall performance. It is therefore necessary to use high quality components in the audio signal path, of performance equal to or better than the power amplifiers.

The operational amplifiers and the capacitors are the most critical components, since 1% resistors are readily available. For active filters the operational amplifiers need to have high input impedances, wide bandwidths and low distortion. The universal NE5534 unfortunately has quite a poor input impedance, which makes it unsuitable with these circuits.

JFET op-amps have very high input impedances, but often have poor distortion figures. Examples such as the LF351 and the TI071 have distortion levels of less than 0.02%, which is inadequate for today's high fidelity standards.

The recommended amplifiers are the AD711 and AD712, made by Analog Devices. At a similar price to NE5534's and NE5532's, these JFET amplifiers provide exceptional bandwidth and distortion characteristics with adequate noise levels. The AD711 is a single package while the AD712 is a dual package. In Adelaide they can be obtained from Trio Electrix Pty Ltd.

All the capacitors used in the filter circuits are of the same value and should be matched to within 1% for best performance. Good quality poly-propylene capacitors are usually of close tolerance within a batch so this should not cause any problems.

Polypropylene capacitors are the best choice for audio filters and come in blue block packages. Polycarbonate capacitors are not quite as good and come in red block packages, while polyester capacitors come in green packages. Polyester 'green caps' are not recommended.

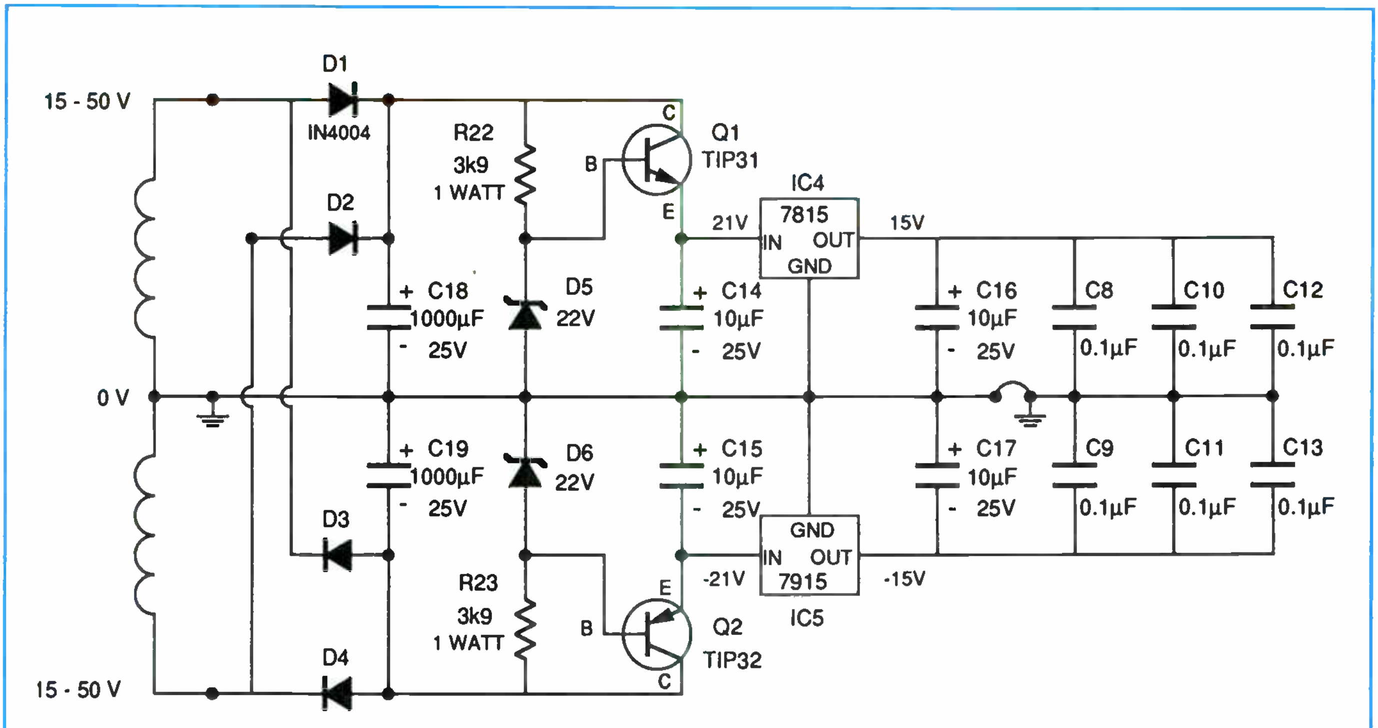


Fig.13: The power supply circuitry for the crossover. It can produce the necessary +15V and -15V for the op-amps, from either a separate transformer or from the power amplifier supply.

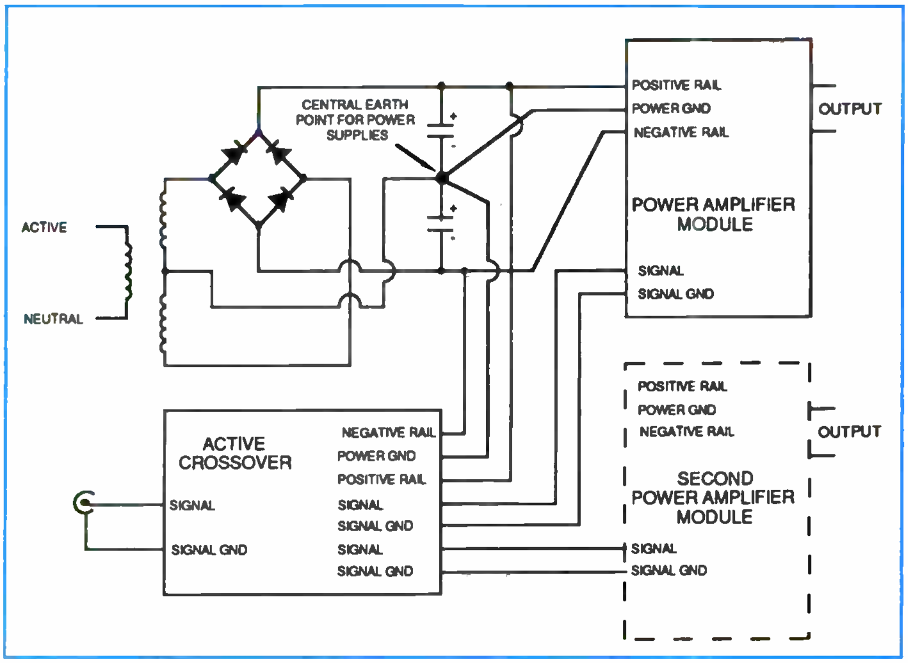


Fig.14: Wiring the crossover to two power amplifier modules. Extreme care needs to be taken with the polarity of the power rail connections. All signal connections are made with shielded cable.

Power supply

For versatility the power supply has been designed so that it will run from a separate power transformer or the power amplifier power rails. Since the current required is quite low, using the power amplifier transformer will save the expense of another transformer. The circuit is shown in Fig.13. Where a separate transformer is used, a 15V-0-15V type is required. Power is supplied to a bridge rectifier made from four 1N4004 diodes.

Two 1000uF reserviour capacitors provide smoothing. The rails supplied by this combination can be connected directly to the regulator ICs. The transistors, zener diodes and 3.9k resistors should be omitted and a link placed between the collector and emitter connections. If the power amplifier's supply is used, the rectifier diodes and filter capacitors can be omitted.

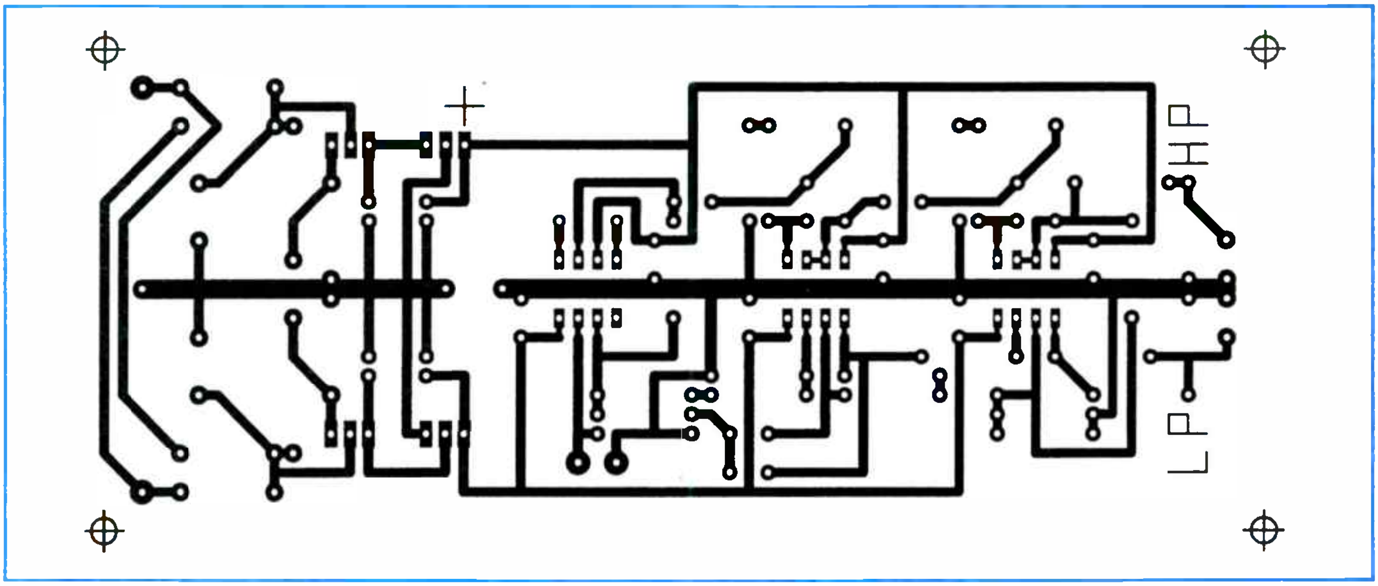
Links need to be placed across D1 and D4. A transistor has been used as a series-pass regulator, to reduce the rail voltage to a value suitable for use with a three terminal regulator. The base voltage is set at around 22 volts by a 22V zener diode and a 3.9k resistor. The 0.7V drop across the base-emitter junction means that around 21V is supplied to the regulator. For power amp transformers greater than 40V-0-40V the transistors will require small heatsinks. Capacitors are placed at the input and output of the regulator ICs to improve stability and transient response. Each operational amplifier package is bypassed using 0.1uF capacitors.

To prevent hum loops it is very important to follow the wiring diagram given in Fig.14. Hum loops are caused by taking the signal earth to the zero volt point of the power supply at more than one place. Since most power amplifier modules have their own earth return, it is important to keep the active crossover independent from the power supply earth.

Building a system

An active two-way speaker system requires four power amplifiers. This requirement may put off the faint hearted, but rest assured the improvements are quite audible. The simplest way of experimenting with active systems is to use two identical stereo power amplifiers, and build two stand-alone active filters with their own power supplies. This is the most expensive method, but it has the advantage that you don't have to build your own power amplifiers.

Another approach is to build an integrated loudspeaker system. This involves building a loudspeaker enclosure to house two amplifier modules and the active crossover. The main advantage here is saving on cabinets and power supplies. Obviously the need for neat rack-mount cabinets is alleviated, since all the electronics can be tucked away out of sight. A further bonus is that the power supply need only be large enough to run the speaker drivers as a combination, rather than independently. In effect we



.ig.15: The PCB pattern for the crossover (one channel), reproduced here actual size.

are driving four power amplifier modules from the power supply of a standard stereo arrangement.

Once the overall arrangements have been decided upon, the construction of the crossover can begin. The crossover point is the first parameter to be established. Since most tweeters cannot be driven at their resonant frequency, this is a good place to start. As an example the Vifa D25 tweeter used in the Vifa SA-100 kit has a resonance of 1500Hz. Multiplying this figure by 1.5 will give a safe crossover point with the filters described here. Filters with lesser slopes will require a higher crossover frequency to avoid driving the tweeter at its resonance.

If you are modifying speakers with known crossover points then simply choose the next highest value from the tables. Choosing a lower value may damage the tweeters. Table 1 shows the component values for building Butterworth aligned filters. R13 is changed to 15k and R15 is omitted. Note that the crossover frequency is:

$$f = 1/(19.55 \times 10^{-9} \times R)$$

Table 2 shows the component values for building Bessel aligned filters. The crossover frequency quoted is where both filters have the same output level. Note that the crossover frequency here is:

$$f = 1/(12.55 \times 10^{-9} \times R)$$

where R is R2-R4. The other two resistors R5-R7 and R8-R10 add up to 4/3 times the value of R. Occasionally this cannot be produced exactly with standard resistors. Another consideration when building an active system is isolating power-on thumps. These will be produced by both the crossover and the power amplifiers at turn on and turn off, which will not only be annoying but harmful to the drivers as well. A turn-on delay device for the amplifier outputs is probably the best solution, ideally with DC detection as well.

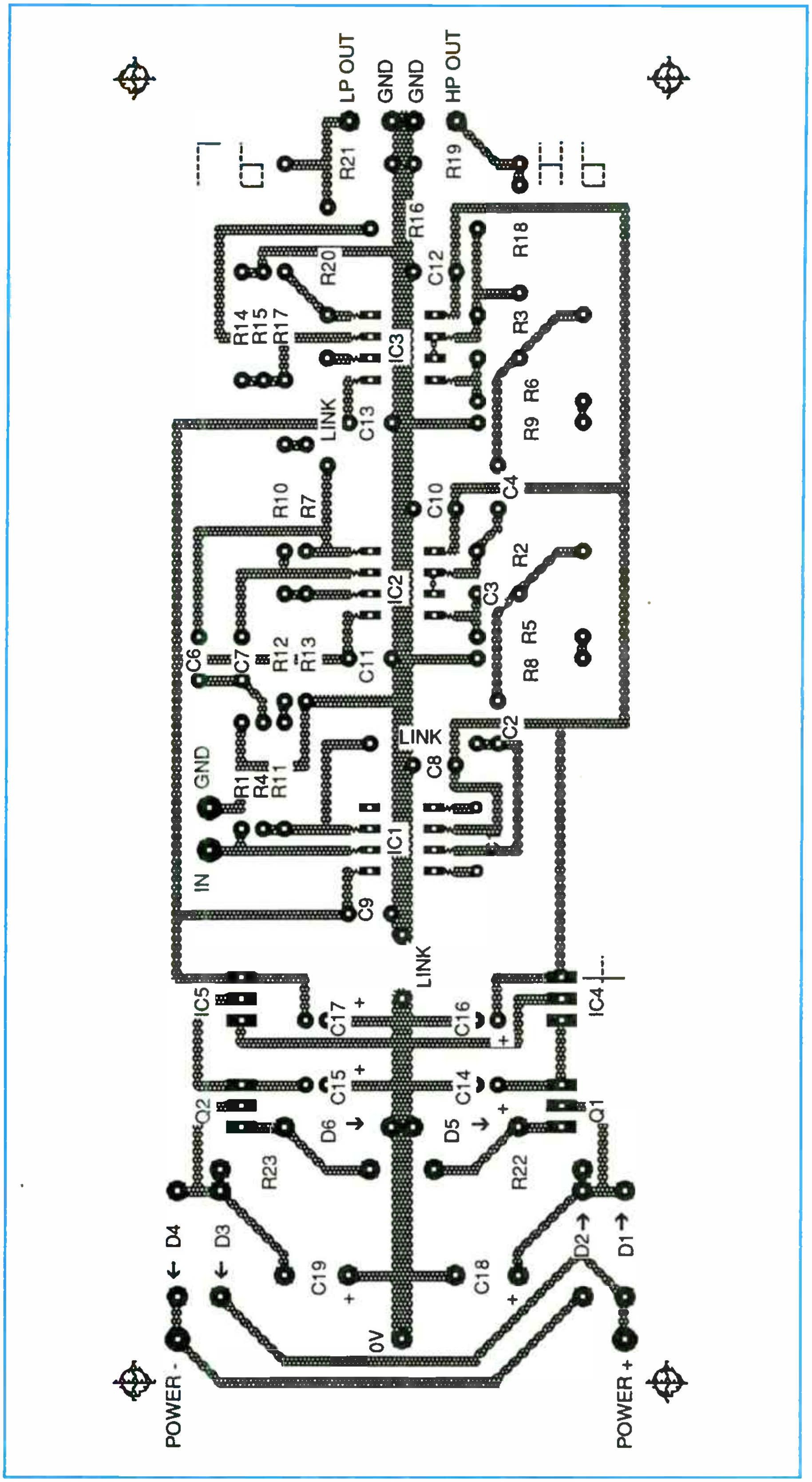
Testing

While testing the system the volume levels should be kept low. If an oscilloscope and oscillator are available, then a few output measurements around the crossover frequency will show if all is well.

The low-pass output will not work without the high pass output, so make sure the high pass filters are working first. Failure is most likely to be caused by incorrect power rails or component positioning. If everything checks satisfactorily, connect a CD player and listen to the difference. Most noticeable will be tighter transients and a smoother response.

Vocals and solo instruments will be improved significantly, especially in stereo imaging.

For organ enthusiasts the bass will be tighter, even if it won't be any deeper. Happy listening! ■



The author's wiring diagram for the active crossover PCB.

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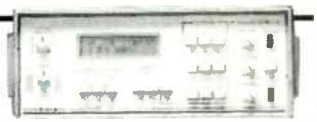

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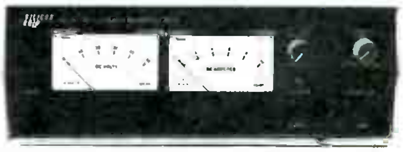


Features: • Variable output • Variable current limit • Separate Earth Terminal • Individual Volt and Amp Meters • Constant 13.8V setting • Short circuit proof
Specifications: • Output voltage 0-45V • Output current 8A @ 35V, 6A @ 40V • Load regulation 1% • Ripple and Noise 40mVp-p at 8A 35V • Current limit 800mA-8.6A • Over current limit 9A • Foldback current less than 2A

Video to TV Transmitter

(SC Dec '91)

Watch the Video from any Room in the House! No Wires

This TV transmitter enables you to transmit signals from the output of your VCR to a second TV set in the house without messy splitters and cables. Two versions available for videos with UHF or VHF outputs.

K 5860 UHF Version
K 5865 VHF Version **$74.95**
NEW FOR '92

Baby Room Monitor

(S.C. Jan '91)

K 1180
$24.95

NEW FOR '92

This Baby Room Monitor allows you to listen to your baby from a remote location using a conventional FM receiver. It runs from a single 1.5V AA battery and includes a muting facility so that it only transmits sounds above a certain level.

Low Voltage Cut-Out for Cars and Boats

(SC Jan '92) *NEW FOR '92*

Build this simple little device, and avoid getting caught out with a flat battery during your holidays. It simply connects into a 12V accessories power line, and shuts off the flow if the battery voltage drops to a dangerously low level. Ideal for battery powered camping fridges etc. Adjustable Cutout Variable from 10.9V to 11.9V. Includes Automatic or Manual Voltage Reset Function.

K 4328 **$24.95**

Digital Altimeter for Gliders and Ultralights

(SC Sep/Oct '91)

This compact digital altimeter can display altitude up to 19,990 feet with 10 feet resolution. Accurate to better than 3.5 percent. A must for hang-gliders, ultralights etc. Operates on 9V battery.

K 2580 **$299.00** *NEW FOR '92*

Infra-Red Light Beam Relay

(SC Dec '91)

This simple project allows you to monitor a doorway or a path using an infrared light beam. When someone walks through the beam, it triggers an alarm for a 1 second period. Ideal door monitor for shops or for security around home or office. Requires 12V DC plugback (M 9002).

K 1920 **$32.95** *NEW FOR '92*

Low Cost 'Karaoke' Adaptor

(EA Nov '91)

It's time to bring out all those hidden vocal talents that you've always known were there. With this project you can remove the lead vocal from almost any recording, and replace it with your own via a standard microphone. It's a great way to liven up a party!

K 1170 **$34.95** *NEW FOR '92*

240V Power Relay

(EA Jan '92)

K 6070 **$59.95**

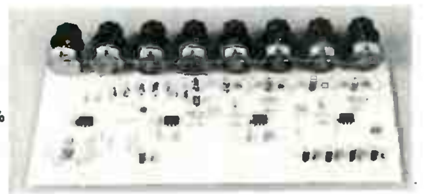
Activate all Your Hi-Fi by Turning on just the Amplifier!

Here's a simple project that monitors the power drawn from a 'master' socket and automatically switches on a 'slave' socket. It is versatile, because it can monitor one or several appliances plugged into the 'master' and switch on one or several devices plugged into the 'slave'. Ideal for Hi-Fi's or computers with peripheral hardware.

4 Channel Guitar Mixer and Preamp

(SC Jan 1992) *NEW FOR '92* K 5535 **$49.95**

This unit features separate bass, midrange and treble controls, very low noise and distortion, separate input level controls plus an output level control. Ideal for use with most musical instruments from keyboards to guitars to tape decks. In fact, you can feed it with just about any audio signal — it's not just limited to guitar outputs.
• **Distortion:** (at 1kHz and 100mV Input) less than 0.0075%
• **Frequency Response:** 18Hz-35kHz (+/-3dB).
The kit includes PC Board, potentiometres, input sockets and all specified components. The kit does not include the optional ground plane, nor the 15V power supply board.



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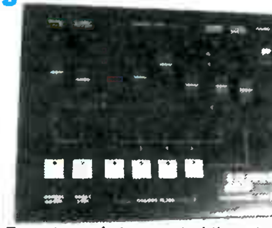
ALTRONIC COMPONENTS

New 4-Channel Lighting Desk

(SC June/July '91)



Make your stage production a professional show with this new Lighting Mixer. Ideal for amateur theatre groups bands etc.

This 4-channel lighting desk is intended for theatre, disco and music group applications. It has heavy duty circuitry and is able to cope with spotlights rated up to 1000 watts or more. It has been designed and built for the rigours of commercial use. You can flash each channel up to any brightness as set by the 'Flash Master' fader. Similarly, the 'Channel Master' control fades all lights up or down, to or from their individual fade settings. Two chaser faders control the rate and lamp brilliance when the unit is operated in chaser mode. The lights can be flashed to full brilliance or to an intermediate setting as set by the 'Chaser Master' fader.

K 5815 **$329.00**

2 Way Active Crossover

(E.A. Jan '92)

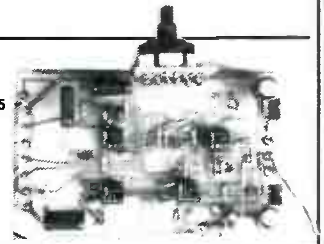
This great new kit enables you to customize your sound system in your car or at home. The circuit simply connects between the audio source and the amplifiers. There are two outputs, one for bass and another provides signal for the upper range. Thus each amp is dedicated to a frequency range (i.e. one for bass, one for midrange and treble). Because no passive crossover is required in the speaker one per channel is required. Operates on + and -15V rails. The result is much better sound with less distortion.

K 5570 **$19.95**

Surround Sound Decoder

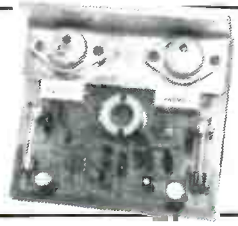
K 5585 **$39.95**

(E.A. Jan '92)



Build this new surround sound processor and envelope yourself with the stunning realism and dramatic sound impact available from surround-encoded videos or TV transmissions. It can also enhance conventional stereo, by providing a rear or 'ambiance' channel.

50W Mosfet Module



50 Watts RMS into 8 Ohms. This great module features moderate power output at low harmonic distortion. Simple to build and compact in size this unit makes a great replacement module for your old Hi-Fi or buy two and make your own stereo amplfier.

K 5115 **$49.95**

Stereo 50 + 50 Watt Midi-Style Amplifier

(SC Feb and March '92)

Replace That Old Beaten Up Amp!

This fantastic new amp has all the features of commercial units costing hundreds of dollars more using tip 142/147 transistors it is capable of producing a total of 50 Watts per channel RMS. Into 8 Ohms makes an ideal replacement midi unit.

Performance:
Output Power: 55W into 8 Ohms, 80 watts into 4 Ohms
Harmonic distortion: less than 20Hz to 20kHz

K 5045 **$299.00**

0-30V Power Supply

(EA Jan '85)

K 3210 **$109.00**

Features: • Variable Output • Short Circuit Protected • Full 1 Amp Available • Variable Current Limit • Separate Earth Terminals • Dual Scale Meter • 3-30V to 1 Amp Max with Variable Current Limit • Output Current: 0 to 1 amp • Load Regulation: 0.2% Max • Output Ripple: 2mV RMS Max.

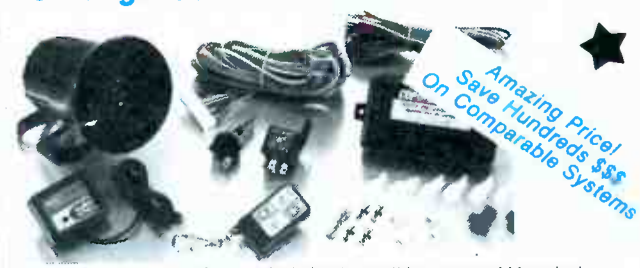
High Energy Ignition System

(SC May '88)

This "state of the art" electronic ignition system uses the same semi-conductors as found in modern motor cars. Extends the life of plugs and points. Increases power and improves fuel economy. Compatible for 4, 6 and 8 cylinder engines. Install one into your car and start saving $$$ from the very first day.

K 4015 **$58.50**

New High-Tech Remote Car Alarm



This amazing new model features just about everything you could imagine! Multifunction keyring remote control will arm and disarm alarm (and activate central locking if fitted), chirp the horn, turn on car headlights, panic and even open the boot (if actuator fitted). One remote can control two alarms.
Other features include: Starter inhibit, valet mode, central locking interface, flashes car indicators when tripped, auto reset plus much more!

S 5230 **$249.00**
S 5231 Replacement Remote Control **$48.50**

DIRECT IMPORT PRICE

Economy Alarm Panel

For Homes and Small Commercial Premises

This is a 3 zone alarm control panel designed for the protection of homes and small commercial premises. It employs the latest advanced electronic circuitry offering the highest degree of quality and reliability. It will accept either active or passive normally open or normally closed sensors making it both a versatile and effective protection system. 12V battery charger inbuilt. See Altronics '92 catalogue for full details.

S 5480 **$139.00**

Flush/Surface Mount Alarm Panel

With stylish compact good looks this alarm blends smoothly into any residential or office decor by either flush mounting into the wall, or surface mount. 3 sectors include 24 hour panic/fire, perimeter and internal which can be isolated enabling the alarm to be armed at night with occupants inside whilst still protecting entries. simple 4 digit access code for operation. See Altronics '92 catalogue for full details.

S 5490 **$119.00**

UHF Microprocessor Controlled Wireless Security System

Apart from the flawless operation of the system one of the great features is its application with rented or leased premises — let's face it, money spent on installing a wired system in your home or office, factory, etc is irrevocably lost when you move on. With this system you simply take it with you. Ultra high-tech and push button operation makes this unit a breeze to install and operate. Features 6 sectors plus 2 x 24 hour fire and tamper circuits. The **S 5240** system includes main controller, 1 Passive Infra Red Movement Detector, 1 window or door Reed switch, wired siren, power supply, back-up rechargeable battery, and a special personal remote. All sensors are radio transmitters which means no wiring is neccessary (except for the plug pack and siren). The whole system is coded so it can not be interfered with and can be changed any time by the owner. Each individual sensor can be easily set to operate on any sector. The main controller utilizes latest EEPROM technology which means things like selecting user on/off codes, isolating sectors are a breeze. Includes a myriad of other amazing features, too many to mention.

Call ALTRONICS today for a free colour brouchure.

Complete system includes:

- 1 x Control Panel
- 1 x Passive Infra Red Detector/Transmitter
- 1 x Door/Window reed Switch/Transmitter
- 1 x Hand Held remote Control/Transmitter
- 1 x Horn Speaker — 10 watt/wired
- 1 x 240V AC adaptor
- 1 x 1.2Ah Back-up Battery
- 1 x Set of batteries for all transmitters

S 5240 Complete System

Only **$679.00**

External Siren

C 2015 **$15.95**

Door/Window Reed Switch & Transmitter

S 5247 **$72.95**

Personal Remote S 5250 **$62.95**

Wireless Remote Keypad

S 5255 **$135.00**

Passive Infra Red Movement Detector

S 5245 **$155.00**

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Vintage Radio

by PETER LANKSHEAR

A really fine collection!

One of the finest collections of vintage radios I've seen has been assembled by pioneer collector Ray Knowles of Hastings, New Zealand. Recently, on behalf of *EA* readers, I was privileged to be able to photograph and discuss with Ray some of his treasures.

Some vintage radio collections emphasise a particular theme — concentrating on an era, a type of receiver, on one manufacturer, or even one country. Ray Knowles' interests have been described as 'eclectic' and consequently there is plenty of interest for everyone.

First off, I asked Ray how he came to start collecting. Like many who grew up in the austerity of the late depression and World War II period, he was, as a youngster, restricted in pursuing his radio listening interests. One longstanding ambition had been to own a really good shortwave receiver, with reasonable audio quality.

Eventually, in 1976, he purchased a multiband radio — but found its performance disappointing. Then in a secondhand shop he discovered a loctal valve receiver, made by AKRAD about 25 years previously. Here at last was a radio that met his expectations.

With the realisation that older receivers could be superior to their more modern counterparts, and that he could now afford some of the radios that he had admired as a boy, Ray became interested in early radio equipment. This was the era when colour TV and solid state home electronics were becoming established, and the repair of valve radios was discouraged by an industry eager to sell the new technology.

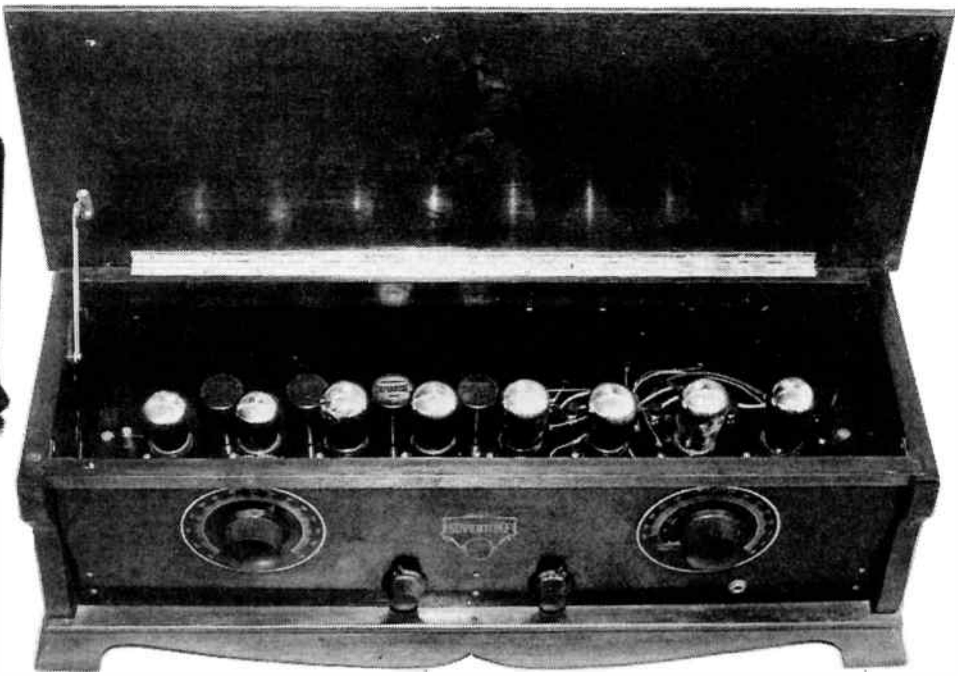
Radios given away

Fifteen years ago 'old radios' could often be had for the asking. They were in little demand, and even the simplest of repairs cost more than a receiver was worth. Faced with the alternative of dumping them, owners were only too happy to give their radios to a good home, and Ray soon found that he had the genesis of a radio collection.

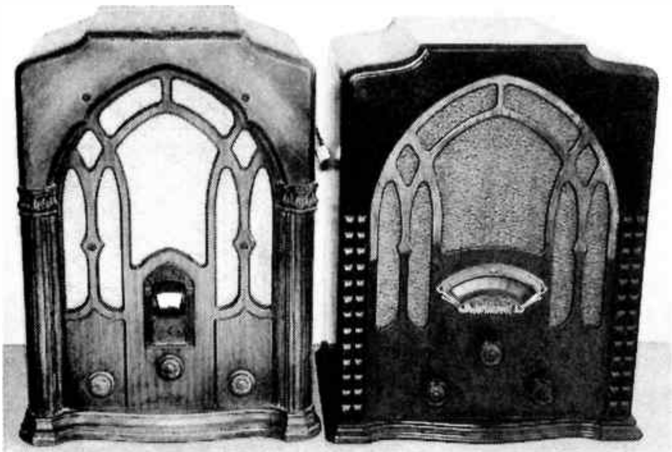
Visits to auction sales and second hand

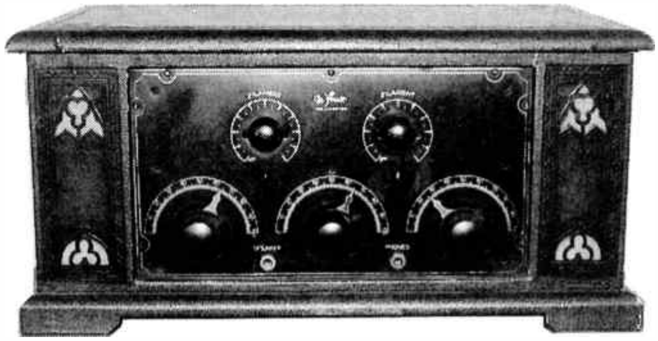
The oldest radio in Ray's collection: a British General Electric 'No.1' crystal set, dating from 1922.

