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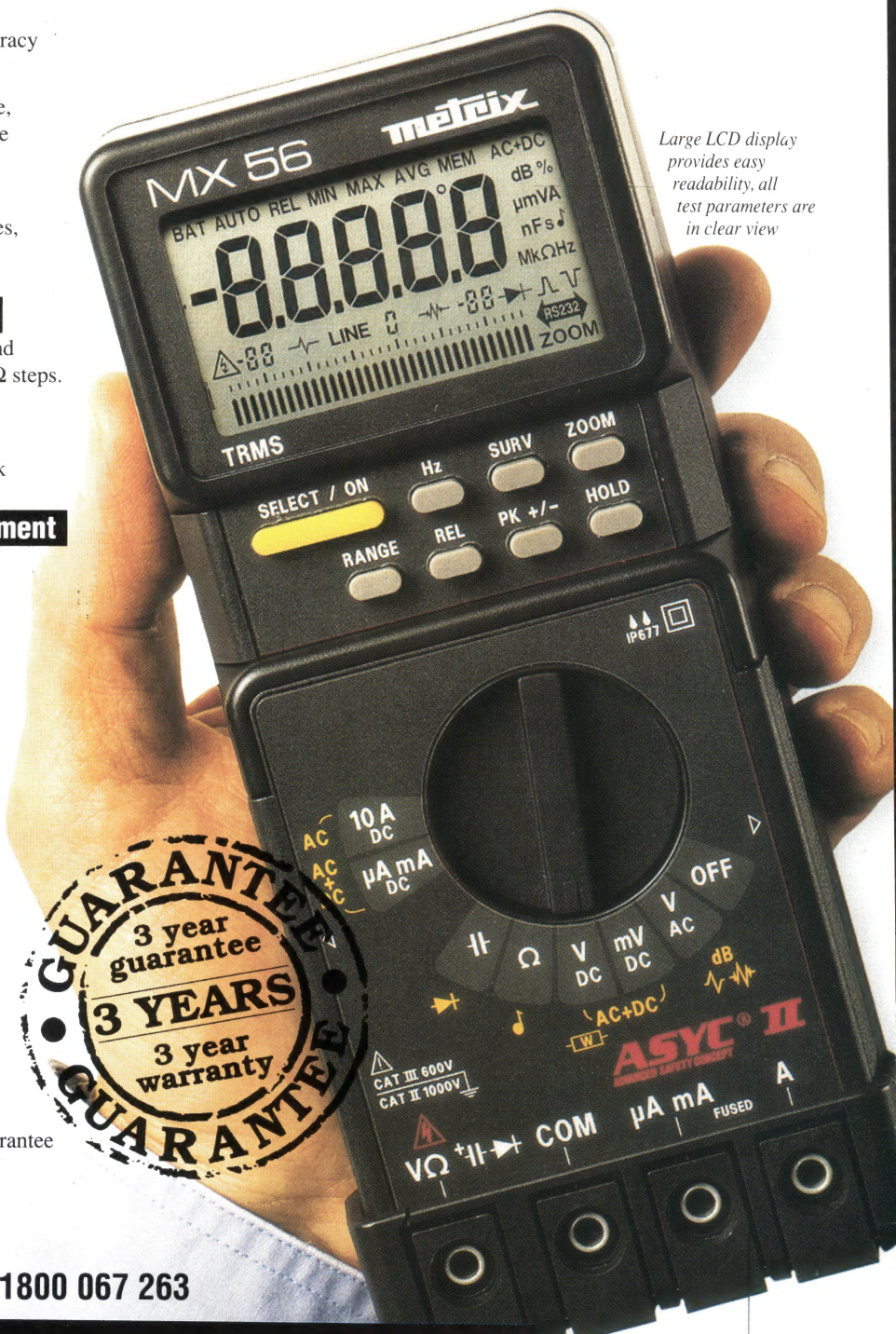
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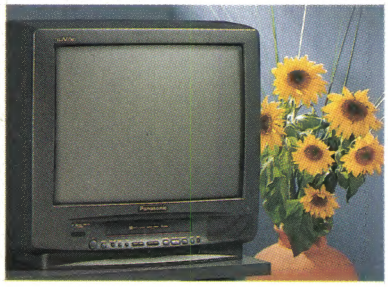
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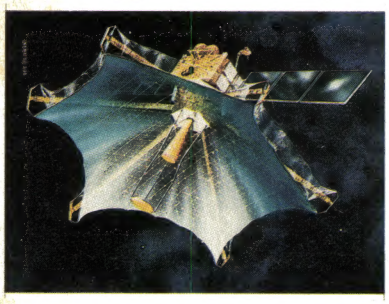
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Locally made VCR/CTV



Panasonic has just released this VCR/colour TV combination, the first such unit to be made at the company's MELCOA factory in Penrith, on Sydney's western outskirts. You'll find more information on page 8.

Even bigger radio 'scopes



In their quest for higher resolution, radio astronomers need even larger telescopes than are provided by the current 'synthetic aperture' terrestrial arrays. The next step is therefore to use orbiting 'scopes, to make up even larger synthetic dishes. Geoff McNamara explains, in his story on the VSOP and Radioastron projects starting on page 26.

On the cover

Nowadays many people aren't able to use an external antenna for short-wave reception, due to either limited space or edicts by the body corporate. Our new low cost Active Indoor Antenna project is designed to solve this problem; it's described in Jim Rowe's article, starting on page 58. (Photo by Dick Smith Electronics)

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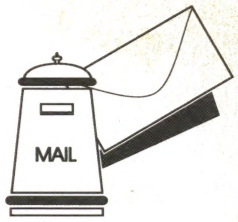
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LETTERS TO THE EDITOR



DAC kit for CD players

Contan Audio has developed a digital-to-analog converter (DAC) kit for compact disc players. It is based on the Burr-Brown 20 bit DAC, PCM63P and the Crystal Technology CS8412CP receiver chip. We believe that this kit project would be of interest not only to audiophiles, but to most audio enthusiasts because of its audio quality at an inexpensive price. Besides, it is very easy to build.

The current projected price for the kit excluding casing and power transformer is $350. A commercial DAC of this quality easily exceeds $1000 retail price.

Electronics Australia will only publish this project if there is sufficient interest from the readers. In order to get it published, we encourage readers and their friends to write or phone the magazine and let the Editor know of your interest.

I hope you can publish this letter as soon as you can.

Tean Tan,
Contan Audio,
Mount Waverley, Vic.

Cache RAM scam

Thanks for your article 'WARNING; SOME CACHE RAMS AREN'T' in the October *Electronics Australia*. The story finally resolved for me why my 486dx4-100 motherboard was not as fast as I thought it should be.

I am writing to let you know that there appears to be more than one version of this scam around. The one that I have is more tricky than the one you reported. In your story, you said that the first indication is that you could not DISABLE the External Cache in BIOS. However, on my board, you CAN DISABLE and ENABLE the Cache and the boot-up BIOS message dutifully reports 0k Cache or 256k Cache accordingly — so based on this, you would think that all is OK.

However as you can see from the enclosed copy of my letter to my supplier, the other tests do prove the point regardless of the DISABLE results.

You may be interested to know that, even though my board is different to the one in your story, the cache chips are 'IDENTICAL' to those on your board.

You might want to print a follow up advising your readers that there are more than one version of this scam around, and that the DISABLE CACHE test is not conclusive. However, the TS branded chips are probably a good indicator. If you can enable/disable the Cache, try running speed tests with both settings to see if the 'Cache' is giving any benefit.

Once again, thanks for resolving a problem that I have been grappling with for four months.

Col Smith,
Cambridge Park, NSW.

Oral radio history

Back in April 1994, I promised to update you on the 'Once Upon a Wireless' project as featured by you in the May 1994 edition of *Electronics Australia*.

I'm happy to advise that the project now has 173 interviews lodged in the collection at the National Film and Sound Archives in Canberra. We now have volunteer committees working in every mainland state of Australia, carrying on that important work.

These oral history interviews tell the story of Australian commercial radio in a unique way. That story is now being preserved for the benefit of all Australians.

I'll update you again as the project draws to a close at the end of calendar 1996.

Brendan Horgan,
Director and Company Secretary,
Once Upon a Wireless Ltd,
Willoughby, NSW.

DIY sexism?

Reading the article on DIY faultfinding in the September 1995 issue of *EA* brought back memories of doing repairs for my wife's relatives in a small town in Malaysia, using nothing more than a borrowed screwdriver. I certainly impressed the relatives with the repair of a TV and video game, but I now carry the basic tools and a multimeter whenever I visit!

However, I was disappointed with the language used in this article. Things like

'bugger', 'the proverbial male canine's genitalia' and things like 'lend you his wife', does nothing to encourage females to read your magazine and enter the profession. The high degree of sexism that pervades our culture was brought home to me recently when my three year old daughter declared, "Only boys can be engineers" and "Only boys can use tools".

So, please inform your writers that they should leave this sort of language expression for the mens locker room!

Peter King,
Procon Technology,
Mount Waverley, Vic.

Comment: Sorry if you were offended, Peter. Have you been to the movies lately, or even listed to the radio? By modern standards, the article was fairly restrained, surely.

Tide calculator

I am writing in reply to the letter to the editor in July 1995 from Captain Richard C. Hope regarding a Tide Calculator. May I please inform your readers that such a program exists, called WINTIDE and PCTIDE. This program was written by my good friend Roy Beckham ZL1GN.

The program contains tide times and heights for over 4000 ports around the world, including tide times that are not published for remote islands and reefs. You can also calculate your own tides using the Admiralty method. It works with any IBM compatible.

The program also includes a calculator type Sun Almanac in case of satellite navigation failure. ASTRONAV walks you through the Sun sight reduction process, with no Nautical Almanac and you can redo your calculations with modified data in seconds. No other data re-entry required. If you have a current Nautical Almanac, ASTRONAV can walk you through Star, Planet and moon sextant sight reduction with data taken from just the daily page. The calculator does it all for you and saves your last sight to disk.

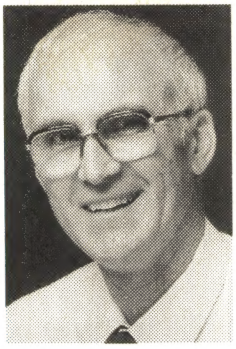
Roy is a brilliant navigator and has written this program over many years. It is good until the year 2099.

The program is available for NZ$35 incl. P&P. Please contact Roy at 27 Fifth Avenue, Mount Albert, Auckland NZ.

Phil Brown, ZL1CCR,
Putaruru, NZ.

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

EDITORIAL VIEWPOINT



Tomorrow's digital multimedia: let's make sure they're 'open'...

As I sit down to write this, there have been many stories in the daily papers about the planned merger of Pay TV operators Foxtel and Australis, and the way this will inevitably reduce the diversity of choice for Australian subscribers. While that may be true, to a certain extent it's deflecting attention from a much more important concern regarding our longer-term media options.

For various reasons, all of the existing analog-based delivery systems for subscription media are proprietary. It's that fact, together with the small size of our market, the way we've allowed service providers to become carriers and also allocated service provider/carrier licences on the basis of 'highest bidder' auctions, that has resulted in the development of a near-monopoly situation. But the important lesson here is that this must not be allowed to happen again, with the coming digital media.

Without a doubt, digital technology will soon revolutionise human communications, education and entertainment. We're not looking at a mere 'upgrade' of broadcasting and conventional media, nor merely the addition of a transitional medium like pay TV; we're looking towards the future information superhighway, and the availability of a whole raft of new interactive information and entertainment services.

Digital technology already has the potential to make all of these services *truly* 'open', in the sense that they can share a common interface for encryption/decryption, user billing etc. With digital technology, it doesn't matter whether you wish to access the information by optical or coax cable, microwave, satellite, VHF/UHF broadcasting, audio or video CD, digital tape, CD-ROM or whatever. The transport medium is immaterial; the important point is that it can be made transparent, so that any content provider is free to offer their material or services directly to the customers — us.

But for this to happen, history has shown that the functions of information carrier and service provider must be kept separate. In other words, those companies and organisations providing the delivery media (i.e., the 'carriers') must be prevented from themselves acting as a service provider. Otherwise, another near-monopoly situation will almost certainly develop again.

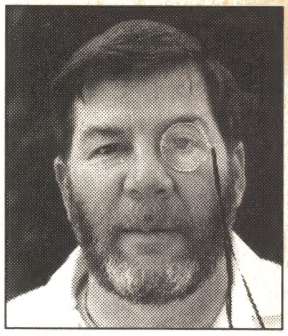
This is surely an area where our Minister for Communications and his department should be taking a high profile planning role, to ensure that Australia's new digital media can provide the maximum benefit to ALL citizens — not just a few wealthy media moguls. But they've been pretty quiet to date, giving the impression that for some reason they're deliberately sitting on their hands. For all our sakes I hope this is not so.

To end up on a happier note, this is of course our last issue for 1995. So to all of our loyal readers and advertisers, please accept our best wishes for a Happy Christmas and New Year season, on behalf of the editorial and advertising team at *Electronics Australia*. I hope you'll join us again next month, as we continue exploring electronics in 1996 — our seventy-fourth year of publication.

Jim Rowe

Moffat's Madhouse...

by TOM MOFFAT



It's all in the mind...

With the end of the year rolling around, it's common to start looking back at things that have happened in the past. But this year we'll do something a little different — try to look into the future, although using information gathered in the past 12 months. So let's once again raise those hoary old subjects of life in outer space, and time travel.

Oh no — more new-age waffle! Well, not quite; some of the waffling has been done by people of such eminence as Professor Steven Hawking of Cambridge University, and Professor Paul Davies of the University of Adelaide. Both of these men are generating theories that challenge conventional thinking right down to the very roots of religious beliefs. We would be very silly to ignore them.

Perhaps the question "is there a God?" would make a good analogy for "is there life in outer space?" or "is time travel possible?". The matter of God seems to slot people into three categories: religious people definitely believe in a God, and they structure their lives around that belief. Atheists are just the opposite, they totally deny the existence of a God. In between are the agnostics, who 'hold that the ultimate cause (God) and the essential nature of things are unknown or unknowable or that human knowledge is limited to experience' (courtesy of the *Macquarie Dictionary*).

Same goes for alien life, or time travel. Many, perhaps the majority, are adamant that these things are impossible. Others feel that they are not only possible, but here. Their beliefs generally earn them the label of 'UFO crank'. And in between are the science agnostics, who just don't know if these things are real or not, but they are prepared to listen to arguments both ways. I count myself in this third group.

Thus it was with interest that I discovered Paul Davies' little book entitled *Are We Alone?*. This is all very heavy philosophy, but written in a lovely style that even I can comprehend. In fact it's so clear I'm afraid Professor Davies is in danger of losing his academic's licence...

I think what Paul Davies did was explain to me the opinion I had already been forming, but didn't quite understand — if you get my drift. It is based on the concept of infinity. If infinity is 'true', then it follows that there must be an infinite number of planets in the universe. If there is an infinite number of planets, then there must be an infinite number that can support life. Similarly there must be an infinite number that *cannot* support life. An infinite number of anything is thus able to contain infinity itself. (That's my line, not Davies'. Now you can see why I confuse myself!)

So that should prove that we are NOT alone in the universe. HOWEVER it appears unlikely that we will ever *meet* any of our interesting neighbours, because of another concept brought up by Professor Davies: particle horizon. The way I understand it, this is the distance beyond which, because of the limited speed of light, light emitted by an object will never get to earth. And since nothing can travel faster than the speed of light, then *things* emitted by an object beyond the particle horizon will never get here either. So it seems that the particle horizon must be the limit of our universe, for all practical purposes. Given that limit, infinity — from our point of view — ain't infinite!

Even though there may be an infinite number of planets able to support life, the odds against any given planet are overwhelming, for various reasons such as temperature and pressure. So the number of suitable planets within our particle horizon isn't large, and the number of planets close enough to allow physical travel to Earth is minuscule, if not zero.

Then again, we could be wrong. So let's consider these arguments to be a dose of fertiliser, poured upon our feeble brains to make our thoughts grow over the holidays...

Time travel?

Now to time travel. You may say "impossible", and I may say "why not?". There is no evidence to prove time travel is possible, but then again there is nothing to prove it is *not* possible. People like Einstein postulated things like the space-time continuum, and it has been shown experimentally that it is certainly possible to compress or expand time.

The most concrete evidence probably came from that Hewlett-Packard atomic clock that was flown around the world aboard a jet aircraft. At the end of the journey it was established that the clock had gained time — not a large amount, but certainly significant compared to a similar clock that hadn't gone anywhere.

So the velocity of the clock on the aircraft was exchanged for some of its time. It ended up in a different place in time than it would have had it not made the journey through space.

These experiments do have rather profound ramifications, because they prove that there is indeed a mechanism for changing the normal passage of time. All we have to do is learn to control it directly, rather than observe it as a side effect of another process: velocity.

Against this background come the thoughts of Stephen Hawking, who must be the most powerful thinker on this planet at the moment. Speaking before a packed audience at Oxford University's debating hall, Professor Hawking stated that time travel is certainly possible, although its existence has not yet been proved. He said "We have experimental evidence that space and time are warped, so is there enough warping for time travel?"

"I think this is an important area for research, but one has to be careful not to be labelled as a crank."

Professor Hawking then went on to suggest that a curved tube in space known as a "wormhole" might just be the mechanism needed for time travel. But if time travel will be perfected in the future, "why hasn't someone from the future come back to tell us how to do it?". Good question.

Accidental *deja vu*

Maybe there is some other kind of mechanism. Consider the phenomenon known as *deja vu* — 'the sense or illusion of having previously experienced something actually being encountered for the first time' (*Macquarie Dictionary* again). We have all experienced this. Think about it. Could *deja vu* be some ill-defined and totally accidental form of time travel, maybe just in the mind?

I discovered a similar and much more powerful effect while travelling around the USA. One of my stops was Denver, Colorado, where I'd spent some time attending technical school back in the 1960s. I decided to try to find the school 30 years on, without success. But what I did find was the Olin Hotel, where all the students stayed.

I walked along the footpath to this place and paused at the doorway. And then I was hit, literally, with a blast from the past. All these images of life in the Olin came back with such clarity that it felt like it was all happening again. I could see the faces of people I knew, I could name names I'd forgotten so long ago. The Olin was a good place, it had 'good vibes', so those flashbacks were a most pleasant experience. And it was all so real!

I felt compelled to take some photos of the Olin, even though photos of buildings are usually pretty meaningless and boring. I was most interested in the hotel's doorway, since that's where that great floodtide of memories seemed to roll out from. When I got back to my own hotel that night I grabbed my computer and wrote down the whole experience, as a series of notes. Much of this stuff was later used in Moffat's Madhouse in June this year, along with one of the photos of the doorway.

What I think happened here was that NO images actually came out of the Olin Hotel. They were stored in some long-forgotten video recorder in my brain, and looking into the doorway of the Olin simply hit the play button. The tape hadn't been replayed for years, but its images were just as good and clear and colourful as the day they were recorded.

Now... I know damn well that the things in those images actually happened, and I HAD been there 30 years before. But what about the case when the video in your mind starts replaying memories, triggered by the sight of something, but you KNOW you've never been there before. How was it recorded? When? Maybe it wasn't really recorded at all, but you just slipped back in time to experience the memories live. Accidental time travel?

After that experience outside the Olin Hotel, I looked forward to similar experiences possibly triggered by visits to other places from my past. Take, for instance, in Santa Fe, New Mexico. I used to go skiing there a lot, and after skiing we would all adjourn for some socialising at a place called La Posada (The Inn, in Spanish). I thought it might be interesting to visit La Posada once again. Trouble is, driving up the road to Santa Fe, I couldn't really remember how to get to La Posada. I knew in general what part of town it was in, but that was about it.

It is said that Santa Fe was laid out by a drunken Indian riding a blind burro during a snowstorm. The roads twist and wind and gyrate even in the middle of town. But as I entered Santa Fe, past the first pub and then the Blind and Deaf School, everything became automatic. I'd cruise along and then feel the urge to turn right or turn left.

A few minutes later, 30 years after my last visit, I ended up right at the front gate of La Posada. Again a case of the play button in the brain being triggered by familiar sights.

And another instance: a visit to Los Alamos to dig out some stories for *EA*. The public relations guy gave me careful instructions on the phone; even faxed me a map. "Use the truck route", he said. I didn't know of any truck route when I worked at Los Alamos 30 years ago, but I did have his map so there should be no problem.

On the big day I again made my way through Santa Fe and then up the road toward Los Alamos, about 65km further on. This road traverses Indian country, and I soon came to a sign advising tourists to tune to an AM broadcast frequency to hear a description of the area; it was one of those little 'narrowcasting' services. So I flipped the radio over to be greeted by this guy speaking English with a Hopi Indian accent, talking about this land and his ancestors.

It was fascinating stuff — "I used to live over there to the right, at the bottom of that cliff", he said. "And we've got sheep. And my father lives just over that hill."

Suddenly he's in the present tense, just rappin' with his memories. I'll bet he came out here with his tape recorder, to his ancestral land, and just let his thoughts flow.

I was so busy listening to this Hopi Indian fellow that I forgot all about the map, and I soon found I was grinding my way up the original road to Los Alamos. As in the Santa Fe journey, I'd just got there on autopilot after a 30 year absence. What I saw when I got to Los Alamos was familiar — the lovely pine forest, the fenced-off labs, the airstrip that falls off into a canyon; all there and more or less intact.

It seems then, that the most successful travel back through time, in the mind at least, depends on physically being at the location in question. And the location must be fairly consistent with the way it was at the time.

How does this recognised triggering of past experiences relate to accidental *deja vu*? Is there some connection? Maybe it's all just in the imagination, but then maybe again it's not. This, like so mysteries in the world, certainly merits contemplation. Maybe next month we'll unlock the meaning of life... ❖

KITS KITS KITS KITS

The following kits which were developed by TOM MOFFAT are now available exclusively from:

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READER INFO NO. 2

What's New in VIDEO and AUDIO





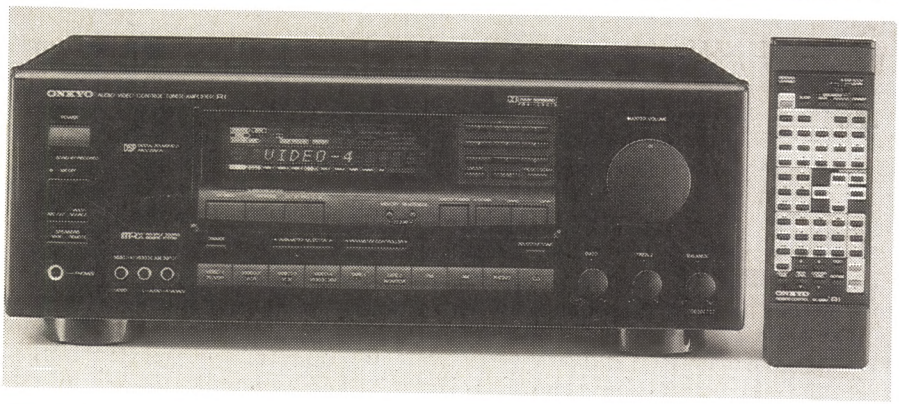
'Home theatre' surround receiver from Onkyo

The new Onkyo TX-SV727 AV Surround Receiver is claimed to feature the very latest DSP circuitry made in the USA by Motorola, and to provide features that make it ideal as a Home Theatre command centre.

The TX-XV727 delivers 100W RMS per channel in stereo mode, or 80W RMS to the front left, centre and right channels and 250W RMS to each of the rear channels in surround mode. Heavy duty power supplies and discrete output circuitry help to accurately drive the most demanding low impedance loudspeakers to produce dynamic, transparently clear sound from any source.

The receiver is equipped with fully digital Dolby Pro-Logic surround sound, to faithfully recreate the dynamic realism of a movie theatre.

Onkyo chose Motorola's 56000 family DSP circuitry for the heart of their new receiver both because it's reputed as being the best, and because listening tests proved it worthy enough to accommodate the stringent requirements of Onkyo's engineers. The TX-SV727 also offers a choice of four dramatic digital surround modes — Dolby Pro-Logic Theatre, Hall, Live and Arena.



Kenwood systems have 'home cinema' features

Kenwood's latest Spectrum Series hifi systems, the Spectrum 995 and 795, have in-built Dolby Pro0Logic decoding, an FM/AM Quartz Digital Timer (995), double cassette deck, and five disc carousel/CD player. To complete the home theatre set-up, both the 995 and 795 can be coupled to a number of Kenwood's optional AV products including a seven band graphic equaliser, four way speaker systems and various additional 'surround sound' speakers.

The flagship Spectrum 995 system provides six channels of amplification to

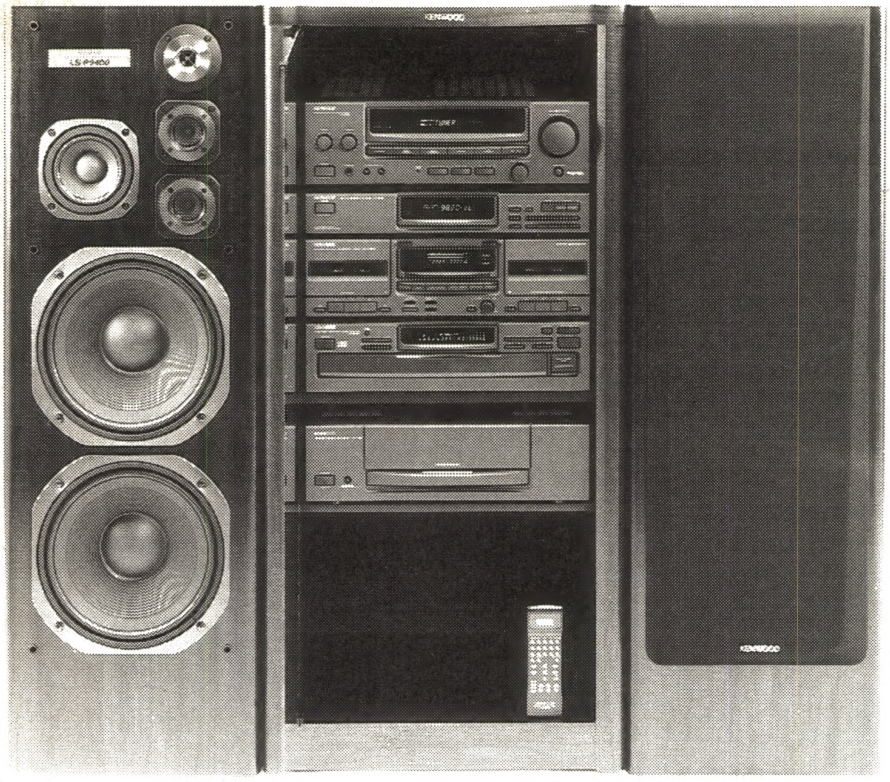
CTV-VCR combination is made in Australia

A new Australian-produced Televideo integrated colour TV and VCR has recently been added to the extensive Panasonic colour television and video cassette recorder range. The new TC-21SV10A replaces the previous model TC-W21, which was fully imported. It is the first time that Panasonic's television factory, MELCOA at Penrith on Sydney's outskirts has produced a combination television/VCR unit.

The built in VCR is a two head machine which includes G-code programming and a six program/one month timer, still/advance, auto repeat and digital tracking. The TV section has a 51cm screen and includes automatic electronic tuning and manual search options with memory for up to 60 positions. The TC-21SV10A has a sound output of three watts and can replay NTSC tapes as well as PAL. As with all MELCOA produced televisions, it has been tested in accordance with the Australian Standard AS3250 for electrical safety and has been approved through the Standards Australia T Mark Type Tested Scheme.

The Panasonic TC-21SV10A is available from leading electrical retailers for an RRP of $1649. For further information contact Panasonic's Customer Care Centre on 132 600.





recreate the full ambience achieved by Dolby Pro-Logic 'sound steering' technology. Able to produce up to 100 watts for the front (left, right, and centre) channels and 20 watts from each of the surround and rear channels, the 995 qualifies for the 'big league' in home theatre systems.

To recreate the earth trembling bass notes that accompany many of today's high technology films, the Spectrum 995 incorporates outputs for connection to a subwoofer and also offers video inputs/outputs for VCR and laser disc player connection.

The Spectrum 795 system is also designed to integrate with existing audio/video products such as laser disc players and/or VCRs, but provides a 100 watt stereo A/V surround amplifier that needs no additional surround sound amplifiers to recreate the 'home theatre' experience. When used in 'surround' or Dolby Pro-Logic mode, the Spectrum 795 system A/V amplifier produces 70 watts for the front left/right speakers, 30 watts for the centre channel and 15 watts to each of the surround channel speakers.

Both the Spectrum 995 and 795 are covered by a two year parts and labour warranty and are available at selected Kenwood dealers. The Spectrum 995 has an RRP of $2399 and the Spectrum 795 $1699 or $1499 with mechanical cassette deck control.

'Cigarette box' video camera

The OL-30C CCD electronic iris video/audio/sensor intercom camera is fully featured in a 'cigarette case' style compact and lightweight case. It is supplied with a 4.3mm wide angle lens, in-built microphone, pre-amplifier and loudspeaker.

Horizontal resolution is 390 lines, signal to noise ratio better than 48dB, low light illumination one lux with excellent infra-red sensitivity. Camera connections are via a single compact and tidy six pin modular socket; an additional socket provides 12V DC output and an alarm input for use with PIR and other sensors.

The camera requires 12V DC, has 75-ohm composite video output, a standard 1/4" x 20TPI threaded mounting point, measures 62 x 75 x 35mm and weighs only 130 grams.

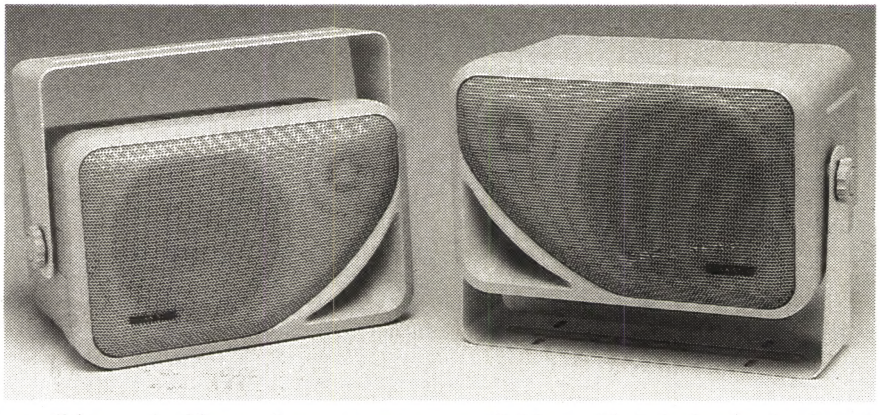
Also available to facilitate and simplify installation are 20 metre, 5mm diameter multi-core camera cables, with six pin modular plugs and couplers. The camera is also available in the OLS-30IC set, together with a 20 metre camera cable and swivel wall/ceiling camera mounting bracket.

Further information is available from Allthings Sales and Services, PO Box 25, Northlands 6021; phone (09) 349 9413 or fax (09) 344 5905.

Weatherproof speakers

Akai's new SRM-500 all weather speakers are designed for both inside and outside sound reinforcement applications, and can be conveniently fixed under awnings or mounted on walls. Convenient wall mounting brackets also allow the speakers to direct sound in a wide dispersion.

The SRM-500's are equally at home in the kitchen, study, workshop or any environment where speakers need to be 'out of sight, out of mind'. Capable of sustaining up to 100 watts input, the SRM-500's employ a 120mm carbon polyproplene woofer that will withstand the rigours of harsh environmen-



conditions. A 32mm dome tweeter covers the mid to high frequencies.

Covered by a 12 month parts and labour warranty, the SRM-500's are available at Akai dealers and selected department stores.

For further information contact Akai on (02) 763 6300.

Yamaha's CDC-755 five-disc CD changer



CD changers have become very popular, even though many purists may still regard them as less desirable than single-disc players. This month our reviewer Louis Challis tested the top model in Yamaha's new range of 'carousel' changers, and came up with some surprising results..

Over the last two years, a quiet but dramatic change has occurred in CD purchasing preferences in Australia and the USA. During that period, CD 'carousel' changers have outsold the 'tried and true' single disc players which previously dominated market sales.

Most of us who have a single-disc CD player — including 'yours truly' — have been aware that most CD manufacturers have improved the performance of most of their mid-line and top-of-the-line CD players, whilst simultaneously cutting the purchase price.

But I discovered during a recent trade presentation in Sydney that carousel CD changers and stacked CD changers now account for more than 60% of annual CD player market sales in Australia, and it would appear that their percentage is growing every month.

I was also advised that as yet, the Europeans have *not* emulated that trend. Apparently only a relatively small proportion of CD player sales in Europe are carousel CD changers.

It requires little by way of discussion or explanation to convince most new purchasers of the multiple advantages to be gained by purchasing a carousel CD changer. The ability to load up five discs, and provide five hours or more of continuous music without effort is most appealing. If the CD changer is used as a basis for a background music, or to provide music for a party, that convenience soon assumes an irresistible dimension.

The real question, and that which concerns most intending purchasers, is "What am I losing by way of performance, to gain that seemingly irresistible advantage?"

Impressive features

The CDC 755 Natural Sound Compact Disc Changer is Yamaha's 'top of the line' model, in a range of three new Carousel CD Changers released in August of this year.

Although the recommended retail price is only a modest $599, this CD changer incorporates a number of attributes and features:

- A very practical and convenient PLAYX-CHANGE system, which facilitates changing any or all of the other discs on the tray, whilst the fifth is playing.
- A disc drawer which opens fully, to provide access to any, or all of the five discs.
- 'Pro-Bit' technology, about which I will have more to say, together with an S-Bit Plus DAC.
- Automatic 'Peak Level Searching Capability', which facilitates optimally setting recording levels so that once set,

a cassette recording dubbed from the CD can be close to optimum.

- An excellent 'tape edit facility' which provides convenient CD-Tape Synchro Recording.
- An optical digital output, which may prove to be advantageous for some users.
- An 'intelligent digital servo system' (which most certainly appears to provide superior tracking performance in the presence of dirty, scratched, or poorly pressed discs).
- A 'program file memory' for use with one selected disc only, and which will consequently be infrequently used by most purchasers.
- A 33-key remote control, incorporating a volume control capability — which most users frequently require and which every modern CD player should now provide.
- A claimed 'silent CD changer' mechanism.

Of the claimed features, I could only fault the last one. During disc changes, the noise level at 1m is typically 50dB(A) with peaks of 55dB(A) — which simply can't be described as 'silent'. Perhaps 'quieter' would have been a better adjective to use...

The front panel of the CDC-755 CD Changer is black, neat and attractive, with subdued white lettering above each of the main controls. The controls are simple to understand, easily familiarised, and laid out in four major areas.

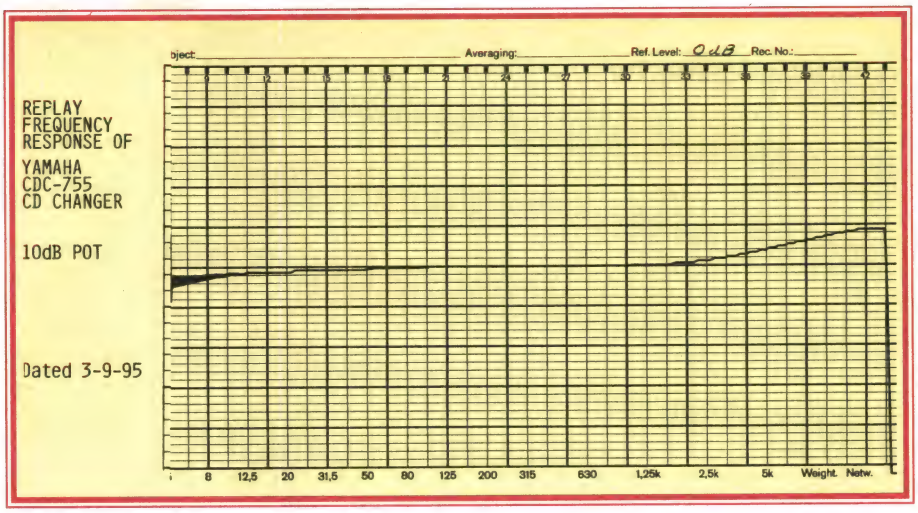
Most of the upper fascia is taken up by a wide disc tray, which opens relatively quietly (and certainly more quietly than the disc change mechanism).

To its right are the PLAYXCHANGE button, which opens the tray to facilitate changing the four discs that aren't currently playing. Adjacent is a conventional OPEN/CLOSE, which terminates the playing sequence, and brings out all five discs. Below these controls are the normal STOP button and the PLAY/PAUSE button.

In the lower half of the fascia is an illuminated power switch, a sensible but slightly smaller than normal display panel, and two rows of pushbuttons. The upper row incorporates the PROGRAM button for setting and selecting program content (but only on one disc), a FILE/SAVE button to save the data which has just been entered, and five separate DISC SELECT buttons, so that you can change from the current disc to that whose number you have nominated.

Adjacent at the right hand end of that row of controls is a SKIP/SEARCH toggle bar, which allows you to advance within a track, or reverse to a previous track by pushing the appropriate end of the bar.

The lowest row of pushbuttons and controls, incorporates 11 buttons, one labelled '+10', and the others from '0' to '9' inclusive. The 0 button has a second PEAK function, which is activated to automatically search for the peak level on the disc before recording the material onto a cassette.



The plotted replay response of the Yamaha CDC-755 CD changer. The rise at the top end is really quite small, at only 0.9dB at 20kHz.

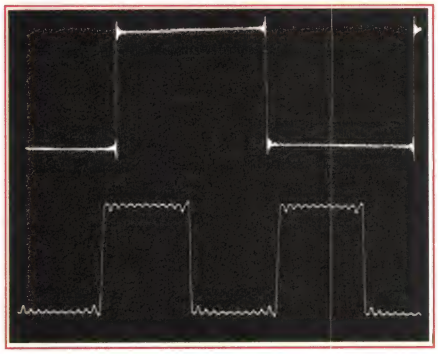
At the extreme right-hand end at the bottom row of controls is a toggle bar which provides output level adjustment for the signal being fed to your amplifier or cassette recorder.

The last control is a 6.5mm stereo headphone socket, which provides a controlled volume signal for personal monitoring, should that be desired.

The display panel is simple but sensible. Five large red numbers are displayed on the top left hand side, with a circle around the disc that is actually playing. (Of course you have to remember which disc is in which compartment...)

You can select one disc and replay it, or all five discs. The display then confirms, and subsequently reminds you of that configuration, and the display will remind you what you have selected.

Below the five primary disc numbers, the number of tracks on the disc being played are displayed (up to a maximum of 20). Only those tracks remaining to be played are actually illuminated. The track being played is displayed by means of a large number. At the right hand end of the display four different time options may be selected by pressing the TIME display select mode button on the remote control. Those four selectable time options are: the length of time the current track has been playing, the remaining time available on the track being played, total remaining time on the disc, or total recording time on the disc.



The response of the CDC-755 when playing squarewave tracks at 100Hz (top) and 1kHz (below). As you can see, they are excellent in terms of both symmetry, uniformity and the degree to which ringing is damped.