The shot at left shows just one corner of Ray Knowles' magnificent collection. At right is an Atwater Kent model 447, a high performance seven-valve four band mantel set which is one of Ray's favourites, and represents AK designs at their best.



Above left: a fine example of an AWA model 24 Radiolette mantel set of 1934. Along with the model 27, it was the first in this well-known series of reflexed superheterodynes. There is no dial light; the pointer moves in front of the dial scale. Above right is a very rare Supertone eight-valve battery superhet of the 1920's, made by the Buckwalter Corporation and with double-acting Remler tuning capacitors with brass vanes that open like the wings of a butterfly.





The two similar-looking sets at left cover four countries: the one on the left is an American RCA with a British HMV label, which almost certainly inspired its companion — a Pacific made in New Zealand in 1934, but with a cabinet made by Australian firm Ricketts and Thorpe in Sydney! At right is an impressive-looking five-valve TRF set of 1925 which carries what was then a prestige brand name: the De Forest F5 Radiophone.

shops provided further additions, many of them classics. Others were obtained by approaching and negotiating with their owners. Now, 15 dedicated years later, the impressive Knowles collection contains many rare, interesting and historic receivers.

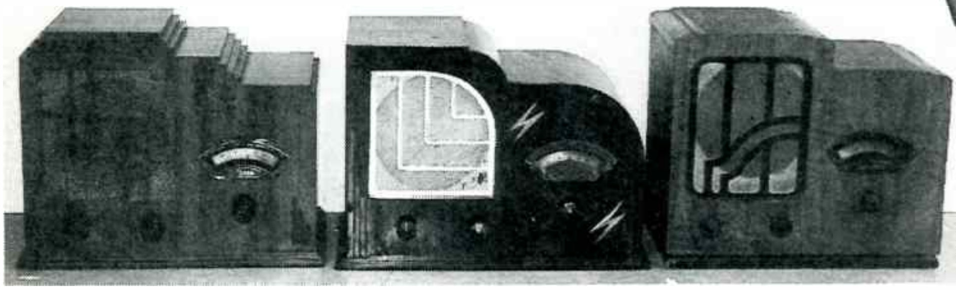
Although the days of easy pickings are gone, Ray still uses the same methods for locating additions; but generally he has to work harder and pay more. One simple method still works occasionally and appeals to me. His house has a verandah visible from the street, and some obviously old but not too valuable equipment is left on view. He says that it is remarkable how often new contributions are quietly added!

Space at a premium

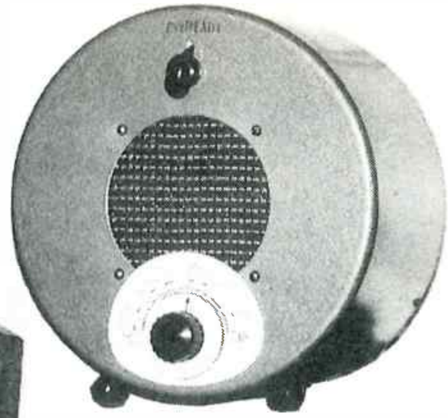
Wisely, Ray did not overfill his house with receivers, and before long there was the inevitable lack of space. A disused workshop on the property was adapted to house and display the bulk of the collection. Now it, an annex, the garage and a shed are all bursting at the seams. It is clear that Ray will soon have to be embarking on another building expansion programme.

Inevitably the question is asked — how many radios are there in the collection? As any collector will know, this is hard to answer. As well as the prime display radios, there are always duplicates, swaps, chassis without cabinets, cabinets without chassis and the inevitable 'junkers' — incomplete radios to be cannibalised or repaired when and if the missing parts turn up. Ray estimates that his collection of complete radios stands at around one thousand and growing!

Has Ray an ultimate goal? Not really. He considers that his collection will never be finished, and in common with



Below: Three different versions of the same basic five-valve superhet, all made by Radio Corporation (NZ) Ltd in 1934. From the left they are the Courtenay 205, the Pacific (with an Art Deco chromed grille) and the Philips 5H. Ray is currently seeking yet another version, called the Troubador.



Above: The Eveready four valve 'Saucepan' radio of 1949, made for use in remote African villages.

many collectors, finds that the fun is in continued collecting. And not having specialised, he acquires serendipitously.

There are many quite unique receivers. On entering Ray's home one is confronted with a handsome and rare 'Ariel' grandfather clock radio. Around the corner in the lounge is a magnificent English made HMV record player with an enormous separate loudspeaker cabinet, imported especially for the 1953/54 Royal Tour of New Zealand to be on hand in case the Royal visitors wished to relax to some music. In the dining room for everyday listening is a Columbus model 91, a large mantel receiver with bandspread shortwave, push-pull output and a 10" loudspeaker.

However, it is upon entering the main display building that the visitor receives the full impact of the collection. From floor to ceiling there are ranks of receivers — some familiar, others unusual — and many rare and exciting.

The main display contains radios that any collector would love to own. But then you are shown into a sort of 'Holy of Holies', a side room where many of Ray's real treasures are kept: Atwater Kents, a Browning Drake, RCA's and more — they are all there.

The photographs here only capture a small sample and cannot do justice to the range and variety. But they may help to give some idea of the quality, extent and scope of the Ray Knowles Collection. ❖

Experimenting with Electronics

by PETER MURTAGH

FM radio microphone

How about building this simple radio mike, and you will be able to transmit on the FM frequency band. This means that you can use any FM radio to pick up your signal. And since the transmitter frequency can be adjusted, you could even build two transmitters, operating on different frequencies, to operate as a 'wire-less' intercom. To do this, of course, you would need two radios to act as receivers.

This simple radio mike uses just two transistors. The first acts as an amplifier for the sound signal produced by the electret microphone. The circuit built around the second transistor acts as the actual FM transmitter.

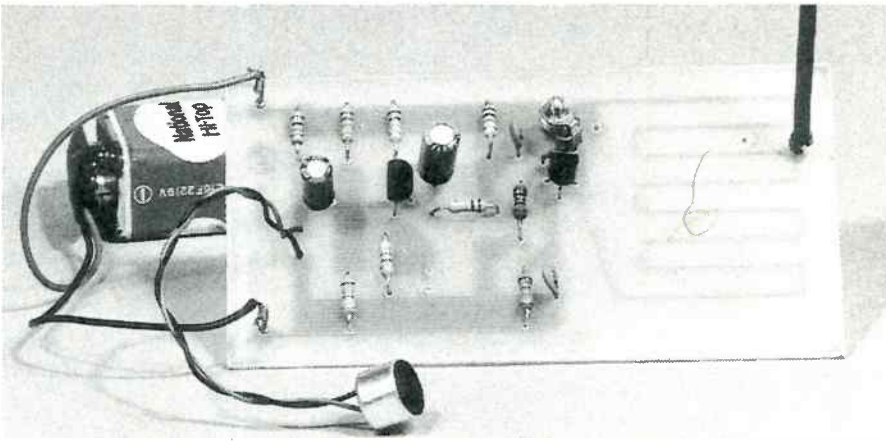
There are two ways that radio stations broadcast their programs — amplitude modulation (AM) and frequency modulation (FM). For the first mode, the signal is conveyed by the carrier frequency by altering (modulating) the height of the wave (its strength or amplitude).

In the second mode, the signal is used to alter the actual carrier frequency. With AM, the height of the wave changes, but not its frequency — with FM, the height stays the same, but the frequency alters. Our circuit uses the FM transmission mode.

Of course, this transmitter is VERY low power — you don't want *all* your neighbours listening in to your message! (And they don't want your signal interfering with their music either.) A quick check on our prototype showed that you could hear its transmission almost up to about 50m away. Other uses for such a radio mike could be to monitor a baby's bedroom, or even to plant a 'bug'. But the circuit is not really designed for such permanent uses, since it draws an 8mA current, which won't take too long to flatten the battery.

Construction

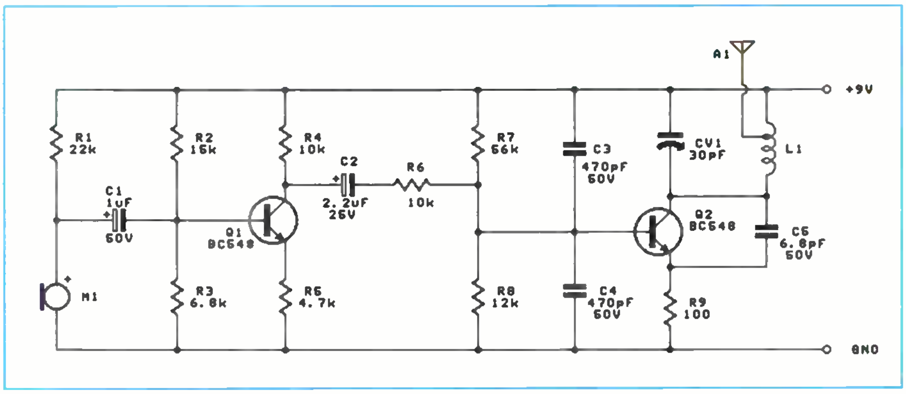
Once again, we haven't given a breadboard or strip-board layout for this project. The reason for this is that the transmitter requires a very low-value inductor for its tuned circuit (more details on this in 'How it works'). To make an accurate, low-value inductor, we have built it onto the PCB itself. The zig-zag pattern on the board is actually a low-value 'coil'. This means that you must use the PCB to get the 'coil'.



Start your construction by soldering all the resistors onto the board, then the capacitors and transistors. Remember to insert the electrolytic capacitors (and, of course, the transistors) with the correct orientation. The ceramic capacitors are bipolar, so they can be inserted either way. Finally, solder in the tuning 'trimmer' capacitor CV1, the microphone leads, and the aerial.

But before soldering, check your trimmer capacitor — some have three lugs, while some only have two. Our PCB design can accommodate either. The three-lug models are easier to insert, as they can only go the one way on the board. But if your trimmer only has two lugs (like ours), make certain that only one lug is attached to the +9V rail.

For the aerial, use a length of insulated wire, about 14cm long, though the actual length isn't that important. As you can see from the photo, we used the full length of the leads on the microphone, even though shorter leads would be less likely to pick up radio frequency (RF) interference. We found that we had no trouble with feed-



The schematic shows how the circuit is built around two transistors. The first (Q1) forms an audio amp for the microphone, while the second (Q2) generates and modulates the frequency of the broadcast signal.

back, provided that the speaker in the radio did not face anywhere near the mike.

The advantage of the longer leads is that it makes it easier to point the mike directly at the announcer. This way you needn't touch the circuit board while transmitting, and so you can avoid your body adding stray capacitance which changes the transmitting frequency.

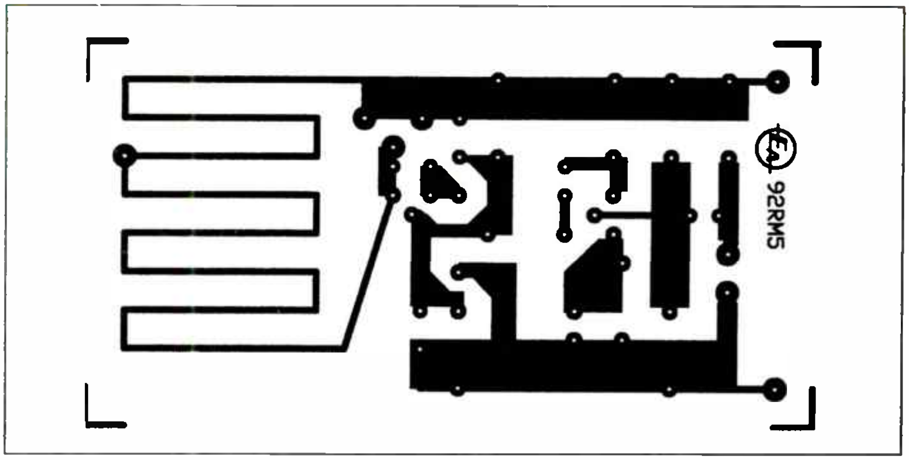
Tuning

A standard FM radio will tune to frequencies between 88 and 108MHz (megahertz, or millions of cycles per second). By adjusting the variable 30pF (picofarad) trimmer capacitor, our transmitter is capable of operating anywhere in that whole range.

Start by tuning your FM radio. Find a spot which isn't used by a radio station (we used 100MHz). With the volume turned up more than usual, there should be a reasonable amount of background noise present. Now tune your transmitter. Slowly adjust the trimmer capacitor CV1 until the FM radio goes quiet. This should mean that the transmitter and receiver are tuned to the same frequency. Check that they are by talking into the mike. If you cannot hear yourself, then try another spot on the dial. It is difficult to fine tune your transmitter, because even touching the PCB will alter its transmitting frequency, especially if you are using a metal screwdriver to alter CV1. So, once you can hear any signal on the radio, leave the transmitter alone, and fine tune the radio.

Changes

The main changes which you can make are adjusting the transmitting frequency by altering CV1, and adjusting the length of the transmitting aerial to vary the signal strength. In general, the longer the aerial length, the more energy is transmitted. But be careful about broadcasting too powerful a signal (see 'How it works').



Here's the actual size pattern to be used to etch the PCB. The zig-zag pattern at the left forms the low-inductance 'coil' for the tuned circuit, which determines the broadcast frequency.

One other change could be necessary if the microphone that you are using produces a very low signal. We built our prototype with a 10uF capacitor placed beside resistor R5 (its position is shown as C6 on Fig.1). This gave a very high AC gain (over 600) for our mike, which proved to be too much, because it badly distorted our signal.

By removing C6 our gain was reduced to 2, which turned out to be all that the electret microphone required. With a less sensitive mike, C6 could be re-inserted. And also, resistor R1 would probably have to be replaced to increase the current flowing through such a mike.

How it works

Transistor Q1 amplifies the signals coming from the mike. Resistors R2 and R3 bias on the transistor, so that any variations in the microphone current, which pass across C1, are amplified evenly (without distortion). R4 and R5 determine the gain of the audio amplifier stage, while R1 determines the DC current flowing through the mike.

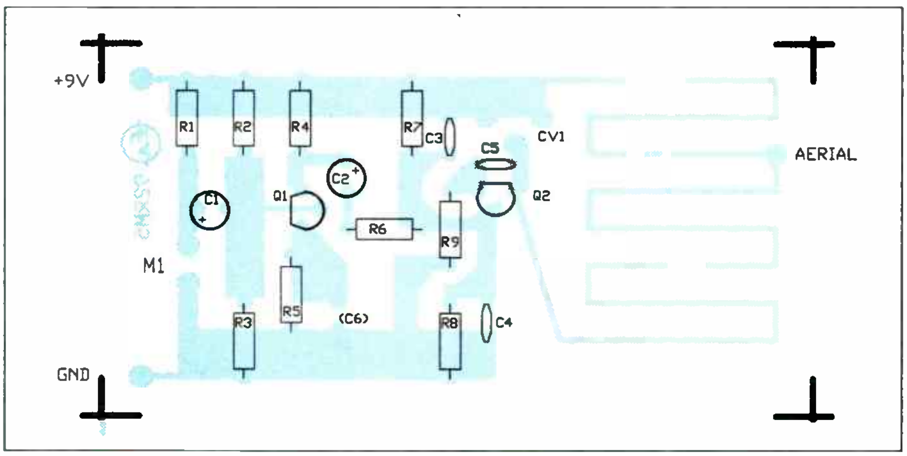


Fig.1: Note that a 10uF capacitor (C6) can be added to the right of resistor R5 to greatly increase the gain of the audio amplifier built around Q1. This modification could be necessary if you use a low gain microphone.

Before seeing how this audio signal produces FM radio transmission, let's investigate the idea of a tuned circuit which is at the heart of the actual transmitter. This is the circuit built around CV1 and L1, and maintained by transistor Q2. How does such a tuned circuit work?

When the capacitor CV1 is charged, it tries to discharge itself through the inductor L1 (the 'coil'). But the changing current passing through L1 sets up an field which impedes CV1's discharge. It does this so well, that when CV1's energy is spent in forcing the discharge, the field reverses the tables and recharges the capacitor.

It then maintains its contrary nature by opposing the recharging! The energy originally stored in CV1 ends up alternating between being stored in that capacitor and stored in the inductor's field. (A similar thing happens when waves pound onto a breakwater — they bounce back off the breakwater and head back out to sea, until the next wave comes crashing back. The same water can continue to move in and out.)

The frequency of the tuned circuit oscillation depends on the size of both the capacitor and the inductor. The smaller their values, the higher the frequency. That's why our high 100MHz transmitter needs a low value capacitor and inductor.

This oscillation will tend to gradually die away, as some of its energy is lost by being transmitted as radio waves through the aerial, and the rest is used up flowing through C3, C4, R9 and C5.

(Notice that these four components form a low impedance AC pathway for the oscillation.)

PARTS LIST

Miscellaneous

PCB 97x51mm, coded 92RM5
electret microphone insert
hookup wire

Resistors

All 1/4W, 5%

1	22k	R1	red-red-orange
1	15k	R2	brown-green-orange
1	6.8k	R3	blue-grey-red
2	10k	R4,R6	brown-black-orange
1	4.7k	R5	yellow-purple-red
1	56k	R7	green-blue-orange
1	12k	R8	brown-red-orange
1	100 ohms	R9	

Capacitors

PC-mount electrolytic:
1 1uF,50V C1
1 2.2uF, 25V C2
Ceramic:
2 470pF, 50V C3,C4
1 6.8pF, 50V C5
Trimmer:
1 3-27pF CV1

Semiconductors

2 BC548 NPN transistors Q1,Q2

While these oscillations are occurring, what length aerial will transmit the most energy? At a frequency of 100MHz, the length of the transmitted wave is 3m, so a 3m aerial is theoretically the best length. A quarter wave-length also works well, so we're now down to 75cm. But this length could still be too efficient, with our broadcast interfering with our neighbours' FM reception. Hence, we've kept the aerial length down to an inefficient 14cm.

The role of transistor Q2 is to prevent the oscillations gradually dying away to nothing. (Q2 is biased on by resistors R7 and R8.) Capacitor C5 provides the positive feedback which makes the transistor's emitter-collector current vary at the same frequency as the tuned circuit. This keeps the current flowing in the tuned circuit, and so maintains the oscillations.

The feedback works by transferring the oscillating voltage (at the collector) to the emitter, which varies the base-emitter voltage. This makes the base-emitter current (and hence the collector-emitter current) vary at the oscillation frequency.

So much for the oscillator, but how does the audio input, which is fed through the isolating capacitor C2 to the base of Q2, cause frequency modulation? Very simply, because the oscillating frequency depends on the *total* capacitance of the circuit. The audio signal affects the capacitance of the base-emitter junction of the transistor. These small alterations cause small frequency changes, which are added to the basic tuned circuit frequency, producing FM.

All we need now is an FM radio to pick up these transmissions. We're on air!

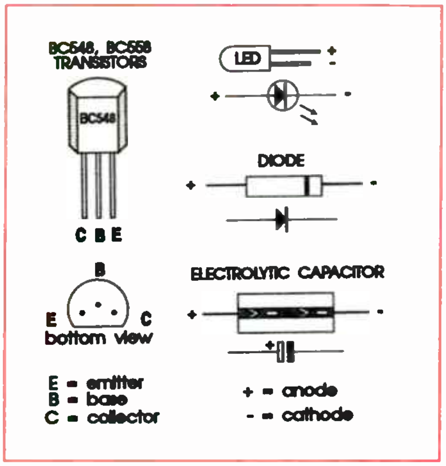


Fig.2: Component leads identification.

Transparencies

A high contrast, actual size transparency (negative) is available for only $2 for anyone wishing to make their own printed circuit board. This special price applies for transparencies for projects in this series only. Write to *EA*'s reader services division.

Happy experimenting — and please send us your comments on the circuits we have published as well as ideas for future projects. ❖

THE SERVICEMAN

Continued from page 51

out in frustration. I was assured that they had never had such a bad run with Amigas, but that they would solve my problem, if they had to go bankrupt doing it!

I was told that the latest batch of machines to reach their store had all been a new model, from China or Taiwan or somewhere, and of the 10 they had received, eight turned out to be faulty in one way or another. So out came computer number four. This was one of the older series, the last one in stock. And just to guard against any likelihood that the crashes I had experienced earlier were caused by hardware problems, they exchanged the memory upgrade from the video pack for a new, faster, proprietary unit. So now, Amiga number four is working perfectly. No more locked out keyboards, no more baulky disc drives. All lights come on at the right time. And hopefully, no more crashes.

But what a saga, to get to that stage! The pity of it is, for me, that I still haven't got to see the inside of my new computer! I'll have to wait a year for that pleasure, when the warranty runs out. ❖

Electronics Australia

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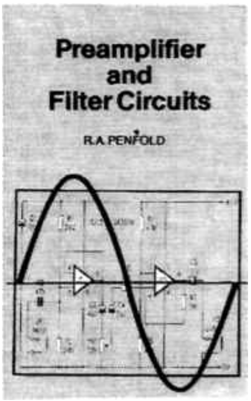

Preamplifier and Filter Circuits
This book provides circuits and background information for a range of preamplifiers, plus time controls, filters and mixers. The circuits described are simple and previous experience of electronic project construction is not needed.
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Introducing Digital Audio, CD, Dat and Sampling. - Second Edition:
This book bridges the gap for the technician and enthusiasts who have worked with audio circuits. It includes oversampling methods and bitstream techniques and technical terms.
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Computers and Music - An Introduction:
This book explains how to simply set up your own computer music studio. It covers the basics of computing, running applications programs, wiring up a MIDI system plus everything about hardware and the programs.
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Practical MIDI Handbook
Refers to the powerful capabilities of MIDI and how to exploit it, with no knowledge of electronics or computing. It reviews the latest developments in MIDI covering keyboards, drum machines, sequences, mixers, guitars etc.
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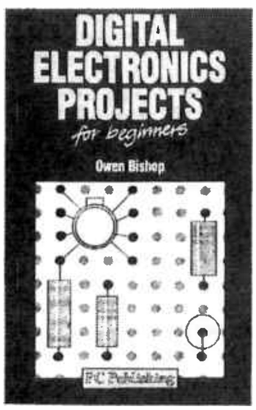

Digital Electronic Projects for beginners
This book provides simple, yet detailed instruction on practical projects. Covering instrumentation to home security plus circuit diagrams, this reference book also offers 'fun' projects for newcomers to electronic construction.
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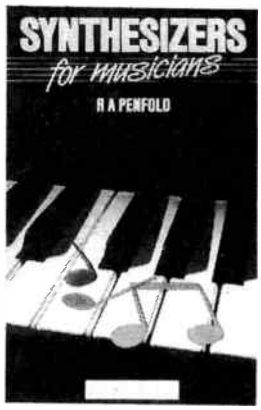
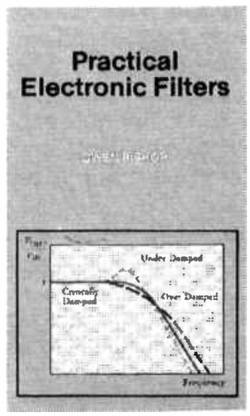


Synthesizers for Musicians
Written especially for musicians, this book explains how to get the best from your synthesizer or sampler. If you want to go beyond using the factory presets or the random poking of buttons, then this is the book for you.
CODE: PC 1003 PRICE: $18.95



Practical Electronic Filters
Practical Electronic Filters explains in a simple form, the understanding of how to work a filter. It presents projects to apply in and around the home, including diagrams that are suited to the beginner and a more advanced constructor.
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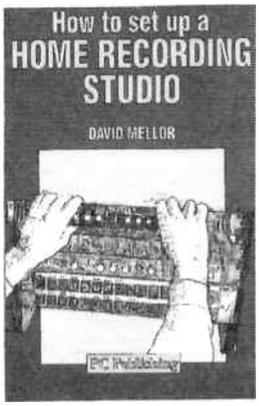

How to set up a home Recording Studio
If you hove o studio at home or ore about to set one up, this book is for you! It describes the setting up of an 8 to 16 track studio with an outline of the musical and recording gear needed.
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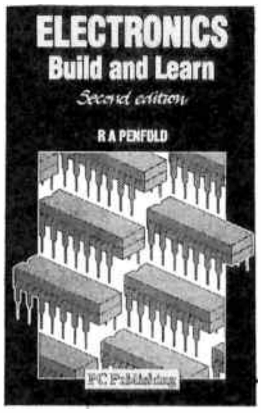

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This book is the perfect balance of theory & practice. It introduces common electronic components ond how they are built into useful circuits. An essential for the beginner, providing practical tests and experiments.
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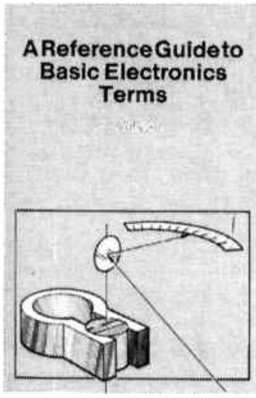
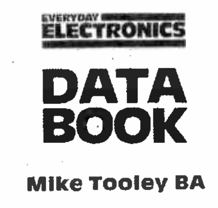


A Reference guide to Basic Electronic Terms
A comprehensive A to Z guide of electronic terms. This book chooses ond explains some of the more important fundomentol terms (over 700), making the explanations easy to understand and avoiding high level mathematics.
CODE: BP 2860 PRICE: $16.00



Everyday Electronics Data Book
This book is an involuable source of informotion of everydoy relevonce in the world of electronics. A must for everyone involved on electronics who wants to put theory into practice.
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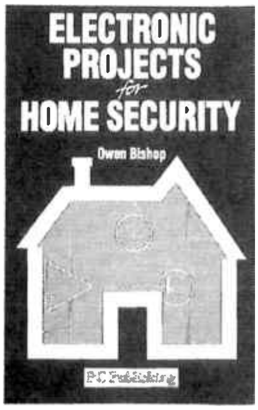

Electronic Projects for Home Security
This book deals with the many aspects of home-security and how to construct your own security system. It covers the latest in technology, whilst remoining simple and relioble in its instruction.
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This book covers the topic of electronic power supplies, including batteries, simple AC supplies, switch-mode supplies ond inverters. Subjects dealt in detail are devices, their operating principles ond typicol circuits.
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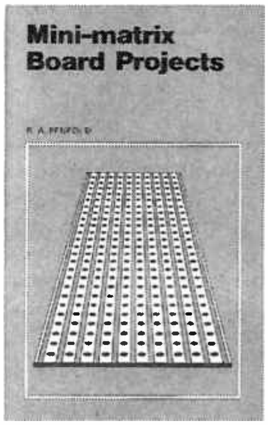

Mini Matrix Board Projects
This book provides you with 20 useful and interesting circuits, all of which can be used on o mini matrix boord, which is just 24 holes by 10 copper strips.
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A unique book for both the professionol ond home constructor on 'How to Moke' your own R.F., I.F., Audio and Power coils, chokes ond transformers etc.
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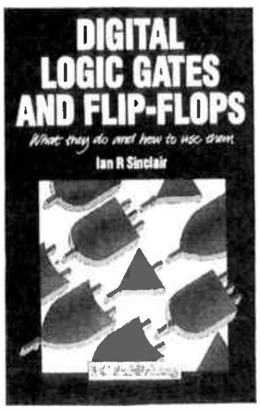

Digital Logic Gates and Flip-Flop
Intended for enthusiasts, this book aims to provide o firm understanding of gates and flip-flops thoroughly ond from the beginning. It is for the user who wants to know more than o few rules of thumb about digitol circuits.
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The PC Music Handbook
This book takes the reader through the creative possibilities of the personal computer. Full of practical tips on equipment plus exploration of sequencing, sampling ond notation.
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SHORTWAVE LISTENING

by Arthur Cushen, MBE

Exciting listening to CIS stations

This year promises to be one of great interest to shortwave listeners as the Commonwealth of Independent States (CIS) formerly USSR, moves into its own local state broadcasting service. This includes a move to shortwave for each of the States, the operation of commercial radio stations in Russia and the expansion of Western broadcasters into the Moscow area.

The first Russian commercial radio station has been in operation for some months, and has its studios in the buildings of Radio Moscow. Using the slogan 'Radio Ala' the broadcasts have been testing on several frequencies in their 24 hour a day operation, and have been heard on 11685 and 11965kHz at 0700. The programme generally consists of identification in Russian, a five minute news bulletin and then popular light Russian music. The station is attempting to promote Russian folk music, but there is also music from other countries. The programme forms an 'easy listening' type of service.

Reception reports have already been received from listeners in most parts of the world, and the station is keen to learn where its signal is being heard. The address of the station is Radio Ala, PO Box 159, Moscow 125047, Russia.

There are two mediumwave transmitters in St Petersburg, which operate on shortwave 0700-1700 on 11685 and 11965kHz, and 1700-0700 on 5040 and 6015kHz.

Radio Yerevan, Armenia has a five minute news broadcast in English for listeners in the United States, 0354-0359 daily. Reception has been excellent on 17605kHz, while 9750kHz also provides a fair signal. The station announces that they are operating in several frequency bands.

Before 0354, programmes are of Armenian folk music; after the English news broadcast, there is a short announcement, in Armenian, of frequency details followed by the station's interval signal.

Siberian relays

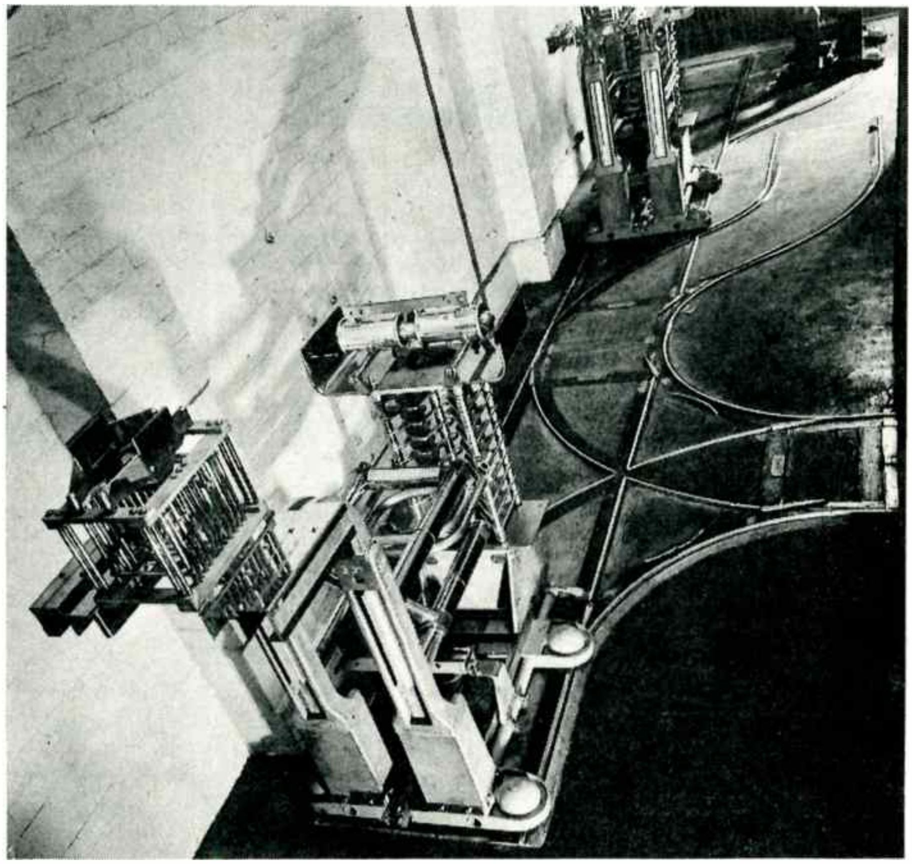
From Siberia, there is news of great interest to listeners in the South Pacific, as these are the stations that we will hear more readily. Many plans have been announced concerning the use of transmitters in this part of the CIS.

An interesting broadcast in French at 1200 from Radio France International has been heard on the mediumwave frequency of 1485kHz, and this is presumed to be coming from a transmitter in Siberia.

Adventists World Radio has made arrangements to lease time on one of the transmitters in Siberia located at Novosibirsk, described as one of the largest Russian transmitter sites, with units of 100 and 250kW. AWR will carry gospel programming in 13 languages to the Asian continent and will be operating 24 hours a day.

English broadcasts are 0000-0100, 0700-0800, 1300-1400 on 11855kHz; and 1900-2000 on 9835kHz. The programmes will be put together in the new studios at Tula, just south of Moscow.

The new Russian Service will be backed up by the long established Asian Service, which AWR operates from Guam on transmitter KSDA. This service includes English 0000-0045 on 15610kHz; 1600-1645 on 19980kHz; 2300-2345 on 15610kHz; and then on Saturdays and Sundays only; 0200-0245, 1700-1745, 1800-1845 on 13720kHz.



A photo of the BBC's Daventry transmitting hall in 1938 when the RF tuning components were shunted by rail into the transmitter, to effect the frequency change.

This item was contributed by Arthur Cushen, 212 Earn St. Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time.

Another organisation using the Russian transmitters is Deutsche Welle, Cologne, which is using a former jamming transmitter to beam programmes into Asia.

English is broadcast 0200-0250 on 12055kHz, and this is followed at 0300 with a broadcast in German. The second transmission in English is 1600-1650 on 7305kHz.

Reports on reception of this new relay facility are requested, to be sent to the Deutsche Welle studios in Cologne.

Not only have Russian transmitters been offered to broadcasters, but the system has asked US organisations to find sponsors to use the idle transmitters.

George Jacobs, formerly of the Voice of America and now a consultant in broadcasting, stated on Media Network that "A privatised section of Radio Moscow is offering medium and shortwave facilities to broadcasters in the United States, including Christian Science Monitor, as well as to the BBC, Radio Liberty and the Voice of America".

The mediumwave frequency will be on 926kHz, which in the past has carried the Radio Moscow World Service. It will now carry programmes from international stations, including both English and Russian.

Radio Free Bougainville

The receipt of a new broadcaster from Bougainville in the Northern Solomons was noted earlier this year with broadcasts on 3880kHz. Bougainville, formerly a part of Papua New Guinea, is seeking independence. The station used the slogan 'Radio Free Bougainville', and was officially opened at 0800 on January 31 by the President of the Bougainville Republic.

Our reception of the broadcast on 3880kHz has been very good, and the full transmission has been followed on a regular basis from around 0900 to its sign-off at 1112 with the National Anthem.

The station is also announcing a World Service using a frequency in the 13 metre band between 21450-21500kHz, using USB. This transmission is scheduled at 2300 and 0600 to the Americas; 0400 and 0700 to Africa, Asia and the Pacific; and 1300 and 1400 to Europe.

The address is Humanitarian Aid Co-Ordinator, PO Box 1203, Honiara, Solomon Islands.

The station claims to be an operation organised by the International Amateur Radio Union, and it is obvious that radio amateur equipment is being used from the frequency chosen and the type of transmission. Broadcasts are in Pidgin and English and the full schedule is given in both languages before the station closes at 1112.

This broadcaster brings back memories of Radio Venerama broadcasting from Espirito, Santo — which was heard with a similar type of broadcast in 1982, using the 80-metre amateur band for its transmissions. That broadcast was eventually jammed by the authorities in Port Vila, and its plans to break away from the Vanuatu Government were foiled.

BBC uses 90 transmitters

The British Broadcasting Corporation in its External Services is now using 90 high powered transmitters, located not only in the United Kingdom but also in many parts of the world. In the United Kingdom, there used to be five main sites: Rampisham in the south west of England, Daventry in the Midlands, Skelton in the north west, Wooferton on the English-Welsh border and Orfordness on the Suffock Coast.

However, the transmitting site at Daventry has just been taken off shortwave broadcasting. It was first put into operation in 1925, with the mediumwave station 5XX, and in 1932 it opened the Empire Service.

Later in 1935, it was the site where Robert Watson Watt conducted the successful experiments with an airbourne target that were to spawn the development of RDF (radar). This development was to prove vital not only in the war, but also in the safe conduct of civil aviation and maritime transport.

Overseas, the BBC transmitters are located at Antigua in the Caribbean, Ascension in the South Atlantic, Lesotho in south west Africa, Cyprus in the Mediterranean, Seychelles off the coast of Africa, Masirah off the coast of Oman, Singapore and the new base at Hong Kong. There is also a transmitter located in Berlin to serve central Europe.

As well, the BBC has exchanged agreements with Radio Canada International, and uses RCI's Sackville transmitters to beam programmes to North and South America. It also uses transmitters of the Voice of America, on an exchange basis, to cover the American continent.

The BBC, as well as operating the World Service which is available for Australia and New Zealand, also carries an External Service beamed to various parts of the world in some 36 languages. For listeners in Australia/New Zealand, the World Service in English is operating 1800-2300 on 11955kHz, and 2000-2300 on 15340kHz, for our morning reception.

Transmissions during our evenings commence at 0600 on 7150, 9640, 11955 and 17830kHz, and from 0900 they continue on 11750 and 17830kHz.

For Australia, there is an extension to 1330 on 9740kHz, while many BBC frequencies beamed to south and south-east Asia provide good alternative listening. ❖

AROUND THE WORLD

CANADA: Radio Canada International is now confirming reception reports from its Montreal studios, through the courtesy of Canadian International DX Club — which is providing the manpower to handle listener's reports. RCI, with its programme beamed to Asia in English 1330-1400, is carried on four Asian transmitters. The frequencies of 6150 and 9535kHz are broadcast from transmitters at Xian, China, and the other two outlets 6095 and 9700kHz originate from Kimjae, Korea.

FRENCH GUIANA: A new transmitting site is being built jointly by France and Switzerland at Kourou, French Guiana, and will house a 500kW transmitter. The location is the site of the French Rocket Station. Swiss Radio plans to use the transmitter to cover North and South America and the Pacific.

NEW ZEALAND: Radio New Zealand International from May 3 is using 11735kHz for its morning transmission at 1700-2200. Tests were recently carried out on 7305, 9525, 9645, 9745 and 15305kHz to find a suitable frequency for our summer transmissions. At the moment, from October it seems 15305kHz will be used for the transmission 1700-2200.

SAIPAN: Two transmitters from Saipan both carry gospel programming. KHBI of the Christian Science Monitor has a service to Australia from 0800, on 13615 and 17555kHz. KFBS of the Far East Broadcasting Company broadcasts mainly in Asian languages, but has one transmission in English, 1930-2000 on 9465kHz.

SWITZERLAND: SRI uses three overseas relay bases, and broadcasts from China in English from 1330 on 7480 and 11690kHz. Two transmissions originate from Moyabi, Gabon at 2100 in English and 2230 in Portugese, Italian and German, both on 12035kHz. At 0200 a broadcast in English from Brazilia is heard on 17730kHz.

USA: Three new shortwave services have been granted licences by the FCC in recent weeks. Radio Miami International at Miami, Florida is to use a 50kW transmitter to beam programmes to Central and South America. Broadcasting from Upton in Kentucky a new station WJCR Worldwide, is scheduled to operate later this year on the following frequencies: 7485, 7540, 15660 and 15675kHz. A new Catholic gospel station near Birmingham, Alabama will use the call WEWN and will have four transmitters. The first transmitter will be on air in October and the other three during later months.

Low cost multi-band portable receiver:

SANGEAN ATS 818CS FEATURES DIGITAL TUNING

Dick Smith Electronics has just released a compact new multi-band portable radio/cassette recorder from the Sangean company in Taiwan. The ATS 818CS offers full digital synthesiser tuning, for accuracy and convenience, coupled with 45 memory channels to store the tuning data for frequently-used signals. It also provides 'serious listening' features such as a BFO for CW/SSB reception, adjustable tuning rate and bandwidth, an RF gain control for LF and HF, an LCD signal strength indicator and dual inbuilt clocks for UTC and local time.

by JIM ROWE

Not all that long ago, there was a fairly clear distinction between true 'communications receivers' and multi-band portable radios. Although the latter often covered much the same overall frequency range as the former, their more limited performance and facilities tended to make them suitable mainly for what we might call 'casual' listening.

The tuning arrangements were often quite crude and poorly calibrated, and this together with modest sensitivity, poor selectivity and the lack of refinements like adjustable IF bandwidth and an RF gain control made it almost impossible to separate and 'copy' signals in crowded HF bands. Not only this, but few multi-band portables were provided with a stable and readily adjusted BFO (beat-frequency oscillator) — making them virtually useless for reception of CW or SSB signals.

But in the last few years, thanks to galloping IC and microprocessor technology, the differences between the two types of receiver have been steadily blurring. The appearance of relatively low cost programmable PLL (phase-locked loop) chips made it possible to provide even modest sets with stable, calibrated digital tuning, while low cost ceramic filters and specialised ICs allowed many of the other limitations to be overcome at relatively low cost.

The nett result is that nowadays, it's possible to obtain for only a few hundred dollars portable multi-band radios with performance and features that are very close to those of the full-scale (and very expensive) communications receivers that were produced only a few years ago. In many cases the new sets are easier and more convenient to use, as well.

The Sangean ATS 818CS is a good case in point. Measuring a modest 296 x 192 x 68mm and weighing 2kg (less batteries), it combines a multi-band digitally tuned communications receiver with a reasonable quality cassette recorder. The radio section has full PLL synthesised tuning, and effectively tunes continuously from 150kHz in the LF spectrum right up to 29.999MHz at the top of the HF bands. Not only that, but it 'throws in' the international VHF FM broadcasting band (87.5 - 108MHz) as well.

As with many modern communications receivers, tuning can be performed in a variety of ways. You can key in any desired frequency in the receiver's range, via the keypad, for virtually 'instant' tuning. Or you can move along the spectrum in the traditional way, using the rotary tuning knob — which can be set for two different tuning 'speeds' using a 'Fast/Slow' switch. There's also a pair of 'up' and 'down' tuning buttons, which step the tuning up or down in fixed increments.

Incidentally the receiver has four main band selection buttons, one of which selects the VHF FM band. The other three are labelled 'LW', 'MW' and 'SW', and as these suggest they are used to subdivide the LF-HF coverage into the three traditional categories: long waves (150 - 519kHz), medium waves (520 - 1620kHz) and short waves (1620kHz - 29.999MHz).

Although the receiver essentially tunes the full LF-HF range from 150kHz to 29.999kHz, and any frequency in this range can be tuned directly using the keypad, each of the FM/LW/MW/SW buttons effectively limits the range of the rotary tuning and up/down tuning buttons to within the selected main band. Within each of these bands the tuning becomes 'circular' as far as these controls are concerned.

So if you're in the MW band and try tuning upward from 1620kHz, the receiver will jump down to 520kHz and 'start again from the bottom'; conversely if you try to tune below 520kHz on the same band, it will jump up to 1620kHz and come down from there. The same thing happens on the FM band, with any attempt to tune above 108MHz producing a jump back to 87.5MHz, and vice-versa. This can be a little disconcerting if you're used to the now fairly standard continuous tuning system, but it shouldn't be a problem in normal use.

The effect of the 'Fast/Slow' tuning rate switch varies from band to band. On the LW band, it gives a choice of either 9kHz or 1kHz increments; on the MW band, either 9/10kHz or 1kHz; on the SW band(s), either 5kHz or 1kHz; and on the FM band, 100kHz or 50kHz. The manual 'Up/Down' buttons generally provide tuning steps corresponding to the 'Fast' increments, on each band.

If you're an old timer who still thinks in terms of the traditional 'wavelength' labels for the various international shortwave bands, the ATS 818CS will even let you jump immediately to each band (13 in all) merely by pressing the 'Meter' key (yes, US spelling!) followed

by one of the numeral keys. Each key on the keypad thus serves double duty, as both a numeral key for frequency/time/memory channel entry, and a wavelength band identifier.

Other handy facilities related to tuning include the ability to 'scan' the current band for active signals, and the facility to store and recall the frequencies for up to 45 frequently-needed signals. Groups of nine memory channels are allocated for the LW, MW and FM bands, while 18 channels are provided for the full SW band.

The current tuning frequency of the receiver is displayed clearly on an LCD panel, in large 14mm-high numerals. Also displayed on the same panel are the current memory channel (if one is in use), and a 'bar graph' display of signal strength.

Also the time — in either local or universal (UTC) form — as the ATS 818CS also provides a built-in dual time digital clock. Along with dual timekeeping this can be used as an alarm clock, as a 'sleep timer' for the radio, and for activating the radio and/or recorder at a predetermined time. By the way the LCD panel is provided with a back light, which can be disabled when not needed, to conserve the batteries.

Along with these features the receiver provides such refinements as a manual RF gain control, to allow sensitivity adjustment and control of overload; a two-position IF bandwidth/selectivity switch (Wide/Narrow); an adjustable BFO for Morse and SSB reception; and an audio tone control for further control of bandwidth.

The manual RF gain control only operates on the LW/MW/SW bands, as does the BFO. Similarly the selectivity switch also only works as such on the lower bands, becoming a Mono/Stereo switch on the FM band.

More subtle facilities provided by the receiver include a 'key lock' switch, to prevent accidental flattening of the batteries; a 'dial lock' switch to disable the rotary tuning control, minimising accidental detuning from a wanted frequency; and a switch to select the MW band 'Fast' tuning increments of either 9kHz or 10kHz.

Like most portable receivers, the ATS 818CS provides an inbuilt ferrite rod antenna — used here for LW and MW reception — and a telescopic rod antenna, which is used for SW and FM reception.

However it also provides a 3.5mm miniature phone jack, for connecting an external antenna to give improved DX reception. There's also a (stereo) headphone jack and a connector for running the receiver from an external DC source (+6V).

Finally, the receiver also features both a built-in carrying handle and a rear tilting bail, to allow convenient table top operation.

The cassette recorder section of the ATS 818CS is a fairly standard stereo design, with AC bias and permanent magnet erase.

In addition to being able to record from the radio section, it also has a built-in electret mic for 'live' mono recording. There's also a Normal/CrO_2 switch, and another switch to adjust the bias oscillator frequency for beat note minimisation in recordings.

Sangean ATS 818CS

All in all, then, in terms of facilities the Sangean ATS 818CS is a pretty impressive little unit. As you might expect it is fully microprocessor controlled, and uses 15 integrated circuits, 61 transistors, 8 FETs, 53 diodes and two LEDs.

The receiver appears to operate as a conventional single-conversion superhet on FM (10.7MHz IF), switching to double conversion for the other bands.

In the latter configuration the first IF is 55.845MHz, with FETs used for the RF stage, balanced first mixer and first IF stage (which should give a good overload/cross modulation performance). The second IF is 460kHz.

Incidentally the unit normally runs from four 'D' sized dry cells (or an external 6V source), with three 'AA' cells also being used to provide backup for its memory channels, etc.

How it performs

We checked out the basic performance of a sample ATS 818CS with the instruments, and it gave quite a good account of itself.

The effective sensitivity on the LW band was fairly consistent at 30uV, and varied from 30uV to about 20uV on the MW band. On the SW band it varied from around 10uV at the low end, improving to less than 1.5uV between about 5MHz to 25MHz, and still holding at around 3uV at 29MHz.

The FM sensitivity was around 60uV for good quieting. These figures suggest that the set is not 'super hot' but sensitive enough for most normal users.

Similarly the working selectivity of the set on all three 'AM' bands was consistently about +/-3.5kHz in the 'Wide' switch position, and +/-2.5kHz in the 'Narrow' position.

While the latter means that the set still has some difficulty in separating SSB and particularly CW signals in really crowded sections of the HF spectrum, it's not at all bad for a set in this price range.

The set's BFO has a tuning range of about +/-3.5kHz, and is commendably stable. The LCD 'S meter' also seemed to be quite practical, with its seven indication steps corresponding to signal levels of approximately 5uV, 8uV, 10uV, 12uV, 20uV, 220uV and 1mV respectively at 10MHz.

Listening tests carried out in a typical suburban location, with the ATS 818CS coupled to a simple balanced-T antenna via a balun, showed that it is very suitable for general LF-HF reception. The controls are convenient to use, and in contrast with many sets in the same price category, it is quite capable of allowing stable and clear demodulation of most SSB signals.

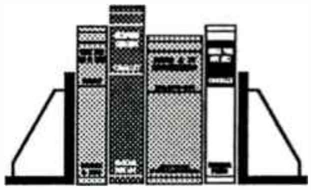
We could only find a couple of 'birdies', due to the set picking up its internal oscillators, and these were at quite a low level where they seem unlikely to cause much of a problem.

In short, our evaluation is that the Sangean ATS 818CS is really very good value for money at the quoted RRP of $399. It should make a fine 'first set' for the newcomer to shortwave listening, as well as a good 'standby' set for those with a higher performance communications receiver.

And of course it can also be used for normal day-to-day listening, on both the MW and VHF FM bands, as well as being capable of duty as a clock radio and tape recorder.

You should be able to find the ATS 818CS in stock at most of the Dick Smith Electronics stores and dealers. It is listed in their new catalog as D-2842. ❖

NEW BOOKS



Short wave radio

PASSPORT TO WORLD BAND RADIO, edited by Lawrence Magne, 1991. Published by International Broadcasting Services. Soft cover, 255 x 180mm, 382 pages. ISBN 0-914941-27-5. RRP $34.95.

This book is produced each year to assist and promote listening to World Band Radio — 13 bands of frequencies within the shortwave spectrum.

The early pages contain small items on the advantages of listening to world radio, how an atlas comes in handy and the need to understand the concept of 'world time' — officially called either Greenwich Mean Time (GMT) or Co-ordinated Universal Time (UTC). It tells you how to get started, with suggestions of who to listen to, with the author's list of 'The 20+ Big Signals'.

Then comes the major sections of the book, beginning with an article on how to choose a world band radio. These hints are then applied to a 40-page survey on models available on the market. For convenience, the models are grouped in three categories: portables, mid-size and table tops. Price, advantages and disadvantages, plus a summary are given. Those models deemed worthy are endorsed as 'Editor's Choice'.

Next comes 'What's on tonight'. This lists those broadcasts which can be received during the evening prime time. For convenience, these are grouped for North America, then East Asia and the Pacific, and finally Europe.

Further groupings are then given for 'Worldwide Broadcasts in English', followed by other language broadcasts in 'Voices from Home'.

For those who wish to follow up their listening by writing to the broadcasters, a list is given of stations which reply to listener correspondence and do not require payment for return postage costs.

The last section of the book are the 'Blue Pages' — 170 pages of them. These are designed for quick reference purposes. The listing is based on frequency, from 2310-25970kHz. It gives the various stations, their location and power, times of broadcast, languages used, targets, etc. To cover the large number of stations, this information is given in abbreviated form. A glossary is given at the back of the book.

If you wish to develop an interest in listening to World Band Radio, then this book will give you a lot of the necessary information. It will also give you a good idea of the models that are available and their price range. And the various listings will allow you to select your program by either time, language, or frequency. I believe the book would be extremely useful as either a newcomer's introduction, or as a general listening reference.

The review copy came from Craig Tyson, a WA contributing editor. It is available from all Dick Smith Electronics stores in Australia, and in New Zealand from Arthur Cushen, 212 Earn Street, Invercargill. (P.M.)

Programming

USER INTERFACES IN C, by Mark Goodwin. Published by Management Information Source, 1989. Soft cover, 235 x 180mm, 344 pages. ISBN 1-55828-002-2. RRP $55.00.

This book is designed to provide the C programmer with the necessary knowledge for quick and easy implementation of graphical user interface techniques on the IBM PC and compatibles. A user interface that uses GUI techniques such as windows, pull-down menus, pop-up menus, dialog boxes, and on-line help can almost totally eliminate the need for a separate manual.

By improving the programmer's knowledge in the area of low-level display programming, the book aims to allow the programmer to customise the user interface toolbox routines, to meet their application's specific needs.

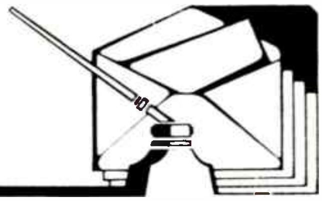
The book was written using Microsoft QuickC 1.0, and requires one of the C compilers listed in Appendix C. It assumes that you have a working knowledge of the language C. The material covered includes how the MS-DOS video and IBM PC ROM BIOS video function; low-level assembly language routines; C routines for positioning and displaying the cursor, displaying single characters, and setting individual character attributes; how to open and close, draw and scroll display windows, along with horizontal and vertical scroll bars; pop-up, pull-down and dialog box menus; error message display, trapping hardware errors and Ctrl-C interruptions; and 'Simple Ledger', a complete general ledger accounting system, which illustrates how the 'Windows' toolbox is used to build an application program.

There are also three reference guide appendices: the Windows toolbox, with the syntax, a description of its purpose and a coding example for each of its function; the IBM PC ROM BIOS video functions; and how the Windows toolbox is compiled by a variety of C compilers.

The book is obviously for programmers — most of its contents are code listings. But I like the way that the author ties together all the routines which he develops, by showing how to use them in his 'Simple Ledger' example. I found the book to be well illustrated and explained, and easy to follow.

The review copy came from Woods-Lane of Mona Vale. It is available from normal booksellers, who should also be able to provide a diskette containing all the program listings used in the book, for a further $45. (P.M.) ❖

Information centre



Conducted by Peter Phillips

A Q and A session

There's lots of questions this month, and fortunately answers to match. Not all the answers are mine, as some contributors also offer solutions to technical problems they've overcome.

The letters this month are mainly about project problems, with some also giving solutions to those encountered during construction. I especially welcome these letters, as this way we all share in a hard-won solution to a technical problem.

Of course, not all constructors will experience the particular problem, particularly if it's due to something like component characteristics being either rather marginal or out of specification. Even the best of designs suffer from this, and try as we do, it's impossible to make all circuits completely independent of component parameters.

The first letter is possibly an example of this very effect, as the problem encountered by the writer in the 1988 Frequency Counter is one I've not heard of before. The letter starts with another problem, this one about an AM/FM car radio:

50MHz Counter

I am writing about a problem encountered with a new car radio, a four speaker AM/FM stereo radio-cassette unit made by Fujitsu. The problem is that in AM mode (mono), the bass sounds are distorted. This seems to occur on most AM stations, but particularly 3MP (1377kHz). The FM section is fine, suggesting that the speakers and audio amplifier are OK. I have also encountered this problem with other portable radios.

Could it be that the 25Hz pilot tone gets through and mixes with the audio signal to produce this distortion? Perhaps others have experienced this problem.

On another matter, I have recently built the 50MHz Frequency Counter published in the May 1988 issue. However, the display was showing random signals with no input connected and the sensitivity of the counter was not satisfactory. At first I thought that harmonics of the 1kHz multiplexing signal were getting through to the input, and even suspected the input ECL amplifier IC.

It turned out that due to the design of the PCB, all of the current flowing through the ground track back to the regulator had to pass near the input ECL IC. This meant that all of the noisy logic currents were flooding the input, producing the random readings and reduced sensitivity (increased noise level).

The problem was cured by cutting the ground track at the corner of the board near IC2, and soldering a wire between the ground terminal of the regulator and the ground track near C6 — thus making the logic currents pass through the wire to ground, at a point away from the sensitive input circuitry.

The counter is now very sensitive, measuring signals lower than 70mV p-p, and zeros with no input. I hope this information will be useful to other constructors. (R.S., Glen Waverley Vic).

It's difficult to say whether the stereo pilot tone is the culprit R.S., although this could easily be tested by tuning to a station that doesn't transmit in stereo, such as the ABC RN stations.

I have not noticed distortion of this type on the various AM stereo receivers I have access to, and somehow I think the problem is more fundamental. There may be a fault in the radio, such as an open-circuit power supply bypass capacitor. This type of fault can cause some strange effects and is one I always check for when faultfinding.

Some time ago I had distortion in an AM/FM tuner that, as it turned out had a design flaw. The distortion was only on AM and was quite pronounced. The cure was to add an emitter follower stage between the AM section and the audio amplifier.

This had the effect of reducing the gain of the AM section and also providing a better impedance match. Rather radical, and probably not a solution to your problem, but it illustrates the point that the AM section of a radio may not be as well designed as the rest of the set, on the basis that distortion in AM often seems to be accepted as part of the deal.

Thanks for sharing your solution on curing a noise problem in the frequency counter. I have not had any letters describing this problem before, so perhaps the ECL amplifier IC supplied in your kit has a higher than normal gain.

Still it's good to know you solved the problem with such a simple modification. I'm sure other readers will be interested as this counter has been built by many constructors.

NiCads & things

The next letter asks a number of questions on a variety of topics.

Can you possibly give me some information about constructing an ultrasonic cleaning device such as those used by jewellers. On an another topic, I also want to use battery operated, 9V burglar alarm equipment on my car. Is it feasible to safely test the alarm by increasing the supply voltage, or should I play it safe and install a voltage regulator? What determines the maximum input voltage to a device?

Another problem I have concerns an Arlec re-chargeable torch fitted with NiCad batteries. After three years of very little use, it now gives me only 30 seconds of adequate light even after a weekend's charging. Two of the three cells give a negligible voltage reading. A portable electric drill also has the same problem. Can you suggest a way of renovating the batteries, which have *given nowhere near the 1000 recharges service I understand is claimed?* (M.N., Goodna Qld).

As yet we have not published an ultrasonic cleaning device, M.N., although such a device should not be difficult to construct. The idea is to place an ultrasonic transducer (suitably protected) in a container of cleaning fluid, and to excite the transducer with suitable drive circuitry. The ultrasonic waves then do all the work — at least so the theory goes.

A typical piezo transducer operates somewhere around 40kHz and requires an oscillator tuned to the appropriate frequency to drive it. A design that uses something similar is described in the ultrasonic movement detector, presented in April 1990, page 80. Perhaps you could adapt part of the circuit to your requirements.

Concerning the 9V burglar alarm equipment, without having details of the circuit it's difficult to say whether it could operate safely at a higher supply

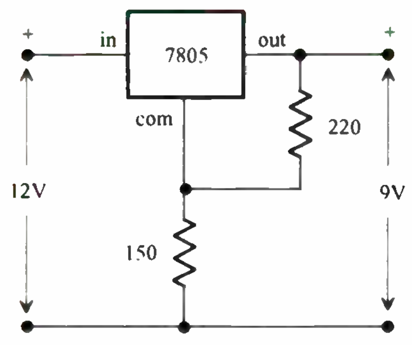


Fig.1

voltage. There are many things that limit the safe operating voltage of a circuit, but the main limitation is the current taken by the various components as the supply voltage is increased. If the current is too high, the component (resistors, relays etc) might overheat. Some components such as ICs are designed to operate with one value of voltage only, and exceeding this can destroy the IC.

However, you could try connecting the equipment to a power supply in series with an ammeter. While you increase the supply voltage, watch the current reading. If it doesn't increase significantly, then perhaps a higher operating voltage is not a problem. Also check for any overheating.

But given that the battery voltage in a car can rise to over 14V, it may be better to use a 9V regulator just to be sure. A circuit that uses the commonly available 7805, 5V regulator IC is shown in Fig.1. The resistors increase the output voltage to 9V. Check the temperature of the regulator and add a heatsink if it gets too hot. Also, a 0.1uF capacitor connected between the input and common terminals of the regulator will improve the regulating action of the circuit.

It may be possible to rejuvenate the NiCad batteries in your torch (or drill) by cycling them through a number of charge-discharge cycles. However, if the batteries won't take a charge at all, then I suggest you replace them. This sort of problem often arises when the cells are continually trickle charged, rather than regularly discharged and then charged over a 14-hour period at their rated charge current.

A NiCad discharger was described in September 1989 and a companion charger in July 1989. The articles about these projects might give you a few ideas as well. Incidentally, a problem that some constructors have experienced with this charger concerns the timer section. A possible cure is to add a 0.1uF capacitor from the anode of D1 to ground. I've printed errata and comments over several issues about this project, in July 1990, page 159, May 1990 page 127 and January 1990, page 174. The comments give solutions and descriptions of the problems with the charger.

Stereo TV kit

If you built, or want to build the stereo TV decoder described in March and April 1985, you'll be interested in the next letter.

I would like to know if there are replacement parts available for the stereo TV decoder originally available as a kit from Dick Smith Electronics in 1985. The parts no longer available are the demodulator LVNZAV01, the tuner PCB V325/U322 and the transformer TM 2006-1.

Can you tell me how I can complete the unit, or perhaps advise me if I can connect the audio output of the TV set directly to the decoder. Also, could I use a 15V, 1A transformer to supply the 12V regulator in the circuit? (W.D., South Granville NSW).

I'm told that DSE do have replacement modules for this kit, but the original PCB needs slight modifications as the replacements are mechanically different.

In the original circuit the AC supply to the 7812 regulator section is 17V, but a 15V supply will be suitable. In fact it may even be better, as the voltage drop across the regulator will be less. Providing this drop is at least 2V, the regulator will work correctly. Naturally, you'll still need another source of 37V AC for the 30V DC supply.

You cannot connect an audio signal directly to the decoder, as the circuit requires the FM sound carrier at 36.875MHz. However, it might be possible to derive this signal from a TV set, at a point directly after the IF stage. Either connect the IF output directly to the 4.7nF (0.0047uF) capacitor connected to pin 1 of IC8, or if the signal level is too low, to the input of the amplifier stage around Q101 and Q102. This would allow you to bypass all the bits you can't obtain. You lose the UHF facility, but if this is not required, then it doesn't matter.

Remote control

These days virtually everything electronic has its own infrared remote control unit — except train sets, as our next correspondent laments.

I am 15, and if possible would like to build an infrared remote controlled power unit for my model train layout. But how? I have looked back through copies of EA but have found very little, although one design, described in the April 1986 issue seemed partly useful.

This circuit offers a single channel and is based around two 555 timers in the handpiece to give a pulse modulated carrier, transmitted by two infrared LEDs. The receiver contains an amplifier IC, type uPC1373 and the decoding is performed by an LM567 PLL tone decoder IC. The circuit then controls power to a device plugged into a socket on the circuit.

The controller I have designed needs five buttons on the handpiece; two direction buttons, two speed buttons and a stop button. The receiver needs to be able to accept the signal and control either the power level with eight voltage-divider chains using a 4051 analog multiplexer, or the direction with a transistor bridge circuit.

If I use a design similar to that given in the April 1986 edition, I would need to multiply everything by five. Is there any other way of achieving the same thing, such as with a single chip, like the one available for the Teletext decoder remote control unit?

There seems to be no books available about infrared control in either the library or from electronic parts suppliers. Is there a book available, or if not, how can I do it? (C.I., West Chatswood NSW).

IR remote control is more complex than it first appears, C.I. These days, the transmitter is usually based around a single IC, and the handpiece designed for the Teletext decoder is typical. However, the problem is not so much with the transmitter but with the receiver. When a button is pressed on the handpiece, a code is transmitted, and the decoding circuitry in the receiver has to decode the signal for each button and produce a signal at one of the various outputs.

We described another single channel IR remote control switch in November 1988, and an IR remote control tester in September 1990. The article describing the tester has quite a bit of information on how the signal is coded, and it might help you understand the operation of an IR remote control system.

We described an eight-channel IR remote control system in the June and July 1987 issues, which could probably be adapted to your needs. However after almost five years, you may find some of the parts for this design a little hard to obtain.

The IR receiver-decoding circuit used in the Teletext decoder could be used in your application, although it relies on a pre-programmed single chip microprocessor. This IC may be available from DSE, but is normally sold as part of the kit for the Teletext decoder.

As well, you'll need a separate 6MHz clock for the IC. So you would need to convince DSE to sell you the various bits, rather than a complete kit. Still, there is no harm trying. The article describing this project appears in the June 1989 edition.

An alternative you might want to consider is to use the 16-channel UHF remote control switch described over four issues, starting in November 1988. This project will probably cost less than an IR remote control unit, and because of its flexibility, lends itself ideally to your application.

The outputs are relay contacts, rather than IC outputs, so isolation is automatically provided between the load and the receiver. This project was designed by Oatley Electronics, who can be contacted on (02) 579 4985.

Big numbers

Ever wondered how big a billion grains of sand is? The next letter has the answer...

What is a billion? I find it difficult to avoid political matters when the word 'billion' appears — as politicians and their minions seem to use a billion dollars as a basic unit. As most people know, a billion is a thousand millions — 1,000,000,000, written in scientific notation as 10^9.

But, do we have any idea of the sheer magnitude of a number like a billion? It's easy to visualise a thousand as the number of those little millimetre marks on a one-metre rule, and also as the number of such rules placed end to end on a one kilometre stretch of road. Put a thousand of such ruler bearing one-kilometre stretches end to end. One billion of those tiny millimetres reach roughly from Sydney to Melbourne.

A tonne is a million grams, or a billion milligrams. A grain of sand (fairly fine) would weigh about a milligram, so there are about a billion sand grains in a heaped box-trailer load.

A can of beer is 375ml. A billion of these is 3775 million litres or 375,000 tonnes. Three or four big oil-tankers! For Scotch drinkers, a smallish 30,000-tonne tanker will suffice to carry a billion nips. (R.V., St Georges Basin NSW).

Thanks R.V., I've often wondered how to describe a billion. From your description, if a dollar coin is about 2mm thick, a billion dollars in $1 coins stacked face to face would extend from Brisbane to just outside Melbourne. Our national debt would therefore travel right around Australia. Rather awesome when you put it that way!

Oscillator mods

Here's a letter from a reader who offers a modification to the Low Distortion Oscillator described in the Feb/March 1989 editions. The end result is a frequency scale far less crowded at the high frequency end. Here's how it was done...