On the back of the CD changer there are a pair of RCA coaxial sockets for the analog audio outputs and an optical digital output socket. With the cover removed, the relatively small main printed circuit board becomes visible on the right hand side of the cabinet. Yamaha was amongst the first of the large Japanese manufacturers to invest the appropriate R&D funds and match those funds with an ultra-modern LSI semiconductor production facility.

It only takes a few seconds of examination to realise how a CD changer with the power and potential of the CDC-755 can be manufactured, for what is an unquestionably low selling price.

The disc play mechanism at the rear of the cabinet is cleverly and sensibly isolated against vibration from the rest of the mechanism, to provide effective decoupling. This is frequently important, if not critical in many residential situations where the equipment playing is too close to (or may be even sitting directly on top of) the loudspeakers.

On examining the printed circuit board I discovered that there are just two large LSI chips, two somewhat smaller dual-in-line chips, and approximately a dozen or so other small DIL or conventional transistors and other semiconductors mounted on the board.

When compared with the first Sony CDP 101 (which was the 'mother' of all CD players) , or even the CD1, which was Yamaha's first CD player, the printed circuit board of the CDC-755 is comparatively bare. By way of example, the CD1 used no less than 72 IC's and 40 transistors.

The obvious absence of large numbers of semiconductors, quite apart from the size of

the single primary printed circuit, only confirms the magnitude of the current consumer industry revolution. The advances in special purpose LSI circuit components have now reached the stage where it is possible to provide a markedly superior product without prejudicing any significant performance ability. This has been achieved with simultaneously dramatic reductions in manufacturing costs — and more importantly to you, an obvious drop in the product's RRP.

Objective testing

The objective testing of the CDC-755 Changer proved to be an eye opener. It soon became clear that here is a CD changer which outperforms most 'top of the line' single-disc CD players which I have previously tested, and with which I now have some familiarity.

The frequency response, although not ruler flat, is close enough to it over the range 5Hz to 22kHz to gain the first of its many stars. Whilst the replay response curve displays a gentle rise between 2kHz and 20kHz, that rising response only conforms to +0.9 decibels at its peak. A rise of that magnitude would be very difficult to detect. Surprisingly enough, at least two members of my listening panel could detect it, and correctly identified its presence.

The 0.4dB droop at 5Hz is not significant, nor I suggest, relevant. Few systems can faithfully reproduce sound at such low frequencies with any degree of linearity. More significantly, human hearing is extremely insensitive below 30Hz.

The D-A conversion linearity of the CDC-755 Changer is clearly far more important. It incorporates Yamaha's new Pro-Bit system, which provides the ability to adopt 16-bit conventional formatted digital data, which is then reprocessed by continuously sending the lower bit data into a data storage section. That section keeps track of the different data, and then cleverly analyses the changing data pattern before, during as well as after the creation of the analog output to extract additional information.

The digital correction data is then appropriately recombined with the original 16-bit signal data to provide a 20-bit equivalent data stream. That data stream then has an unsurpassed linearity backed up by an overall resolution, which is markedly superior to that provided by a conventional 16-bit DAC system. The dynamic range of a normal 16-bit system is 96dB, while that of a 20-bit system is 120dB; there is a significant difference between the two.

Armed with this knowledge of how the Pro-Bit system works, I set myself the task of objectively either proving, or disproving Yamaha's highly vaunted claims.

I soon discovered that the D-A conversion linearity of the Changer, is virtually ruler flat down to -70dB.

Between -70dB and -100dB, using four different test discs, I confirmed that the output conversion linearity exhibits a small but obvious trace of non-linearity. However although measurable, it would not be, or should not be readily audible.

The conventional test software cannot provide an appropriate means of evaluating or confirming the veracity of Yahama's claims for its Pro-Bit system. But I was not ready to admit defeat, so I spent considerable time in devising a test which would allow me to evaluate the conversion linearity of the Pro-Bit DAC circuitry over the critical -60dB to -120dB range.

Measured Performance of Yamaha CDC-755
Five disc Carousel CD Changer
Serial No. Y028535 SU

1. **Frequency response** — 5Hz to 22.05kHz +0.9 -0.4dB

2. **Linearity @ 1kHz**

Nominal Level	Left Output	Right Output
0dB	0.0	0.0
-1.0	-1.0	-1.0
-3.0	-3.0	-3.0
-6.0	-6.0	-6.0
-10.0	-10.0	-10.0
-20.0	-20.0	-20.0
-30.0	-30.0	-30.0
-40.0	-40.0	-40.0
-50.0	-50.0	-50.0
-60.0	-60.1	-60.1
-70.0	-70.2	-70.1
-80.59	-81.8	-81.7
-89.46	-87.9	-87.8

3. **Channel Separation**

Frequency	Right into Left dB	Left into Right dB
100Hz	-99.6	-104.5
1kHz	-99.0	-104.5
10kHz	-19.6	-90.6
20kHz	-82.7	-82.0

4. **Harmonic Distortion @ 1kHz Level**

Level	2nd	3rd	4th	5th	THD%
0	-	-117.5	-116.9	-113.5	0.0004
-3.0	-112.1	-114.2	-114.0	-116.0	0.0004
-10	-104.0	-102.6	-108.0	-	0.0008
-30	-91.0	-93.0	-93.2	-92.5	0.0048
-50	-78.1	-76.4	-81.0	-77.0	0.025
-60	-70.1	-68.9	-70.5	-65.9	0.074
-70	-53.9	-50.7	-51.9	-55.0	0.047
-80	-	-34.2	-43.6	-42.6	2.2
-90	-15.8	-13.0	-24.9	-20.0	29.9

Harmonic Distortion @ 100Hz Level

Level	2nd	3rd	4th	5th	THD%
0	-108.2	-116.4	-111.2	-	0.0005
-20	-92.8	-	-101.8	-	0.0024
-40	-76.4	-	-78.6	-	0.019
-60	-48.5	-48.6	-47.9	-66.8	1.47

Harmonic Distortion @ 6.3kHz Level

Level	2nd	3rd	4th	5th	THD%
0	-101.5	-	-	-	0.0008

5. **Emphasis**

Frequency	Recorded Level	Output Level (L)	Output Level (R)
1kHz	-0.37dB	-0.40	-0.40
5kHz	-4.53dB	-4.1	-4.1
16kHz	-9.0dB	-8.3	-8.4

6. **Signal to Noise Ratio**
   - Track 23 Without emphasis — 104.1 (unweighted) -119.5dB(A)
   - Track 24 With emphasis — 104.0 (unweighted) -119.0dB(A)

7. **Frequency Accuracy** — -0.8Hz error for 19.999kHz test signal

8. **Square Wave Response** — (see X-Y plots from Storage CRO)

		RESULT
Track 37 100Hz	Square Wave	Excellent
Track 38 1kHz	Square Wave	Excellent

Dirty Record Test
- Interruption in Information Layer — Passed all levels up to and including 1300 micrometres

Black Dot at Read Outside — Passed all levels up to 800 micrometres

Black Stripe Test — Passed all levels on Test Disc Nos 1 and 2

Vibration or Displacement Test
- Acceleration Level — 0.8 G RMS onset of mistracking — Passed

Output Impedance
- Headphone amplifier output impedance — 120 ohms

First I configured my Bruel & Kjaer level recorder system with a 75dB logarithmic potentiometer, in lieu of the more customary 50dB or 10dB potentiometers. Then I hunted down two special test discs, which I had previously purchased to cope with an unusual situation of this type. Those discs provide fade-to noise signals covering the critical range from -60dB to -120dB. One disc has a dithered signal, and the other has a conventional signal.

With these discs as a starting point, and supplemented by other equipment, I closely examined the lowest 60dB section of the CD Changer's conversion capability. This is a portion of the D-A conversion range which few manufacturers ever talk about, and which relatively few reviewers bother evaluating.

I plotted the critical -60dB to -120dB conversion linearity characteristics as level recordings, using the 75dB potentiometer. An examination of the recordings confirmed the presence of obvious traces of non-uniformity around -85dB. If however we ignore those minor localised aberrations, the output below -85dB was particularly linear. More significantly, it was comparable with, if not better than that provided by most other CD players that I have previously tested.

The presence of obvious increases in random noise at the lowest levels on the level recording (between -105dB and -120dB) is quite normal. The presence of that noise must be anticipated, when you consider that there aren't really 'any bits left' in the dynamic range of the system. What impressed me most however, was that this dynamic performance is comparable with the performance standards that I have come to expect from CD players costing as much as four to six times the selling price of the CDC-755 Changer.

I proceeded further with my objective testing, and acknowledge that I was delighted to observe performance characteristics that were so good. Even the distortion figures at 0dB and 1kHz proved to be remarkably low.

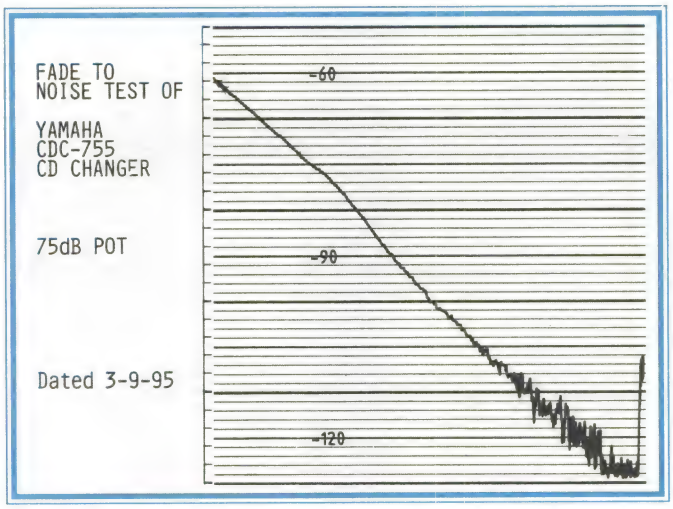
Whilst the manufacturer claims a THD figure of 0.0025% or less, I measured 0.0004%. The total harmonic distortion figures proved to be quite acceptable all the way down -70dB. Below that level, where there are relatively few significant bits left to be processed, one must expect some dramatic or major changes in the distortion characteristics of the signal.

Thus by way of example, at -90dB the distortion is effectively 30%. You shouldn't be confused or disturbed by such numbers, as at those low sound levels it is impossible for you to detect the distortion unless you turn the volume control up to maximum gain (which I can't recommend).

Unlike most other CD players which I have tested, the distortion characteristics at both 100Hz and 6.3kHz were extremely low. The 0.0025% distortion which the manufacturer acknowledges as a limit at 1kHz is not exceeded at 100Hz until the signal level drops below -20dB. Based on my testing, this is also likely to be the trend at *any* frequency below 1kHz.

Next I decided to evaluate channel separation. I was pleased to note that this was considerably better than I have recently observed in other modest priced CD players (or changers). Even at 20kHz, which is the top of the range, the channel separation is better than 82dB, and a performance of that order is highly commendable.

The next series of objective tests generally separate the 'men from the boys', as it were. The dirty record test, using the standard Philips test disc, proved to be a breeze — all levels of interruption in the information layer, black-dot readout and black-stripe test were passed without any signs of malfunction, nor audible interference on the output signal.



The conversion linearity of Yamaha's Pro-Bit system, as plotted using a 75dB logarithmic pot on a Bruel & Kjaer level recorder, in the critical region below -60dB.

CD players have improved immensely since Philips produced their test discs back in the mid 70s. To compensate for those improvements, I then loaded two special Sony CBS test discs which provide black stripe tests covering the range 500 micrometres to 1300 micrometres (1.3mm at its widest point, which is an awesome test). The CDC-755 changer played right to the end of the 1300um black stripe without a hiccup, with no sign of the nasty 'chirp — chirp — chirp' sound that most other CD players exhibit well before the end of the disc, and the end of the test strip.

Thus far, the objective tests were looking remarkably good. I proceeded to the next test, which was an evaluation of the peak vertical vibration levels required for CD mechanism mistracking. With the CDC-755 Changer on my large vibration shaker table, I was surprised to observe that the unusually high level of 0.8G RMS was required to destabilise the system. That level is the highest I have yet recorded from any CD player or changer.

I could now understand why (and more pointedly how) Yamaha's design engineers took so much trouble in isolating the internal disc drive mechanism from the rest of the system. I also examined the square-wave test response of the CDC-755, at 100Hz and 1kHz. I examined the wave shapes on the storage CRO and plotted them onto an X-Y plotter. As you will see from those plots, both of the square-waves display excellent wave shape symmetry and uniformity. This confirms that the S-Bit Plus DAC is doing an excellent job, and tends to support the view that the Pro-Bit system is not introducing any spurious data into the system output.

The last test which I performed was to measure the noise emission of the disc drive during the disc change-over cycle, which I discussed briefly earlier.

The measured noise level at 1m during the disc change cycle is typically 50dB(A). That noise level is many decibels quieter than the previous generation of Yamaha CD Changers; however it does not conform to what I would describe as being 'silent'.

This question of noise emission was the only aspect of the CDC-755 Changer regarding which I am unable to be complimentary. It is not that the CD Changer is not relatively quiet, but rather the word 'silent' conveys a very different meaning to me, as it would to most other prospective purchasers.

Listening tests

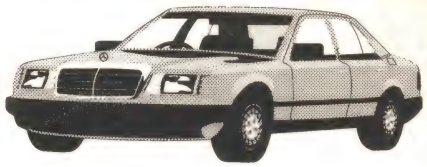
The subjective evaluation of the CDC-755 Changer proved to be a great pleasure. The first disc that I chose for my listening panel's evaluation was a brand new disc from Kathleen Battle entitled 'So Many Stars' (Sony Classical SK68473). Kathleen Battle has has one of the most sensuous and beautiful soprano voices in the world, and on this disc she is supported by such famed musicians as Grover Washington Jr., Cyrus Chestnut, Christian McBride and James Carter, who provide superb accompaniment, and a wide range of musical sounds.

I used this disc in an A-B test sequence, to compare the performance of my existing CD player with that of the CDC-755 Changer. My existing CD player is particularly good (and that is why it's there). Surprisingly, the CDC-755 displayed an unquestioned edge over it.

The test panel's consistent comments were that the top end of the frequency response in the critical 2-16kHz region, the CDC-755 was audibly superior.

Continued on page 32

AUTOMOTIVE ELECTRONICS



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

Catalysers, lean burn and the oxygen sensor

It's some time since this column looked at this interesting subject, so this month I've decided to do so. Among other things we look at the feasibility of making your own PC-controlled O_2 sensor test meter and signal injector, prompted by the availability of a high grade oxygen sensor. However I also explain why you have to use some care in interpreting the readings from any of these simple testers.

In the bad old days before catalyst technology, some of the more adventurous vehicle manufacturers attempted to achieve pollution control by means of the 'Lean Burn' principle. These engines typically ran mixture strengths around the Lambda 1.3 mark (19:1 AFR).

The Lean Burn system was notorious for 'flat spotting' and generally behaving badly in awkward situations — often from standing starts or halfway across an intersection! While the concept was good, the emission of oxides of nitrogen was unacceptably high, and with engine management systems being in their infancy, the precise control necessary to keep these designs running at constant peak efficiency was simply unachievable.

To try and convert a contemporary engine to run at the kinds of air/fuel ratios for Lean Burn is a major undertaking. Today's engines simply won't run above Lambda 1.2 (17.5:1 AFR). However, some manufacturers are returning to the Lean Burn pathway (notably Toyota and Honda), and with specially designed combustion chambers are running mixture strengths of Lambda 1.4-1.6 (20-22:1 AFR). These designs require a completely new approach to the combustion chamber design, with special attention to eliminating crevices — such as the sharp valve clearance 'flycuts' in the piston crown in some high compression/valve angle applications.

Any design that incorporates protrusions into the combustion chamber must also be redesigned, to eliminate the chance that the inevitably higher temperatures which accompany the lean burn chemistry could ignite the mixture at an inconvenient moment (pre-ignition).

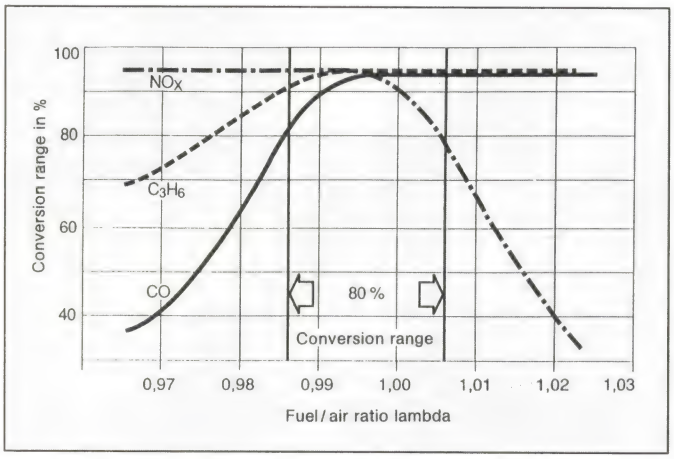


Fig.1: The three way catalyser works best at this band of operation, providing the engine keeps feeding it little bursts of fuel known as the 'Lambda Frequency'. (Courtesy Bosch Australia).

The Lean Burn concept has been revived by our own local manufacturers for the average vehicle, but when operating under certain conditions. When the right conditions are met, such as constant speed over 100km/h for five consecutive minutes, the firmware in the ECU begins to reduce the injector pulse width and operate the engine in the 'Lean Burn' mode.

This gives great fuel savings during highway driving, but the emissions of oxides of nitrogen tend to rise dramatically and the need for a three-way catalyst treatment (hydrocarbons and carbon monoxide, plus oxides of nitrogen) is clear.

There was an argument that oxides of nitrogen emitted at that point in the drive cycle (between towns) didn't matter. However the residents of suburbia close to freeways may take a different view, don't you think?

Now that emissions legislation has tightened even further, the adoption of catalytic converters in the exhaust stream has meant that the consumer enjoys a more responsive engine — although at a small sacrifice of economy. As vehicle emissions legislation stands at the moment, catalyst technology is coping very well and most manufacturer's emissions labs are pouring their resources into improving the fuel economy of their model line-up.

The purpose of all this preamble is to set the background and lead into an explanation of the function of the oxygen sensor in more detail.

In the January 1994 edition of *EA*, my predecessor Al Younger presented an article on the 'King of all Sensors' — the oxygen sensor. Included in the story was a design for making your own O_2 sensor tester, with a ten-LED display. In reading back over the story I couldn't help noticing a gap in the information that Al presented, and as a consequence there seemed to be a need for another article that goes into more depth. So here goes!

As Major Al quite rightly pointed out, the catalyser has a maximum effi-

ciency rating of about 90 to 95% at almost exactly the stoichiometric point. To run the catalyser in its best operating band it must be fed a small amount of carbon monoxide and hydrocarbon, to keep it 'lit'. The ECU therefore maintains a routine of varying the pulse width of the injectors very slightly when in light throttle conditions, to provide 'fuel' for the catalysing process.

In medium to wide throttle conditions, there is plenty of excess fuel escaping from the combustion chambers to keep the catalyst furnace fairly roaring. I mentioned a small sacrifice in fuel economy for catalyst technology, and it should be quite plain now where the extra fuel is going.

Fig.1 shows the conversion efficiency of a three-way catalytic converter with a Lambda frequency of 0.5Hz, showing how well the system can work when the complete engine management plan comes together.

As some of this column's readers may be aware, a number of O_2 sensor testers have recently appeared on the market, purporting to interpret the sensor voltage output into the corresponding percentage of O_2 plus Lambda or AFR values. Furthermore some testers have appeared with their own sensors built into a manifold (rather than use the vehicle's own sensor), which attaches into the tailpipe.

It is important to note however, that these testers must be used in conjunction with a Gas Analyser and some form of Engine Analyser, before firm conclusions can be drawn from the readings.

Inquiries by yours truly at Robert Bosch Australia have unearthed a special purpose oxygen sensor with some interesting additional benefits. Designed especially for research, the oxygen sensor in question was built to provide the input for the Bosch LA2 Lambda Analyser.