To avoid the crowding at the high frequency end of the scale that occurs when a dual linear pot is used, I looked around for a reverse-log pot. These seem to be generally unavailable, although Allen Bradley may be a possible source that I've yet to try. So I then decided to see if a dual log pot could be used, but with the elements reversed.

I located a 100k dual log pot from Tandy (cat. 271.1732), disassembled it and reversed the two elements so the front of the element was to the back. This then gave the required reverse-log characteristic.

To reduce the 100k value I shunted the pot with fixed resistors, bringing it down to 13.27k, including the series (or minimum R). The value of the series resistor was chosen as 1/11, or about 1.1k. The final values worked out, for a pot with a measured resistance of 92.8k, to 14.3k for the shunt resistors and 1.1k for the series resistors.

The whole assembly no longer delivers a reverse log characteristic, but tends to vary towards the linear curve. However, it is still much better than using a linear pot, with the specified series resistors.

Although I haven't built the unit as yet, according to some simple mathematics, the mid point of the frequency scale is now 40Hz, rather the original 28Hz. This assumes capacitor values of 4.7uF instead of the specified 10uF values. There is also a slight 'woof' at around 50Hz due to the tap on the pot normally used in conjunction with a loudness control.

Incidentally, in my case the pot elements were within 7% of each other, although matching may not be this good in all cases. (B.P., Port Macquarie NSW).

Thanks for your letter B.P. I hope you'll write and let me know if the theory is supported in practice. I suspect the distortion figures will increase with this modification, although they may still be lower than typical figures for a conventional Wein bridge design.

Ideally, a non-linear wirewound pot is required, but your method is certainly cheaper and given that the pots are more readily available, probably more viable.

However, I must admit to being intrigued as to how you reversed the elements. I assume this would have required a degree of modification to the case of the pot and to the wiper. Still, it is an innovative approach.

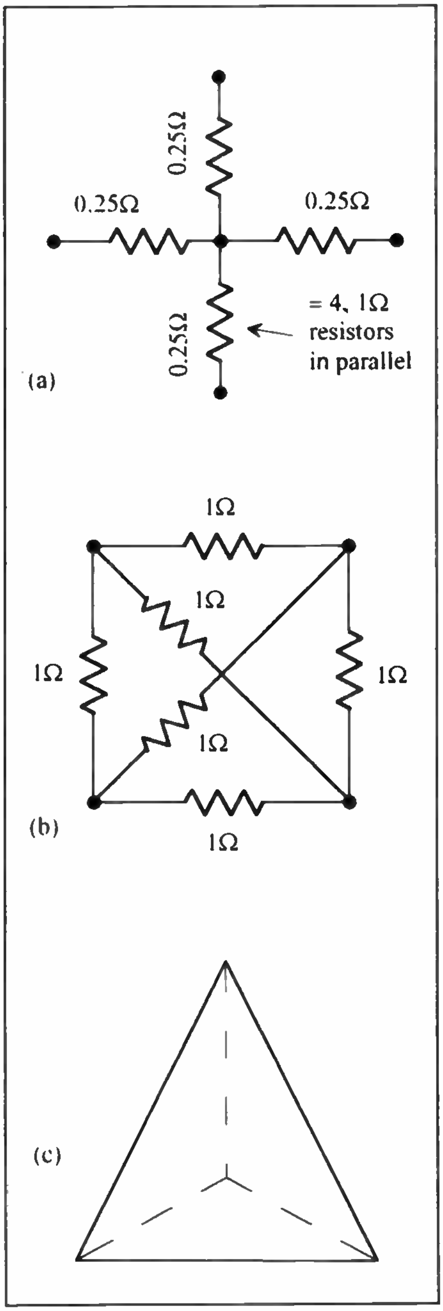
What?

The question this month is perhaps more mathematical than electronic, but the contributor (D.L from Tumblong) has managed to get a reference to electronics into it.

It's a mite tricky, and I used a graphics program on my computer to verify the answer supplied by D.L. I'll show you how next month. Here's the question:

Two audio enthusiasts decided to repaint their speaker enclosures. Each had a new one-litre can of paint; one red and the other white, chosen to suit the decor of their rooms. The more conservative of the two decided that perhaps white was too stark and mixed a spoonful of his mate's red paint to tone it down a bit. His mate, annoyed at having his paint nicked, promptly took a spoonful of the now slightly pink mixture and stirred it into his can of red paint.

The question is: which, if either, tin of paint was more adulterated?



Answer to April's What??

The simplest solution is shown in Fig.2(a), where each of the 1/4-ohm resistors is made from four parallel connected 1-ohm resistors. Therefore, you need 16, 1-ohm resistors.

A more elegant solution is shown in Fig.2(b), which uses only six of the 1-ohm resistors. From a geometric point of view, the output terminals can be thought of as the nodes of a tetrahedron (shown in (c)), with the resistors placed along the six edges.

Because of the inherent symmetry in the tetrahedron, the resistance between any two vertices will be equal, in this case 0.5 ohm: ❖

NOTES AND ERRATA

On p.110 of our February 1992 issue, the article entitled 'Programmable Dialler' showed the facsimile number instead of the phone number. For those readers who have tried to contact Nidac Security, 2 Cromwell Street, Burwood 3125, the correct phone number is (03) 808 6244.

ALL NIGHT HI-LIGHT TORCH (November 1990): The hysteresis associated with the 'low battery' indicator has been found to be more of a nuisance than it is worth, because of false triggering at lamp switch-on.

The problem can be eliminated by replacing resistor R12 with an 5.6m 0.25W resistor which will only allow LED2 to come on at the point determined by the setting of RV2.

After replacing R12, re-adjust RV2 so that LED2 illuminates when the battery voltage falls to 5.7V. ❖

NEW KITS FOR EA PROJECTS

Jaycar Electronics has released the following kit for recent *EA* projects:
SINE/SQUARE WAVE GENERATOR (March 1992): The Jaycar kit includes ALL specified components including IEC mains input plug, instrument case and front panel. It also includes 1% metal film resistors, and the *ultra low noise* version of the LM5534AN op-amp. The kit has the catalog number KA1742, and is priced at $59.95.
Also Dick Smith Electronics has released the following kit for a recent *EA* project:
ACTIVE CROSSOVER (May 1992): The DSE is a 'short form' kit, with the PCB and components. It has the catalog number K-5405, and is priced at $29.95.
NOTE: This information is published in good faith, from information supplied by the firm or firms concerned and as a service to readers. Electronics Australia cannot accept responsibility for errors or omissions.

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.

May 1942

Shale oil: Unfortunately, drilling in Australia has not located petroleum (flow or well oil) of any consequence. However, oil is being made by the destructive distillation of shale and coal to meet the wartime demands for fuel. Although it is called shale oil, the shale does not contain any oil as such, but a substance called 'kerogen' or pyro-bitumen. Under the effects of heat, this first breaks down into bitumen, and then, with further heating, into gas, crude oil and water.

The crude oil, according to the method of retorting, is either a heavy, thick dark-coloured liquid containing little motor spirit, or a thin, light-coloured liquid containing a large amount. The first mentioned method of extraction is currently being used at Glen Davis near Lithgow NSW.

May 1967

Satellite TV: Very early on June 7, television viewers in Australia's eastern states will be able to watch the first direct satellite telecast from North America. The telecast will cover Australia's Special Day at EXPO '67 in Montreal, Canada.

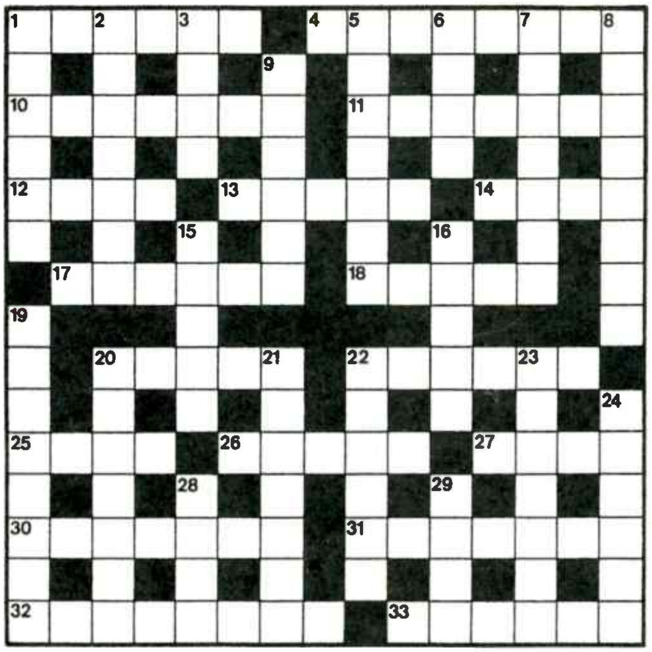
The program will be relayed 1000 miles by microwave radio from Montreal to Rosman, North Carolina USA. From there, NASA will make available, without charge, its satellite television link to Cooby Creek near Toowoomba, Queensland. This link is via satellite ATS-B, which is in orbit over the equator, roughly 23,000 miles above the centre of the Pacific Ocean. From Cooby Creek the picture will be sent to the ABC control centre in Sydney, where it will be converted from the USA 525-line standard to the Australian standard of 625 lines.

Germanium ICs: IBM have developed germanium integrated circuits which are said to be faster than the fastest silicon circuits so far reported. They take advantage of the inherently greater speed, or mobility, of electrons and holes in germanium, which permits switching speeds of about three times that of silicon devices of comparable size.

The experimental circuits have measured switching delays of 35 pico-seconds, even though the Ge devices are about three times as large as the smallest Si circuits. (Switching delay is closely related to device size). The larger size is necessary since germanium oxides are unstable, and so cannot be used to form impervious layers on the wafer, as can silicon oxides.

Moon bounce: The US Navy has taken delivery of a system called 'Moon Bounce' to communicate between its ships and shore. Ships at sea will beam teletype messages to the moon, which will act as a passive reflector. The reflected signal will be received by shore-based ground stations. By using microwave techniques, the Navy can overcome conditions in the atmosphere and ionosphere which interfere with long-range communications at medium and high frequencies. ❖

EA CROSSWORD



ACROSS

1. Common term describing SI. (6)
4. Name of space shuttle. (8)
10. Concerned with the shape of the Earth. (7)
11. Element named after a planet. (7)
12. Precipitation detected by radar. (4)
13. Electronic sounds. (5)
14. Brand of power tool (4)
17. Offer resistance. (6)
18. Track of CRO spot. (5)
20. Features of a diffraction grating. (5)
22. Equivalent of work. (6)
25. Assign to certain position. (4)
26. Boundary of a field. (5)
27. Group of three. (4)
30. Such a point is the perigee. (7)
31. Frequency changer. (7)
32. Name of former measuring system. (8)
33. Construction that clears current? (6)

DOWN

1. Large resistance unit. (6)
2. Metal named after a god. (7)
3. Integrated services digital network. (1,1,1,1)
5. Horned instrument. (7)
6. Apple's first customer? (4)
7. Small current. (7)
8. Form analogous system. (8)
9. Cylindrical cover. (6)
15. Shape of thread. (5)
16. Display face. (5)
19. Name of effect caused by power line's loss of load. (8)
20. Emitter of UV. (7)
21. Distributions of radiation. (7)
22. Apply current to coil. (6)
23. Said of distorted voice transmission. (7)
24. Heat leaves this for the sink. (6)
28. What is changed electronically in a modern auto? (4)
29. Dissembler exposed by a polygraph. (4)

SOLUTION FOR APRIL

EA with ETI marketplace

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Amateur Radio News

Gosford Field Day

This year's Gosford Field Day seemed to attract even more people than last year — possibly due to the better weather, for most of the day at least.

As usual there was a 'flea market', not only in the aptly named Agricultural Pavilion but also spilling out alongside to become a 'boot market', with vendors offering goods from temporary tables and the boots of their cars. This provided many opportunities for the acquisition of pre-loved equipment and components, even before the official Disposals auction began in the Dwyer Pavilion.

In addition there were many trader stands, with firms such as Icom Australia, Dick Smith Electronics, Oatley Electronics, RCS Radio and Stewart Electronic Components all offering many products of particular interest to the radio amateur.

Oatley Electronics demonstrated some of the uses for the low cost gas laser projects that the firm markets, creating quite a bit of interest.

Also attracting interest from many visiting amateurs were the displays of 'fortuitous' satellite TV reception, from two firms: Videosat and AV-COMM. Videosat again had its mobile demonstration bus on site, with various dishes and systems on display — including a low-cost decoder to allow viewing of E-PAL (encoded PAL) on a standard PAL receiver. AV-COMM was demonstrating its new low cost receiving system for Optus/Aussat signals, which combines a 1.8m dish and mount, antenna/LNB combination with magnetic polariser, 30m feed cable and digital synthesiser receiver with IR remote control — all for only $995.

Technical seminars presented during the day included one entitled 'Packet Radio without the Bulldust', by Dave Horsfall VK2KFU; another on the history and theory of spread-spectrum communications, by John Faulkner VK2DVW; a talk on NET/ROM, by John Robinson VK2XY; and a discussion of 9600bps packet modems and radios, by Adrian Blake VK2ALF.

In addition a number of amateur radio clubs, organisations and affiliated groups had displays. These included ALARA, AAPRA, ANARTS, WICEN NSW, the WIA and its educational service, and the Gladesville ARC. The NSW Police Radio Electronics Unit also had a display, while the Central Coast ARC had a display of ATV equipment and the Castle Hill Military Radio Group had a display of historical military radio gear.

In all, it was a very successful field day, with events and displays to interest almost everyone with an involvement in amateur radio. The hosting Central Coast Amateur Radio Club is to be congratulated, on maintaining Gosford as the premier annual event in Australian amateur radio.

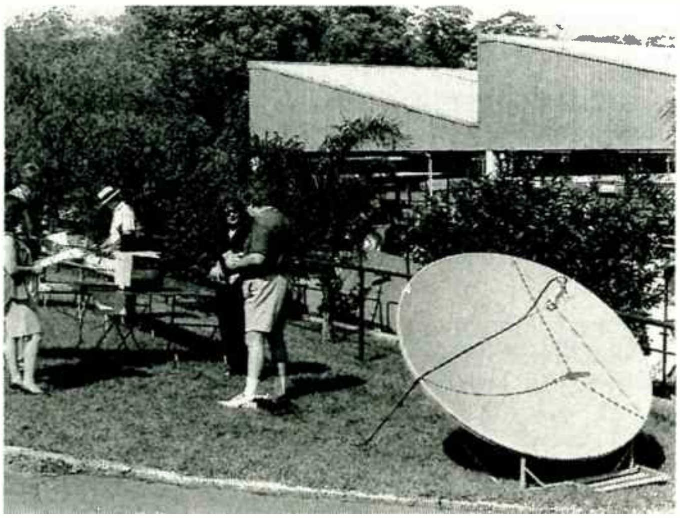
Summerland ARC

Graeme Virtue, VK2GJ has sent update information on this club, which meets at clubrooms in Richmond Hill, Goonellabah (north coast of NSW). The clubrooms are operational on Thursday evenings and Sunday afternoons, with other times by arrangement.

The club callsign is VK2AGH, and the club conducts HF nets on 3.605MHz Monday to Friday at 2030 UTC, and on Sundays on 3.603MHz at 1000 UTC. A CW net runs nightly on 28.200MHz at 1230 UTC. VHF nets on either repeater VK2RIC or VK2RBB are held on Fridays at 1000 UTC, while the WIA broadcast is relayed over VK2RIC on Sundays at 0100UTC. An informal 'net' is also held each Tuesday afternoon at the Lismore Workers' Club, at 1705 local time.

The club runs four voice repeaters (three VHF/one UHF) and three packet digipeaters (two VHF/one UHF). The packet BBS is VK2YDN-1, and the local PMS is VK2Ea-2.

Club membership is available to anyone interested in any branch of electronics, amateur radio, computers, remote control etc. Enquiries may be made directly or to PO Box 524, Lismore 2480. ♦



Left: The Gosford Field Day 'flea market' expanded outside the Agricultural Pavilion to become a 'boot ' market, which attracted quite a bit of interest from bargain hunters.

Right: AV-COMM was demonstrating its low cost satellite TV receiving system, which sells for less than $1000. This includes a 1.8 metre dish and mount, antenna and LNB, cabling and synthesiser receiver with IR remote control.

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REVIEW OF HEME 'ANALYST 2000P' CLAMP-ON DMM/SCOPE

A LOOK AT THE LATEST SOLDERING PRODUCTS

I^2C AND THE ACCESS BUS: BASIC CONCEPTS

GE PRODUCES HIGH-QUALITY 52W BEAM OF 532nm GREEN LIGHT FROM Nd:YAG SOLID STATE LASER SYSTEM

NEWS HIGHLIGHTS

JAPAN BUYS AUST. SOLDERING STATION

Australian firm Royel International has effectively cracked the Japanese market with its locally developed and manufactured Thermatic Soldering Station — although the product won't be marketed in Japan carrying the Royel label. It's being sold by distributor Japan Unix as the Unicon-105, after having been chosen by the firm after three years of intensive testing and comparison against competing products.

Royel's MD Alan Royston is justifiably proud of the achievement, which he says demonstrates that at least one item of Australian technology has been able to gain access to the Japanese market.

He is hopeful that this acceptance will help persuade Australian distributors to support Australian products like the Thermatic, which have demonstrated the ability to compete strongly on an international basis.

LITTLE HAVOC FROM VIRUS

This year's March 6th passed with only a few reports of corrupted personal computer disks caused by the so-called 'Michelangelo' virus — despite dire predictions by visiting American promotors of virus-detection software packages, and their local publicity agents. It was something of an anticlimax, in fact.

A rather nasty variant of the well-known 'Stoned' virus, Michelangelo gives no taunting message; instead it wipes the first 17 sectors of the first four tracks on every cylinder of an infected computer's hard disk, if the machine is booted up on March 6 of any year (March 6 is the birth date of the classical painter/sculptor Michelangelo). The virus is believed to have originated in Taiwan, and to have been spread via software accompanying hardware from that country.

Australian anti-virus expert Roger Riordan claims to have been the first to isolate the virus in early February 1991, and his well-known *Vet* package has been able to detect and remove the virus since its version number 6.4. Riordan also claims to have named the virus.

In the absence of a virus detection/removal package, one of the few clues pointing to an infection by Michelangelo is a reduction in the 'top of memory' reported by DOS: from the usual 655,360 bytes, for a standard 640K machine, to 639K.

A3 LASER PRINTER USES OZ CONTROLLER

Dataproducts Corporation, a leading US based page and line printer manufacturer, chose Australia for the World launch of its new HP PCL5 compatible 300/400dpi A3 laser printer. Using an Australian designed and manufactured controller board, the new LZR 1555 boasts performance and features never before offered in a laser printer under A$9000, according to Dataproducts' Australian Vice President, Mr Paul Press.

"We chose the controller from a local company, Pacific Semiconductor (PacSemi), after reviewing many competing products at our head office in the USA. The ability to emulate HP's PCL5 language as found in the HP LaserJet Series III at increased speed was critical to us," he said. "We have positioned the LZR 1555 as a workgroup or network laser with the added advantage of handling A3 sheets. The PacSemi controller gives us the throughput to match our 15ppm printer enginer," he added.

The Dataproducts LZR 1555 is a high duty cycle, high speed laser printer with 15ppm throughput in A4 mode and eight ppm in A3.

According to Paul Press, the PCL5 controller "gives first page print times up to three times faster than the HP IIIsi and, because copy pages don't need redrawing, duplicate pages print at the rated engine speed."

Included in the LZR 1555 is an attractive range of HP compatible scalable fonts similar to CG Times and Univers, with font size scalable from 1 to 999 points.

Also included are 14 bitmapped fonts, in courier and line printer style. Standard memory is 4MB with up to 12MB available, in 4MB increments as an option. To cater for workgroup applications, the LZR 1555 features three input ports that can be separately configured, allowing simultaneous sharing by one parallel and two serial users. Dataproducts are planning to release a network controller for the LZR 1555 with TCP/IP protocol within the next few months.

H-P DIGITAL SCOPE WINNERS

During the period November 1991 — January 1992, *Electronics Australia*'s new and renewing subscribers were eligible to win one of two new Hewlett-Packard HP 54600 Series 100MHz 'analog feel' digital sampling oscilloscopes. The lucky winners were:

Winner of the first prize, an HP 54601A four channel instrument valued at $4693, was J. Kiss of Condoblin, NSW.

Winner of the second prize, an HP 54600A two channel instrument valued at $4652, was Mr G. Beutel of Mount Waverley, Victoria.

Our congratulations to these subscribers on their good fortune, and we hope they are able to put these excellent instruments to profitable use. Our thanks also to Hewlett-Packard Australia, for their help in sponsoring the promotion.

OPTUS BEGINS ITS NETWORK

Optus Communications, Australia's new telecommunications carrier, has commenced installation of its national network. The Minister for Transport and Communications, Senator Richardson, laid the first length of optic fibre cable at a groundbreaking ceremony in Goulburn, NSW.

The Optus network will stretch from Cairns to Perth by 1997, requiring supply and installation of more than 250,000 kilometres of optic fibre. The first section of the network will be laid between Sydney, Canberra and Melbourne. Work is scheduled for completion by the middle of 1993.

Commencement of the cable-laying project marks two significant supply agreements. One is between Optus and Leighton Contractors, which will be responsible for placing the cable and related civil works. The other is between Optus and Olex Cables, which will supply Optus' cable needs from its plant in Tottenham, Victoria. The two contracts together are values at more than $200 million over the next two years.

The Chief Executive of Optus, Mr Bob Mansfield, said the company's plans for installing the most advanced telecommunications network in the world were on schedule. Mobile communications service is due to commence in June with domestic long distance and international telephone services becoming available towards the end of the year.

GRANT TO DEVELOP LASER MACHINING

The IR & D Board has awarded a $302,600 grant for the development of an automated high precision UV laser machining technique for use with polymers and ceramics, to a research team comprising representatives from the Centre for Lasers and Applications, Macquarie University, the CSIRO Division of Manufacturing Technology and industry partner Visiray.

Chairman of the IR & D Board's Manufacturing and Materials Technology Committee Len Whelan said the new technology would have important implications for Australian industry.

"Laser equipment for medical applications is being marketed world wide as a result of the research, and this project will maintain Australia's leadership in the field", he said.

SANYO SETS SOLAR CELL

Engineers at Sanyo's Functional Materials Research Centre, in Osaka, Japan, have claimed a breakthrough in research and development of amorphous solar cells. The company's R&D team has produced a 100 x 100mm amorphous single junction solar cell with an effective conversion efficiency 11.1% — the first time such a rate has been achieved.

High quality amorphous film, which is a key element in increasing the conversion efficiency of amorphous silicon solar cells, is obtained by producing high quality i-layers through ultra-high vacuum reaction chamber methods and p-type amorphous silicon carbide film doped with trimethylboron.

The recent increase in conversion efficiency was achieved through the formation of a new ultra-thin buffer layer and laser patterning methods based on this high quality film.

According to Sanyo, this accomplishment puts the company in a strong position of attaining the goal set by Japan's MITI backed New Energy and Industrial Technology Development Organisation (NEDO) of 12% effective conversion efficiency by 1992.

HUBBLE STUDIES JUPITER'S AURORAE

NASA's Hubble Space Telescope (HST) was recently used to study aurorae — not on Earth, but one-half billion miles away on the giant planet Jupiter. The HST made observations of Jupiter over a four day period when ESA/NASA *Ulysses* spacecraft swung by the giant planet.

Ulysses used Jupiter's immense gravitational field to get a 'slingshot

BRIGHTER GREEN LASER BEAM

GE solid state laser researchers claim to have established a new brightness milestone for light in the green region of the spectrum, opening the door to a variety of potential applications in manufacturing, communications and medicine.

The high quality, 52-watt beam generated by the GE team more than doubles the previously published brightness record for green light produced with solid state lasers.

To achieve the high brightness green beam, the GE researchers began with a commercially available solid state laser that produces a beam with average power of 16-watts and good quality in the infrared part of the spectrum (1064nm). After being passed through a telescope and other optical elements, the beam was fed into a specially built neodymium-doped yttrium-aluminium-garnet (Nd:-YAG) face-pumped laser of the type invented at the GE R&D Center some 18 years ago. This amplified the beam to 92-watts while retaining the good beam quality.

The 92-watt beam that emerged from the face-pumped laser was then passed through a focusing lens and fed into a 'frequency doubler' — a crystal of lithium triborate — that halved its wavelength to 532nm. This produced the 52-watt green beam in combination with an invisible infrared beam. To separate them, the two beams were passed through a dispersing prism.

NEWS HIGHLIGHTS

boost' out of the plane of the Solar System and onto a trajectory toward the sun, where it will study the sun's polar regions never before visited by a spacecraft. *Ulysses'* closest approach to Jupiter occurred on February 8th.

While passing Jupiter, Ulysses made measurements of Jupiter's powerful magnetic field and the flow of subatomic particles along magnetic field lines. Simultaneously, HST was looking at aurorae, one visual manifestation of these electrical fireworks.

These joint observations will provide a unique opportunity to combine ultraviolet images and spectra with information on particles and fields. This will lead to a better understanding of what produces and maintains auroral activity.

NEW HOME COMPUTER SHOW FOR MELBOURNE

A new computer exhibition called the Home Computer Show will be staged later this year in Melbourne.

The Home Computer Show will be held from 13-15 November at the Royal Exhibition Building and will be targeted at the home computer user and the education market. It will include personal computer, electronic games, shareware and all types of products for the home and small business user.

Christopher Murray, Project Manager for the new show, said his firm Australian Exhibition Services believed that the market was now viable for a home computer show.

"US researchers predict that by 1999 personal computers may outnumber children in the average US household and that by the end of the decade there will be an average of 2.2 personal computers in each household," Mr Murray said.

"AES believes that a similar situation exists in Australia. The same factors as cited in the Texas survey, are at play here: lower prices, an increase in the number of people working from home, and the desire for children to have computers with access to online information services."

In Australia more than $350 million was spent on home computers and electronic games in 1991. It is estimated that the potentional growth of this sector in the next 12 months is 14%.

FCC APPROVES CDMA TRIALS

The US Federal Communications Commission (FCC0 has granted QUALCOMM Incorporated an experimental licence to conduct field trials and studies in the 1850-1990MHz band. The company will use its Code Division Multiple Access (CDMA) spread spectrum technology in these experiments to demonstrate the feasibility of using its CDMA digital cellular system for personal communications services (PCS) in the 1850-1990MHz band.

"CDMA is ideally suited for implementation in this band," said Harvey White, the company's chief operating officer. "QUALCOMM's CDMA 1.25MHz wideband channel is broad enough to provide for all the inherent advantages of a spread spectrum signal while being narrow enough to fit into the less congested portion of the 1.8 - 2.2GHz spectrum, thus simplying transition and regulatory issues including the PCS bandsharing possibilities. This will ensure a non-interfering use of the proposed spectrum.

The FCC has indicated that it may open up portions of the 1.8 - 2.2GHz band for the new PCS services. Numerous studies of this band indicate that there is unused spectrum and the intent of much of the 1.8 - 2.2GHz PCS experimentation is to determine the level of coexistence that can be accomplished between existing 1.8 - 2.2GHz users and new PCS providers.

Existing form of PCS include cordless telephones, paging services and cellular telephones, each of which is identified by its own telephone number. Expanded forms of PCS using CDMA would provide subscribers with a single, hand-held communications unit with a single telephone number that could be used in a variety of environments including the home and the office in conjunction with a wireless PBX, or for vehicular and pedestrian mobile public telephone services.

QUALCOMM has also announced that Matsushita Communications Industrial of Japan has signed a support agreement for its CDMA technology. Under the agreement, Matsushita will have access to QUALCOMM's technology in order to respond to industry requests for CDMA cellular phones. It also has the opportunity to become an early licensee of CDMA technology.

"We're delighted to announce our association with Matsushita," said Dr Irwin M. Jacobs, president and CEOF for QUALCOMM. "Advanced communications companies such as Matsushita will help to ensure the availability of CDMA-based wireless products to users everywhere. This represents another step in establishing broad industry support for the company's technology among equipment manufacturers." QUALCOMM has previously entered into agreements with AT&T, Motorola, Northern Telecom, OKI Electric, Alps Electric, Clarion, Nokia and Sony Corporation.

NEWS BRIEFS

- ***Eveready*** has a new marketing team: Geoff Hobart has been promoted to Manager, Total Customer Satisfaction, while Kevin Grindrod has taken on his old position as Manager, Marketing Planning.
- ***Amtex*** has been appointed as exclusive Australian and NZ distributor for the Modgraph range of PCs and Super VGA monitors.
- The ***State Electricity Commission of Victoria*** is mounting a major international Symposium and Exposition from June 1-3, 1992 to highlight the enormous potential of electric vehicles. The three-day event will be staged at Melbourne's Hyatt on Collins Hotel.
- ***Elenex Australia***, usually staged annually in June, will now be held later in the year to avoid conflict with the end of the financial year. This year's conference, on the 29th and 30th of September, will have the topic of surface mount and related technologies.
- ***Dynamic Component Sales (DCS)*** has been appointed the Australian distributor for the US-manufactured Benchmarq range of integrated circuits.
- ***Standards Australia*** has recently published a draft on 'Private mobile satellite earth terminals'. The draft proposes definitions, methods of measurement and minimum performance requirements for private mobile terminals intended to access the AUSSAT 'Mobile-sat' system. For copies, phone National Sales Centre on (02) 746 4600.
- ***Siemens*** has appointed Mr Thomas Ruberto as Victorian Dealer Manager of its Advanced Information Products department.
- ***Marconi Instruments*** has been appointed Australian agents for 'Intertrack', a PC-based software package which links electronic design and production.
- ***WARSASH***, a supplier of specialist electronic and opto-electronic equipment to researcher and OEM customers, has expanded into new premises. The new address is GO7 The Watertower, 1-9 Marian Street, Redfern 2016; phone (02) 319 0122.
- Aerovox USA has appointed Sydney-based ***Crusader Electronics*** as exclusive Australian and NZ distributors of its AC oil and energy discharge capacitors, as well as its EMI/RFI filters.
- ***Imagineering Rentals***, which recently changed its name to ***Instrumentation and Computer Rentals (ICR)***, has released its 1992 catalogue.

BAILEY WINS $11.5M EXPORT CONTRACT

Process control group Bailey Controls Australia has won an export contract to Indonesia worth $11.5 million. The company has been commissioned by an agency of the Ministry of Mines and Energy of the Government of the Republic of Indonesia, to supply an instrumentation and control system for a new power plant on the island of Java.

Known as the Paiton Steam Power Plant, the project has been given high priority by the Indonesian Government to meet the urgent need for additional domestic and industrial electricity supplies in this rapidly expanding area.

With its INFI 90 process management solution, Baily Controls won the contract over tenders from 17 international companies. The plant is due to begin operations in the middle of 1993 and the first deliveries of control systems will take place half way through 1992.

GPT RESTRUCTURES

GEC Plessey Telecommunications (GPT) Australia is restructuring. Consolidation of the organisation's activities will see an overall reduction in staff numbers by up to 100, mainly from its manufacturing division. The restructure was expected to be completed by the end of March, 1992.

Mr Roger Parrack, managing director of GPT Australia, said, "These were tough decisions and the company deeply regrets the hardships such decisions inevitably cause. However, the restructure is necessary to better position the company for the opportunities that will develop in the competitive environment of the telecommunications marketplace over the next three to five years".

Current economic pressures have led GPT Australia to review manufacturing costs and efficiencies. As part of its restructure, GPT Australia has ceased printed circuit board assembly. This activity will be subcontracted to specialist Australian based organisations, in line with the company's philosphy to source from Australian organisations whenever cost/quality permits.

HPM SPONSORING UNSW STUDENTS

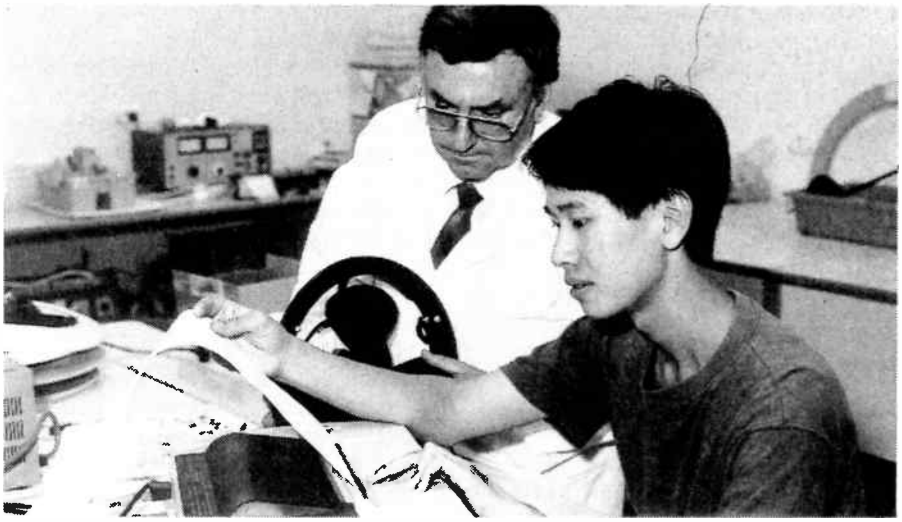
HPM Industries, a leading Australian manufacturer of electrical accessories, is currently sponsoring two places within the University of New South Wales' Co-operative Education Programme aimed at providing students with the best possible future within their industry.