Unfortunately I only have the information about the LA2 Lambda-Anzelge in German, so I won't reprint it here just now as my spell checker will probably have a fit. (Maybe Bill Gates will consider a translator as part of the next Word Upgrade?)



Fig.2: The heavy duty oxygen sensor from Bosch. Note the almost complete metal casing around the sensing tip. (Courtesy Bosch Australia).

Luckily the info on the sensor itself was in English, and combining this with a range of source material from other Bosch publications and notes from some Society of Automotive Engineers seminars, I am able to present a bit more detail here.

Special sensor

The first thing that strikes you about the sensor is its four wires, rather than just one or perhaps three for a heated device. The '0 258 104 002 Oxygen Sensor' was designed principally for a wide range of test applications, with good resistance to thermal and physical shock by means of the protective metal 'thimble' covering the outer ceramic electrode.

This 'full metal jacket' casing around the tip (see Fig.2) means that exhaust-borne contaminants are less likely to damage the sensor, and brief exposure (several dyno runs) to leaded fuel should be well within its operating tolerances.

So how does it work, you ask? A small hole about 1.5mm in diameter in the end of the sensor tip allows sufficient ingress of the sample gas to ensure a rapid response (50ms at 800°C).

Given the exhaust gas speed through most automotive tailpipes under driving conditions, the reduction in size of the sampling orifice is not a significant impediment to the speed of analysis when balanced against the benefits of sensor longevity and resistance to contamination.

The output from the sensor fits the standard for all 'solid electrolyte' Zirconium Oxide (ZrO_2) type sensors, with the characteristic 'step' profile from rich to lean at the Lambda 1 point (Fig.3).

What is lambda?

At this point perhaps, I should go into more of an explanation about the meaning of Lambda (λ). Essentially it is the ratio of the *actual* air-fuel ratio divided by the *ideal* air-fuel ratio.

For example if the actual AFR was say 14.5 and the ideal for leaded fuel is 14.7:1, then the Lambda value would equal 0.986. Conversely by working the formula backwards, multiplying 14.7 by 0.8, for example, gives us the rather rich mixture composition of 11.76:1 AFR.

The only thing to bear in mind is that the ideal AFR is not the same for all fuels. CNG (compressed natural gas), for example, reaches the stoichiometric point at 16.06:1.

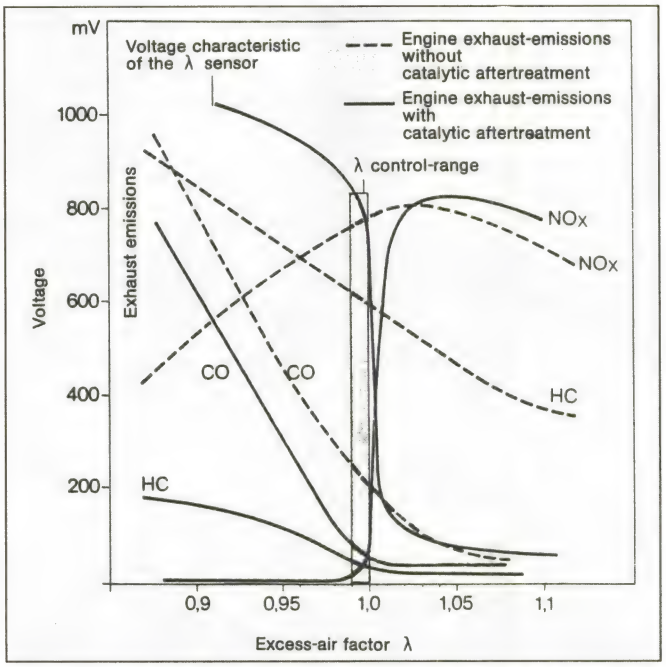


Fig.3: Significant reductions in pollution levels are possible using catalyst technology. (Courtesy Bosch Australia).

Sensor voltage

Before we start to get too far into the nitty gritty of what the O_2 voltage readings represent, it is as well to offer a word of caution. At the high end of the scale (0.7 - 1.0 volts) it gets increasingly difficult to be certain of the actual oxygen content in the sample gas. Although the sensor voltage keeps rising as the fuel mixture gets richer, the oxygen concentration hov-

ers around the 0.2 - 0.3% mark before the catalyst.

Generally speaking, at rich mixture concentrations, the hydrocarbon content rises. This cools the sensor and has a significant effect on its output of the sensor. Despite the heating element attempting to keep it above the minimum operating temperature, variations occur that make it hard to be sure of the actual percentage (see Fig.4).

Not only that, but at the rich end of the operating spectrum for petrol engines, the exhaust oxygen concentration changes very little from excessively rich (λ<0.85) to the lean end of best power (λ=0.95). Taken in isolation therefore, the O2 readings alone can be a bit misleading, as there are many contributing factors that come into consideration.

The more expensive exhaust gas analysers on the market today go into a great deal of software contortions to come with a meaningful Lambda and AFR figure, based on measuring more than just one gas. So that's why some discretion/experience must be used when diagnosing your car with the oxygen sensor only. Specialist vehicle repairers use expensive equipment for the very good reason that their reputation depends on it giving them the truth, the whole truth and nothing but the truth!

Having said that, there is nothing to stop you from checking that your vehicle is in a good state of tune, including an exhaust gas test (preferably with printout) on a dynamometer at your local tune-up specialist, to establish a starting point from which to 'take off and land' with your DIY diagnosis.

The voltage curve

If you look at my chart in Fig.5, you will observe the linear 'Oxygen versus Lambda' response of the sensor from Lambda 0.95 to 1.4. Out of necessity I have reduced the chart to fit the magazine; however you can see the six plot points making up the curve, and as we don't really care what happens after Lambda 1.3, I think we can ignore the rest.

The voltage output from the sensor, on the other hand, is not so obliging when it comes to nice clean linear responses. Looking at the chart in Fig.3, the characteristic stepped voltage output from Lambda 0.92 to 1.1 looks the same as other zirconium oxide sensors.

Twin sensors

I was recently made aware of a new design using one sensor before and one sensor after the catalyser, on a sophisticated system fitted to an imported exotic. Now I'm only surmising about the implications here, but it seems to me that the only explanation can be a sort of 'double check' by the ECU to see if the catalyser is functioning properly.

If the oxygen level before and after the catalyser is the same, then it is safe to assume that there was no change in the levels of CO, HC and NOx concentrations, and the ECU needs to 'relight' the catalyser. When the 'cat' is hot and functioning correctly, the excess air left over from combustion is used up within the catalyser monolith during the conversion process, leaving a close to zero level of O2.

By monitoring the 'before and after' difference in oxygen, the ECU can more accurately control the efficiency of the conversion capability of the catalyser.

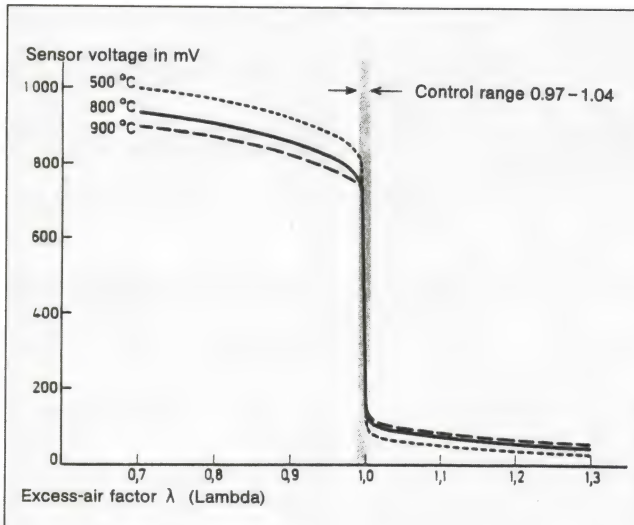
Planned project

The staff designers at *Electronics Australia* have very generously offered to describe the electronics and programming required to build your own digital oxygen sensor analyser for use with a laptop computer, based on the heated oxygen sensor from Bosch mentioned earlier (part number 0 258 104 002). Having said that, any automotive oxygen sensor will do, but the accuracy depends on the sensor being fully hot, and therefore a heated sensor is best.

An interesting feature of the project will be the ability to 'inject' an accurately known voltage level into the ECU's O2 sensor port, to simulate rich, lean or perfect values. The advantage of this additional capability is to check the response of the ECU at the injector, and it also provides a stable setting for base adjustments.

If you already own or have access to a laptop (or desktop computer if you don't wish to test a mobile vehicle), the cost of the project will depend largely on whether you are going to use the sensor already fitted to your vehicle or take the project further and build a 'tailpipe tester' complete with manifold and clamp.

Continued on page 50



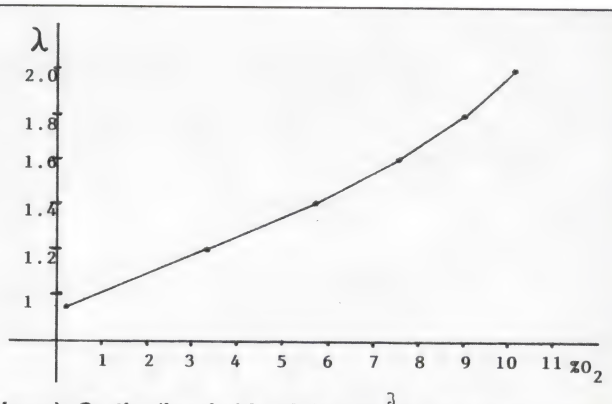
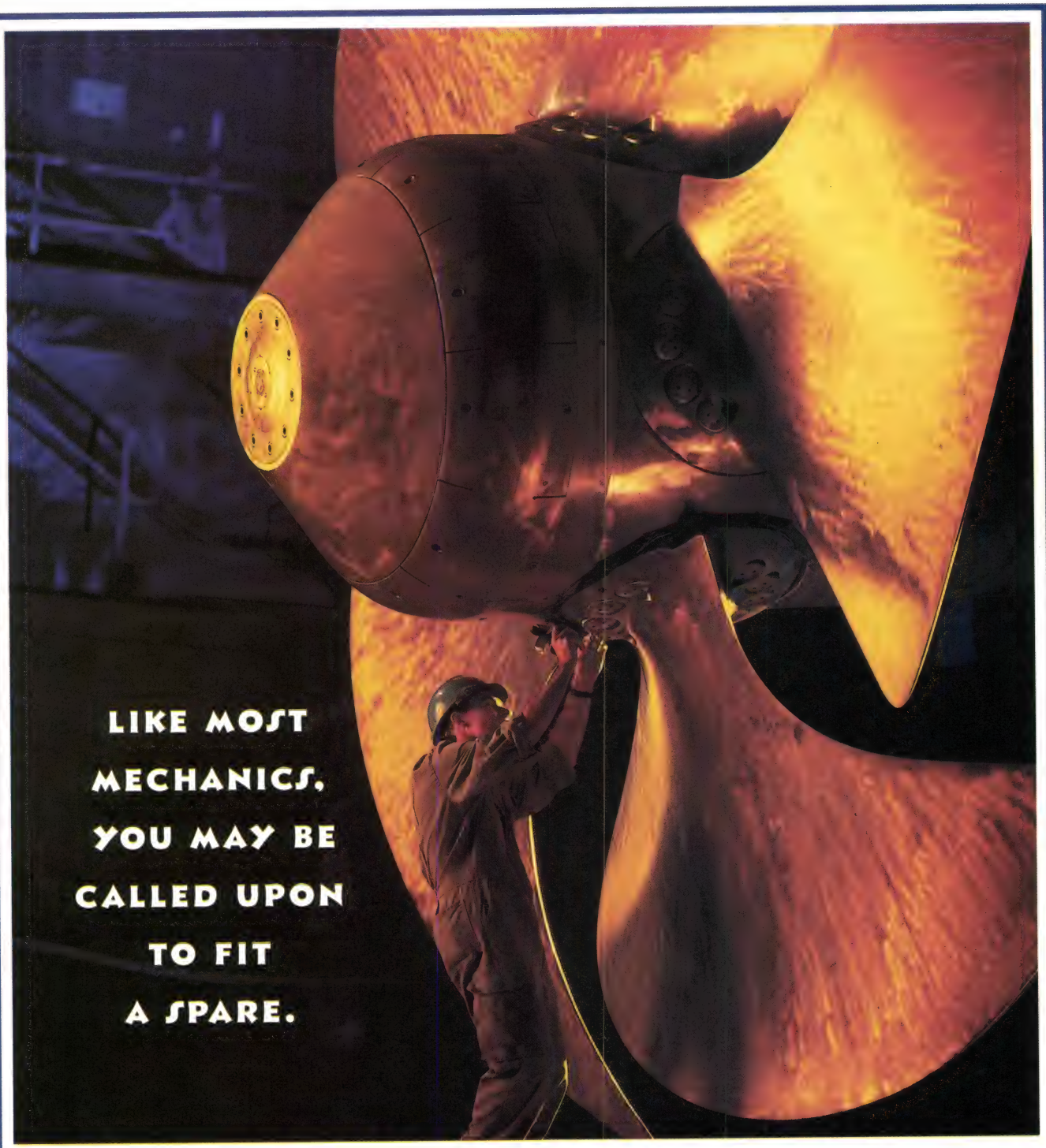


Fig.5 (above): On the 'lean' side of the oxygen sensor's output, there's an almost linear relationship between oxygen level and Lambda. Fig.4 (left): A voltage/temperature chart emphasising the error that can creep in when only one gas is measured using an unheated oxygen sensor. (Courtesy Bosch Australia).



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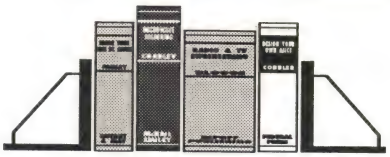
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NEW BOOKS



Test instruments

ELECTRONIC INSTRUMENT HANDBOOK, Second Edition, edited by Clyde F. Coombs Jr. Published by McGraw-Hill, 1995. Hard covers, 242 x 190mm x 40mm thick (pages not cumulatively numbered). ISBN 0-07-012616-X. RRP $170.

The first edition of this book was published back in 1972, and became a classic reference on T&M instruments. But a lot has happened in T&M over the last 23 years, and happily editor Clyde Coombs Jr has now been able to produce this fully re-written and updated second edition. It's complete with the original foreword by the famous Professor Frederick E. Terman of Stanford University — still quite relevant.

Mr Coombs himself recently retired after a 30-year career at Hewlett-Packard, and most of the contributors who have written the book's 44 chapters are also instrumentation specialists from the various divisions of HP. So it has a great deal of credibility — a veritable 'HP Bible of T&M', you might say.

It's a massive work, and covers just about every conceivable aspect of testing, measurements and instrumentation. The chapters are grouped into 12 sections, progressing from basic measurement concepts through each of the various main kinds of instrument, instrument usage and measurement techniques, to automated testing systems and software based virtual instruments. Needless to say it's also up to date, with heavy emphasis on digital instrument technology and plenty of material on microwave and lightwave measurements.

The material is of a uniformly high standard, with clear and concise text explanations, informative tables and illustrations. Many chapters also include a list of references for further reading.

In short, a most valuable reference book on modern test and measuring technology.

The review copy came from McGraw-Hill Australia, of PO Box 239, Roseville 2069. (J.R.)

Radio scanners

TUNING IN TO RF SCANNING from Police to Satellite Bands, by Bob Kay. Published by McGraw-Hill. Soft covers, 187 x 233mm, 150 pages. ISBN 0-07-033964-3. RRP $36.95.

This book offers a relatively non-technical coverage of radio scanning as a hobby, assuming that the reader has little technical knowledge but a great deal of enthusiasm. It starts by describing what to look for in choosing a suitable scanner, and then examines indoor and outdoor antenna designs, followed by coaxial cables and other accessories.

Next it examines the regulations and laws, although as it's a US book, some of these won't apply in Australia.

Popular targets to monitor are described in chapters six and seven. These are quite an eye opener, as they show just how easy it is to eavesdrop on a conversation. For example, did you know that a cordless phone conversation can be picked up by a scanner up to several kilometres away?

Computers and their role in radio communications are explained in chapter eight, while chapter nine describes how to build a professional quality listening post. The final two chapters answer commonly asked questions and list the various magazines, clubs and organisations dedicated to scanning as a hobby.

While this book shows how to use a scanner, it also shows just what is going on 'out there'. If you are worried about the security of your communications (and it seems we all should be), it will certainly explain what to look out for.

The review copy came from McGraw-Hill, PO Box 239, Roseville 2069. (P.P.)

Hifi reference

AUDIO & HIFI HANDBOOK, Second Edition, edited by Ian R. Sinclair. Published by Butterworth-Heinemann (Newnes imprint), 1995. Soft covers, 233 x 155mm, 820 pages. ISBN 0-7506-2489-2. RRP $70.

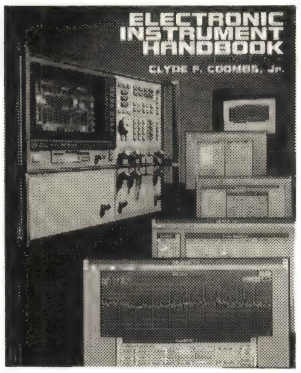
This is a soft cover version of the revised, updated and renamed 1993 second edition of the *Audio Electronics Reference Book*, first published in 1989.

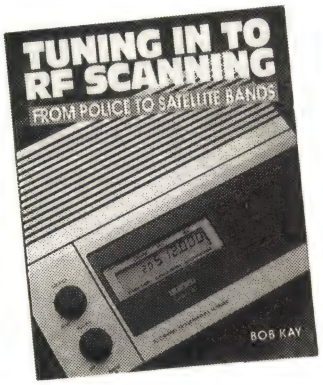
Editor Ian Sinclair is of course a prolific and well known UK technical author himself, and was apparently a protege of the late Fritz Langford-Smith, of *Radiotron Designers Handbook* fame. Which is interesting, because even before I discovered this connection (from Mr Sinclair's dedication), my first impressions of his book were that it was very much in the style of a latter-day *RDH*. Perhaps it was because of the way each chapter is written by an acknowledged practitioner in the field concerned...

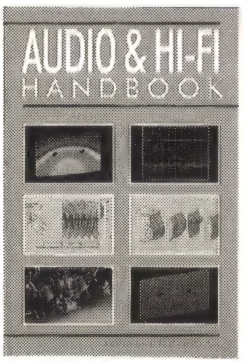
In this case, the experts concerned are British engineers such as Don Aldous, John Borwick, John Linsley-Hood, Stan Kelly and quite a few others. Collectively they cover just about every aspect of modern audio and hifi, including a lot of updated material on digital technology (including DAT, DCC and MD). About the only omission I noted was a chapter on surround sound.

The text is generally quite concise, and fairly well served by illustrations — although some of the diagrams are clearly hand drawn and a little rough by modern standards.

On the whole, though, an excellent reference on modern audio technology, and now much more reasonably priced. The review copy came from Butterworth-Heinemann Australia, of PO Box 146, Port Melbourne 3207. (J.R.) ❖







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NIKOLA TESLA: CREATIVE GENIUS, OR CRACKPOT?

Fascinated by the way turn-of-the-century inventor Nikola Tesla has become a worldwide cult figure, Tom Moffat has done some research into Tesla's life and achievements. He also paid a visit to the Tesla Museum in Colorado Springs, during a trip to the USA earlier this year. Here's what he found...

by TOM MOFFAT

Nikola Tesla is best known as the man who gave to the world AC (alternating current). This is a rather grand story in itself — the horrid feuds and downright sabotage between Tesla on the AC side and Thomas Edison who was promoting DC. Tesla had the Westinghouse Company backing him, and in the other corner Edison had Edison Electric.