HPM's Chief Executive Officer Stuart Romm says the Co-operative Education Programme has bridged a vital gap between university and industry. "The Co-operative Education Programme is designed to give students as much practical experience as possible while they are studying. Once they have completed their course they not only have over a year's work experience to fall back on, they also have a better idea of where they would like to work and in what areas they would like to specialise in," Mr Romm said.

University student John Lew has just completed a nine and a half week training period with HPM, as part of the programme. John 20, now in his third year of an Electrical Engineering Degree, is one of only 17 students selected from his course to be involved in the programme.

Within the Electrical Engineering school, students are encouraged to work with at least one company from telecommunications, power and manufacturing fields. John chose HPM because of the good impression it left on him after a site visit in his first year at University.

While at HPM, John spent the majority of his time in the Research and Development department. Gaining 'hands-on' experience John became involved in a number of projects including the design and construction of a safety switch module tester and a 360V power supply to test surge protection devices.



INMARSAT-M BEGINS IN US THIS YEAR

A new digital mobile satellite voice communications system, Inmarsat-M, will be available commercially by the middle of this year, in the USA.

Inmarsat-M will provide satellite telephone and other services through lightweight, low cost terminals which can be installed in road vehicles or ships and small boats, and will also be produced in briefcase-sized personal versions.

"Inmarsat-M is a significant milestone in a growing family of new systems being planned by Inmarsat for the 1990s and beyond, including a global satellite paging system and a global handheld satellite telephone service, all of which will feature smaller terminals and lower equipment and satellite usage costs," said Olof Lundberg, director general of Inmarsat.

The first member of Inmarsat's partnership to offer Inmarsat-M will be COMSAT Mobile Communications of the United States, which will provide a telephone service through its Southbury, Connecticut, and Santa Paula, California, land earth stations by the middle of the year.

The service will be expanded by the end of the year to include facsimile and data communications and full global coverage is expected in 1993. COMSAT has announced charges for its Inmarsat-M service of USD 5.50 per minute.

The Inmarsat-M system supports direct-dial all-digital telephony, as well as 2.4kbps data and facsimile services. Next year will also see the introduction of Inmarsat-B, another digital system, which will provide high quality voice and telex communications as well as data (at a rate of up to 16kbps) and facsimile (at a rate 9.6kpbs). Inmarsat-B call charges are expected to be lower than for Inmarsat-M.

Other Inmarsat Signatories who have announced plans to offer Inmarsat-M/B services include British Telecom, France Telecom, Kokusai Denshin Denwa of Japan, Norwegian Telecom, the Netherlands PTT and Australia's AOTC. ❖

Handy computer program:

Software scientific calculator

Want a program that does all the usual scientific-type calculations? Yes, another one! But in addition to performing all the familiar calculator functions, E²CALC also provides some very useful extra features. So read on...

by PETER MURTAGH

As expected, the 'calculator' function of E²CALC performs all the normal scientific calculations. To speed up entry, single key entry is provided for common values like pi, ln2 and root2, etc., and for multiples from 'pico' to 'mega'. Data can be entered in either algebraic mode or reverse-polish notation. In addition, you can toggle between conventional display and engineering format, and between angles in degrees and radians. If required, keys can be made to 'beep' when pressed.

Personally, I prefer to use an ordinary calculator rather than a computer one for my everyday use. But if more information is required in complex calculations, then E²CALC could prove to be very helpful. This is because it permanently displays the contents of its four memories, plus the contents of the X, Y and Z registers used in calculations. It also stores the results of each sub-calculation on a 99-entry stack, and lets you scroll through this to check each sub-result of the process.

Working with complex numbers is also supported. You can enter the data in any format. The program allows entry in any of the formats, and displays the results in all. If desired, it will draw the Argand diagram.

Another option allows you to convert numbers between their decimal, binary, octal and hexadecimal formats.

However, the program is more than just a standard calculator. It can also tell you what combinations of preferred-value resistors will give you a specified resistance (and within a nominated tolerance); and also the individual resistor values you need to form a voltage divider, having specified the total resistance and the voltage taps required. And best of all, there is the 'formula solver'.

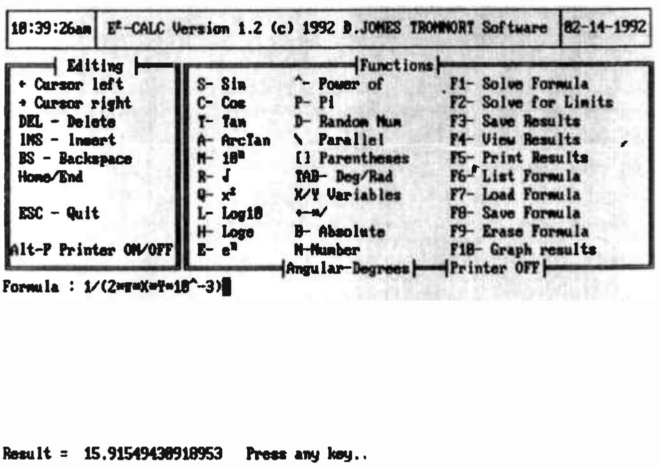
This utility lets you enter (and save for future use) a formula, with up to two unknowns. When you enter the variable(s), it calculates the answer. You can even specify starting and finishing values for these variables, along with a step increment, to obtain a range of results. These results can be graphed, as well as printed out in tabular form. With its unlimited levels of parentheses, it can handle quite elaborate expressions.

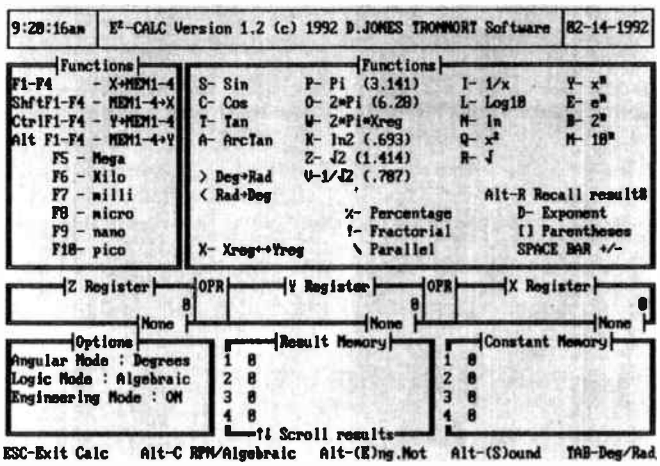
The E²CALC 1.2 reviewed here is the second version of the program. The program's author intends to add more options to the menu in the future, and correct any bugs which users discover.

One bug which I discovered involves the entry of negative powers of 10. These can be entered in such a way that they appear correct on the screen, but calculate wrongly. For example, the calculation of $10^{-2}+5$ (which appears on the screen as 10^-2+5) can be either 5.01 or 1!

The latter answer can appear because of the non-use of the 'N' key. This key is supposed to be used to enter a constant into the formula, but the program quite happily enters positive numbers without using it. But a negative is entered as the operator 'subtract', followed by a positive number. The program then seems to equate everything after the two consecutive operators to zero. The fact that an (in

Continued on page 137





***Left:** The screen for E²CALC when using the 'formula' option. The equation for calculating the capacitive reactance (1/2π fC) has been entered, with X and Y being the variables for frequency (kHz) and capacitance (uF). The result shown (15.9 ohms) was calculated after pressing 'F1' and entering the values 1 (kHz) and 10 (uF).*

***Right:** When using the 'calculator' option, you can enter many common values, and multiples of units, with single-key entry. Note how the contents of all registers are permanently displayed, and can easily be interchanged.*

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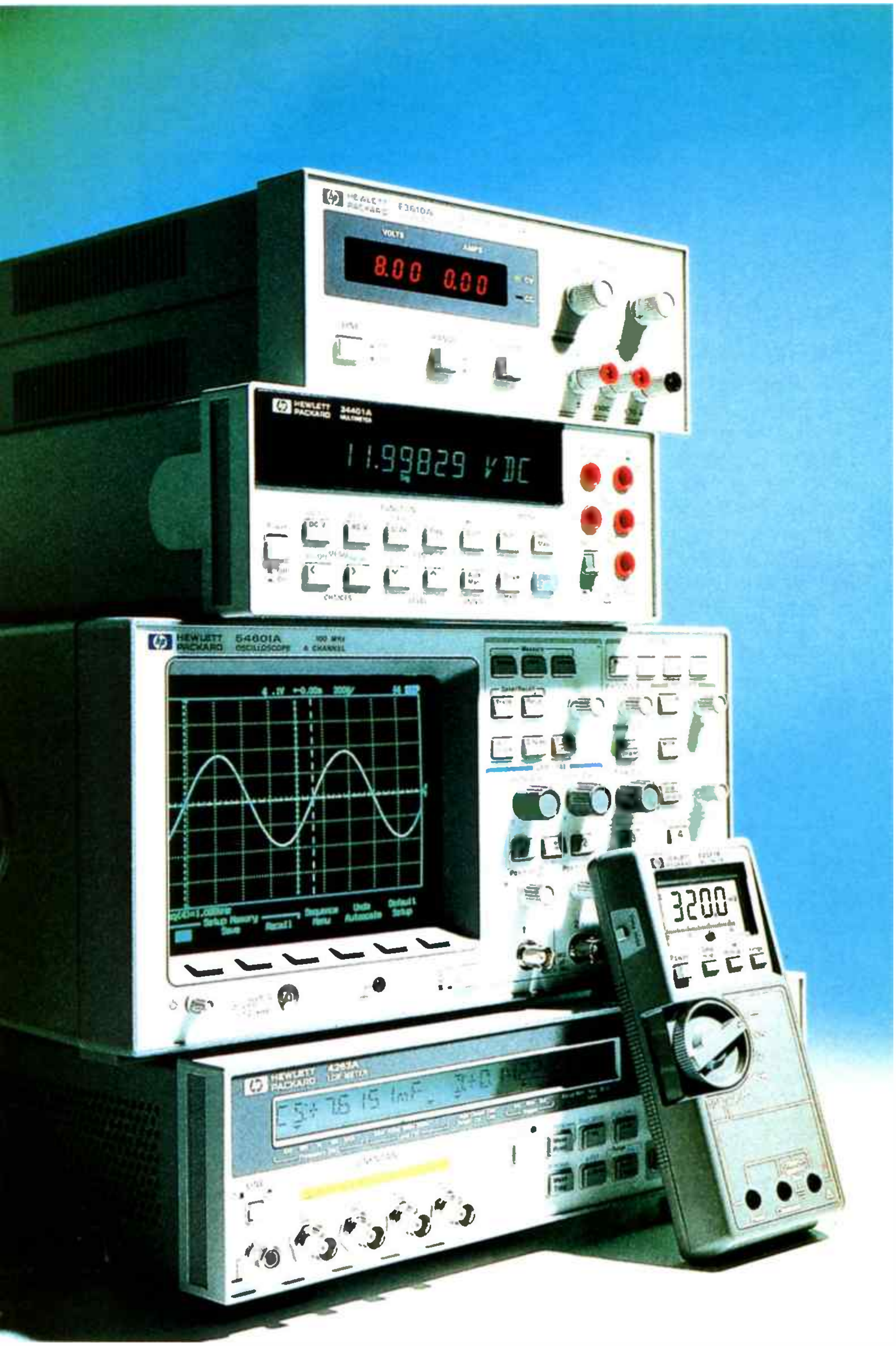

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You won't find a better 100 MHz digitizing scope than the HP 54600 Series. It combines an analog look and feel with digital trouble-shooting power for around $4,040 (2-channel) or $4,695 (4-channel).

At less than $5,780, the HP 4263A LCR Meter lowers the cost of high precision 100Hz to 100kHz benchtop and system component measurements.

And the 8-function HP E2373A is just one of the HP E2300 Series 3 1/2 digit handhelds priced from $160 to $310.

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Silicon Valley NEWSLETTER

Apple puts Windows claim at US$4.4 billion

Four years after it first filed the landmark look-and-feel copyright infringement lawsuit against Microsoft, Apple has put a whopping US$4.4 billion price tag on the damages it will seek to recover if it wins the case — which is scheduled to go to trial this summer.

By any account, Apple has thereby set a record for the amount of damages claimed in a copyright suit. The amount represents twice the annual sales of Microsoft, and more than 70% of Apple's current annual sales. It also represents more than half the US$7.35 billion equity stake Bill Gates holds in his company.

Although most of the original charges in the case were dismissed by the two US District Court judges who have been on the case since 1988, a key part of the suit remains to be resolved through a trial.

The key issue deals with the overlapping window feature of the Macintosh user interface. Microsoft copied this feature into Windows 2.0, even though it was not part of the 1985 licence agreement with Apple that allowed Microsoft to develop the Windows 1.0 program.

Earlier court rulings granted Microsoft the right to use the agreement to develop Windows 2.0 and future generations. But the court so far has agreed with Apple that the issue of overlapping windows and other issues not covered in the agreement will have to be decided through trial.

A ruling in Apple's favour could ruin Microsoft. In addition to huge damages, the company would be forced to radically redesign Windows to bypass Apple's overlapping windows concept. Most analysts agree that this would be a very difficult task.

Compaq cancels Silicon Graphics deal

In what may well be a clear sign that last year's ACE consortium is heading for the history books, Compaq announced it is calling off the far-reaching agreement it had struck with Silicon Graphics just last spring.

That agreement was at the core of the formation of the ACE consortium, which was aimed to develop a new MIPS-based standard for next generation desktop computers. Compaq paid Silicon Graphics US$50 million in return for the right to use the company's leading edge graphics technology. Compaq also agreed to buy US$134 million worth of SG stock.

Now Compaq said it will sell those shares back to SG for US$150 million. However, Compaq will pay SG US$3.75 million in royalties for the use of SG's technology.

Kevin Bohrer, vice president for systems marketing at Compaq said the deal was called off after the two firms failed to agree on a common research direction.

Chip advisory committee abolished

After five years of having its advice completely ignored by the White House, the National Advisory Committee on Semiconductors has been abolished by the US government.

The NACS was formed by Congress in 1987, to advise the President on issues affecting the US semiconductory industry, which was struggling and had seen its worldwide market share decline sharply. As the NACS issued its final report a few weeks ago, US market share had declined another 15% since the group was formed.

Some of the highlights of the NACS were a 1988 proposal calling for massive US investments in HDTV technology. After President Bush changed his mind on HDTV support, the group called for the formation of the Consumer Electronics Capital Corporation, a US$1 billion venture capital fund to be run by the government and that would invest in companies developing high tech products aimed at mass markets. And finally, in 1991, the NACS put together MicroTech 2000, a proposal for the development of a billion-transistor chip by the turn of the century, a project said to be as ambitious as putting a man on the moon.

In the final report, the NACS issued a number of general policy statements, essentially a grouping of a number of ideas that have been floating around in the industry and in Washington for years.

NEC opens US$600M chip plant

The world's most advanced semiconductor factory has opened — not in Japan, but in Roseville, 10 miles north of Sacramento in California.

NEC said it is betting US workers can produce world-class products, including

Bush cuts Sematech funding by 20%

In his fiscal 1993 budget proposal President Bush has proposed cutting the annual subsidy for Sematech from US$100 million to $80 million. He also called on Congress to make the R&D tax credit permanent.

The cut in Sematech funds was widely anticipated. The amount of the cut came in at the low end, but politcal observers have speculated in the past that Congress may increase the reduction during the budget process.

Overall R&D spending by the US government will increase only 2% in 1993, to US$76 billion. Of this, US$45.2 billion will go to the military and civilian research will total US$31.4 billion, a respectable 7% improvement over this year.

One of the projects for which Bush is asking large increases is the High Performance Computing Initiative, which would receive US$803 million — a 23% increase over 1992. HPCI involves the building of a network of high speed data highways across the US linking both civilian, military, government and university research laboratories.

"My plan is to provide record levels of support, over $76 billion this year alone, for people who will explore the promise of emerging technologies," President Bush said in his State-of-the-Union address.

But industry and government analysis said that the Bush proposal offered no major new initiatives.

Military spending still gets 39% of the R&D budget, only slightly below the 60% level of last year.

But for a US economy and industry that needs a lot of support to get on its feet, Bush could have been more aggressive in increasing the civilian share of the federal research pie.

4Mb DRAMs, at the US$600 million state-of-the-art chip plant.

At the 'Open House' ceremony, NEC declared its confidence in US workmanship. Ironically the opening came just a day after the speaker of Japan's Parliament infuriated most of the US public with his statement that American workers are lazy, illiterate and demand too much money for poor quality work.

"I am very upset. I have worked in Roseville for more than four years. People here work very hard," commented Takehiko Kubota, the NEC vice president who runs the NEC facilities in Roseville. "Nobody would ever bet US$600 million on uneducated workers."

The NEC DRAM plant is but the latest in a series and key to NEC's strategy of placing production of the bulk of its US chip sales near the company's customer base in the US.

Kubota added that out of NEC's seven DRAM chip facilities in the world, the Roseville unit ranks second only to the firm's main Japanese plant in overall quality and productivity.

Kubota also stressed that in building and equipping the facility, NEC has focused on using as many US contractors and equipment suppliers as possible.

Chip deal fails, SIA may seek sanctions

The US-Japanese Chip Trade Agreement, signed only six months ago with much diplomatic grandstanding, appears 'dead in the water,' and the US-based Semiconductor Industry Association is preparing to ask the US government to take steps to punish the Japanese for their inability to live up to the terms of the agreement.

The situation is likely to add more tension to the already increasingly sensitive issue of trade imbalance between the US and Japan.

Foremost, the latest data collected by the SIA show that during the past 12 months, the US share of the Japanese market has increased a scant 0.1%. And in the past two months, the marketshare is actually showing a decline.

Under the terms of the agreement, the Japanese have pledged US companies would achieve a 20% share of their market by the end of 1992. At the time, the US marketshare was estimated at around 13.5%. Just two months ago, the Japanese agreed to use the US method of calculating marketshare as the only yardstick by which to measure improvement. But with less than a year to go, the Japanese market has proved as difficult to penetrate as ever, leaving US annual sales to Japan at around US$1.5 billion on a total Japanese domestic market of more than US$20 billion. By comparison, the Japanese sold US$9 billion worth of chips into the US market, which totalled less than US$16 billion in 1991.

At the SIA office in Washington DC, Alan Wolf said he couldn't speak for the SIA's board of directors. "But sanctions have to be a possibility. The trade agreement is at best troubled. Further trade action is something the administration is going to have to consider if things don't improve."

According to some reports, the SIA is considering asking President Bush to impose punitive tariffs on Japanese products from industries that buy particularly few US-made chips, including consumer electronics and automotive — which typically use less than 6% in US-made chip content.

The SIA fears that if the agreement fails to work, the US industry may well find itself completely shut out of the vast Japanese chip markets of the mid-to-late 1990's.

NeXT software for Intel 486 systems

In a clear effort to broaden the market for software applications for his NeXT 'professional workstations,' Steve Jobs has taken his company in a radically new direction by offering a version of the NextStep operating system for Intel-based personal computers.

Jobs said chances are his firm could generate more sales and profits from the advanced operating system than from its hardware business. Still, NeXT will continue to sell the NeXT computers, and to underscore that point, NeXT has introduced several new models that operate on faster micro-processors.

Jobs, at the opening of the first Next-World Expo in San Francisco, said there will soon be more than 10 million computers built around the Intel 486, the minimum processor level required to run NextStep.

The Intel computers will also require additional graphics boards to handle NextStep's graphics-intensive user interface and display. The Intel version will be available in the third quarter.

NeXT will be selling the NextStep software for US$1000 per copy. The company is also talking with Compaq, Dell and other system manufacturers about bundling the software with their hardware.

Although NeXT has had problems selling its computer systems, there has been almost universal praise for the NextStep object oriented and multi-tasking-based operating system.

IBM's massively parallel R&D lab

In another step towards entering the supercomputing market, IBM has opened a laboratory devoted exclusively to researching massively parallel processing technology. The Highly Massively Parallel Supercomputing Laboratory is located in Kingston, New York.

IBM said it expects to launch its first MPP computer some time in 1993.

If nothing else, the IBM move will lend a great deal of new credibility to the entire concept of stringing hundreds and even thousands of processors together, to generate machines that are able to process huge volumes of data.

For IBM, the decision to invest in MPP technology was not an easy one. The formation of the lab followed months of intense internal debate over the need to divert from IBM's traditional computer architecture.

However, IBM cannot afford to miss out on a potentially huge market for MPP systems, machines that could end up competing effectively with IBM's traditional mainframe machines.

GM, Thomson team up for satellite TV

In an effort to bring television to even the most rural and remote sections of the United States, General Motors and its Hughes Electronics subsidiary, in cooperation with France's Thomson Consumer Electronics, have agreed to build a satellite TV network.

The 'DirecTV' system will involve Hughes-made satellite receiving equipment, including 18" satellite receiving dishes. The dishes and receiver will cost around US$700 and will carry the RCA brand name, which is owned by Thomson. The small dishes will compete with the current 6-8 foot dishes, which typically cost between US$1500 and $2500.

DirecTV users will be able to receive up to 100 television channels. Thomson officials said they expect the system to go into operation in 1994.

Besides the rural area, Thomson and GM expect the system to be popular in areas already served by cable television. Besides offering more channels than most cable operators, consumers are getting increasingly fed up with the high monthly cost of cable service.

The one-time purchase of a $700 system, would easily pay for itself in one to two years, depending on the various movie channels and other costly options consumers are currently buying from their cable company. ❖

Heme Analyst 2000P clamp-on DMM/scope

Designed and manufactured in the UK, the Heme Analyst is a hand-held AC/DC multimeter and clamp-on current/power meter which also allows the viewing of current and voltage waveforms, on the inbuilt LCD screen. This makes it a remarkably useful instrument.

Clamp-on current meters have been available for quite a few years now, and have become widely used by people working in the electric power and power/control electronics areas. The ability to measure current levels in almost any conductor, without having to break the circuit, makes them very attractive.

More recently, instruments have appeared that combine this type of current measurement with a voltage measuring and multiplier function, allowing both voltage and — more importantly — power measurements to be made as well. Many of these newer instruments are electronic and digital, and often they are able to measure both apparent power (volt-amps) and power factor as well as true (RMS) power.

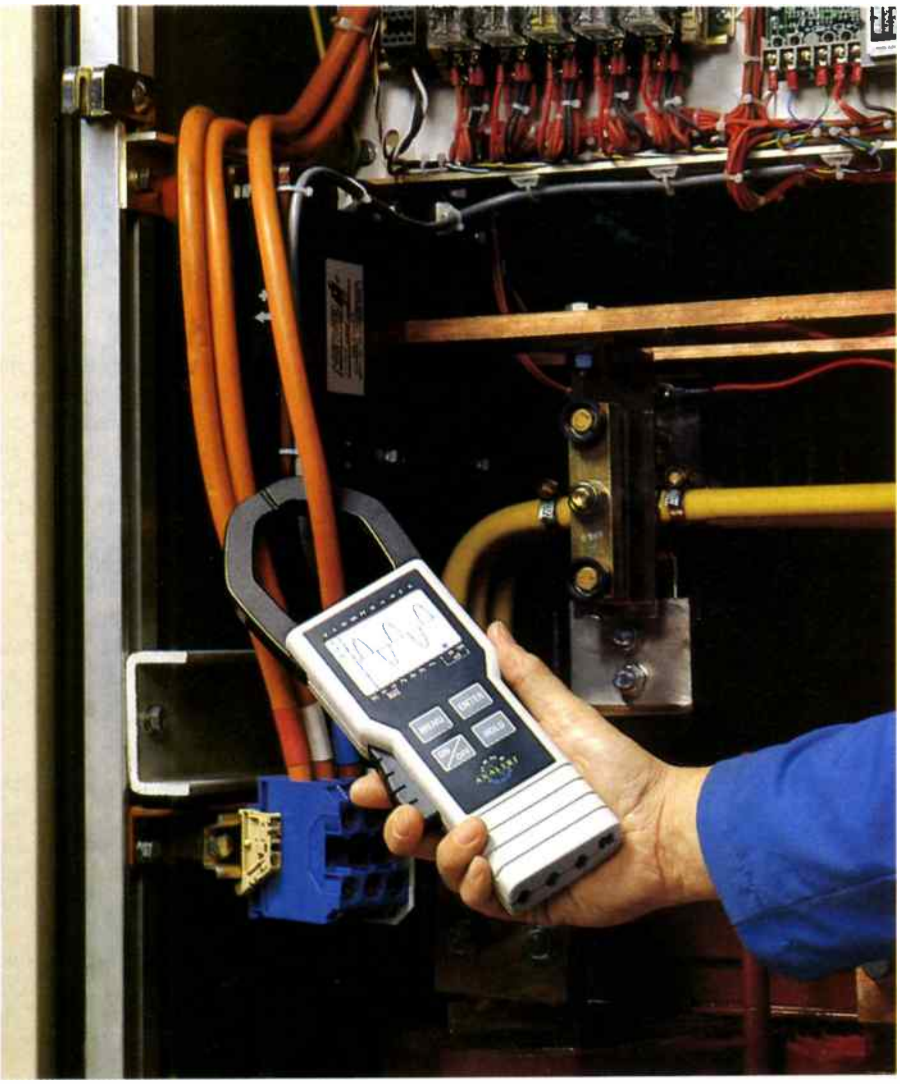
The new Heme Analyst 2000P goes one big step further again, by providing an inbuilt LCD 'scope' display, using which you can examine the waveform of either the voltage or current as desired. This allows you to check for things like waveform distortion, switching transients, harmonic generation and so on — all of which are becoming more and more important, in these days of switch-mode power supplies and phase-control of power.

As if this weren't enough, the 2000P also provides facilities for frequency measurement (5 - 1000Hz), resistance and continuity measurement. It also provides both 'instantaneous' and 'true-RMS' analog signal outputs, during current measurements, to allow connection to other instruments. An optional opto-isolated digital output allows measurement data to be downloaded to a logging system. In short, it's almost a complete power electronics testing lab in a single hand-held package. A package which measures a modest 280 x 96 x 52mm overall, and weighs only 850gm.

Many ranges

Thanks to its Hall-effect sensor, the 2000P measures up to 2000 amps, for either DC or AC-peak. There are actually three current ranges, with full-scale readings of 40A, 400A and 2000A respectively, and corresponding resolutions of 10mA, 100mA and 1A. Autoranging is provided, and AC readings can be measured in either average or true-RMS value. There is also the option of peak indication, for both DC and AC, and measurement of short- term surges.

Rated accuracy for both DC and true-



RMS AC is +/-1%, with an effective frequency range of 10Hz - 1kHz and a maximum crest factor of 6. The 2000P is rated to withstand an overload of up to 10,000 amps.

The voltage ranges on the 2000P allow DC measurement to 1000V and AC measurement to 750V RMS. Again there are three ranges, with full-scale readings of 40V, 400V and 1000V respectively and resolutions of 10mV, 100mV and 1V. Here the rated accuracy is +/-0.5% for both DC and true RMS AC, with the same frequency range and crest factor range as for current.

True power measurements can be made for both DC and AC, up to a maximum of 2000kW. In this case there are four ranges, with full-scale readings of 4kW, 40kW, 400kW and 2000kW respectively and resolutions of 1W, 10W, 100W and 1kW. The rated accuracy is +/-2% of each range, with the same frequency range as before.

Not surprisingly, the 2000P will also measure the power factor. This is done with a single range, varying between 0.3 capacitive (current leading by 72.5°) and 0.3 inductive (current lagging by 72.5°). The resolution here is 0.01, and the accuracy +/-3%. The frequency range is again 10Hz - 1kHz, and the voltage and current can range from 5V and 5A up to the same maximum values as their separate ranges.

In addition to real power and power factor, the 2000P will also give readings for apparent power if you wish. Here the ranges are 4kVA, 40kVA, 400kVA and 2000kVA, with readings in true-RMS and resolution, accuracy and frequency range as for real power.

Frequency measurements can also be made, from either the current clamp or voltage probe inputs. Here the single measuring range is from 5Hz to 1kHz, with a resolution of 0.1Hz and an accuracy of +/-0.5% of full scale. Minimum inputs are 5A and 5V respectively.

There are three main resistance measurement ranges, with full-scale readings of 4kΩ, 40kΩ and 400kΩ respectively and resolutions of 1Ω, 10Ω and 100Ω. The rated accuracy for these ranges is +/-1% of full scale.

In addition, there is a 'continuity' testing range, reading from 0 - 1000Ω with a resolution of 0.1Ω and a piezo buzzer which sounds below 100Ω. There's also a Diode Test range, which basically measures forward voltage drop on a 0 - 2V range.

For all of these DMM/power meter ranges, the readout is in 13mm-high digits on the 2000P's LCD screen. Below the digits there is also a 'bar-graph' type analog scale, with 22 segments. When you switch the instrument over to its 'scope' ranges to examine waveforms, the active area of the display changes into a matrix of 120 x 64 pixels.

There are actually two basic scope functions, allowing examination of either voltage or current waveforms. In each case there are three ranges, with the same full deflection values as for the voltage and current measurement ranges. The vertical display resolution for the ranges is 1.25V/A, 12.5V/A and 62.5V/A, and in each case there's a choice from three fixed timebase ranges: 1ms, 10ms or 100ms per horizontal division.

Rated accuracy for scope-mode measurements is +/-3%. The display refresh rate is once every two seconds.

The electrical analog outputs provided by the 2000P during current measurements are provided via bayonet-locking 2.5mm jacks on the base of the instrument, described as 'miniature BNC' sockets. Matching adaptor cables are provided. The output voltages are scaled at 10mV/A, 1mV/A and 0.2mV/A for the 40A, 400A and 2000A ranges respectively, with both instantaneous and true-RMS signals being available simultaneously.

The input jacks for voltage measurements are alongside these output jacks, but a mechanical 'interlock' shutter system prevents access to the sockets when voltage measurements are being made. This is to prevent the risk of damage due to voltage breakdown.

The 2000P has in fact been designed to comply with 'Protection Class II' as defined in IEC 348, and the safety requirements for Electrical Measuring Apparatus in IEC 414 and IEC 1010. The voltage input jacks are shrouded for safety, and also fitted with a bayonet-type locking system to prevent accidental disconnections.

For applications where power, power factor or voltage measurement data must be downloaded to other instruments or systems, Heme can provide an opto-isolated digital data output adaptor which attaches to the side of the instrument.

Incidentally the complete Analyst 2000P is powered from a single 216-sized 9V alkaline battery, which fits inside the rear of the case. The current-clamp jaws will fit around circular conductors of up to 60mm in diameter, or rectangular conductors up to 68 x 22mm.

Our impressions

We were able to try out an Analyst 2000P for a few days, by courtesy of Heme's Australian distributor Fastron Australia. We found it very impressive, although we didn't really have high-current AC sources and similar facilities to put it through all of its paces.

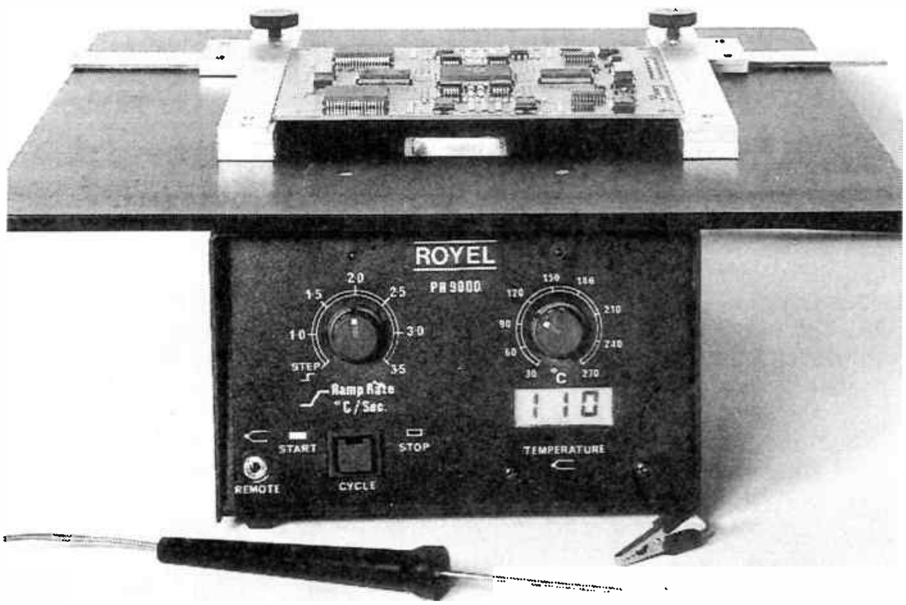
Despite its flexibility and many measuring ranges, operation proved to be very easy and intuitive — thanks to a simple menu system. For impatient drivers (like this reviewer!) it can sometimes take a few seconds longer than you expect to change a measurement parameter (like the timebase range, in scope mode), because of the way the menu system is negotiated with only two buttons, but in practice I doubt if this would be a problem.

Overall we liked the wide range of measurements available, the clarity of readout and the care that has obviously been taken to maximise operator safety. The latter is surely most important in an instrument that will frequently be used to make measurements in situations where there are potentially fatal voltage and current capabilities. For those who need to make current power and waveform measurements in high voltage/high current environments, the Heme Analyst 2000P should be a most valuable instrument.

Further information is available from Fastron Australia, 14 Dingley Avenue, Dandenong 3175; phone (03) 794 5566, or fax (03) 794 6670. (J.R.) ❖

New soldering and SMT products

Simplified SMC removal equipment



Royel's new pre-heat unit, the PH9000, when combined with the TW100 tweezer, is said to represent a breakthrough in low cost SMC removal and replacement. It offers the user the ability to repair SMC PCB's without the need to purchase a workstation costing up to $40.

The PH9000 allows the user to adjust the heat-up ramp rate to avoid thermal shock to ceramic chip resistors, capacitors, diodes, etc. (For example, AVX recommends a rate no greater than 2°C per second). The user can select from 0.5 to 4.0°C per second ramp rate, or step heat up to setpoint temperature.

The user sets up the pre-heat temperature to be maintained once the ramp-up mode has been completed. The unit gives a 'beep' when the setpoint has been reached. For example, if repairing a PCB with FR4 (fibreglass) which has a transition temperature of around 126°C, the user can set a pre-heat temperature of around 110°C.

This means the PCB can be held at this temperature for as long as necessary without degrading the substrate or componentry. The unit has a thermocouple which monitors and controls the shaft air temperature. Alternatively, a remote thermocouple can be attached to the underside of PCB (beneath the component to be removed).

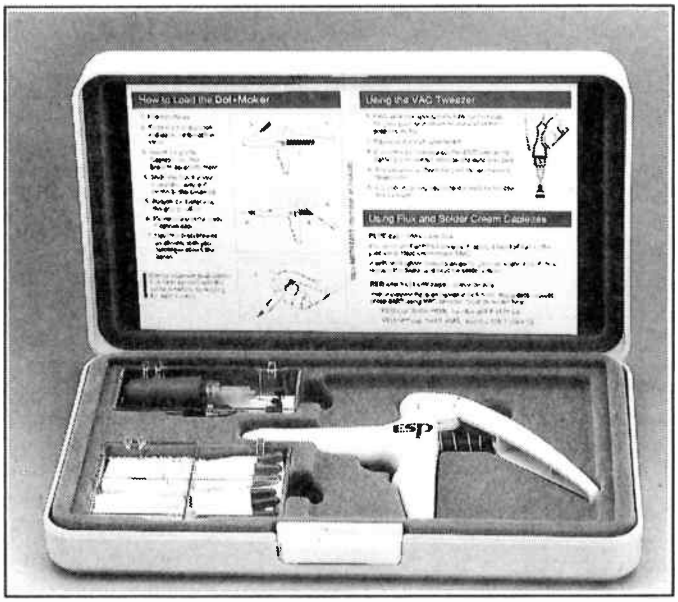
Once the preheat temperature has been reached, the user can remove the package with the TW100. Since the PCB is already at 110°C, the leads only need be heated a further 86°C and so the TW100 does not have to be preset to a high temperature.

Experience with the hand tool shows that the larger the head, the higher the temperature setting to achieve the same head temperature.

The unit has an over-temperature alarm condition, so that if the user does not employ the remote thermocouple correctly, it will provide an audible beep and turn the air heater off so that the PCB is not damaged. The unit is self-contained and requires no compressed air.

For further information circle 201 on the reader service coupon or contact Royel International, 27 Normanby Road, Notting Hill 3168; phone (03) 543 5122.

Manual SMT repair



ESP has introduced a compact Dot.Maker kit which contains the relevant tools and materials needed for efficient SMT and electronic solder-joint repair.

The kit is also suited for rework stations, field repairs or mobile plant inspectors. It contains the Dot.Maker precision hand dispensing tool, assorted solder pastes and paste fluxes in prefilled caplettes, the VAC tweezer, and a handling and placement tool for SMT parts.

The dispenser applies exact deposits of solder paste and paste flux from the caplettes, which can be snapped quickly in and out of the unit. Precise dots of solder paste are placed where needed, and conform to fine pitch geometries.

The VAC Tweezer ensures safe handling and placement of SMD parts, without damage to leads or board scratching. Parts are picked up and released by squeezing and releasing the tweezer bulb. Five sizes of interchangeable pads/tips are supplied to handle a wide range of components.

For more information circle 203 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999.

Soldering/solvent fume extractor

BTR Indeng has released the new Nederman 2000 system, providing a practical extraction-at-source system that will cope with chemical and solvent fumes.

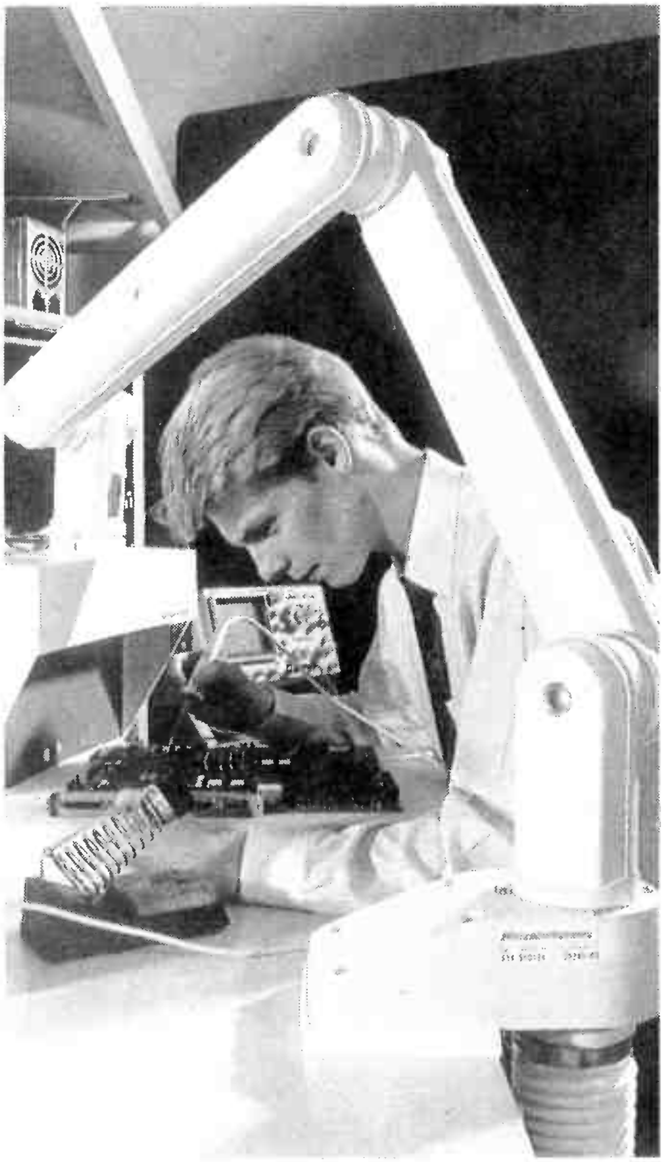
The system, which comprises an extraction arm with new, universal hood, a fan, thyristor regulator and a filter, has been designed so that individual workplaces can have an easily positioned extractor at the source of contamination.

In the filter unit are a gas filter of activated carbon, which can effectively separate fumes from the most common solvents, and a two-stage particle filter, with a separation capability of 99.97% for particles measuring 0.3um.

Under normal conditions, i.e., six hours soldering per day, the average life of the disposable filter is in excess of six months. Filter life can be increased by mounting filters in series.

The Nederman system 2000 is supplied as a total package, including a screw driver, the only tool required to assemble the complete unit.

For further information circle 202 on the reader service coupon or contact Edward Keller, 3 Walker Street, Braeside 3195; phone (03) 580 1666.



Portable soldering iron analyser

The new WELLER portable WA2000 Soldering Iron Analyser has been developed for testing soldering stations for compliance with the new DOD-2000 specification.

The WA2000 is portable, with a battery life of 50 hours. It is capable of accurately testing tip temperature, tip to ground resistance and tip to ground noise (mV RMS).

Tip temperature: the unit can check either temperature stability or absolute temperature when measured with a thermocouple. The contact pyrometer is used for monitoring stability to the DOD-2000 specification.

Tip to ground resistance: The WA2000 accurately measures the resistance of an iron from its tip to the ground post on the plug.

Tip to ground noise: this is typically associated with any electrical voltage that is induced by the iron itself. This low level voltage can be measured from the working area of the tip to ground.

The kit consists of the tester unit and its vinyl case, a ground cord adaptor, two contact pyrometers, two thermocouple assemblies, a recorder calbe assembly, an iron stand and a 9V battery.

With today's constant requirements for quality, accuracy and consistency WELLER offers you the WA2000. A calibration and certification service for the WA2000 analyser is also offered — a valuable asset in meeting Standards Australia and Quality Endorsed requirements.

For further information circle 206 on the reader service card of contact Cooper-Tools, PO Box 366, Albury 2540; phone (060) 21 5511.

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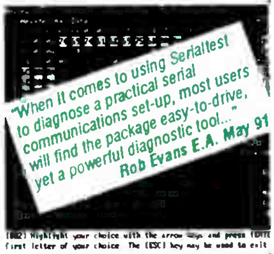
- Handles baud rates up to 115.2kbaud.
- View each byte in ASCII or EBCDIC, decoded to hex, decimal, binary or octal



- Writes captured data directly to disk to allow maximum capture buffer
- CRC checksum calculations
- Auto-configuration to any of the comms ports 1 to 4
- Time-stamping (absolute and relative) including delta time calculations
- Split line DTE over DCE display

$480

Send $10 for a demo disk, refundable on purchase.

Here's a few hot tips...

We are now stocking a full range of Scope soldering irons and accessories. Ideal for maintenance workshops and production lines. Take your pick from –

Superscope

Maintenance and repair iron with manual temperature control for medium to heavy duty soldering
- 20W to 100W adjustable
- Adjustable 200° to 500°C
- 5 seconds to reach 20°C
- Low 4V supply
- Automatic switch-off

Miniscope

The pencil iron with real power. Manual control of temperature while soldering. Suits light to medium duty work
- 10W to 70W adjustable
- Adjustable 200° to 500°C
- 5 seconds to reach 20°C
- Easy owner maintenance
- Low 4V supply
- Automatic switch-off

ET60L 60W 24V Soldering System

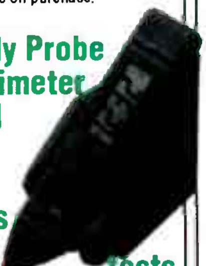
- Infinitely adjustable 200°C to 470°C
- Illuminated temperature readout monitors actual tip temperature
- Select tip temperature required
- Zero voltage switchning for maximum component safety
- 60W of back-up power – 30W pencil option
- Burn-proof flexible lead

Scope Irons		
SCOPE-ET60L-1	60W Adjustable w/- Disp	225.40
SCOPE-MINISCOPE	MINISCOPE Handpiece (needs PSU)	55.60
SCOPIE-PH20-5PK	5 Piece Hobby Pack	41.95
SCOPE-PSU	Power Supply Unit	63.55
SCOPE-STAND	General Purpose Stand	14.20
SCOPE-SUPERSCOPE	SUPERSCOPE Handpiece (needs PSU)	50.30
Spares for Superscope		
SCOPE-SK2-01A	SS Tip 6.4mm Dual Flat	1.50
SCOPE-SK2-01B	SS Tip 3.2mm Conical	1.50
SCOPE-SK2-02	SS Stainless Barrel	8.95
SCOPE-SK2-03	SS Element	1.50
SCOPE-SK2-04	SS Bead Retaining Nut	0.40
SCOPE-SK2-05	SS Ceramic Bead	0.20
SCOPE-SK2-06	SS Push Rod	7.70
SCOPE-SK2-06A	SS Push Rod Assembly	10.20
SCOPE-SK2-07	SS Return Spring	1.20
SCOPE-SK2-08	SS Flexible Lead	10.70
SCOPE-SK2-09	SS Bakelite Lock Nut	3.25
SCOPE-SK2-10	SS Brass Nut	2.80
SCOPE-SK2-11A	SS Handle Body Only	7.15
SCOPE-SK2-12	SS Switch Ring	3.60
SCOPE-SK2-13	SS Rubber Grip	0.95
SCOPE-SK2-14	SS Grommet Spring	1.85
SCOPE-SK2-15	SS Grommet Nut	3.60
SCOPE-SK2-11B	SS Complete Handle	20.30

Appa Model 95 Multimeter

Check these value features –
- ***3999 count high resolution***
- ***Eleven functions – Vdc, Vac, Adc, Aac, ohms, diode, logic, continuity, frequency, capacitance and transistor hfe***
- ***Peak hold button***
- ***Automatic power off***
- ***0.5% basic accuracy***
- ***Shock proof from 1.5m drop***

Ranges
Vdc 400mV, 4V, 40V, 400V, 1000V
Vac 400mV, 4V, 40V, 400V, 750V
Adc 400μA, 4mA, 40mA, 400mA, 2A, 20A
Aac 400μA, 4mA, 40mA, 400mA, 2A, 20A
Ohms 400Ω, 4kΩ, 40kΩ, 400kΩ, 4MΩ, 40MΩ
Frequency 0-4MHz autoranging, 40MHz (500mV min)
Capacitance 4nF, 40nF, 400nF, 4μF, 40μF
Transistor hfe 0-1000 pnp/npn
Continuity 2kHz buzzer, <50Ω
Logic to 20MHz
Power Off after 15min
$166.80, $139.00 ex tax



Handy Probe Multimeter Ideal for tight spots tests Logic too!

No need to turn your head to read this multimeter. The readout is right there in the probe! Auto and manual ranging, 3.5 digit large 14mm LCD display - all in a handy probe. Logic testing function for CMOS/TTL. Data Hold button, Diode test, Continuity buzzer. Display shows all functions. Protected to 250V
- DC Voltage from 200mV to 500V
- AC Voltage from 2V to 500V
- Resistance from 200Ω to 20MΩ
- AC/DC Current to 200mA
- Continuity check to 2kΩ
- Logic Testing to 1MHz and 1μs
- Diode Test 2V

$55.00

Weller Soldering Stations WTCPS

Transformer powered low voltage soldering station. Features Weller closed-loop method of controlling maximum tip temperature to protect temperature sensitive components.
- Grounded tip protects voltage and current sensitive components.
- 48W stainless steel heater construction
- Non-burning silicon rubber cord
- 15 tip sizes - 0.8mm to 6.00mm
- 11secs to recover for 37°C drop
- Choice of tip temperatures 315°C/600°F, 370°C/70°F, 430°C/800°F

$155.00
ex tax $140.00

Weller WPA2 Pyropen

The ultimate cordless soldering iron
- No electricity
- No batteries
- Gas operated
- Ready to use in 30 seconds
- Refill in moments
- Hot air blower and mini-torch burner
- Up to 3 hours use from one filling

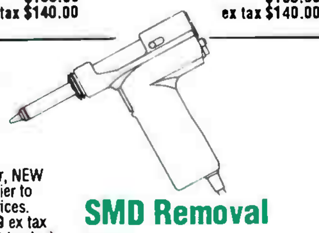
Weller Pyropen weighs only 90gm and offers temperature control from 200 to 500°C. It has a built-in ignitor and gas level indication. Flame and temperature are easily controlled by sliding lever. Choice of 14 tip shapes plus 4 gas/hot air blowers. Can be used for brazing up to 1300°C with special tip. Supplied in metal storage box containing tip wipper.

$165.90
ex tax $140.00

Tips for your Weller Iron are all $10.00 each

WELLER-PTA6	1.6mm 315d Sdriver
WELLER-PTA7	1.6mm 370d Sdriver
WELLER-PTA8	1.6mm 430d Sdriver
WELLER-PTAA6	1.6mm313d Sdriver
WELLER-PTAA7	1.6mm 370d Spade
WELLER-PTB7	2.4mm 370d Sdriver
WELLER-PTB8	2.4mm 370d Sdriver
WELLER-PTBB7	2.4mm 370d Spade
WELLER-PTBB8	2.4mm 430d Spade
WELLER-PTC6	3.2mm 315d Sdriver
WELLER-PTC7	3.2mm 370d Sdriver
WELLER-PTC8	3.2mm 430d Sdriver
WELLER-PTCC7	3.2mm 370d Spade
WELLER-PTF7	0.8mm 370d Con Flat
WELLER-PTH7	0.8mm 370d Sdriver
WELLER-PTH8	0.8mm 430d Sdriver
WELLER-PTK6	1.2mm 315d LSdriver
WELLER-PTK7	1.2mm 370d LSdriver
WELLER-PTK8	1.2mm 430d LSdriver
WELLER-PTL7	2.0mm 370d LSdriver
WELLER-PTL8	2.0mm 430d LSdriver
WELLER-PTP6	0.8mm 315d Conical
WELLER-PTP7	0.8mm 370d Conical
WELLER-PTP8	0.8mm 430d Conical

SC5000A DIC Desoldering Tool.



Now fitted with 80W heater, NEW Hot air nozzle makes it easier to remove surface mount devices.
Price is unchanged at $399 ex tax ($478 inc tax)
Stand **$42.50**

NEW SC-7000 DeSoldering Tool

- Now with 100W ceramic heater
- Work on up to 12 layer boards
- Special antistatic housing
- Optional surface mount kit

$482.50 ex tax
$579 inc tax

SMD Removal Kit.

Comes with filter pipe, stainless steel wire and blade rolls, wire holder, blade holder and hot air nozzle. Suits SC5000A and SC-700
$82.80

Solder 1.25, 0.9 and 0.71mm	
250gm	$7.95
500gm	$14.95
Solder Wick	$2.95

Heatshrink Tube

- ***PHS series to UL/DIN standards***
- ***40kV/mm breakdown***
- ***600V rating***
- ***90°C shrink temperature***
- ***Supplied in metre lengths***
- ***1.5mm to 25mm diameters***

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Data free modem also has 'voice'

Rockwell International has announced 'voice' as a further level of integration in two new additions to its data/fax modem family — the RC96V24DP and the RC96V24AC.

The RC96V24DP is an integrated single package data, fax and voice modem engine designed for multimedia communications. A pin-for-pin compatible upgrade to the RC9324DP data/fax engine, the RC96V24DP features adaptive differential pulse code modulation (ADPCM), voice compression and decompression. The integrated voice compression eliminates the need for additional stand-alone compression chips.

The second member of the data/fax voice family is the RC96V24AC. A pin-for-pin compatible upgrade to the RC96V24AC, the new product provides a complete system solution by adding a controller and firmware, and delivering data/fax/voice functionality with one phone line.

The RC96V24AC incorporates a new AT&V command set extension, designed to control the voice-messaging functionality. This new command set permits control of voice messaging by PC-host software applications.

For more information circle 273 on the reader service coupon or contact NSD Australia, PO Box 264, Box Hill 3128; phone (03) 890 0970.

Dual MOSFET SO package

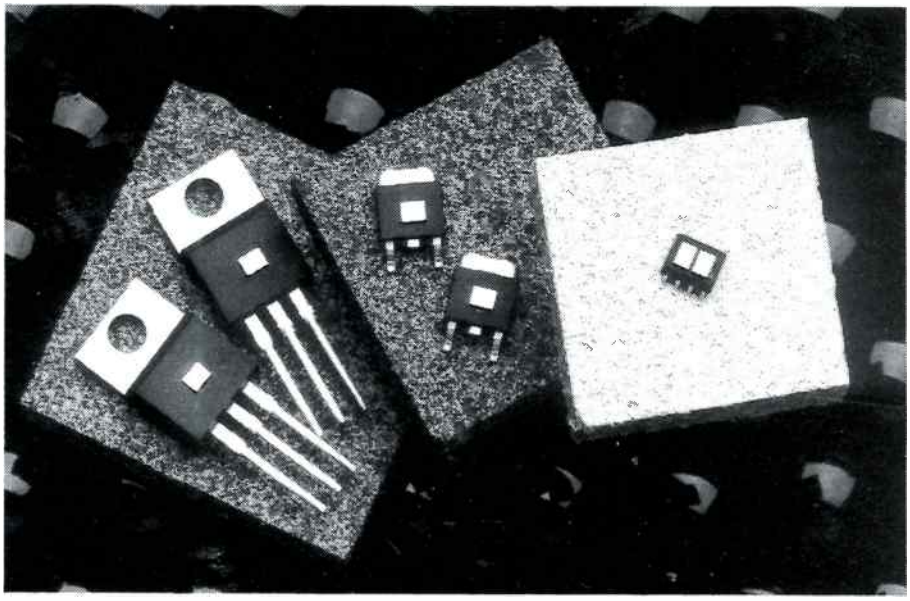
Siliconix has made three additions to its surface-mount family of MOSFETs for motor control and power switching. The Si9953DY, and Si9955DY each contain two MOSFETs in a tiny 8-pin SO (small outline) package.

Designed to reduce space requirements and lower assembly costs in motor control and power switching applications, one of these devices in an SO-8 replaces two discrete MOSFETs in the DPAK or TO-220 package.

The Si9955DY, with 20V n- and p-channel MOSFETs, is ideally suited for motor control applications in products such as computer disk drives and tape drives. The Si9953DY, a dual p-channel device, can be used for load switching in such products as laptop computers and cellular telephones.

The dual n-channel Si9955DY with its 50V rating is suitable for higher voltage (24-36V) motor control applications in computer peripherals (i.e., printers and plotters) and automobiles (i.e., ventilation, mirror positioning), and DC to DC switching applications.

For more information circle 271 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766.



Low power RS-485 transceiver

A new bus transceiver that meets the requirements of the RS-485 standard, but consumes less than five milliamps per channel of power supply current, is now available from Texas Instruments.

The bidirectional device enables data transmission between multi-channel systems to be executed more efficiently. It is well suited for use in industrial process control systems, automotive multiplex wiring buses and Small Computer System Interface (SCSI) systems based on the RS-485 standard.

The RS-485 standard which is designed to move data between multi-channel systems at speeds of up to 10Mbps, requires tolerance of line fault condition voltages as high as 25V. Until now, the only devices able to meet the requirements of the standard were bipolar.

The SN75LBC176 differential bus transceiver offers lower power consumption than bipolar solutions because it is manufactured in TI's LinBiCMOS process technology. This process combines the voltage handling and precision of bipolar transistors with the low power of CMOS transistors to reduce the quiescent current by a factor of approximately 10.

The SN75LBC176 is designed for balanced transmission lines, and allows high speed data transmission up to 10Mbps across distances of 100m, or as far as 1.2km at 100Mbps on unshielded twisted pair cables.

The transceiver combines a three state differential line driver and a differential input line receiver, both of which operate from a single 5V power supply. Externally, they can be connected to function with a single direction control or separate driver and receiver.

The differential bus lines are connected internally and can send or receive data over a common-mode voltage range of -7 to 12V.

For more information circle 272 on the reader service coupon or contact Texas Instruments, 6 Talavera Road, North Ryde 2113; phone (02) 878 9000.

Ultra bright amber LEDs

Hewlett-Packard has announced a series of ultrabright amber and reddish orange light emitting diodes (LEDs), 10 times brighter than existing amber LEDs and bright enough to be visible outdoors in sunlight.

The MLMA series of LEDs opens the door for outdoor applications in automobiles, moving message panels and traffic control signals, as well as indoor applications that need a low-current light source alternative — the front panels on office and medical equipment, for example.

The amber HLMA-BLOO LED offers a highly focused viewing angle (3°) and an average intensity of 8.4 candela at 20mA. The amber HLMA-CLOO LED has a slightly wider viewing angle (10°) and an intensity of 1.3 candela at 20mA.

The HLMA-DGOO LEDs come in reddish orange or amber, respectively, with a viewing angle of 34° and a typical on-axis intensity of 650 millicandela at 20mA. The wide viewing angle makes these devices appropriate for use in moving message signs, automotive lighting and battery powered signal lights.

For more information circle 276 on the reader service coupon or contact VSI Promark Electronics, PO Box 578 Crows Nest 2065; phone (02) 439 8622.

SCSI-2 hard disk drive controller

Cirrus Logic has introduced the CL-SH450 SCSI disk controller, a single integrated circuit that supports both 40MHz NRZ disk transfer data rates and the 10-megabyte per second 'FAST' SCSI-2 standard. These features are ideal for disk drives used in workstations, high-end personal computers, and in network file server applications.

Most of the hardware required to build a complete SCSI Winchester disk drive controller subsystem is contained within the CL-SH450.

The intelligent buffer manager of the CL-SH450 enhances performance by decreasing access times between the host and disk interfaces. Functions the buffer manager performs are such efficiency-tasks as allowing the transfer of noncontinguous blocks of data and alerting the microprocessor of potential buffer overruns. Implementation with either DRAM or SRAM solutions is an option that provides design flexibility.

Greater performance is also achieved by automating many functions with the chip. The CL-SH450 eliminates microprocessor intervention by directly performing such SCSI bus control functions as arbitration, selection and reselection, as well as automatic disconnection and reconnection depending on the data available in the buffer. Consistent with setting performance and small-form-factor standards, the CL-SH450 is a low-power CMOS device with power management features.

Further information is available from Cirrus Logic, 1463 Centre Pointe Drive, Milpitas, California 95035; phone (408) 045 8300.

Triple video A/D converter

Siemens has released what it claims to be the fastest video analog to digital converter so far for television's three colour components. The SDA 9205-2 integrates three 8-bit video A/D converters on one chip, with a scanning rate of 30MHz. The fact that the chip permits oversampling, i.e., it uses a scan rate that is more than twice the signal frequency, means that external anti-alias filtering can be simplified due to internal digital filtering. The special features of the new converter include internal clamping and separately selectable scanning data formats, in conformity with the international standard CCIR/Rec. 601/656.

In order to accommodate the three analog to digital converters required on one chip, the SDA 9205-2 was designed using modern CMOS technology which permits high speed and high integration density with low power consumption.

With a signal to noise ratio of 46dB, the SDA 9205-2 is suitable for digital image processing in PCs, televisions and video recorders, studio equipment and video printers.

For more information circle 274 on the reader service coupon or contact Siemens Components, 544 Church Street, Richmond 3121; phone (03) 420 7314.

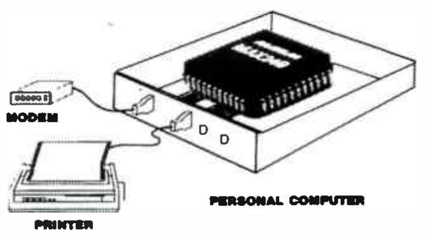
RS-232 chip has two DTE ports

The MAX249 is one of seven new devices from Maxim's RS-232 line of +5V multi-channel drivers and receivers. The MAX249 is the first transceiver to offer six RS-232 drivers and ten RS-232 receivers, forming two complete Data Terminal Equipment (DTE) serial ports in one IC.

An important feature of the MAX249 is its separate shutdown mode for each port. In shutdown mode, power supply current is reduced to 8uA(typ), and the MAX-249's receivers are still able to receive data at up to 20kpbs.

The new device also uses space saving 1uF capacitors, making it ideal for RS-232 applications where space is limited, such as laptop PCs. The MAX249 meets all EIA-232D and EIA/TIA-562 specifications, and is guaranteed to operate at data rates up to 64kbps.

For more informationcircle 275 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.



High speed 2Mb SRAM

The new 8F8259C from EDI is a very high speed 2Mb CMOS Static RAM, organised as 256K x 8. It is based on two high speed 256K x 4 static RAMs, mounted on a multi-layered epoxy laminate (FR4) substrate, with access times from 20 to 55ns.

The 32 pin 0.6" DIP pinout adheres to the JEDEC standard for 2-megabit devices, ensuring upgradeability with future monolithics. All inputs and outputs are TTL compatible and operate from a single 5V supply. The device is fully asynchromous, requiring no clocks or refreshing for operation. With a wide operating temperature range, it is suitable for use in uncontrolled and hostile environments.

The 8F8259C typically consumes 170mA operating, which drops to 1mA in standby. It is ideal for applications that require a large array of very high speed SRAM that ensures upgradeability from 128K x 8 up to 512K x 8 devices.

For more information circle 277 on the reader service coupon or contact KC Electronics, PO Box 307, Greenborough 3088; phone (03) 457 4666. ❖

NEW PRODUCTS

Label and tag remover

Adhesive labels and tags can be very difficult to remove from many products, including compact disc cases, books, software manuals, equipment front panels etc. Some of the solvents that are often used in an effort to remove the labels can damage the product itself.

These problems are a thing of the past with 'Tag Off', a new product designed specifically for label and tag removal.

Tag Off is a clear, non-toxic, non flammable, virtually odourless and environmentally safe liquid which softens and dissolves almost all adhesives used on labels, tags and adhesive tapes. It also leaves no sticky residue, and has also been tested for safe removal of tape from the human body.

Tag Off is available in a variety of container sizes, from a small 'sampler' bottle to large containers for industrial users.

For further information circle 241 on the reader service card or contact Elantec Australia, PO Box 2000, Strawberry Hills 2012 or phone (02) 698 1470.

Microwave power sensor

Hewlett-Packard has introduced the HP W8486A power sensor, which features an unusually low standing-wave ratio (SWR) for millimetre frequencies, resulting in accurate measurements with low measuring uncertainty.

A true root-mean square diode detector in a novel mounting configuration gives the sensor a specified SWR of only 1.08 (28dB return loss), which makes mismatch uncertainty a very small part of the typical measurement. This is well-matched performance for mm-wave bands.

The new power sensor extends the application coverage of HP average power meters through the 75GHz to 110GHz W-band.

It is designed for metrology labs, mm-wave radar, communications and various scientific-research applications.

For further information phone Hewlett-Packard Australia on 008 033 821.

CRO for transient recording

The Nicolet NIC-310 portable transient recording oscilloscope features highly accurate 12-bit digitisers, allowing you to capture and then zoom in on the details of your signal, taking a closer look than ever before.

One of the best applications for the NIC-310 is the capture of signals which occur only once. You can visually set the trigger position on the screen with any chosen amount of pre-trigger and post trigger data. This allows you to capture signals which occur before the trigger — 'pre-trigger' signals — which are usually essential to fully understand a transient phenomenon. For slow speed signals, commonly associated with biological experiments, the NIC-310's ROLL mode allows you to monitor the output on a continuous display, even before the stimulus is applied and the trigger is initiated. Features like this mean that transient capture is a sure thing, not hit-or-miss.

For more information circle 242 on the reader service coupon or contact Emona Instruments, PO ox K720, Haymarket 2000; phone (02) 519 3933.

SAW resonators

Siemens has developed a new series of surface acoustic wave resonators for the various radio control frequencies in a number of countries. In addition to the low insertion loss, which is typical of these types of components, they provide highly accurate frequencies with tolerances down to +/-67kHz.

The resonators have been developed for frequency stabilisation of oscillators in low power radio controls, and are thus suitable for applications such as alarms and garage door openers. The new range includes types for Germany and Scandinavia (centre frequency 433.92MHz), France (224.5MHz), Great Britain (418.0MHz), Canada (312.0-MHz), USA (315.0MHz) and South Africa 403.55MHz), as well as Australia (303.875MHz). Typical insertion loss figures, depending on model, are 7.5 to 10.5dB. All resonators in this range are supplied in TO39 packages and are available as samples.

For further information circle 243 on the reader service coupon or contact Siemens Components, 544 Church Street, Richmond 3121; phone (03) 420 7716.

Bench power supplies

An LCD information panel, which provides simultaneous dual channel metering of voltage, current and power, is the main new feature of Farnell's P Series bench power supplies.

A selectable analog display of these parameters is also available on 28 segment bargraphs in the same information windows.

Operating status — constant voltage, constant current or overvoltage trip — is also annunciated. The custom display is backlit and is adjustable for viewing angle and ambient lighting conditions.

The first three models comprise: a dual-output autoranging switcher which will deliver up to 30V or up to 10A within a power envelope of 60W per channel; a dual output series — pass regulated supply rated at 0-35V, 2A with parallel, series and tracking modes; and a dual output 0-35V, 2A supply with independent or tracking modes. The latter model (PDA3502A) has analog meters, The others (PDD3010A and PDD3502A) the new LCD panel.

For further information circle 247 on the reader service coupon or contact Elmeasco Instruments, PO Box 30, Concord 2137; phone (02) 736 2888.

Low power solenoid valves

KSO-GO2 low watt Daikin solenoid valves are now available, which are claimed to operate on a holding current of 0.45A. So the valves can be operated by means of a 'command' output, from sequencers or similar devices.

The solenoid valves are available in 24V DC, and have excellent applications on mobile equipment, such as garbage compactors and other specialised vehicles. They have an operation time as low as 0.10 seconds, and are available in a number of spool arrangements. Their weather-proof rating of IP65 makes them ideal for external use.

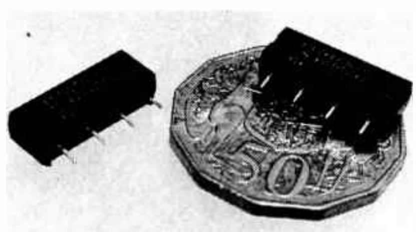
For further information circle 244 on the reader service coupon or contact Australian Hydraulics, 2 South Street, Rydalmere 2116; phone (02) 638 5000.