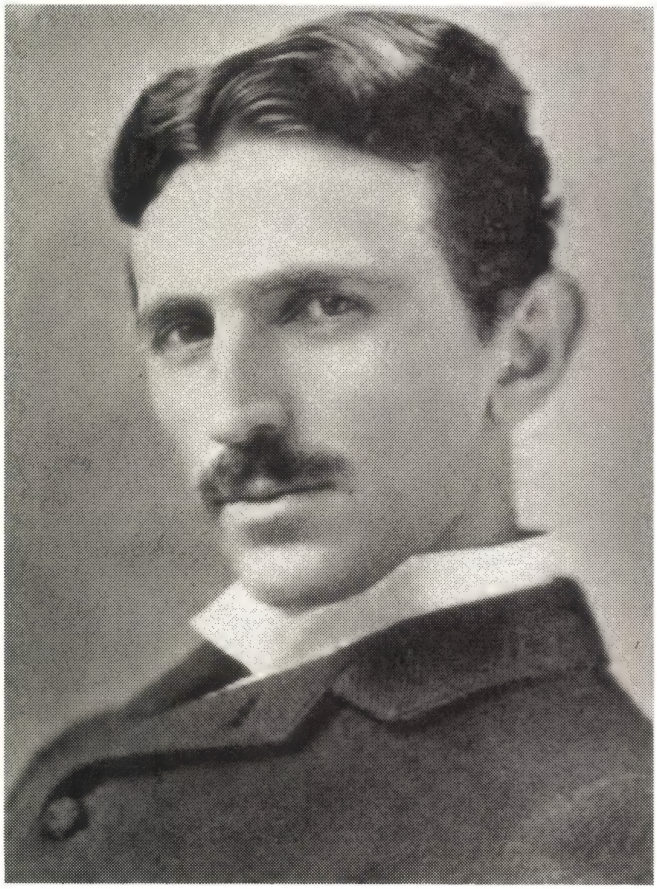
Dirty pool was the order of the day, with Edison even kidnapping pet dogs and electrocuting them in full public view, with AC, to show how dangerous it was. (Of course he failed to point out that the job could have been done just as well with DC!) As a result of these demonstrations, it is said that the first-ever commercial application of AC was to power the electric chair at Sing Sing prison.

But the AC/DC battle was only small beans for Tesla. He (supposedly) invented a death ray, and he was certainly able to hurl enormous lightning bolts around Colorado Springs. Although he kept careful notes of these experiments, most of them 'disappeared', and Tesla was officially labelled a crackpot.

Unofficially, Tesla was responsible for some of the most startling electrical and electronic research ever carried out on this planet, or any other planet for that matter. In fact one of his biographers, Margaret Storm, thought Tesla was so clued up she was convinced he came from Venus. To celebrate this fact, her book on Tesla was printed in green ink. But just because a fellow comes from Venus is no reason to label him a crackpot.

As for Tesla's 'disappearing' research notes, papers associated with such things as the death ray project are now said to be held within a top security US government vault where they remain to this very day.

Public information about Tesla's death ray is very sketchy, but it is definitely known that the device was based on a particle-beam principle. It just so happens that a particle-beam weapon was a main feature of the United States' 'Star Wars' program that was under development right up until the end of the Cold War.



A picture of Tesla at the age of 38, taken from a book published in 1894 on the inventor's researches and writings. (Picture courtesy of J.L. Elkhorne.)

Would it be uncharitable to think that Tesla's work from the turn of the century was the inspiration for the Star Wars particle-beam weapon? What other ideas did Tesla come up with, that might have military uses at some time in the future?

Such suggestions are usually dismissed as wild claims from unstable weirdos, but consider this: during my visits early this year to US research establishments such as Los Alamos and Sandia National Labs, some of the nation's top scientists, quite spontaneously, made special efforts to debunk the work of Nikola Tesla.

These comments came right out of the blue, in the midst of interviews about totally unrelated topics. And they didn't have any idea, at the time, that I was also researching a Tesla project for *Electronics Australia*. It is interesting to note that both Sandia and Los Alamos were reported to be right in the thick of the Star Wars research.

First seen in Bosnia

If Tesla did come from Venus, it must have been aboard a kryptonite meteor — falling in Superman style near Sarajevo in Bosnia.

At precisely midnight on July 9, 1856 there sprang forth within the hospital delivery room one screaming baby Nikola, ready and willing to change the course of life on Earth.

It took all of five years before little Nikola came up with his first invention, a waterwheel featuring a turbine without blades. This gadget later matured into a remarkable uncloggable

pump which is now in commercial production in the USA.

I saw a working model of this pump, made of clear plastic, in the Tesla Museum in Colorado Springs. It was set up to pump water around in a circle — from the output, through plastic pipes and a valve, and back to the input. The water had been dosed with lots of styrofoam beads which flowed around with it.

If you slowly closed the valve, the water would still get past but the beads would get trapped, backing right up to within the pump itself. But when the valve was opened again, the beads, and water, all flowed smoothly. This kind of treatment would have wrecked an ordinary pump.

Tesla spent his youth gaining a successful technical education at various places in what was formerly known as Yugoslavia. He then entered the work force, even signing on for a time with the Budapest branch of the telephone company owned by his future arch-rival Thomas Edison.

In fact it was Edison's work which convinced Tesla to migrate to America. However through one of Tesla's characteristic mishaps, he lost all his money and tickets. Undaunted, he bluffed his way aboard a ship, claiming an occupied cabin was his, and a few days later he was in New York.

In a feat almost unknown back then, Tesla stepped off the migrant ship and straight into New York's high society. This wasn't so much because of his achievements, which by then were not inconsiderable, but because of his appearance and demeanor. Tesla was one snappy dresser, considered very handsome and quite the ladies' man. They were fascinated by him. (It's interesting to note that even in modern times, five out of seven Tesla biographers I have come across are women.)

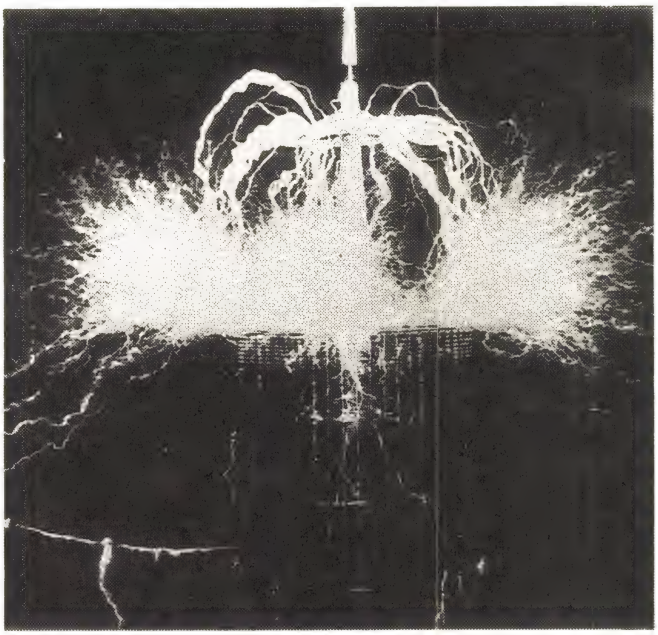
Tesla was quite aware of his attraction to women, and he used it to good advantage to finance his work. At one stage he even sweet-talked the daughter of J.P. Morgan, said to be America's richest man, into handing over a few million for his research.

Among male friends he counted such luminaries as fellow scientist Albert Einstein and the author and humourist Mark Twain. Some of Twain's writings suggest he was just as full of 'bulldust' as Tesla was... they would have made a good pair.

Hated skin contact

Tesla had some strange quirks in his makeup which caused his attraction to women to go totally wasted, except for the financial side. Tesla absolutely hated being touched by another person, so any woman in his company, no matter how beautiful, had to stay no closer than arm's length.

One of Tesla's closest relationships was in fact with a man, an army officer. This went on for many years and, along with his physical aversion to women, led to rumours that Tesla was homosexual.



A photo of the secondary of the Colorado Springs 'magnifiying transmitter' in operation, in mid 1899. The system produced up to 12 million volts at the aerial electrode, and on starting up would produce artificial lightning reaching over 135 feet. (Courtesy of J.L. Elkhorne.)

However he found the touch of a man just as abhorrent as that of a woman, and there is every reason to believe Tesla ultimately died a virgin.

The officer's wife, like most women, was quite smitten by Tesla's charm, and she constantly arranged quiet little meetings between the two of them. Later she began sending Tesla what can only be described as love letters. Eventually it was revealed that the woman's husband, Tesla's officer friend, was aware of these goings on and what's more, he approved and even encouraged them. Looks like some good soap opera material here...

Back to Tesla's habits: like the reclusive Howard Hughes, whom Tesla resembled in some ways, Tesla had a fetish for cleanliness. When he visited his favourite high-society restaurant in New York's Waldorf-Astoria Hotel, his table had to be furnished with exactly 18 napkins. Tesla also had an unnatural attraction to things divisible by three, hence the significance of eighteen.

There were also some powerful compulsions. Even more than being touched, Tesla loathed touching another person's hair. The smell of camphor would drive him absolutely wild. If he tore up bits of paper and put them in a dish of water, he would experience a nasty taste in his mouth. He spent his mealtimes working out the cubic content of his dishes and his food. When walking, he always counted his steps.

Tesla's senses were supersensitive. He would hear the sound of a fly landing on a table as a dull thud in his ear. He claimed to be able to hear thunderclaps 500 miles away. And he could feel vibrations in the ground as people moved about him. Something like a carriage passing miles away would jar him terribly, and in some places he had to sleep with pads under the bedposts to get any sleep.

So it looks like they make them different from us, on Venus. But despite his quirks — or perhaps because of them — Tesla was able to indulge in some very powerful thinking indeed, with his ideas generally backed up with working examples. However Tesla sometimes mis-fired in the publicity stakes, resulting in others getting the credit for some of his inventions.

Take, for instance, radio. We all know radio communication was invented by Marconi. But this is wrong, according to a United States Supreme Court decision in 1943. The verdict was decided in favour of Tesla, following the discovery of some circuit diagrams Tesla made for a lecture in 1893. The 'transmitting apparatus' shows an alternator driving some tuned circuits, using symbols very similar to those we use today for circuit diagrams. This information pre-dated Marconi's work by several years.

Colorado Springs

Probably the most fascinating side of Tesla's work involved the wireless transmission of electric power.

This idea has been pooh-poohed by

Nikola Tesla: Creative Genius, or Crackpot?

commercial interests since it was first proposed, but they did of course have a motive: if electric power could be promulgated far and wide, without wires, where would you put the electric meter? In other words, how would you charge for it?

A successful wireless power transmission scheme would thus be a disaster for existing commercial interests, who charge by the measured kilowatt-hour.

So, as with the particle-beam technology mentioned above, it is believed that details of Tesla's wireless power transmission scheme were, ah, 'submerged'. However, careful study of some of the surviving documents provides insights into what Tesla was on about.

Most of us first heard the Tesla name connected with the word 'coil'. The Tesla Coil is a classic device for generating high voltages. Basically it is a simple transformer, with a low impedance primary, and a high impedance secondary implemented as a very long piece of wire wound as a helix. A car ignition coil is an example of this type of transformer, and it can of course provide some pretty impressive sparks from a 12 volt battery.

The Tesla Coil improves efficiency, and thus the voltage generated, by making both the primary and secondary resonant at some frequency which is generated by a buzzer-type device interrupting the primary voltage to set off a string of damped oscillations.

Some experimental Tesla coils use a radio-frequency oscillator to drive the coil directly at its resonant frequency. This produces a fan-like corona discharge from the top of the coil, a pretty but not very exciting display. The older mechanical interrupter method results in big fat juicy sparks, much more satisfying.

Although I'd read about them, I had never met a Tesla coil in person until I paid a visit to the headquarters of the International Tesla Society in Colorado Springs in the USA. I was ushered into a large room in which several exhibits of Tesla's inventions were set up.

There were spark-making devices such a Leyden Jar arrangement and a Jacob's Ladder, and on a bench a decent-sized Tesla coil of around 100 watts power.

Impressive demo

But on the floor in the centre of the room was the real showpiece — a Tesla coil standing perhaps my own height, with the secondary coil about as big around as an oil drum.

Two wires led away from the coil's base, suspended above the floor, to a big step-up transformer that had once seen service atop a power pole. Another cable led from the pole transformer to an industrial-strength power point that had been specially installed to provide 230 volts instead of the usual American 115V.

Tesla Society President J.W. McGinnis turned off the lights and then fired up the Leyden Jar, which did lots of snapping and sizzling and then produced nice blue sparks crawling all over its surface. Next came the table-top Tesla coil; lots of humming and snapping, and then four-inch mini lightning bolts reaching up into the air.

Then McGinnis said, "stand over against that wall, and whatever you do, don't move". Once I was safely in position, he picked up a hand-held controller at the end of a long cord, and then said, "I'm going to do a countdown now: three, two, one..." and then he hit the switch.

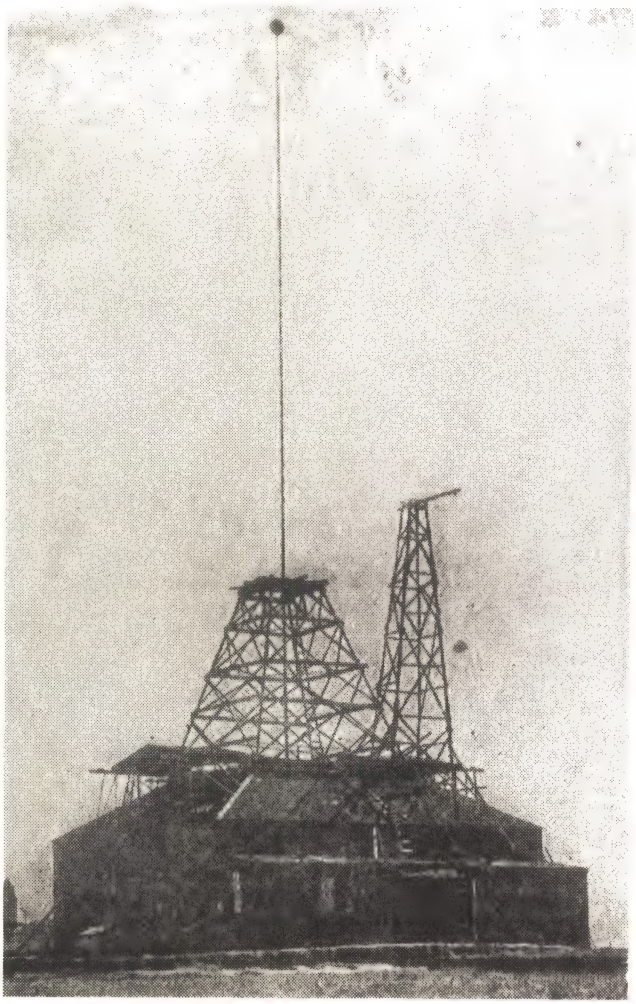
The big coil in the centre of the room suddenly erupted into a frenzy of wild lightning bolts, that writhed around the top of the coil and shot off about five feet in all directions. One occasionally reached up and zapped a fluorescent light fitting in the ceiling, with a resounding bang.

I was just blown away. You know those ads you see for mobile phones, featuring the little cartoon character with his jaw dropping below his chest? Well, that was me. That coil buzzed and banged and lashed the air with enormous blue whips, and the room reeked of ozone. I was mesmerised. What a show!

Meanwhile, of course, television sets several blocks away cringed in terror, mauled by enormous bursts of RF interference.

There was something deliciously antisocial about that Tesla coil — something akin to throwing a big string of firecrackers into a crowded street. Here was a device that had no other purpose for its existence other than to make a lot of noise and bad smells, and impress the hell out of people!

I later learned that this particular Tesla coil was made in 1939 to star in Hollywood movies. You know how it goes: Boris Karloff's lying there on the operating table with electrodes attached to his head, and Frankenstein throws this big knife switch and yells "It's alive! It's alive!" and the sparks start flying, and then Boris Karloff sits up and blinks his eyes... Yeah!



The Colorado Springs laboratory building in 1899. The primary coil was a loop 51 feet in diameter under the floor of the building. Tesla claimed to have transmitted 10kW of power to a point 26 miles away. (Courtesy J.L. Elkhorne.)

A *real* Tesla coil!

Well now, that million-volt monster in

the Tesla Society's museum was a piddling little thing compared to the ones that Tesla himself built. On May 18, 1899, Tesla arrived in Colorado Springs for some serious experimenting, funded by the above-mentioned J.P. Morgan and his understanding daughter.

Colorado Springs was chosen for two reasons. One was Tesla's friendship with Leonard C. Curtis, of the Colorado Springs Electric Company. Tesla was going to need LOTS of power, at the right price (free).

The other reason for Colorado Springs was, in Tesla's own words, "The perfect purity of the air, the unequaled beauty of the sky, the imposing sight of the mountain range, the quiet and restfulness of the place — all around contributed to make the conditions for scientific observation ideal. To this was added the exhilarating influence of a glorious climate and a singular sharpening of the senses."

I can certainly agree with Tesla's description of the place. When I was a kid my family had a holiday cabin on the lower slopes of Pikes Peak behind Colorado Springs, and it was glorious. The weather was indeed perfect, even improved in the summer by thunderstorms that came through regular as clockwork at 4pm every afternoon to cool the place down. Otherwise the air was very dry — an ideal insulator for high-voltage experiments.

Tesla established his temporary home in room 207 (divisible by three) in the Alta Vista Hotel, and set up his lab in an open field, one mile from the city and at an elevation of 6000 feet.

Lab is long gone

Ninety-five years later the lab is long gone, but I thought it would be interesting to try to find the site anyhow. Tesla described the site as 'near the School for the Blind and Deaf', and since that still exists, that got me fairly close. The Tesla Society pinned it down even further, although with two different versions.

One version put the lab site in the city's Memorial Park. The park is not a memorial to Tesla, but to firemen all over the USA who have died in the line of duty. There is however a small sign commemorating Tesla's activities 'on this site...'

The Tesla Society said the sign was somewhat misplaced, and to get to the exact spot it was necessary to walk something like '60 paces west and then 40 paces south'. This I did, and then I got my daughter Fiona to take a photograph of me standing exactly on that magic spot. Tesla's beloved 'imposing sight of the mountain range', Pikes Peak, is in the background.



Tesla planned to transmit news broadcasts, time and navigation signals and other information as well as power, from the Wardencliff site on the east coast of America. Copper sheeting was never added to the hemispherical electrode as the tower was razed during World War 1. (Courtesy J.L. Elkhorne.)

The other version locates the lab at '22 Foote Street', possibly because this house has been advertised for sale several times as the site of Nikola Tesla's lab.

The sign in Memorial Park is quite near the end of Foote street, and 30 seconds' walking along it puts you right in front of number 22. So the two sites are really close together — perhaps within 150 metres or so.

Receiving apparatus

It was at this lab that Tesla was able to hear thunderstorms '500 miles distant'. He had built a receiving apparatus which would respond to the lightning, and then he'd step outside an hour later to listen for the bang...

He eventually began tracking the regular 4pm thunderstorms, from their origins around Pikes Peak until they headed out east along the plains. And from these experiments came the biggest "Eureka!" of Tesla's career.

He noted that as the storms moved further away, his electromagnetic pulse detector declined in output, as expected. But once the storms got to a certain distance, the intensity began increasing again, and at twice that distance the readings again decreased. He saw this as a cyclic variation of electromagnetic intensity with distance, and deduced that it was caused by some resonance within the earth itself. What Tesla was of course observing were standing waves — or as he came to call them, stationary waves. He thus saw the earth as a big 'metal ball', which could conduct electricity as easily as any wire.

All Tesla needed to do to transmit his own electricity was to somehow couple energy from the power generator into the 'resonant earth'. And, of course, a Tesla Coil was chosen to do the job. But this time he came up with an enhanced design using a tertiary coil linked to the secondary coil, with the whole works resonant at 50kHz. This became known as his 'magnifying transmitter'. Perhaps in recognition of what was to come, Tesla adorned the door of his lab with a sign: 'Abandon hope all ye who enter here' — from Dante's *Inferno*.

The completed magnifying transmitter stood over 200 feet high, a building that looked somewhat like a fat bell-tower with a big metal mast topped by a large copper ball. Tesla reckoned it would be capable of generating 100 million volts. During initial tests the magnifying transmitter did sling some rather impressive lightning bolts, and it caused flashovers in lightning arresters of buildings 12 miles away!

Full power test

Eventually it was time to test the magnifying transmitter at full power. To mark the occasion, Tesla dressed in his Sunday best. He arrived at his lab full of apprehension; electricity had never before been applied in the quantities he intended to use. What would happen? Would the magnifying transmitter ex-

plode, or simply melt down? Would Tesla be barbecued, or even vaporised?

To observe the full result of the test, Tesla wanted to watch the big secondary coil within the building, as well as the copper ball on top of the tower. So he decided to stand near the door where he could see both, and get an assistant, Kolman Czito, to throw the switch on his command — closing it for exactly one second, and then open it. With both men in position, Tesla took a deep breath and yelled "NOW!"

Here it helps to visualise that scene in Frankenstein's lab, with the Doctor watching closely as his assistant Igor grips the big knife switch and rams it home. For Tesla, sparks sizzled around the secondary coil while big fat arcs snaked around the overhead ball.

Well, so far so good, and nothing blew up. So for the next test, Tesla told Czito to close the switch and leave it closed until Tesla ordered it open again. Tesla moved further outside, where he could view the entire mast and ball. Then he yelled, "NOW! CLOSE THE SWITCH!" (It's alive! It's alive!)

It seemed that the longer the switch was closed, the more energy built up in the system, and soon bolts of fire were surging through the coils and the ground beneath the station was shaking. Outside, lightning bolts shot 135 feet from the copper ball and the resulting thunder claps were heard in the gold mining town of Cripple Creek, up in the mountains 15 miles away.

By now Czito was starting to panic; no order to open the switch had been forthcoming. Maybe the boss was lying outside, a pile of smoking bones. Actually Tesla was standing outside in his greatest moment of glory, revelling in the fireworks display. But suddenly everything went dead.

"What did you do that for", Tesla bellowed, "I told you to leave the switch on until I ordered it off!"

But Czito had not touched the switch. Instead the power had failed. When Tesla rang the Colorado Springs Electric Company to complain, he was told that the power station's generator was on fire and the whole city had been blacked out. Soon a standby generator was brought on line, along with the lights of Colorado Springs. But Tesla's power feed had been 'isolated'.

When he pleaded to be re-connected so he could continue his experiments, he was told — firmly — no. Relations with the power company were finally restored when Tesla volunteered to have the burnt-out generator repaired at his own expense.

Further experiments were somewhat more controlled, with Tesla tuning and tweaking his magnifying transmitter to minimise the sparking and maximise the amount of energy transferred into the earth, which was the intention in the first place.

As an analogy of how Tesla saw this working, consider the earth as a partially inflated soccer ball. If you take a finger and prod the soccer ball anywhere on its surface, you will feel the result as increased pressure. And the pressure felt would be the same anywhere on the ball you care to place your hand. Electricity 'prodded into the earth' at Colorado Springs should be recoverable at the same strength anywhere on the earth's surface, regardless of how far it is from the transmitter.

Experts in power transmission said there was no possibility at all that Tesla could have transmitted wireless power. But documents do reveal that Tesla set up an experimental power receiving device in a house at Castle Rock, about 60km up the road toward Denver. And when he turned on his magnifying transmitter back in Colorado Springs, enough power was recovered to light the entire Castle Rock house.

How do the experts explain that one?



Tom captured this view of the million-volt Tesla coil operating at the Tesla Museum in Colorado Springs, when he visited there earlier this year.

Multipurpose station

Tesla also had plans to modulate his magnifying transmitter with both data and audio signals, and even a time and frequency standard. He proposed a system in which radio signals could be broadcast simultaneously to the whole world, instead of just from point to point. This was, of course, the first inkling of the international broadcasting we have on shortwave today.

Tesla's plan was to build an enormous magnifying transmitter at Wardencliff, on America's east coast, to bridge the Atlantic with a collection of broadcast, Morse code and telegraph services, and a fair measure of electric power to boot. This service was to be made into a commercial operation known as the World System.

But the project was never completed because the financier J.P. Morgan, who had backed previous projects, pulled the plug on Tesla. Maybe Tesla had at long last had a falling out with Morgan's daughter. That blow was really the end of Tesla's long and fruitful career.

Tesla survived for another 40 years before dying, at age 86, in 1943. Upon his death the United States government confiscated all of Tesla's papers and research notes.

Some of the material later turned up in a museum in Belgrade near Tesla's birthplace, but the most significant papers remain, to this day, where...?

Tesla today

More than 50 years after his death, Nikola Tesla has become a kind of cult figure. His unusual ideas have attracted other people with unusual ideas, and they have grouped together under the banner of the International Tesla Society, based in Colorado Springs (PO Box 5636, Colorado Springs, CO 80931, USA).

Now, contact with these people might be a little, er, off-putting in the first instance. When I arrived at their headquarters, I was first greeted by a display of materials concerning New-Age stuff...pyramids, crystals, UFO's, miracle cancer cures, anti-gravy devices, perpetual motion, etc. Whether or not they deserve it, these matters have taken on a kind of mystical character, almost as if they constitute a religion. Practitioners of these things are routinely debunked and ridiculed, although one wonders if the detractors simply fear the promoters might be right.

Anyhow, Nikola Tesla, like it or not, has been sucked into this scene, and his followers are thus tarred with the same brush. One suspects that governments find this a convenient state of affairs, since debunking Teslaism (new word there...) seems to be a prominent government pastime.

The Tesla Society has also got itself involved with a shortwave radio station called WWCR (World Wide Christian Radio), which seems to have become the primary voice of American dissidents. The society's weekly program 'Extraordinary Science Radio Hour' features their president, J.W. McGinnis, interviewing people about such things as optical computers, fluoride in drinking water, super-steam power, and making gold at home. When I was in the USA I listened to a couple of these programs and found them well-produced and interesting — despite their transmission on what's been described as 'Crackpot Radio'.

The Extraordinary Science Radio Hour is aired on Sundays at 11pm American Eastern Standard time. This translates to mid-afternoon in Australia, and on the station's frequency of 5065kHz it's unlikely you'll hear much. WWCR does come through well in the late afternoon/early evening, by which time it's pretty heavily into fundamentalist religion.

There was a more detailed discussion of this fascinating station in my Spectrum column, in *Electronics Australia* for July 1995.



Author Tom Moffat pictured standing at the exact site(?) of Tesla's magnifying transmitter installation in Colorado Springs. Visible in the background is the snow covered Pikes Peak Mountain, which apparently inspired Tesla's ideas.

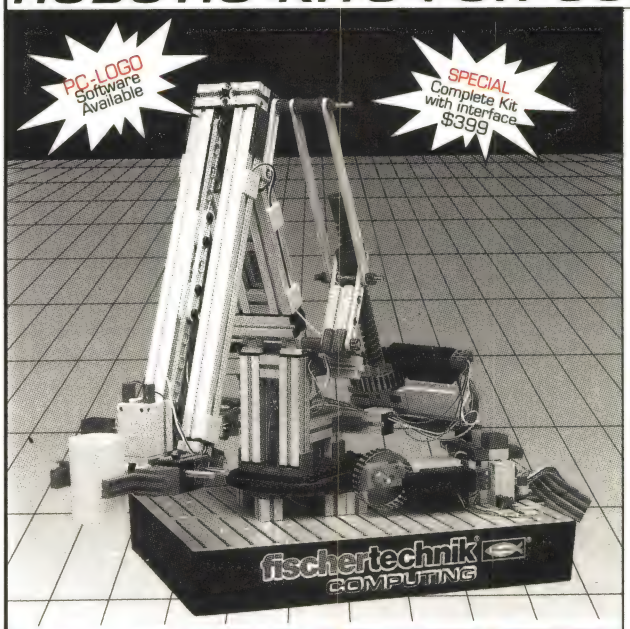
Here we have only scratched the surface of all the wonderful things Nikola Tesla was up to. What we didn't talk about was his excursions into fields such as radar, Kirlian photography, vertical takeoff and landing aircraft, and sophisticated remote control systems.

There will most likely be those who think we've already gone too far with Tesla, of course.

I can visualise in Letters to the Editor. "How dare you let Moffat write that rubbish in a serious electronics magazine!" But think about it — with all this interest in Tesla in the past 100 years, there must be some truth in there somewhere. ❖

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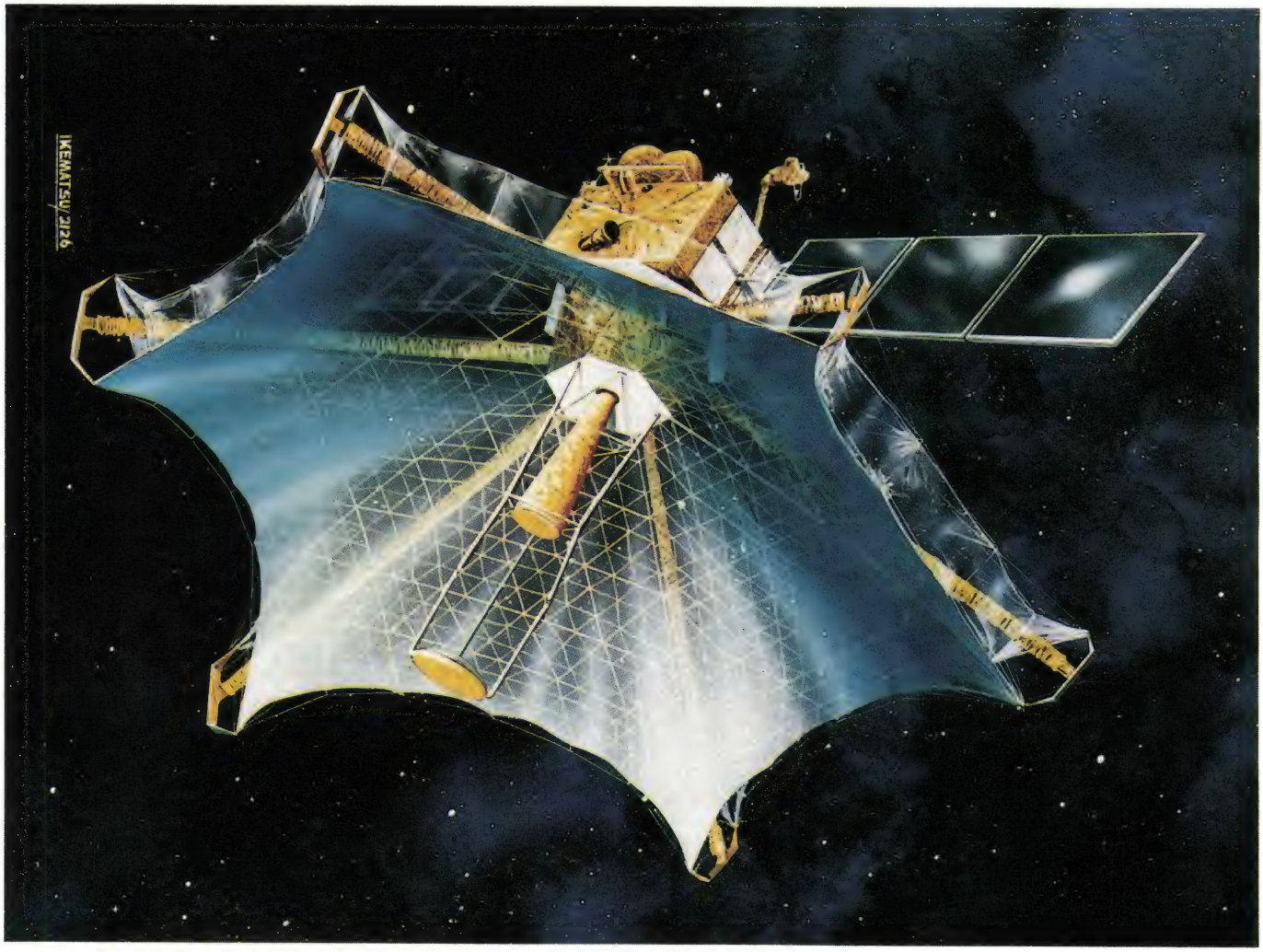
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BIGGEST RADIO TELESCOPE EVER!

In their quest for ever-better resolution, radio astronomers are moving into space. The next step from using multiple earthbound radio telescopes to synthesise a very large dish is to use an orbiting telescope, to synthesise an even *bigger* dish. That's exactly what's happening with the new VSOP and Radioastron projects, and Australia's astronomers are playing a key role in both.

by GEOFF McNAMARA



"The future of VLBI is in space!" said John Reynolds. VLBI, or Very Long Baseline Interferometry, involves linking two or more smaller radio telescopes to simulate a single large telescope. As you would expect, the bigger the telescope, the better the results. So far, astronomers have used telescopes separated by anything from a few kilometres to the diameter of the Earth. But astronomers like Reynolds, who himself works with the giant Australia Telescope's Long Baseline Array, have long dreamt of carrying the technique into space. That dream is about to come true.

It's a simple fact: if you want to see finer detail in the distant cosmos, build a bigger telescope. That's why professional astronomers have always had a case of what amateur astronomers call 'aperture fever' — the desire for ever larger telescopes. The motivation comes from the need for *resolution*: the ability to see fine detail. Higher resolution means more information about the object under study.

But astronomers soon found that there was a limit to the size of the telescopes they could produce, mainly due to the

structures needed to support them. The largest 'optical' telescopes in the world — those that work with visible light — have mirrors on the order of 10 metres in diameter. But this seems to be the limit. Any larger and the mirrors just can't hold their shape.

While optical astronomers have it tough, radio astronomers have it tougher. Resolution in the radio band of the spectrum is more difficult than in the optical band, because of the longer wavelengths involved. This means radio astronomers have had to build much *bigger* telescopes.

Despite an increase in size, however, the performance of radio dishes was still inferior in terms of resolution. For example, the largest radio telescope in the southern hemisphere, the 64-metre Parkes radio telescope, has an angular resolution of 3.0 minutes of arc, or 0.05°. The much smaller 3.9 metre Anglo-Australian Telescope, which works in the optical and infrared, can see details 180 times finer.

To overcome this problem, radio astronomers developed interferometry. In a sense, it's like building the edges of a single huge radio dish, but not bothering to fill in the 'middle'. As with a single dish, the wider apart the edges the better the resolution.

At first, interferometers were measured in tens of metres; then hundreds, then thousands. By the time the smaller dishes were separated by kilometres the technique was dubbed Very Long Baseline Interferometry, or VLBI. One of the best known examples is the Long Baseline Array, where several smaller radio dishes can be linked creating a telescope hundreds of kilometres across. The Long Baseline Array has a resolution at radio wavelengths that exceeds the resolution of the 3.9 metre Anglo-Australian Telescope in the optical.

Astronomers aren't content with a radio telescope the size of Australia, however, and are now preparing to take VLBI to new heights — literally. Using a technique called 'Space VLBI', a small radio dish will be placed into Earth orbit and linked with dishes on the ground. When in use, the space-Earth interferometer will provide astronomers with the resolution of a radio telescope tens of thousands of kilometres in diameter, larger than the Earth itself.

There are two such projects nearing completion. One is a Japanese spacecraft called 'VSOP', the VLBI Space Observatory Project. Due for launch in September 1996, VSOP will consist of a satellite with an eight metre dish orbiting the Earth out to a distance of 20,000km. With this kind of resolving power, VSOP will allow astronomers to peer into the distant reaches of the universe with a resolution of 0.1 milliseconds of arc. This is the equivalent of reading this issue of *Electronics Australia* in Perth — from Sydney!

VSOP will use three low-noise receivers operating at 1.6, 5, and 22GHz. It will orbit the Earth at distances ranging from 1000km to 20,000km in about six hours. At its farthest distance, VSOP will provide an interferometer with a baseline of 30,000km.

The dish VSOP will carry into orbit is a 20th-century version of the ancient art of origami. Made of wire mesh supported by six booms and tension wires, the dish will remain folded until the spacecraft reaches orbit. High above the Earth's surface the dish will then unfold like a giant metal flower. Once deployed, the dish will have a surface accuracy of 0.5mm, and the spacecraft will have a pointing accuracy of 0.01°, or about a 50th the diameter of the full Moon.

**** Astronomers measure resolution in terms of angles of arc in the sky. There are 60 minutes in 1°, and 60 seconds in one minute. The full Moon, for example, is about 30 arc-minutes, or minutes of arc, across.***

Although Australian scientists didn't play a part in the construction of VSOP, they have been very heavily involved in the planning. According to John Reynolds, Australian astronomers are on most of the important committees that decide how VSOP will operated. "This is largely because we control most of the large radio telescopes in the southern hemisphere," said Reynolds.

Ground-based radio telescopes will play two important roles in VSOP: satellite housekeeping and as co-observing stations. All of the telescope's commands and orbit determination will be handled by a 21 metre antenna at the Kagoshima Space Centre in Japan. However, to permit coverage of the entire sky, VSOP will use co-observing stations around the globe, including radio dishes in Japan, the United States, Europe, and Australia. In fact, the use of the Australia Telescope is essential for the observation of southern radio sources.

There's a much more ambitious project underway, however. Called Radioastron, this project was first proposed by the former USSR. Radioastron will consist of a 10 metre dish and will orbit out to 77,000km. When launched around the turn of the century, the spacecraft will create a 90,000 kilometre baseline with Earth-based telescopes, allowing a resolution of an incredible 30 microseconds of arc — five times better than VSOP.

Radioastron is a collaborative effort between 10 countries, including Australia. "We [CSIRO] built the L-band 1.6GHz receiver for Radioastron," said Reynolds. "That's the one piece of equipment that's actually ready, the only one that's space-qualified."

With the dramatic political changes that have occurred in Russia in recent years, the launch of Radioastron has been continually delayed; but Reynolds remains optimistic. "We're hoping it will fly before the year 2000," he said. "They've actually come a long way with the spacecraft, but as you can imagine they've got their resourcing problems."

When both VSOP and Radioastron are in orbit, they'll be astrophysically complementary. While VSOP will be the first all-sky microwave survey instrument, Radioastron's greater sensitivity and higher resolution will make it a superb detection instrument.

For a long time, radio astronomers had to contend with frustratingly blurry images of the Universe. Now, Space VLBI will sharpen their vision, allowing them to peer deeper into the heart of some of the most intriguing mysteries that nature harbours. ❖

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FIRST ENCOUNTERS WITH

THE INTERNET

What exactly is the Internet, and what can it do for you? The best way to find out is to give it a try. There are plenty of Internet Service Providers anxious to take your credit card number and open an account for you. But be warned: it's not quite that simple. Unless you are a computer whiz, you will soon find yourself up to your neck in meaningless jargon. This introduction should help you make an informed decision if you decide to take the plunge...

by PETER VOGEL

The Internet is a means of connecting together computers in different locations, so that information can be sent from one to another. Computers in large organisations can connect directly to the Internet; home or small-office users use the services of an Internet Service Provider (ISP) to gain access.

Your computer (typically a PC or MAC) connects to the ISP's computer (a 'host') via a modem and a telephone line. This host is connected to millions of other hosts by the Internet. The person you wish to send a message to is likewise connected to a host. Millions of other people are connected likewise. You and every other user have a unique address, like a phone number. Here is an example of an Internet address: **fnurk@peg.pegasus.oz.au**. The bit to the left of the 'at' (@) symbol identifies you, while the bit to the right identifies which host you have an account with.