Sub-miniature reed relay

CP Clare has introduced the DSS-4 SIP dry reed relay, which offers designers the superior switching characteristics of the Clare DYAD switch. The small package design of the DSS-4 requires less than 105mm of board area and the 5.08mm maximum width allows spacing of 6.35mm centres.

The input power is as low as 50mW, which reduces the supply requirements, and it features high isolation between input and output, exceeding 1500V AC RMS. Switching rates of 500Hz are allowed.

The bifurcated (split or forked) contacts of the DYAD switch enable each 'finger' to act semi-independently of the other, to provide continuity in the presence of microscopic contaminants. The DYAD switch exhibits virtually no contact bounce, and yields lower dynamic contact resistance and reduced contact noise.



The DSS-4 is ideal for telecommunication and data communications, process control, security and automatic test equipment, and where an auto-insertion SIP relay is required.

For further information circle 248 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766.

PCBs from RCS Radio

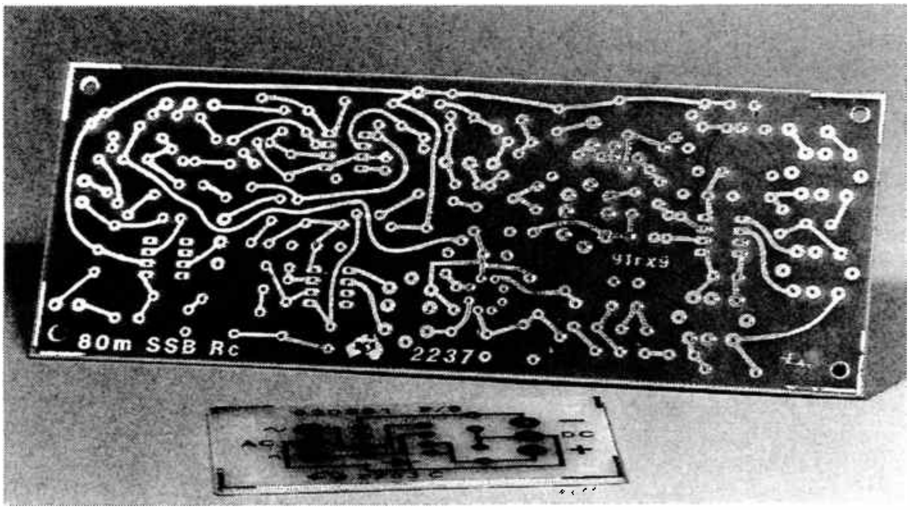
Long established Australian PCB manufacturer RCS Radio has released a fully etched, double-sided board for the 80m SSB Receiver project, described in the September and December 1991 issues of *Electronics Australia.* The RCS board has the upper ground-plane copper layer relieved around lead holes, and does not require any further preparation before component loading. It carries the RCS catalog number 2237 (original *EA* code 91rx9).

RCS has also produced a small power supply board for the Surround Sound Decoder project, described in the January 1992 issue of *EA*. The additional board mounts the rectifier diodes and reservoir capacitors, and gives a very neat and reliable arrangement. It carries the RCS catalog number 2263C.

In addition, RCS has produced a very compact 'Universal Power Supply' board, designed to suit a large number of applications. This board measures only 92 x 33mm, but has provision for mounting four rectifier diodes together with both positive and negative three-terminal regulator ICs, four RB-type electrolytic capacitors and the same number of HF bypass capacitors. The catalog number of this very handy board is 3266S.

A feature of both power supply boards is that all four rectifier diodes are aligned in the same way, to simplify servicing.

Further details are available from RCS Radio, 651 Forest Road, Bexley 2207 or phone (02) 587 3491.



Large digit displays

The Bodet H700 Series offers the latest in seven segment electromechanical displays. The materials used in the construction of the units also allow them to have the widest operating temperature range — from -40 to +95°C — making them well suited to Australia's outdoor environment.

If the application is for a time/temperature display, scoreboard, weight, price, industrial, or any other that requires a large character digital display, then Bodet is ideal. Character heights are currently 100, 150, 250 and 450mm, in either yellow or white vanes on a black background, the units are encased to ensure full protection against dust and direct.

For further information circle 246 on the reader service coupon or contact Davidson, 17 Roberna Street, Moorabbin 3189; phone (03) 555 7277. ❖

MASTERING METER MULTIPLIERS AND SHUNTS

Although the multimeter market is now dominated by digital type instruments, the traditional moving coil meter movement still has an important role to play for voltage or current measurements within equipment. Here's an easy to follow explanation of how to adapt any suitable moving coil milliammeter or microammeter to give the voltage and current range you need.

by J. EMERY

Moving coil 'analog type meters still have their uses, despite the growth in popularity of digital instruments. In many cases it is easier to interpret the meaning of a reading given by a pointer moving over a scale than it is to visualise the meaning of a group of numerals displayed on the display of a digital instrument. It is quite often easier to spot a trend in the readings as well, and to make comparisons. This is probably why many of the latest digital multimeters have an analog 'bar-graph' display, in addition to the digital readout.

A conventional meter is also very suitable for situations where a specified reading should not be exceeded. Here a bold red line can be drawn on the scale of the meter at the appropriate point, so that the basic situation can be seen at a glance and acted upon if necessary.

On the negative side, the accuracy of hobby-type moving coil meter movements may only be within one or even two per cent of their FSD (full scale deflection) and when measuring DC voltages their sensitivity cannot match the 10-megohm input resistance common to most digital multimeters, except perhaps in the higher ranges.

Despite this limitation, moving coil meters are commonly used to measure DC voltages and currents — particularly within equipment — because of their good sensitivity, linear scale and sensible price.

Standard movements are readily available with FSD current sensitivies ranging from one milliamp (with a resistance of 100 to 200 ohms) down to 50 microamps (with a resistance of 3000 to 4000 ohms).

For the rest of this discussion I will use for my examples a standard low cost one milliamp meter with an internal resistance of 200 ohms. I will also assume that the reader has — or can borrow — a DMM (digital multimeter) accurate to 0.5 per cent or better.

Meter resistance

An important parameter of a meter movement is its *internal resistance* — the resistance of the coil of wire inside. This must be known in order to work out the values for any multipliers or shunts, to adapt it for anything other than its nominal current range.

If the internal resistance is not known, then it can be found by connecting the meter to a 1.5V battery, through a suitable variable resistance which will give an FSD reading. At the same time, the voltage across the meter is measured using a DMM (Fig.1).

If the DMM shows 200 millivolts for a full scale reading of one milliamp, then the resistance of the meter under test will be given by:

$$R = \frac{E}{I} = \frac{200}{1000} \div \frac{1}{1000} = 200\text{ohms}$$

Having found the internal resistance, you are now in a position to proceed.

Current or voltage?

The moving coil meter consists essentially of a coil of fine wire — usually wound on an aluminium former — suspended between two pivots in the magnetic field from a permanent magnet. The pointer of the meter is attached to this coil.

Two spiral hair springs locate the coil and the pointer in the zero position and also feed the current into and out of the coil. When current flows through the coil, it sets up a magnetic field which reacts with the field from the permanent magnet, and causes the coil to rotate against the tension of the springs. The pointer accordingly moves across the scale, until an equilibrium or balance is reached, between the current-generated torque and the restoring torque of the springs.

If the current is of the wrong polarity, the coil — and the pointer — will try to move in the reverse direction. For this reason the moving coil meter cannot be used to measure AC without the use of a rectifier. Basically therefore, the moving coil meter measures *current*, but it can be adapted to measure voltage by using a *multiplier.*

Multipliers

If we connect a suitable resistor in series with a milliammeter, then the current through it will depend on the voltage, and the meter, although actually measuring current, will indicate the applied voltage to some scale. A series resistor used for this purpose is called a multiplier (fig.2).

The value of the multiplier resistor can be found by dividing the FSD voltage required by the FSD current of the meter. This gives the overall resistance required for the meter and multiplier combination — so the internal resistance of the meter itself must be subtracted

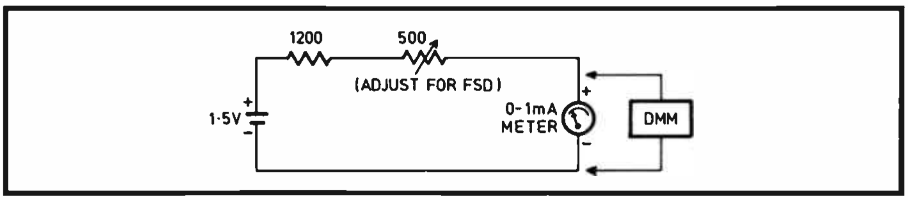


Fig.1: Recommended circuit for measuring the internal resistance of a meter movement. The DMM measures its voltage drop at full-scale deflection.

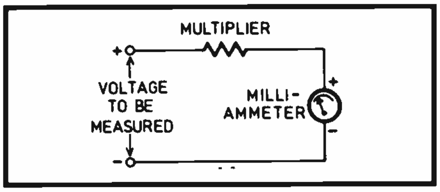


Fig.2: Using a multiplier to adapt a meter for voltage measurements.

ed from the result, to get the value for the multiplier.

Two or more voltage ranges can be obtained from the one meter by using a switch to select the appropriate value of multiplier (Fig.3).

For example, the multiplier required to use a one milliamp meter whose resistance is 200 ohms as a voltmeter with a sensitivity of 20 volts FSD can be calculated as follows:

$$\text{Total R} = \frac{\text{20 volts}}{\text{1 milliamp}} = \text{20,000 ohms}$$

From this we must subtract the 200 ohms resistance of the meter, giving a final value for the multiplier of 19,800 ohms.

The wattage dissipated by the multiplier resistor can be calculated using the formula W = I x E, where I = FSD current of the meter and E = FSD voltage reading required.

This leaves the question of how to get the exact value of 19,800 ohms required. Because this resistance is very close to 20k ohms, one possibility would be to buy a number of close tolerance 10k ohm resistors and try to find two of them which, when connected in series, will give the required value. Another possibility would be to use a 22k ohm resistor and a 220k ohm resistor in parallel which should give 20k ohms.

Some years ago, *EA* published a computer print-out giving a long list — extending over two pages as I remember it — of resistance values which could be obtained by connecting various combinations of different resistors in series and parallel.

From a practical point of view it should be remembered that 19,800 ohms

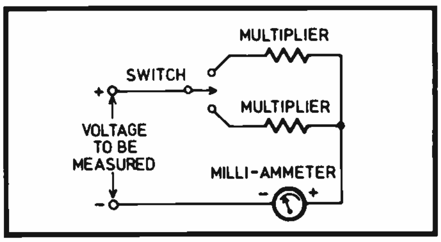


Fig.3: Using two or more multipliers to provide different voltage ranges.

is only a calculated resistance, and does not allow for the fact that the actual meter used may read one or even two per cent high or low. The final calibration adjustment should therefore be made against a meter of known accuracy.

Resistors used for multipliers should be high stability types and should have an ample wattage rating. For measurement of higher voltages (about 250V) they should also have ample voltage rating — or a combination of series resistors used, to share the voltage drop. Many small low-wattage carbon and metal film resistors are only rated for a few hundred volts, regardless of power dissipation, and will break down if this rating is exceeded.

External multipliers

In passing it should be noted that the range of an existing DC voltmeter can be increased in the same way as just described, by connecting a suitable external multiplier resistor in series with it. If for example a 10 volt FSD meter has a resistance of 10,000 ohms, and an external resistor of 10,000 ohms is connected in series with it, then its resistance will be doubled, the current through it will be halved and its FSD will then become 20 volts (Fig.4).

The range of an AC moving iron voltmeter may also be increased in this way. The wattage required for the external multiplier resistor can be found by using Ohm's law.

Shunts

The maximum current that can be directly measured by a moving coil meter is limited by the current which can be carried by the hair springs, although from a practical point of view, the limit is reached at the current which causes the meter to give its full-scale reading.

To enable it to measure larger currents, the meter can be fitted with a *parallel* resistor known as a *shunt* — because its function is to 'shunt' a fixed proportion of the overall current around the meter itself. If we wish to use a one milliamp meter to read up to 100 milliamps, for example, all that is necessary is to connect a low value resistor in parallel with it as shown in Fig.5.

Because we only want one milliamp of the current being measured to flow through the meter, the remaining 99 milliamps must flow through the shunt, whose resistance must therefore be 1/99 of the resistance of the meter.

A general meter for calculating the resistance required for a shunt is:

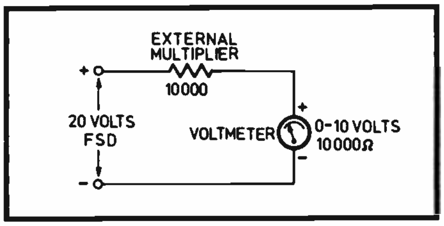


Fig.4: An additional multiplier may be used to extend the range of an existing voltmeter.

$$Rs = Rm \times \frac{Im}{(It - Im)}$$

where Rs = Resistance of the shunt
Rm = Resistance of the meter
Im = FSD current of the meter
It = FSD current required

Note that 'Im' and 'It' must be expressed in the same units.

Using this formula to calculate the resistance of a shunt to enable a one milliamp meter whose resistance is 200 ohms to measure 100 milliamps gives a shunt resistance of 2.02 ohms. For a one amp range, the shunt resistance required would be near enough to 0.2 ohms.

Because of the higher currents and lower resistances involved, more care must be taken in the design and construction of shunts than is the case with multipliers.

Engineering text books will often tell you that the shunt should be made of a material which has a zero temperature coefficient of resistance, but this assumes that the meter used includes a swamping resistor to offset the changes of resistance of the copper wire used for the coil of the meter itself, with changes in temperature. (The resistance of copper increases by about four per cent for each 10°C temperature rise.)

Cheaper meters may not include an internal swamping resistor, and in these circumstances it could be an advantage to make the shunt out of a suitable gauge of insulated copper wire.

In such a situation it is also desirable to arrange for the shunt to be kept at the same temperature as the meter, to keep the ratio of the resistances of the meter and the shunt correct.

If you have any doubt about the meter

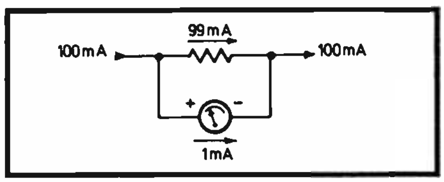


Fig.5: A current shunt bypasses most of the circuit current.

you are using, try measuring its resistance at two different temperatures.

Switching shunts

By using several values of shunt resistors and a suitable switch, a meter with several current ranges can be obtained. There are however two important points which should be observed.

1. A family switch contact should not leave the whole of the current being measured flowing through the meter.
2. Because the resistance of the shunt is much lower than that of the meter, the resistance of the switch contacts should form part of the meter circuit and should not be part of the effective resistance of the shunt.

The simplest way to meet these requirements is to use a *ring shunt*, as shown in Fig.6. This arrangement is so called because the meter and the shunts are connected in the form of a 'ring'.

Because the range switch has to carry the whole of the current measured, this circuit is usually limited to a maximum current of 250 milliamps.

For the 10mA range the shunt consists of all three resistors in series, while for the 200mA range only the resistor CD is used as the shunt and the other two become part of the meter circuit. The resistor CD must be able to carry the maximum current of 200mA while the section BC is only required to carry 50mA and the section AB only 10mA.

Calculation of the values of the resistors for the circuit shown in Fig.6, using a 1mA meter with a resistance of 200 ohms is not really difficult.

Start by calculating the total resistance A to D required for the lowest current (10mA) range:

RS = Rm x It/(It - Im)
= 200 x 1/(10 - 1)
= 200 x 1/9
= 22.22 ohms

Now find the 'ring resistance' by adding this 22.22 ohms to the meter resistance of 200 ohms, giving a total of 222.22 ohms.

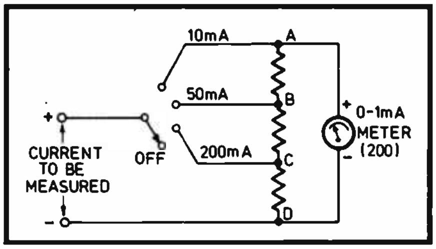


Fig.6: A ring shunt scheme. The text explains how to calculate the values.

For the 200mA range we only want 1/200 of the current to flow through the meter, so the resistance from C to D should be this fraction of the 'ring resistance', i.e.,

222.2/200 = 1.11 ohms

For the 50mA range we want 1/50 of the current to flow through the meter, so the resistance from B to D needs to be 222.2/50 = 4.44 ohms. From this must be subtracted the resistance from C to D of 1.11 ohms, leaving a resistance from B to C of 3.33 ohms.

The required resistance A to B can now be found by subtracting the resistance B to D of 4.44 ohms from the calculated value for a 10mA shunt of 22.22 ohms, giving 17.78 ohms. The results from these calculations are summarised in Fig.7, which also shows how the switch used in Fig.6 for range selection can be replaced with a series of terminals or banana plugs and sockets.

This kind of arrangement is often most convenient for higher current ranges, avoiding the problems of switch contact resistance.

The wattage dissipated by the shunt resistors can be calculated using $W = I^2R$. For example the wattage dissipated by the 1.11 ohm resistor forming the shunt for the 200mA range in Fig.7 would be 0.2 x 0.2 x 1.11, which equals 0.044 watts.

For long term stability and freedom from changes of resistance due to temperature changes, the shunt resistors should be generously rated. The resistor values required should not usually present any great difficulty.

The 1.11 ohm resistor could be two 2.2 ohm resistors in parallel, while the other two resistors are close enough to the standard values of 3.3 and 18 ohms respectively.

Finally, the calibration should be checked against a meter of known accuracy. This has the added advantage that it may allow you to compensate for any small inaccuracy which may be present in the meter itself.

When checking the calibration for a single current range meter, the following procedure will often be found convenient. Select a shunt resistor which gives a reading that is slightly high.

Then connect a suitable low value trim-pot in series with the meter and adjust it to give the correct reading. Finally replace the trimpot with a fixed resistor of the same value as its setting. Alternatively, the value of the shunt may be reduced by connecting a suitable value resistor across it.

Combined volt-ammeter

A typical use of a moving coil meter by a hobbyist is to measure the voltage and current output of a variable DC power supply.

A suitable circuit using a single meter and a single pole 3 position rotary switch is shown in Fig.8, which includes the value of the shunt and the multipliers required for a current range of one amp and voltage ranges of 10 and 20 volts. The one milliamp meter used has a resistance of 200 ohms.

The problem of switching the current through the shunt has been obviated by leaving it in the circuit at all times, although this will result in a small error when reading the output voltage to the load. This disability could be overcome by using a slightly more complex switching arrangement.

AC measurements

A moving coil meter can be used to measure AC by using a rectifier, but from the point of view of the home constructor the idea is not particularly attractive. For AC voltage ranges two circuits are commonly used.

Unfortunately all semiconductor rectifiers have a non-linear forward characteristic at low voltages, which makes it common practice to use a special non-

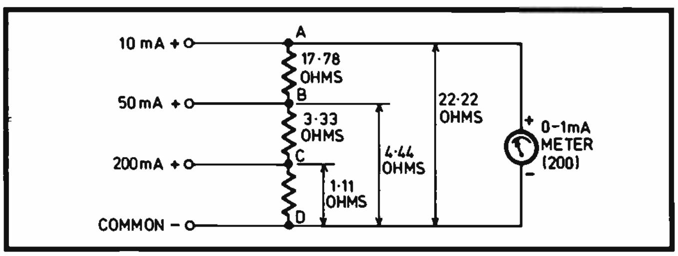


Fig.7: Calculated values for the ring shunt of Fig.6.

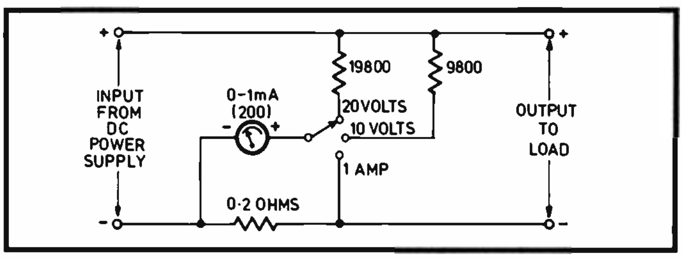


Fig.8: A combined voltammeter system for a power supply.

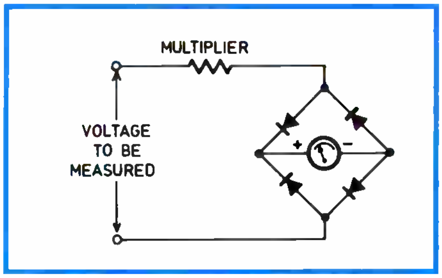


Fig.9: A full-wave bridge rectifier may be used to adapt a meter for AC voltage but linearity is poor.

linear meter scale for voltage ranges below about 10 or 20 volts.

This problem is greater if the full wave circuit (Fig.9) is used, because there will be in effect two rectifiers in series with the meter.

If the half-wave rectifier circuit (Fig.10) is used the value of the multiplier must be halved (and its wattage doubled) and the pointer may tend to vibrate because only each alternate half cycle flows through the meter.

Another point to remember is that because a moving coil meter indicates average instead of RMS value, the readings will be 10% low, unless the resistance of the multiplier or the length of the scale is reduced to allow for this.

Even if this is done, the calibration will only hold true for measurements on AC with a sinewave waveform, because other waveforms will have a different ratio between their average and RMS values.

The provision of current ranges for use on AC requires the use of a current transformer. A shunt is not suitable, because it would be trying to compare the resistance of the shunt with the impedance of the coil of the meter. The non-linearity of the rectifiers generally also proves to be a problem.

Overload protection

Limited, but very worthwhile protection against overload of a moving coil meter can be provided by connecting two silicon power diodes — such as the 1N4004 — in parallel across its terminals. The two diodes should be connected with opposite polarities as shown in Fig.11.

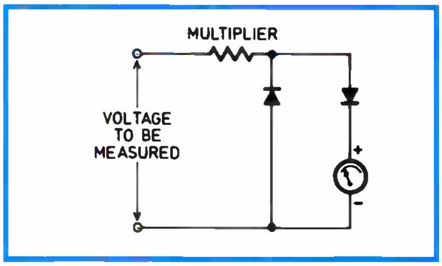


Fig.10: Linearity is better with a half-wave rectifier, but the pointer may vibrate at low frequencies.

Silicon power diodes will not start to conduct appreciably until the voltage across them is about 300 millivolts, while a typical hobby moving coil meter has only about 200 millivolts across its terminals at FSD, so normal readings will not be affected.

However should the voltage across the meter rise above about 600 millivolts, due to an overload, then the resistance of the diodes in their forward direction will fall rapidly. This will usually allow the user time to remove the overload before the meter is seriously damaged.

If the FSD voltage across the meter used is less than 200 millivolts, then the

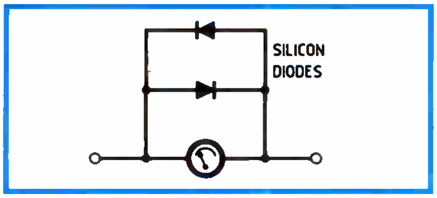


Fig.11: Two silicon diodes may be connected across the meter itself as shown, for overload protection.

protection provided by these diodes will not be as good. On the other hand if the meter has an FSD greater than about 300 millivolts, the readings on the upper part of the scale will be affected. The millivolts across the meter at FSD can be found by using the method shown in Fig.1.

So far, I have not even bent the pointer of any of my meters protected in this way.

Final tips

Before buying a meter and deciding on the ranges you intend to use, consideration should be given to the scales which are already on the meters available. Meters with dual scales 0 to 3 and 0 to 10 are listed in the Dick Smith 1989 catalog, for example, and these scales are staggered in length to suit ranges switched in accurate 10dB steps.

Other meters are available with inbuilt multipliers and scales calibrated for voltage, say 0-20V.

Finally, whether you are fitting a meter movement into a piece of equipment or building a small portable measuring instrument, the finished instructment should be well constructed to provide consistent readings.

It should also be well insulated to guard against accidental short circuits during use, and to protect the user from possible electric shock. ■

Calculator

Continued from page 120

correct) answer is printed can be very misleading.

Interestingly, this only happens when you use the shorthand 'M' key to enter the '10^' — not if the '10' and '^' are entered separately. The latter approach triggers an error message for entering two operators without data between them. While this might only seem to be a minor point, the error could easily be undetected in a complex calculation. (But to be fair to the author, he does suggest hand calculating examples to check the accuracy of each new formula that you enter.)

In the past, I have written short basic programs for my commonly used calculations. From now on, I will be using E[2]CALC's 'formula solver'. Formulas are just so much easier to enter. As stated before, I think that this is the best feature of the program.

And another satisfying aspect of this nifty package is its cost. For only $20, David Jones of TRONNORT Software, 12 Copeland Road, Lethbridge Park 2770 will sell you a copy. Please send cheque or money order only, and state whether a 3-1/2" or 5-1/4" disk is required. ❖

Serial I/O bus for chips and PC peripherals:

A look at I²C and the ACCESS bus - 1

For over 10 years, designers of radio transceivers, TV receivers, VCRs, CD players and many other kinds of equipment have been taking increasing advantage of the I²C bus — developed by Philips to streamline data flow between complex chips. Now a variation on the I²C bus has been developed by Philips/Signetics and DEC, to allow elegant and economical interfacing of computer peripherals such as keyboards, mice, scanners, joysticks and trackballs, modems and printers. This is the first of two articles explaining the basics of I²C/ACCESS bus operation.

by JIM ROWE

When integrated circuits first appeared in the mid-1960's, they typically contained relatively simple circuit modules with no more than 20-30 transistors and a similar number of diodes and resistors.

But ever since then, chip designers have been finding ways of cramming them with more and more complex circuits — with exponentially increasing numbers of transistors and other components.

Modern IC's can contain millions of transistors, and provide a complete functional subsystem on a chip. Examples are microprocessors, RAM and EEPROM memory chips, and controller chips for floppy and hard disk drives or video displays.

In achieving this incredible success story, working out how to manufacture ever-tinier circuit components has been only one of the challenges faced by IC designers and manufacturers.

This is because the mere act of squeezing more and more circuitry into a single chip *in itself* produces other problems — like removing the heat that's generated within your ever-shrinking circuitry.

One of the more significant challenges has been to do with chip *connections*. As chips get more complex, they tend to handle more information — so there's a tendency for complex chips to acquire more and more inputs and outputs. There's supply inputs, reset inputs, control inputs and status outputs, data inputs and outputs, addressing inputs and outputs, and so on. The list tends to grow, almost endlessly...

By about 1980, this trend had resulted in the traditional 'dual-in-line' or DIL chip packages growing to the point where they frequently had up to 40, or even 64 pins. Then designers had to change direction slightly, and go to 'pin-grid array' (PGA) and 'leadless chip carrier' (LCC) packages, to provide more pins again. As a result, many of today's complex VLSI chips now come in packages with as many as 169 pins or more.

Needless to say, if you have a few devices with this many pins on a PC board, the board design can be particularly involved. Frequently each complex device will have a number of groups of pins for things like addressing and data transfer, each group with many

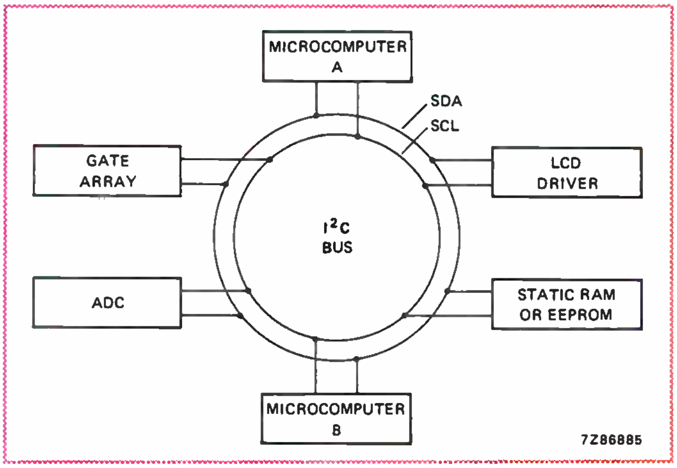


Fig.1: A Philips diagram showing the way an I²C bus is used to link chips in a microcomputer system.

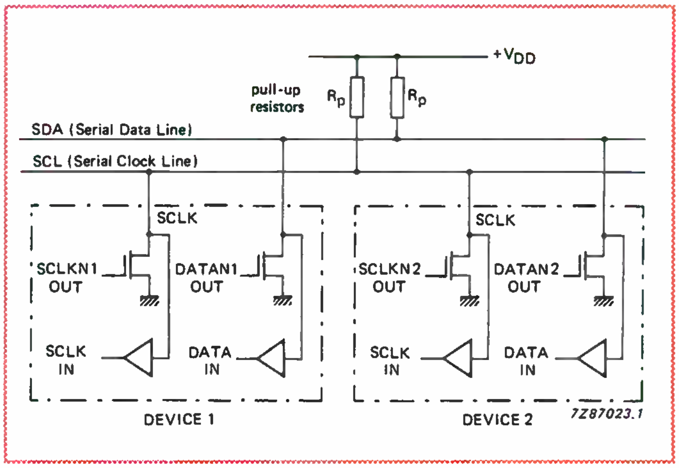


Fig.2: Each device connected to the I²C bus has two bidirectional pins — one for clock signals, the other for data.

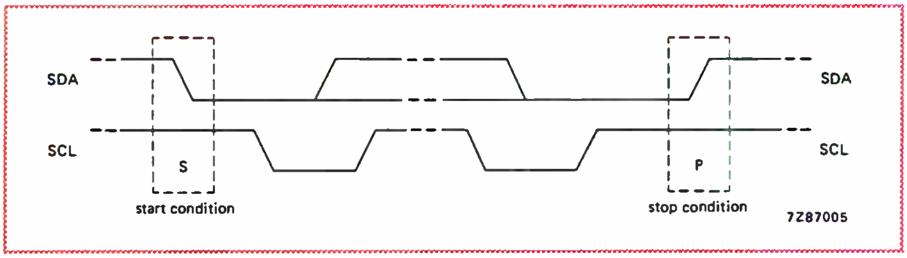


Fig.3: The start and stop conditions for a data transfer are indicated by the master chip changing the SDA line level while the SCL level is still high.

as 32 pins — and there's often a need to link all of the corresponding pins in each group on each device, to form parallel communications *buses*. This is why many of the boards for microcomputers, controllers and other complex subsystems can have as many as 6-8 wiring layers.

Now it's virtually essential to take this multiple-pin, parallel bus approach to inter-chip communications when you have a system where information must pass back and forth between the chips at the highest possible speed. This certainly applies for the main data pathways in things like microcomputers, desktop workstations, video controllers, digital signal processors and so on.

But there are many other situations where data *doesn't* have to be exchanged between chips at super-fast speeds. This is obviously the case in circuits which themselves operate at a low speed, although it can just as often apply in high-speed circuits as well — where many of the basic functional control signals need only be passed between chips at a much lower speed than the main signal processing.

For this kind of low-speed functional control activity, as well as low speed inter-chip communication in general, it turns out that the *serial* communications approach has very worthwhile advantages. The number of device pins can generally be significantly reduced, and with them the number of PCB tracks needed to link the devices together so that they can communicate.

Philips' approach

It was with this philosophy in mind, back in 1981, that Philips introduced its *Inter-IC* or 'I²C' bus system — designed specifically, as the name suggests, for communication between IC chips within a system.

Not surprisingly, the I²C bus uses serial communications, with just two signal lines and ground used to form the data link between chips. One line is used to pass the actual data, and is called the *serial data* or SDA line, while the other carries the *serial clock* or SCL pulses used to strobe or clock the data into its intended receiving chip. As this suggests, the I²C bus uses *synchronous* serial communications.

Each chip designed for the I²C bus therefore has two pins marked SDA and SCL, and in a typical PCB-level subsystem or piece of equipment these pins on each chip are merely linked together, in 'daisy chain' fashion. Fig.1, taken from the Philips data book, shows the basic idea — although it also suggests that the SDA and SCL lines are joined to form a complete ring, which is not necessary.

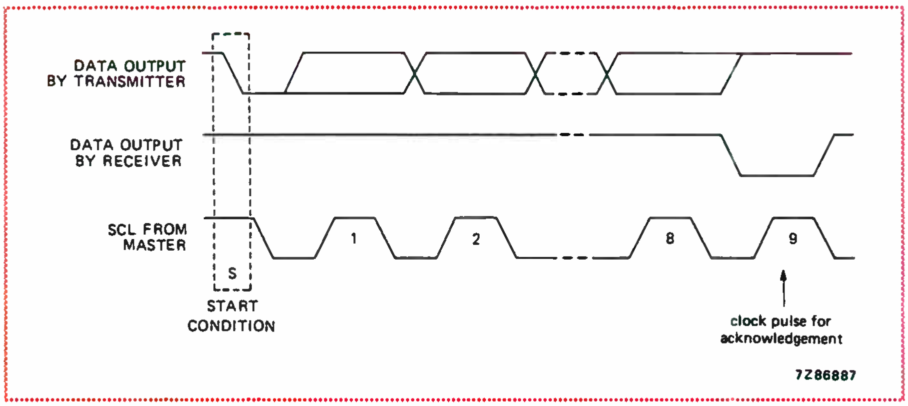


Fig.4: Following each eight bit data byte transfer, the master chip sends out a ninth clock bit on the SCL line. The receiving chip must pull the data line down to logic low level for this pulse, to acknowledge a successful receipt.