What you can do

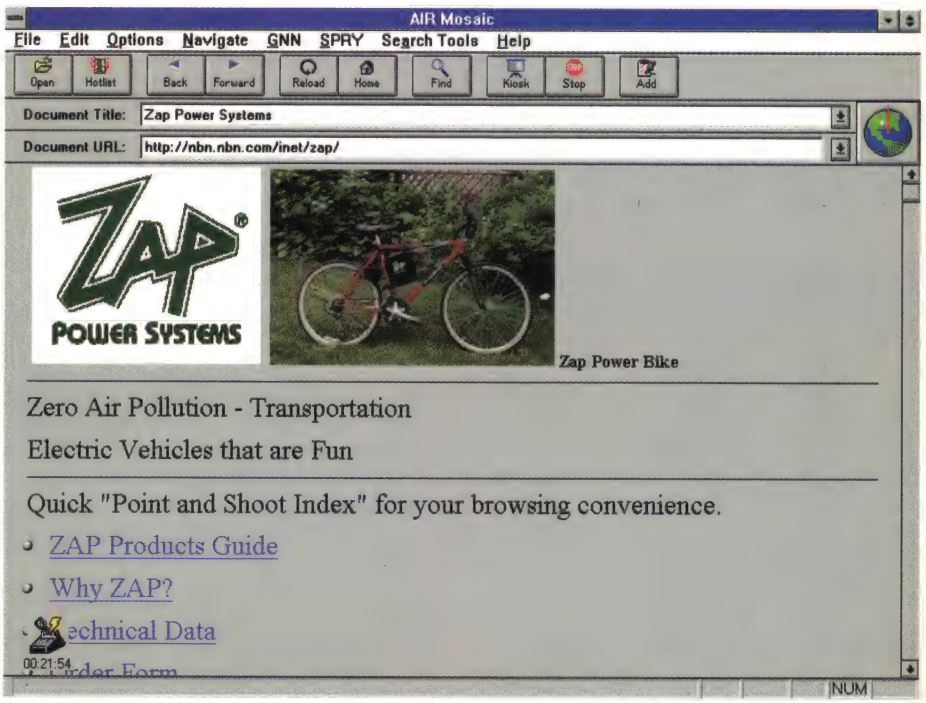
There are four main groups of Internet services that 'the person in the street' might like to explore:

Electronic mail (e-mail): This is a system of sending messages from one computer to another via the Internet. Sending e-mail is similar to sending a fax, except that the message is typed into the sending computer and appears as a message on the receiving computer in electronic form rather than on paper. E-mail is one-to-one communication. It is used for private communication, when the content would be of no interest to anyone but the addressee.

You can use a simple terminal programme (such as Telix, Procomm or Windows Terminal) to send and receive e-mail. However this is the hard way to do it. There are a number of Windows software packages that insulate you from the somewhat obscure mechanics of sending and receiving mail. One of the most popular is Eudora, which is available in either shareware or commercial form. Check that your service provider can supply suitable mail software.

Mailing Lists: This is the Internet equivalent of mass mailing. Any number of people can put their name on a 'mailing list' which covers a particular subject (there are probably thousands of subjects). When someone sends an e-mail message to the mailing list's address, a copy of the message is automatically sent to all the people on the list.

There is, for example, a mailing list on the subject of electric cars. This list lives on a computer somewhere in the US, with subscribers all over the world. The mailing list is used for discussion and information which may be of interest to any of the subscribers. For example,



My Web browser (Mosaic) has taken me to http://nbn.com/inet/zap/, which is a Web page about electric conversion kits for bicycles! Clicking on words that are blue (underlined) takes me to further pages on that subject.

Starting Points

Once you connect to the Net, the world is at your doorstep. But you need to have some idea which direction to head off in. Here are some pointers:

Mail

The first test of e-mail is to send yourself a message. This should come back to you within a matter of seconds. That way you learn how to compose and send mail, and how to receive, read, print and file it.

If you like receiving lots of mail, you can subscribe to mailing lists which automatically send you mail on the subject the list is devoted to. There are thousands of mailing lists to choose from. You can get a listing of some of these by sending a message to **mail-server@rtfm.mit.edu**

Your message should read:

send usenet/news.answers/mail/mailing-lists/*

After a while (could be minutes or hours) you will receive a number of mail messages, containing the names and description of lots of diverse lists. Topics range from AIDS to Zeppelin (Led). You can chose one or more lists to subscribe to. Note that many mailing lists are also available in a digest form, that is, messages are stored up and sent as one long e-mail from time to time (e.g. daily or weekly). This is more convenient that receiving an individual message each time one is posted.

Usenet (news groups)

It's relatively easy to find your way around newsgroups. Although there are some 8000 groups, they are arranged hierarchically and appear on your newsreader screen something like the directory of files in File Manager. You point and click your way through the different levels.

There is little relating to electronics, although plenty about computers. These are grouped together as newsgroup names starting with 'comp.' Within 'comp.' you will find 'comp.graphics', which is again broken down into 'comp.graphics.algorithms', 'comp.graphics.animation' and so on.

There is also an Australian hierarchy. Newsgroups such as aus.ads.forsale contain Australia-specific messages.

For information of interest to new users, look at 'news.announce.newusers'.

World Wide Web

Web pages are identified by a URL (Universal Resource Locator), all of which start with 'http://' followed by something resembling a DOS path name, but using a forward slash (/) instead of the familiar backslash (\) — just to keep you on your toes.

Tell you Web browser to go to **http://turtle.ncsa.uiuc.edu/alan/simpsons.html** and you will see the contents of the file simpsons.html, which belongs to someone called Alan using a server called turtle.ncsa.uiuc.edu.

Similarly **http://www.microsoft.com** will take you to Microsoft's home page (a home page is like a table of contents).

When you start up your Web browser, you will probably be taken to the home page of your service provider or the company that makes the Web browser. There you will find links to other pages. Just keep clicking. Your browser will probably also have a 'hot list' built into it, which will have some Web sites preprogrammed into it.

To find sites related to a particular topic, you can use a 'search engine'. Browsers usually offer a number of ways of searching for Web pages by keyword. Also, a catalogue of Web pages can be found at **http://lycos.cs.cmu.edu/**.

If you go to **http://www.yahoo.com/** you will be able to search for Web pages by category. From there you can click your way to pages such as **http://www.yahoo.com/Science/Engineering/Electrical**.

someone might post a message saying "I am converting a Ford Laser to electric power. Where is the best place to mount the batteries?"

Several readers might respond with their suggestions; there might even be another subscriber to the list who has done such a conversion.

Mailing lists can be accessed by anyone with Internet access, and only mail software is required.

News groups (also known as Usenet, Conference or Forum): Similar to a mailing list — except that the messages are not sent to subscribers. Instead, the messages are 'posted' in a place where anyone else interested can read them and respond if they want. There are thousands of newsgroups, covering just about every subject imaginable.

Special 'newsreader' software is required to read newsgroups. This may be accessible on the ISP's host computer.

World Wide Web (WWW): E-mail and news groups provide information in the form of plain text. The WWW is much flashier, being based on pages of colourful, formatted text with graphics (pictures) if required.

WWW information is organised in 'pages' which have 'links' or pointers to other related pages. To get from one page to the next, you click the mouse on the word or picture of interest, and another page of information about that topic is accessed. The beauty of the WWW is that web pages can link to pages at another site altogether, so that although someone browsing is not aware of it, the next page selected might come from a different computer in another country.

A 'home page' is like a table of contents which contains buttons to click on that take you to the subject selected. For example, an 'on-line shopping' home page might display a dozen different little pictures, linked to further web pages related to particular types of goods. You might click on the picture of a tennis racket and get connected through to a sports goods shop's page, or click on the picture of a house to get to a real-estate agent's page. Some of these commercial web pages allow you to send your order electronically as well as view the pictures.

The WWW is ideal for browsing, but if you're paying by the hour for connect time it can get very expensive!

To access the Web you will need software known as a Web Browser. The two most popular are Mosaic and Netscape. Shareware versions of these are available for evaluation. Check with your service provider.

Exotica: There are other Internet applications that allow you to retrieve software and other files from various hosts around the world (for serious computer users or hobbyists). You can also 'chat' in real-time via the keyboard, and even receive sound and moving pictures (interesting until the novelty wears off).

What you'll need

To connect to the Internet, you will need:

- A computer (most PCs or MACs will work).
- A modem — this is the box that transfers data between your computer and the phone line.
- An Internet account — established with one of the many Internet Service Providers, to allow you access to the Internet via their computers.
- Application software — this runs on your computer and performs the various tasks, such as sending or receiving e-mail, accessing newsgroups etc.
- Some books about the Internet (most large bookstores have a range).

First Encounters with the Internet

- A good supply of strong coffee and/or Valium.
- A robust credit card.

Your computer

Most likely you will be accessing the Net from a PC compatible, running Windows. You can do it from DOS, but the range of application software is much more limited.

The main requirement for your PC is that its serial port must be capable of operating fast enough for the modem (which will be connected to it). Standard serial ports may have trouble working reliably with a modem faster than 9600b/s, so you may need to upgrade to a serial port with a 16550 UART.

This is too technical to go into here, but if in doubt check with someone who understands these things.

The Modem

Modems come in two forms: internal modems are a board that you install inside your computer; external modems are a separate box which plugs into a serial port of your computer (usually COM1 or COM2). External modems are more expensive than internal, but have the significant advantage of not requiring you to fiddle around inside the compute.,

Modems range from cheap and slow to fast and expensive. A fast modem will soon pay for itself in connection time saved. Modem speed is quoted in 'bits per second' or 'baud', which means much the same thing. 9600b/s is fine, but 14,400 or 28,800b/s are even better.

Modems plug into a standard phone socket; there is nothing special about the phone line. Modems can be bought from any computer shop. I have found the Australian made ones work well, and have the advantage of local support if you have problems. Expect to pay between $300 and $600.

Opening an account

Choosing the best Internet Service Provider for your needs is not a simple matter.

For a start, you will not find them listed in the Yellow Pages. You will have to seek them out, by word-of-mouth, or by buying one of the many a PC or Internet magazines they advertise in.

Things to consider when choosing your ISP include:

1. What will you be using Internet for? If you will be using the Net largely for recreation, you will probably want the service that will cost you the least. If you will be using it for business purposes or serious research, you may consider paying extra for a service which will be reliable and perform well.
2. What is the service going to cost? There are almost as many methods of charging as there are service providers. Some services charge purely on the basis of connect time. Sometimes there is a minimum monthly time you pay for whether you use it or not. Other services charge by the amount of data you transfer; some charge a flat monthly fee which includes a certain limit on data transferred. Many services are a combination of all these...
3. How much will it add to your phone bill? If possible, find a service that you can access for the cost of a local call. Be warned: you cannot always tell from the STD codes whether the call is timed or not. In some zones, calls that appear to be local (i.e., you don't dial an STD code) are in fact STD. Likewise, some calls that require an STD code are untimed local calls. You can find out by calling Telecom's 012 number.
4. What services will you be using? If you will be using mainly mail, the amounts of data involved will be relatively small. If you intend to really go 'surfing', you will be using the WWW and maybe downloading large files, in which case the amounts of data can be enormous (and affect your costs accordingly).
5. What Internet services are supported? Not all ISPs offer all services. For example, some offer only a limited range of Usenet groups.
6. What software is offered? Does the service provide access software? If so, how good is it? Does it come with instructions? What does it cost? (Free does not necessarily mean good — I will explore this question further)
7. What technical support is provided? You will probably be calling for help, especially when first setting up and learning the ropes. What support is offered? Is it included in the price? Will technical support cost you an STD call?

The best choice of ISP for you will depend on your anticipated use of the service. If you will be using mainly mail, a few minutes connect time each session should suffice, and unless you subscribe to lots of lists, no more than 100KB of data per day. If you use the Web, you might be on line for hours at a time, and transfer many megabytes of data. Newsgroups lie somewhere between the two.

Estimate your monthly requirements in terms of data volume and on-line time, and then select the service that seems the most economical proposition.

Note that if you are only likely to be using the Internet for e-mail, Usenet and exchanging files, a lower-cost 'Unix Shell Account' may be all you need. If you want full pictures-and-sound access to the World Wide Web, you'll need the more expensive 'SLIP/PPP' type of account. Many ISP's offer a choice.

Useful reference book

One of the most helpful Internet reference books we have come across is *The Internet Complete Reference*, by Harley Hahn and Rick Stout, published by Osborne/McGraw-Hill; ISBN 0-07-881980-6. It seems to be available from most larger bookstores.

Software

As well as an account with a service provider, you will probably need some Internet application software. For a start, you will need a mail program to send and receive e-mail messages. The mail program will also require a communications program, which instructs your modem to connect to the service and then provides a path for data between the mail program and the service.

The major choice you have to make in selecting Internet access software is between 'shareware' and 'commercial' versions.

A number of software companies issue a version of their Internet products in 'shareware' form, which is similar to their commercial product but has reduced functionality.

Shareware is distributed free by several ISPs. This shareware is fine if you are experimentally inclined and have

more time than money to spare. Shareware comes 'as is'; with no manual or guarantee.

If you settle for shareware, be prepared to spend a lot of time wondering whether the problems you encounter are due to you not understanding how to use the program, a bug, or a feature has been deliberately left out of the shareware version (so that you will be inclined to buy the commercial version).

The alternative is to buy commercial software. This can be bought as single applications (such as the Eudora mail program or Netscape Web Browser) or you can buy an integrated suite, such as Internet in a Box or Internet Chameleon.

If it's convenience you're after, I recommend the integrated solution. The one package includes applications to access all Internet functions. Most importantly, commercial packages come with manuals which, if you are old-fashioned like me, make life a lot easier. A complete Internet suite can be had for as little as $199. Unless you have free access to the Net and lots of time on your hands, this outlay may be well worthwhile.

Books about Internet

Start by reading a good general introduction to the Internet; look for titles like *Internet for Normal People*. These books always seem to be much bigger than you want for an introduction, but are worth persevering with.

Getting started

Once you have the modem, software and Internet account, you are ready to roll. The best way to get started is to invite an Internet-literate friend over for dinner, and casually mention that you have Internet access but aren't quite sure how it works. Make sure you choose a night when you don't have to be up early the next morning...

You will probably want to send some e-mail, maybe to yourself as a test. If you like receiving mail, subscribe to some mailing lists. That way you will regularly receive mail. Be careful though; some lists generate hundreds of messages a day, and it costs you connect time to download it all! Make sure you know how to cancel your subscription to the list concerned, should the need arise.

You should also do some Web browsing. This can become very time consuming, so beware of running up a large bill.

When things don't work

If you have chosen to use one of the 'free' or 'evaluation' software packages, you are likely to be flying blind, since there is little in the way of instructions. The ISPs will offer only limited support, since it is not their software, and they have little interest in helping you work quicker on-line. Remember, the longer you muck around trying to get what you want from the Net, the more money they make.

When I had problems with one service — slow response and software bugs — I soon realised I was in for a long argument over whether the fault lay with their service, my software, or my hardware (modems are a popular scapegoat). Threatening to take my business else-

INTERNET SERVICE PROVIDERS

Name	Phone No. & E-mail Address	Charge Regions: STD Codes	Pricing	Accounts
Australia Online	(03) 888 2622 info@ozonline.com.au	02,03	10 hr/month with 1MB/hour, then $20 and $7/MB	SLIP/PPP, UUCP
Ballarat Netconnect	(053) 322 140 info@bnc.com.au	053	$85 rego, $85/month (1 hr/day, then $5/hr)	Shell, UUCP, SLIP/PPP
BrisNet	(07) 372 5296 john@ozspace.brisnet.org.au	07	$75 rego plus various rates	Shell, UUCP, SLIP/PPP
Camtech	(08) 303 3300 support@camtech.com.au	08	$400 reg. $400 annual (5MB/month) THEN $2/mb	SLIP/PPP, UUCP, mail via POP
CompuServe	1800 025 240 70006.101@compuserve.com	002,02,03,06 07,077,08,089	$14.50/month	Full access
DIALix	1902 292 004 info@dialix.com	02,03,06, 07,08,09	1 cent/min (14.4k), 2 cents/min (28.8k), 1 cent/KB	Shell, UUCP
Geko	(02) 968 4333 sales@geko.com.au	02	$20 rego, $30/month, 20MB free, then $1/MB	Shell, SLIP/PPP
Interconnect	1800 818 262 info@interconnect.com.au	02,03,06,07, 08,09	$95 rego, $20/month (2 hr/day, then $9/hr)	Shell, UUCP
Magnadata	(02) 264 7326 info@magna.com.au	02,03	$40 per month ($20MB/month then $2/MB)	SLIP/PPP, Shell
Message Exchange	(02) 550 4448 info@tmx.com.au	02,03,07, 08,089	$95 rego, $1/hour, $2/MB ($20/month min)	Shell, SLIP/PPP, UUCP
Microplex	(02) 438 1234 info@mpx.com.au	002,02,03, 07,08	$25 rego, 65 cents/hour shell, $3.50/hour SLIP/PPP	SLIP/PPP, Shell
Next On-Line	(02) 310 1433 support@next.com.au	02,03,07	$30 rego; various plans	Shell, SLIP/PPP
Odyssey World	(07) 854 1066 info@odyssey.com.au	07	Annual fixed fee $599 (7hr/wk then $6/hr)	Shell, UUCP, SLIP/PPP
Oz-Email	1800 805 874 info@ozemail.com.au	02,03,042, 043,049	$25 rego, then peak/off-peak and business rates	SLIP/PPP, Shell, OzRouter
Zeta	(02) 837 1397 info@zeta.org.au	02	$15/month (10 hours then $1/hour)	Shell, SLIP/PPP

This listing of selected Internet Service Providers is reproduced here by courtesy of our sister publication Your Computer. As fees change quite often, it's wise to check with the providers before committing yourself.

where didn't get me far either, since the ISP would be delighted to get rid of 'problem customers' who complain a lot.

I also had a dispute over billing. Comparing my Telecom bill to the ISP's bill showed charges for connections much longer than the corresponding phone calls. When signing up with an ISP, you may want to consider the wisdom of allowing them to debit your credit card monthly; if you opt for monthly billing, at least you will have a bill to argue over in the case of dispute.

What's the deal?

These grievances highlight problems that can arise when an industry grows like topsy in an unregulated environment. Because the cost of services is not great, it is unlikely that an individual consumer's complaint will be tested in court. However, multiplied by the tens of thousands of customers some ISPs claim to have, the total amounts could be significant.

One of the first issues that would be argued in case of a legal tussle is 'what were the terms of contract?'. The usual method of signing up to an Internet service is online registration. This involves connecting to the ISP, via modem, and following a procedure which includes entering your credit card details and other personal details. The online registration procedure of many service providers offers no explanation of what it is you are actually buying, so the consumer is at a disadvantage from the start.

Under consumer protection laws, the general rule is that you cannot be charged for services not provided. However the Internet business is full of grey areas.

For example, if you connect to the service, but the network is jammed, you are likely to be charged for 'connect time' even though the connection was useless. The ISP would argue that you have purchased connect time, so you should pay for it. I would argue that I had paid for a working service, and should only pay for *useful* connect time.

I recommend that before signing up for a service, you find out exactly what is or is not being promised. The basis of charging is obviously an important issue — a 'per hour' connect charge could be broken down to the second, or the minute, or even 10 minutes. Knowing this detail helps you minimise charges.

A strange business

In some ways, Internet Service Providers depart from the normal rules of business.

The usual rules of economy of scale are inverted. Large number of subscribers can lead to huge backlogs in answering customers' technical support questions.

Also, when a lot of people are online, the system can grind to a halt. Having lots of customers may be great for the ISP, but it's a definite disadvantage for the user.

You should also be aware that if the ISP offers a discount rate for off-peak usage, it is likely that every man and his dog will be trying to use the system at night. This can slow things down so badly that it is actually cheaper to use the system at peak time, when you can get it over and done with in less time.