Note that Fig.1 also shows two microcomputer chips connected to the same I²C bus. This is quite feasible, as the I²C bus definition allows more than one *master* device (such as a microprocessor) to be connected. A 'master' chip is defined as one which initiates, terminates and provides the clock pulses for any particular data transfer on the bus — in contrast with a *slave* chip, which essentially 'does what it's told', at least during that particular data transfer.

If you like, the chip that *initiates and controls* any particular data transfer is the 'master', while the other chip or chips involved in that transfer will be acting as slaves. But this particular master/slave(s) relationship applies only for one particular data transfer, and can change for another transfer.

It's true, though, that normally microprocessors and microcomputer/-controller chips tend to form the 'master' chips in an I²C bus system, while chips like RAMs, ROMs, display drivers, data converters, programmable counters etc., tend to act as the 'slaves'.

By the way, the master/slave concept is quite separate from any concept of the *direction of data flow* during a transfer. For any particular data transfer, it can be either the master or slave chip that acts as the data *transmitter*, while obviously the other chip or chips automatically becomes the *receiver*.

So a chip can be both a master and a receiver, or a slave and a transmitter, for a particular data transfer — and the other two combinations are also possible, as well.

Of course some chips by their very nature tend to fall automatically into one role or the other, in terms of data flow direction. Many chips like display drivers, programmable dividers, frequency synthesisers and digital attenuators will normally always be an I²C receiver as well as a slave, while others like ROMs tend to be transmitting slaves.

Other chips like RAMs and clock/calendars can function as either a transmitter or a receiver, as required, while still generally remaining as a slave device due to their lack of inbuilt 'intelligence'. It's generally only microprocessors and microcomputers/controllers that can act as *both* masters and slaves, and also as either a transmitter or receiver.

Bus addressing

Because of its two-wire 'daisy chain' configuration, the I²C bus has to use a *serial addressing* system — so that for any particular data transfer, the master chip concerned can indicate which chip or chips it needs to send data to, or receive data from. This is done by the master chip sending out an *address byte*, as the first byte of any transfer sequence. Every chip connected into an I²C bus system must therefore be given an address which is unique — at least for that system.

Seven bits of the address byte are used for the actual chip addresses, while the eighth bit is used to indicate whether or not the master chip wishes to read data from, or write data to, the addressed slave(s). Since the system provides seven address bits this allows in theory for up to 128 different chip 'addresses', although some of these have been reserved by Philips for various special and/or future purposes.

Many chips designed for the I²C bus are given a fixed internal address, set by the manufacturer according to guide lines set by Philips.

Others can have their address changed over a certain range, by bringing out some of their I²C address bits to external pins to allow hard wiring. This allows a system to use say a number of nominally identical RAM or ROM chips, with each set up via hard wiring to have different bus addresses.

Wired-OR system

The SDA and SCL lines of the I²C bus are bidirectional, and use a wired-OR system as shown in Fig.2. Each line is fitted with a pullup resistor, and when the bus is free (i.e., no data transfers taking place), both lines are pulled to logic high (usually +5V).

As you can also see from Fig.2, the SDA and SCL pins of each device are typically connected internally to both an input buffer and an output buffer — the latter in the 'open collector/drain' configuration so it is virtually transparent to the bus line when not pulling the line down to logic low.

Hence like the bus lines themselves, the SDA and SCL pins on each device are bidirectional — i.e., used for both input and output.

Timing & protocol

The I²C bus uses positive clock pulses on the SCL line to effectively 'strobe' the serial data bits appearing on the SDA line. As noted earlier, the clock pulses for any particular data transfer are provided by the device which initiates the transfer, and acts as the controlling 'master'.

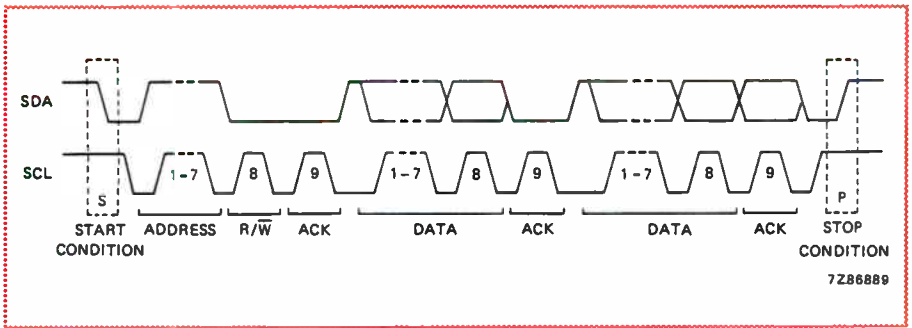


Fig.5: A sample showing a complete I²C data transfer. Note that the first data byte sent is an address byte, sent by the master chip to indicate which chip is to be the slave for that particular data transfer.

In most cases the SDA line can only change its logic level when the clock signal on the SCL line is at the logic low level; when the SCL line goes high during a clock pulse, the data on the SDA line must be stable.

The defined minimum width for the SCL pulses is 4us, with a minimum spacing of 4.7us; with allowance for setup and hold times, this gives a maximum data transfer rate of 100kbps. But there is no *maximum* limit for clock pulse width, or spacing, and as a result data can be transferred at any rate *below* 100kbps. This makes the I²C bus quite flexible.

The only exception to the rule that the SDA line should not change level when the SCL line is high is when a chip initiates and terminates a data transfer sequence, in the role of a 'master'. Here the specified way for the master to initiate a transfer is to pull the SDA line low, while leaving the SCL line high (Fig.3); this is known as the *start condition*.

Similarly the way the master chip terminates a transfer is to allow the SCL line to pull high, with SDA low, and then allow the SDA line to pull high also. This is known as the *stop condition*, and is also shown in Fig.3.

All of the main data transferred on the I²C bus is in the form of 8-bit bytes, with the bits making up each byte sent in order of descending significance (i.e., MSB first).

There is no limit to the number of bytes sent during a particular data transfer, but every byte sent from the transmitting chip must be acknowledged by the receiving chip immediately after it is received, by means of a single data bit.

The master chip supplies the ninth clock pulse to strobe this acknowledge data bit, and if the receiver has accepted the preceding data byte successfully, it must pull the SDA line low before and during this pulse (Fig.4). If this isn't done, the master chip assumes that the transfer was unsuccessful and terminates the sequence.

As noted earlier, the first data byte sent during a transfer sequence is actually the address byte, sent by that sequence's master chip to specify which chip or chips are to be the slave(s) for that sequence, and whether it wishes to write or read data.

This address byte will normally be acknowledged by the slave chip or chips concerned, following which the designated 'transmitter' chip for that transfer will send the required sequence of data

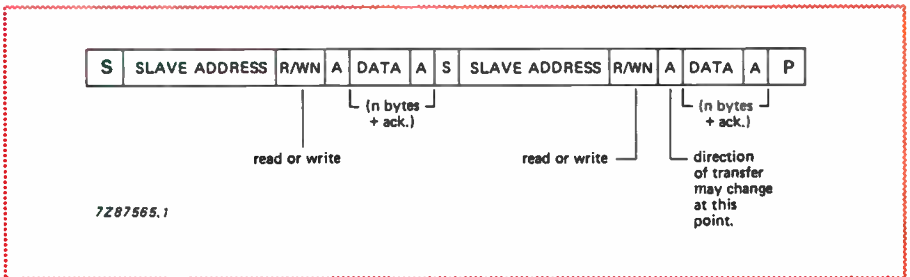


Fig.6: If a operation involves the transfer of data in both directions, a separate address byte must be sent by the master chip before each group of data bytes. This is because one bit of the address byte specifies the direction of data transfer.

bytes. A complete I^2C data transfer sequence will therefore follow the pattern shown in Fig.5.

If a transfer sequence involves data being sent first in one direction and then in the other, both under the control of the master chip, it will send two different address bytes — one for each part of the transfer. Each address byte will have the R/W-bar bit set for 'write' or 'read', as required (Fig.6).

What if two chips try to grab the I^2C bus and initiate data transfers at the same time — a clash of 'masters'?

The bus specification defines an arbitration protocol to cover this situation; basically the chip that pulls the SCL line low *first* 'wins' control of the bus and continues with its transfer sequence, while the 'losing' chip waits until the bus becomes free again.

Wide acceptance

When Philips introduced the I^2C bus concept in 1981, it was probably a bit ahead of its time. Until about 1984-85, Philips itself was the main IC manufacturer producing chips for the I^2C bus, and promoting their use.

But in the mid-1980's, the idea began to 'take off'. First the US radio equipment manufacturers began using it in their new digital models, and then the Japanese makers adopted it as well — not just for radio gear, but also for consumer products like VCR's, CD players, video camcorders and DAT machines.

In the meantime, of course, Philips and the other European manufacturers were increasingly using it for the same applications — along with digitally-enhanced TV receivers, teletext decoders and so on.

The nett result is that nowadays, at least 26 different companies world wide support the I^2C bus, and use it in their chips and/or equipment.

Open up almost any item of consumer electronics equipment, or examine its schematic, and you're likely to find significant use of I^2C for inter-chip communications.

There's no doubt that the bus has played a key role in facilitating the design of many common items of modern electronic equipment, and allowed the increasing level of either digital or digitally-enhanced operation.

I^2C chip range

A wide range of chips are now available with I^2C bus compatibility. Philips alone makes around 100 different chips of this type, including over 40 microcontrollers, six LCD display drivers, five RAM or EEPROM memory chips, and a whole raft of devices for video, radio, audio and telecomms applications.

The latter include teletext decoders, a 'picture in picture' (PIP) controller, PAL/NTSC and SECAM decoders, digital tuning chips, PLL frequency synthesisers, DTMF tone generators and repertory dialers, audio volume/tone control chips, and a voice synthesiser chip.

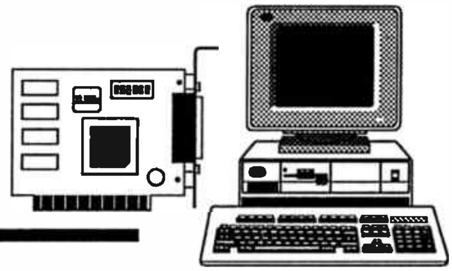
There are also a few specialised devices for digital applications, including an 8-bit I^2C to parallel data converter, a 5-bit high-current driver, quad and octal DACs, and a device which combines an 8-bit DAC with an 8-bit ADC plus 4-channel input multiplexer.

In short, there are now chips available to allow the I^2C system to be used in designing almost any kind of equipment.

In the second of these articles, we'll look at some of the demo modules and development aids that are available to help designers take advantage of the I^2C bus. We'll also look at the ACCESS bus, which Philips/Signetics and DEC have developed from I^2C and launched as a low-cost system for interfacing low-speed peripherals to personal computers.

(To be continued) ❖

Computer News and New Products



VGA-video board

An Australian designed and manufactured VGA-video board for IBM PCs can generate computer video on your TV or VCR at the flick of a switch. It was designed by CCI, to bridge the gap between low cost video display units and the requirements of compatibility with the IBM VGA standards. Video and sync information are generated for all the standard VGA video models at TV standard, including extended super VGA resolutions up to 1024 x 768 in 16 colours.

Although not capable of generating VGA and TV compatible video at the same time, the board can generate high quality TV video which can be recorded on standard VCRs and the latest VCRs which support separate S-video inputs.

The VGA-video board uses the latest Trident TVGA9000 chipset, which is 100% compatible at the register and BIOS level with the IBM VGA standard. It is also downwards compatible with the EGA, CGA, MDA and Hercules standards. The board can operate in either an eight or 16-bit I/O slot, and is supplied with utility and driver software. Its many applications include interactive software demos, desktop video production, low cost character and graphics generators, classroom training and conferences. Another application is for people who own TV monitors and video projects which only operate at TV standards. The approximate retail price (excluding tax) is $500.

For more information circle 164 on the reader service coupon or contact Companion Computer International, 26 Fulton Street, Oakleigh 3166; phone (03) 562 9900.

FACIT laser printer

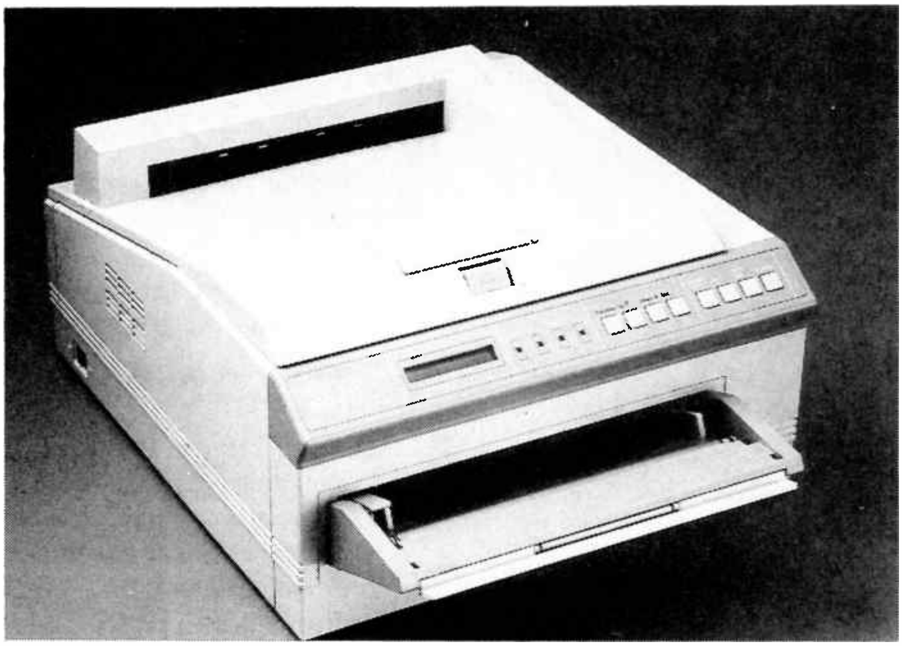
A new compact, quiet and economic laser printer for Word Processing, Graphics and Desktop Publishing with both bitmap and scalable internal fonts has been released by FACIT.

The new Model P8045 is a four page/min unit which occupies little desk space, even when fitted with the optional 300 sheet second paper supply tray. At a low 46dBA noise output, it is well suited for any office situation. The P8045 includes 14 bitmap and a further 16 scalable fonts. In addition, the unit will accept HP Laserjet Series compatible font cartridges and soft fonts. Standard memory capacity is 1MB, which can be expanded to a maximum of 3MB.

Resident command sets included are HP Laserjet III (PCL5), IBM Proprinter XL24e, and Epson FX-850.

The P8045 can also accept the optional PageStyler PDL PostScript cartridge. Advanced plotting capabilities are covered by the HPGL/2 command set.

For more information circle 162 on the reader service coupon or contact Elmeasco, PO Box 30, Concord 2137; phone (02) 736 2888.



Data acquisition

Model MSI-607 is a plug-in card for XT/AT or compatible computers, providing real-world data acquisition and control. The MSI-607 will accept up to 16 analog sensor inputs directly and no external signal conditioning is required.

Thermocouples, RTDs, potentiometers, resistances, strain gauges, LVDTs and variable-reluctance pressure transducers, as well as low-level DC voltages, may be wired directly to the MSI-607 in any combination. All required external excitation and linearisation is provided by the board.

MSI-607 contains 16 single-ended/eight differential-ended and one additional input for cold junction compensation, two D/A outputs and 16 digital I/O bits, which may be individually programmed for input or output. A 14-bit A/D resolution and 11 stages of programmable gain amplification allow for accurate measurements from the signal sensor sources. The analog conversion rate is 5kHz.

Additional models include: MSI-608, which is a 10kHz sampling rate board and the MSI-601, which is half length version of the MSI-607 but with no analog outputs or digital I/O.

For more information circle 163 on the reader service coupon or contact Interworld Electronics, 1G Eskay Road, Oakleigh South 3167; phone (03) 563 7066.

DAT drives

Lynx Technologies, the sole authorised HP DAT Drive distributor in Australia, has just released the second generation of Hewlett-Packard's high performance DAT drives. The two new models, the HP 35480A and HP35470A, (both 3.5" or 5.25") offer storage capacities from 1.3GB(gigabytes) to 8GB per cartridge. Using digital technology, the drives are capable of transferring data at a rate of 44MB/min.

Both drives are suitable for users who want to perform unattended backups and have 300MB or more of disk capacity. The drives are compatible with a range of systems including those from DEC, Olivetti, Fujitsu, IBM, MIPS, NCR, NEC, SG, Sun, Unisys, Pyramid and of course, HP. They are also fully supported in the LAN & PC/workstation environments.

The drives have an uncorrectable error rate of less than one error in 10 x 15 bits. When compared with other tape drive technologies, the HP 35480A is 10,000 times better than 5" reel to reel, 10 to 1000 times better than most QIC tape drives, and 100 times better than 8mm tape drives.

For more information circle 161 on the reader service coupon or contact Lynx Technologies, 99 Spring Street, Bondi Junction 2022; phone (02) 369 1322.

Chip boosts Windows speed

Oak Technology has released a Super VGA graphics chip that can boost the graphics performance of computers running Windows programs by up to five times over existing VGA chips. The OTI-087 is fully compatible with the thousands of existing MS-DOS programs, and can increase the graphics performance of computers running those programs by up to five times.

In addition to improving graphics performance, OTI-087 can bring photographic quality images to personal computers. This is possible because the chip has 24-bit colour technology, also known as 'true colour', which allows it to display 16 million different colours. Computers which show photographic quality images will be able to run advanced multimedia programs.

The new device achieves much of its speed by communicating directly to 80386 or 80486 microprocessors via the high speed local bus, instead of the slower AT bus or ISA (Industry Standard Architecture) bus which is used by existing VGA chips). Advanced processors can create images faster than existing graphics chips can display them. This forces computer users to wait while images are being painted on the screen. The high performance Oak chip will help remove the graphics bottlenecks that create delays.

PC memory upgrade guide

Hypertec has published an updated and enlarged issue of the Memory Configuration Guide, which contains 'everything you need to know about upgrading PC memory'. The 56-page guide, supplied free on request, is designed to help users add the correct type and amount of memory to a number of the more popular personal computers.

As it points out, some personal computers will allow memory upgrades on the motherboard, some use a proprietary slot, and virtually all will allow additional memory boards in the normal bus slots. The Memory Configuration Guide identifies the appropriate manufacturer's product and the fully equivalent Hypertec product for any particular configure.

Hypertec has also released a new edition of 'Understanding PC Memory', a comprehensive booklet, also supplied free on request, which clearly explains machine architectures, types of memory, how memory is used and how it works with the 80386 processor.

For more information circle 166 on the reader service coupon or contact Hypertec, 408 Victoria Road, Gladesville 2111; phone (02) 805 0111.

Fischertechnik computer kits

Procon Technology has been appointed an authorised distributor of the fischertechnik computer-controlled construction kits. A range of kits is available, including a low cost computing kit providing eight micro-switches, three lamps, two motors, one electromagnet and details for the construction of 10 projects. A training robot kit and a plotter/scanner kit are also available.

This fischertechnik training robot, with its three axis movement, has a working radius which extends from 12 to 37cm and a gripper height movement range of -6 to +25cm. The gripper is capable of lifting loads up to 100g, and its positioning system is controlled by three photo-interrupters capable of a repeatability of 1mm. Numerous interfaces and software are available for a variety of computers. Procon Technology's programmable logic control (PLC) software provides a relay ladder logic style programming language that features on-line editing, real-time monitoring of program conditions and forced I/O capability.

Version 2.50 currently supports eight inputs, outputs, timers and counters, and 64 control relays. The computing kit (P./N 30554) costs $280 and the training robot (P/N 30572) is priced at $564. The Procon Technology PLC Starter Pak, including I/O board, cable, interface card and PLC version 2.50 software is currently $390. All boards include sales tax.

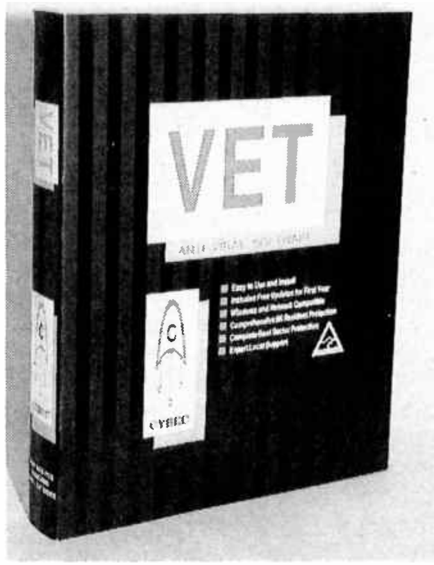
For more information circle 168 on the reader service coupon or contact Procon Technology, PO Box 655, Mt Waverley 3149; phone (03) 807 5660.

VET 6.8

VET Version 6.8 provides even better anti-viral protection than before and still retails at only $90 for a year's subscription. The key features of VET are that it operates with networks, is Windows compatible, easy to install and use.

Initial price includes free quarterly updates for one year, and offers resident protection if required. This Australian-made product is supported by an expert local team and provides complete boot sector protection. New viruses detected by VET 6.8 include 'Padded' and 'Stonehenge'. An even more recent virus is 'Squawk', which has just been disassembled by VET's Roger Riordan. VET 6.81 will be able to find and destroy it.

For more information circle 165 on the reader service coupon or contact Cybec, PO Box 82, Hampton 3188; phone (03) 521 0655.



Vehicle computer collects data

Owners of light commercial vehicles and car fleet operators are likely to benefit from a new lightweight, onboard data collection computer just released in Australia. The system, the FMS1332, has been built for heavy commercial vehicles and complies with NSW laws for monitoring devices, but its compact form makes it equally applicable for smaller vehicles.

The FMS1332 allows fleet operators to properly monitor the day-to-day conduct of each vehicle. It can also be used as evidence in accident investigation, or as a defence in police actions.

The new generation FMS provides two ways of downloading vehicle data to the office computer. It can transfer either by direct extraction using a vehicle data terminal, or with a portable 'smart card' which can be carried to the office. An optional driver entry terminal allows drivers to enter information. The onboard computer weighs just 0.5kg and is only 17cm square, while the cockpit mounted hardcard reader is just 5cm square.

For more information circle 179 on the reader service coupon or contact VDO Australia, 115 Northern Road, Heidelberg West, 3081; phone (03) 450 3111.

Multimedia Sound Blaster

A fully featured Multimedia package has been released for the popular Sound Blaster range of PC-based synthesiser cards.

The Multimedia Kit includes the Sound Blaster Pro stereo card, a high performance CD-ROM drive, Microsoft Windows 3.0 with Multimedia Extensions 1.0, as well as bundled software, and five CD-ROM titles.

Developed by US manufacturer Creative Labs, the plug-in Sound Blaster Pro card incorporates a number of sophisticated features such as a built-in stereo digital/analog mixer for digitised speech and sound effects, twin FM chips that create 22 individual voices, built-in CD-ROM interface, a stereo microphone jack, and a standard joystick port that doubles as a MIDI (musical instrument digital interface) for connection to a synthesiser.

Sound Blaster Pro is priced at $399. The Multimedia Kit costs $1399 with an internal CD-ROM drive of $1599 with an external CD-ROM drive.

For further information circle 167 on the reader service coupon or contact Computamart, 10/12 Main Street, Osborne Park 6017; phone (09) 242 5277. ❖

EA DIRECTORY OF SUPPLIERS

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Suit teachers, doctors, businessmen, and other professionals. Improve and enhance all your presentations. Not a kit, but a complete commercial pen sized laser pointer at an incredible introductory price!

ONLY $199

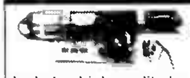
Small pen sized body. Runs on two small AAA battery. Battery life: 2-10 hours. Visible 5mW red (670nM) laser. Projects a visible red spot at more than 50 metres. As used for medical treatment by some doctors and acupuncturists.

SOLAR PANEL GIVEAWAY

Brand New high quality US made, amophourous glass Solar Panels. Dimensions: 150 X 150 X 2.5mm. In normal sunlight they deliver a full 1 Watt whilst charging 6V-8V batteries! Can be connected in series, in parallel, or series / parallel, to increase the voltage, and/or current capacity. For example, in average sunlight, two of these panels connected in series will deliver approximately 150mA of charging current, into a floating 12V (14V) battery: 2 Watts! Four panels can be connected in series parallel to deliver 300mA into a floating battery: 4 Watts! Compare the prices! All the panels have a weather protection film on rear, and the terminating clips are provided.

INCREDIBLE PRICING: $9 ea. or 10 for $75

3mW GAS LASER



Includes high quality low divergence Siemens laser head with an output at about 3mW and one of our reliable and efficient 12V universal laser power supply kits. The tube is used but it is guaranteed. The kit comes with full instructions and it even includes a prewound transformer. The applications include high power laser pointers, surveying equipment, optical experiments, education, holography, medical field, disco displays, etc. ONLY $99

VISIBLE LASER DIODE HEAD

Save, by making your own laser pointer, laser gun sight, medical treatment laser, etc. Produces a well collimated beam. Designed to be powered directly from a 3V battery, or from higher voltages, if a simple constant source is added. Simple circuit included. 5mW (670nM). At an incredible introductory price of: $135

For the head only: Add $8 for the extra "bits" needed to make a complete laser diode pointer. Case, switch, alkaline batteries, and battery holders. Everything you need to make a complete, self contained, visible laser pointer or gunsight.

LCD DISPLAY MODULE

These are brand new 16 character by 2 line modules (16 X 2), has backlighting provision. High quality, high contrast, alphanumeric LCD display modules, with surface mounted control circuitry already mounted underneath the PCB. Require a few millamperes at 5V to operate. We include information.

ON SPECIAL AT $18 ea.

LENS ASSEMBLY

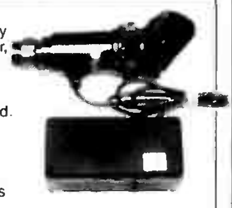
This plastic lens assembly includes a lens with an approximate diameter of 12mm, whose focal point is about ½ the length of the cylindrical tube, which is 20mm long. Mounting holes provided. Great for housing and improving the sensitivity of any light and laser detectors. $5.50

LASER GUNSIGHT

Small black anodised metal body. Removable pressure switch. Vertical and horizontal adjustments. Battery life more than 10 hours continuous. 5mW 670nM class IIIA laser. Range is about 150m, some would claim three times more. Shock tested to 2000g. One year warranty. ONLY $299

Price includes one rifle or pistol mount

NIGHT VIEWER BARGAIN



A very small telescopic monocular IR viewer. Actually ½ of the IR Binocular Viewer, advertised elsewhere in this advertisement. Very small: Length of scope is 130mm without the rubber hood fitted. The assembled scope has high quality military grade optics, and employs a prefocussed IR image converter tube. This tube has a useful response from 600-1300 nM, thus also making it useful when working with IR LEDs, and IR laser systems. The scope has provision for a coaxial E.H.T. connection, and is supplied with a power supply kit, that features a ready assembled inverter on a small PCB. The power supply easily fits into a small plastic case, and can be fitted with a belt clip: Also supplied! At a very small fraction of its real value! Worth $200. $239

ARGON LASER

These air cooled Argon Laser Heads have had relatively "low hours" of operation. They are guaranteed. They produce a bright blue beam (488nM) and have a power output in the 10-100mW range. Limited supplies, at a small fraction of their real value.

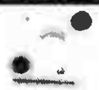
ONLY $800

The head includes power meter circuitry and starting circuitry. Circuit diagram provided. Also provided is a circuit for a simple power supply. We can provide the major components for this supply. Enquire.

I.R. BINOCULAR VIEWER

High quality military binocular IR viewer. Self powered, and originally intended to be mounted on a helmet. Focus is adjustable from 1 metre to infinity. Requires some IR illumination. Powered by one single 1.5V battery. Original fibreglass carry case provided. Limited stock. $649

DIVERGING LENS



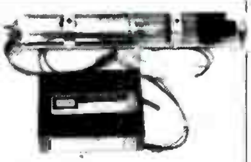
A high quality laser beam diverging (beam expander) glass lens, mounted on an aluminium plate, with mounting screws provided. Dimensions: 25 X 25 X 6mm. Use it to expand the laser beam for Holography, Special Effects, or one of the two lenses required to fine focus a laser beam, for Surveying and Bar Code Reading. $9.90

SILICON SOLAR CELLS

High efficiency silicon cells. With normal sunlight, and under load, each one of these 12.5 X 50mm cells will deliver 0.46V at approximately 175mA: V o/c = 0.58V, I s/c = 188mA. Glass from a very small picture frame, and some silicon could be used to make a 6V / 1.1W (14 cells) or a 12V / 2.2W (28 cells) solar panel! Pretinned connecting solder connections are provided.

ONLY $1 ea.

MAINS OPERATED LASER



Consider this Mains Powered Laser Bargain, for discos, laboratories, photography, holography, medical field, etc. Supplied with two 3mW Seimens tubes, and a brand new potted mains laser power supply. The tubes are used but have plenty of life left in them. They are Guaranteed! $189

We can also supply the mains laser supplies with lower powered tube, at a slightly lower cost. Ring or fax.

INFRA RED FILTER

A high quality, military grade, deep infra red (IR) filter. For medium and high power incadescent spotlights and flood lights. Approximately 130mm diameter and 6mm thick. High temperature pyrex-glass base material. Excellent for night surveillance equipment! Works with IR viewers and some video equipment.

ON SPECIAL AT $55

IR LASERS

This precision collimator assembly was removed from working laser printers, but is supplied with an extra Brand New laser diode to suit. It produces a beam that can be focussed to a fine dot or line. Barely visible. 780 nM/5mW. We also supply a PCB components and instructions kit, for a suitable digital driver circuit that can be used to complete the laser transmitter. Suitable for communications, data links, perimeter protection, bar code reading, medical, etc. Limited stocks. $89

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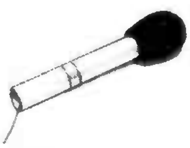

ULTRASONIC CAR ALARM

Crystal locked ultrasonic movement detector and/or a self standing car alarm. Provision for bonnet/boot protection and battery back up. See S.C. May '88. The kit includes the PCB and components, the ultrasonic transducers, but the screw terminals are not provided.

CLEARANCE AT $24.90

THE MICROPHONE

This unit has a built in preamplifier so it can drive any amplifier. Turn your stereo amplifier into a PA amplifier. Also features touch switching, battery check function, etc.

See E.A. Nov. '86.

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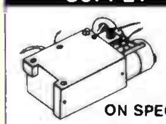

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READER INFO NO. 35

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Fluke quality: Made in the USA by Fluke, with the same rugged reliability that's made us the world leader in digital multimeters. Count on hard-working high performance—and a two-year warranty to back it up.

Large, easy-to-read display: 4000 count digital readout.

Actual size: Easy to carry, easy to use.

***New!* Min/Max record with relative time stamp and Continuity Capture™:** Makes intermittent problems easier to find. Records highs and lows—and "time stamps" when they occurred. In continuity mode, opens or shorts as brief as 250 µs are captured and displayed.

***New!* V Chek™:** For fast accurate checks on power sources and supplies, set your meter on V Chek—and let it do the rest. V Chek will determine continuity/ohms; if voltage is present, it will *automatically* change modes to measure AC or DC volts, whichever is detected. For most initial troubleshooting checks, here's the only setting you need to make.

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Autoranging with manual option: Your choice, depending on your situation.

Sleep Mode: Shuts itself off if you forget, extending long battery life even further.

***New!* Slide switch and a few pushbuttons control all functions:** Designed for true one-hand operation.

Fast, accurate tests and measurements: AC and DC voltage measurements to 600 volts, ohms to 40 MΩ; audible continuity test; and diode test.

Safety—a Fluke standard: Designed to meet UL1244, IEC 1010, CSA and VDE safety requirements; extensive overload protection built in.

Audible Continuity: To perform fast continuity checks, just listen for the beep; no need to watch the display.

***New!* TL75 Hard Point™ Test Leads:** Comfort grip with extra strong tips for extended service life.

For high performance at Fluke's lowest price, get your hands on the new Series 10. Stop by your local Fluke distributor and feel what a powerful difference the right multimeter makes—at the right price. For a free product brochure, contact your local Fluke distributor today.

Fluke 10	Fluke 11	Fluke 12
4000 count digital display 1.5% basic dc volts accuracy 2.9% basic ac volts accuracy 1.5% basic ohms accuracy Fast continuity beeper Diode Test Sleep Mode Two-year warranty	V Chek™ Capacitance, .001 to 9999 µF 4000 count digital display 0.9% basic dc volts accuracy 1.9% basic ac volts accuracy 0.9% basic ohms accuracy Fast continuity beeper Diode Test Sleep Mode Two-year warranty	V Chek™ Min/Max recording with relative time stamp Continuity Capture™ Capacitance, .001 to 9999 µF 4000 count digital display 0.9% basic dc volts accuracy 1.9% basic ac volts accuracy 0.9% basic ohms accuracy Fast continuity beeper Diode Test Sleep Mode Two-year warranty

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