In short, if you do decide to take the plunge, be prepared to be astonished not only by the avalanche of information but also by the strange mechanics of the service itself. ❖

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READER INFO NO. 6

THE CHALLIS REPORT

Continued from page 13

More significantly, the view prevailed that the quality of the audible signal was positively cleaner, and that Kathleen Battle's voice was purer (and better) when played on the CDC-755. In short, after playing the 'So Many Stars' disc the CDC-755 Changer had far more 'stars' on its tally sheet than did my existing CD player.

I proceeded to a pair of Matching John Williams discs, 'The Seville Concert' (Sony Classical SK53359). I loaded one disc onto the CDC-755 and the other into my current home CD player. The two discs were cued so that there was a precise five seconds between the replay of the first and second discs. This close time separation facilitated instantaneous changes from the CD player to the CD changer and back again, for direct and extremely effective A-B/B-A comparison.

John Williams is a superb guitarist, and this disc contains some of his finest music recorded with all the advantages of Super Bit Mapping technology. The music was superb, and both CD replay systems were well equipped for the task. Even so, my sample panel all rated the replay characteristics of the CDC-755 as being superior to that displayed by my existing CD player. I again received firm and consistent praise for the CDC-755's audible purity, and its superior top-end performance.

Frankly, the other members of my panel were extremely positive and very definite about the audible differences. My own impression from the listening tests was that I could hear a difference, that the CDC-755 had the edge on my existing CD player, and that 'dollar for dollar' it certainly had much more to offer.

Conclusions

Irrespective of which way I look at the test data and our subjective evaluation of the CDC-755, there are a number of salient conclusions that are now clearly in perspective. The first is that the performance of this CD changer is equal to, if not better than, any other CD *player* I have previously tested with an RRP under $1200. The second conclusion is that 'dollar for dollar', this five-disc changer outperforms any previous Yamaha single disc player that I have yet tested.

Last but not least, although I am critical of the adoption of the word 'silent' to describe its disc change mechanism, it should be noted that this is the only criticism that I can objectively apply to what is otherwise an unblemished test and subjective evaluation record.

The Yamaha CDC-755 Five-Disc CD Changer measures 435 x 388 x 106mm (W x D x H), and weighs 5.6kg. As noted earlier, it carries an RRP of $599. Further information can be obtained from Yamaha dealers or from Yamaha Music Australia, 17-33 Market Street, South Melbourne 3205; phone (03) 9699 2388, or fax (03) 9696 1273. ❖



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When I Think Back...

by Neville Williams

WORLD WAR II: 'Funny-peculiar' things happened in radio, 50 years ago!

Can you imagine a team of radio 'techs' and muscled he-men toiling long and hard to carve a complete studio complex out of solid rock — underground in the heart of Sydney! Bomb-proof, gas-proof and self-powered, the complex was to have provided the Federal Government with a hopefully secure, official, recognisable broadcast voice in the event of Australia being invaded by an enemy force...

Strictly speaking, what follows is at odds with the 'When I Think Back' theme, because I have no detailed personal recollection of certain wartime initiatives that one would expect people in the radio industry to have known about. I can only assume that they were subject to wartime security regulations which prevented their coverage in the news media.

What I do recall from those days was that industry personnel were well aware that, for the first time in its history, Australia was involved in a major war during which the vast majority of its citizens were directly accessible via broadcast radio. Indeed, by 1939, the public had come to rely on the family radio set for the latest news — rather than on tomorrow's paper or next week's word of mouth, as had been the case in 1914-18.

It was evident that if scheduled broadcasts were suddenly to disappear off-air, confusion, wild rumours, even panic could well follow. And matters would be immeasurably worse if transmissions were to resume, but carrying voices, reports, sentiments and directions emanating from Berlin or Tokyo!

Without saying much about it, the Australian Government apparently decided that, if the worst ever did happen, an invading force must not find transmitters, towers, studios and microphones intact and functional. Installations that could not be defended would have to be disabled or demolished, at the discretion of the relevant military command.

The above remarks were prompted, in part, by the biography of Murray Stevenson published in these columns (June, July, August 1993) and repeated in *Australia's Radio Pioneers*, chapter 29). As its then Chief Engineer, Murray tells how Radio 2UE in Sydney had just installed a more powerful transmitter and a new high efficiency vertical antenna on the river flats near Concord, Sydney. This was in July 1939, two months before the outbreak of World War II.



Fig.1: Architect Harry Seidler and a model of a new building proposed for a site in Darlinghurst vacated by the ABC. The story brought to light this month's story, of ABC efforts during WW2 to ensure continuous broadcasting services in the event of an enemy invasion. (Courtesy of John Fairfax Feature Services.)

To Murray's dismay, the installation was no sooner operative than Army sappers appeared on the scene with instructions to attach explosive charges to the base of the mast. The explanation was brief and to the point: "If Australia was invaded, the Government didn't want the enemy to be provided with viable broadcasting stations"!

Fortunately, said Murray, the military had never needed "to press the button". To which I am tempted to add: Neither did roving vandals who later demolished the MBH factory, in much the same lonely area! (November '95 issue)

But why 2UE, which was just one of several transmitters in the so-called 'swamp'? Try as I might, I could unearth no similar reports to do with other radio stations — just vague 'could have beens', and rumours about explosive charges having been planted under certain bridges and key installations to impede an enemy's progress.

The one thing that might have set 2UE apart in this context was the kind of antenna erected. Most transmitting antennas at the time would have involved towers supported by guy wires. For a team of sappers with an Army truck and cable cutting equip-



Fig.2: George Paterson VK2AHJ, to whom we are indebted for this story. One of the original ABC 'troglodytes', he saw the establishment of the underground complex adjacent to Forbes Street and spent many long hours alone in the 'switch room' after broadcasting stations had closed down for the night.

ment, it would not have required much forward planning to bring any such array crashing to the ground.

But the 2UE site at Concord had been too small to accommodate conventional guy wires, and the antenna was a self-supporting vertical tower with three stout 'legs' resting on huge insulators set into concrete foundations. To bring it down would probably require explosive charges, strategically placed — beforehand!

(I discussed this with Winston Muscio, a retired engineer from STC's transmitter section, who said that he had never heard of formal measures to wreck transmitters being threatened by the enemy — but he had no reason to doubt Murray Stevenson's statement. Thinking back, it is quite possible that 2UE's self-supporting antenna was unique at the time.)

But how did I get involved in this off-beat subject? The answer: mainly because of an article in the *Sydney Morning Herald* dated August 24, 1995. It had to do with a proposal to erect an imposing 43-store apartment building, in the Darlinghurst (Sydney) area designed by architect Harry Seidler. The building would occupy the site on the corner of William and Forbes streets, formerly occupied by the ABC.

While, over the years, I had had reason to telephone ABC staff at the Forbes St. address, the only time I had ever visited the place was a few years back when Stephen Pratley invited me to record an interview for use in his series 'Bright Sparks' — to do with the history of radio in Australia. The exercise involved an hour or more in a glass cubicle on the first floor (I think), but that's about as much I saw of the place.

So it was to be demolished and replaced by 43 floors of private dwellings, ranging in price from around $200,000 to over $2.5 million each for a couple of penthouses on the roof. Big deal! End of story — except for the civic arguments which seem to follow the announcement of any such new development!

But there was more to come. A few days later, I received a phone call and a tape from George Paterson, VK2AHJ, who was presumably reacting to the same news item. Did I realise that Seidler's new building would be sitting atop the bomb-proof underground studios which the ABC had set up at the site during the war?

Bomb proof studios?

What bomb-proof studios? I'd been Acting Editor of *Radio & Hobbies* during the war, and no-one that I could remember had ever mentioned any such project. If 'classified' at the time, the news blackout had been highly effective! But these days it's history, and George Paterson suggested that I contact the Archive Section of ABC/Telstra, which is currently housed at the television centre at Gore Hill, North Sydney.

On the tape, George said that he had joined the ABC as a trainee assigned to a two-storey studio complex at 96



Fig.3: A traditional 1930's style studio where George Paterson learned his trade. In 1936, ABC Chairman Charles Moses was calling for a more harmonious acoustic and visual environment for ABC announcers and artists. (Courtesy Telstra/ABC.)

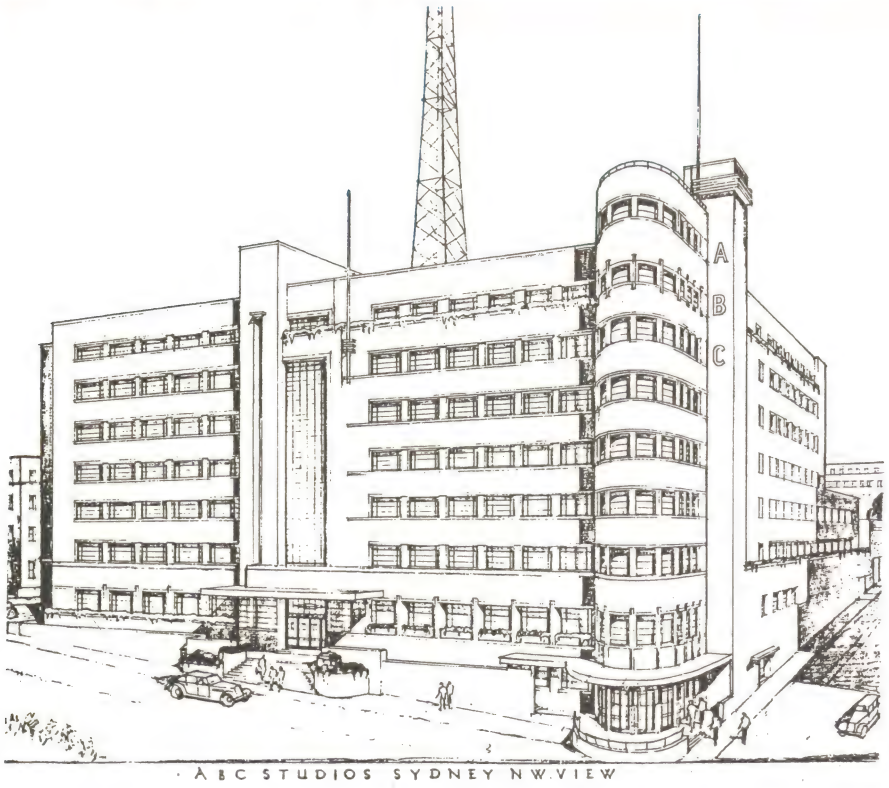


Fig.4: The ABC headquarters planned for Forbes Street in 1936. Wartime conditions dictated a radical change of plans. The ABC now occupies a new headquarters in Ultimo, Sydney.

Market Street, Sydney. The site, he said, has since been obliterated by the Sydney Tower; but back in 1940, it was the main program distribution point for Sydney radio stations 2FC, 2BL, and their associated regionals. There was also a feed to the shortwave service 'Radio Australia'.

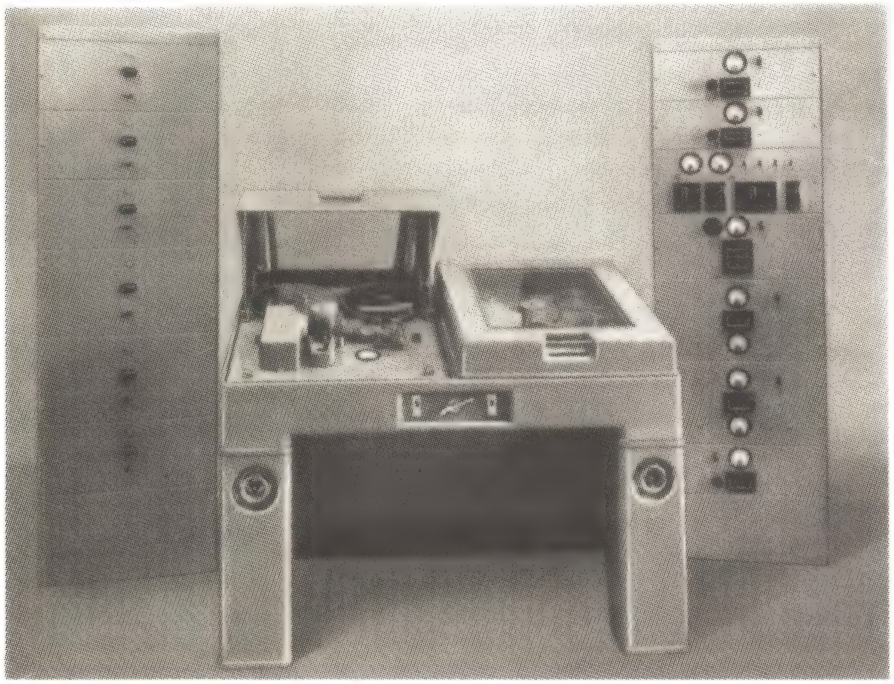
The place already had a history and at least one of the studios dated back to the AWA era, prior to 1932, when the Australian Broadcasting Commission took over all A-class stations, with the PMG's Department assuming responsibility for technical facilities.

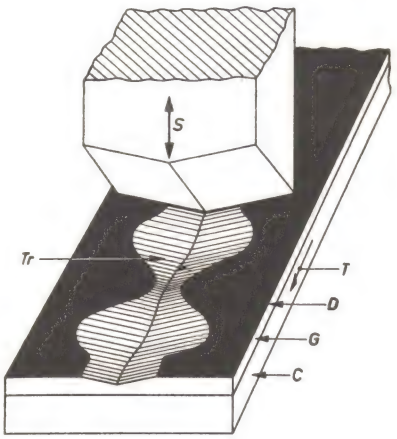
George's job had to do with individual studio and Master Control facilities — the latter referred to as the 'Switch Room'. He recalls that, early in the war, the studio windows, most of which overlooked Market Street, were bricked in, presumably as a precaution against bomb blasts.

During 1942, as George recalls, moves were made to transfer the market Street operation to a site on the corner of William and Forbes Streets. The new studio complex was to be bombproof, gas-proof and able to operate independently of the power mains. It would involve carving a huge hole down through the topsoil, into the underlay of solid sandstone. The hole was to be set back so that some 15 or 20ft of sandstone separated it from Forbes St.

As it happened, the ABC was able to contemplate such a proposition because they already owned the land. Back in August 7, 1936 our own magazine (then called *Wireless Weekly*) had published an interview with Mr (later Sir) Charles Moses, in which he announced that the Commission had purchased a 1-3/4 acre triangular site bounded by William St, Forbes St and Clapton Place.

The Commonwealth Architect, Mr Henderson, a man familiar with overseas trends, had submitted plans for a





At left is the Philips-Miller sound recording equipment made in 1936, and purchased by the ABC for use in Australia. The diagram above shows how the system worked: a vibrating cutter produced what was effectively a variable area sound track.

building appropriate for the ABC Headquarters, administrative and technical, and with ample provision for future expansion. In particular, Mr Moses was keen to see modern studios which would harmonise, acoustically and visually with the quality of current ABC programs.

The site was very accessible, elevated in terms of the cityscape, with an underlay of solid sandstone — ideal for the foundations of a large building. What Mr Moses could not know was that War would frustrate the Commission's best-laid plans, and that the sandstone underlay would be carved out for an electronic 'bunker' and later topped by a much humbler structure.

And that brings us back to George Paterson's underground complex. The 'roof' comprised a massive layer of laminated concrete, topped with rubble and topsoil so that there was little hint as to what was underneath.

Normal access was via a steel bomb-proof door, set into the rockface which opened into Forbes Street, across the road from the Sydney Church of England Girls Grammar School. To provide a second access for emergencies, a tunnel at the rear led up through the rock to the surface.

As it happened, the tunnel proved quite an asset, not for reasons of safety but because it provided a convenient route for ABC personnel needing to interact with back-up services in nearby above-ground offices.

Fifty years on, George confesses that his recollection of the underground installation is fading, but it followed along similar lines to what had been at Market Street. There were three main studios: one each for 2FC and 2BL, and a third for regional programs. The technical facilities were similar to those at Market St, although a touch more modern. Recordings were still a mix of 78rpm commercial pressings and 33rpm 'transcription' acetates, and the pickups still used steel stylii, which had to be changed after playing each side. (What a chore!)

With magnetic tape still several years away, the underground complex had its own facilities for cutting acetate discs.

In this context, George recalls that American radio shows used to arrive on 33rpm transcriptions branded 'Orthocoustic' — a term which, according to my Tremaine's *Audio Cyclopedia*, signified a recording characteristic adopted by RCA/NBC prior to adoption of the official and somewhat similar RIAA standard.

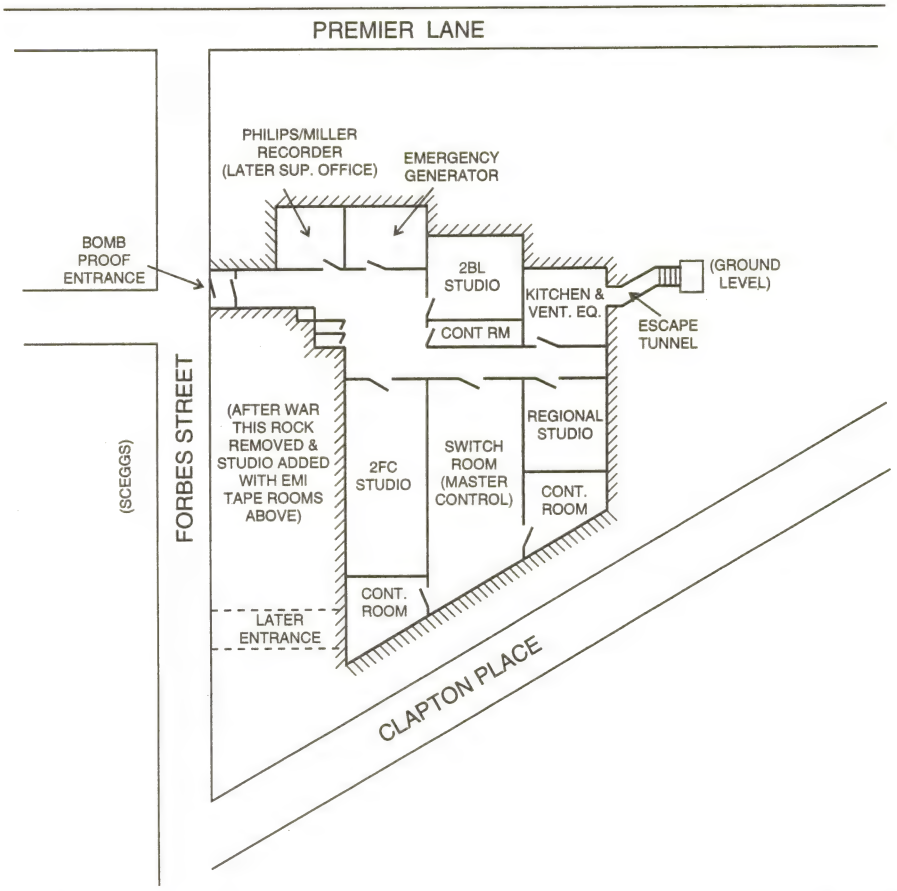


Fig.5: The layout of the underground studio complex (not to scale), as George Paterson remembers it. To the best of his knowledge, the facility was unique, certainly in Australia.

American practice was to play such records with an Astatic crystal pickup, but the ABC also experimented with magnetic types made by the PMG Labs in Melbourne. These were superseded by Decca and Ortofon models, which offered a memorable breakthrough at studio level by the use of diamond stylii — eliminating the tedious chore of replacing steel needles.

No less memorable, however, was the installation of a complete Philips/Miller recording system, which some old-time readers may remember. It used a quarter-inch (celluloid?) tape, coated on one side with a layer of clear lacquer (gelatin?) topped by an opaque layer. In use, it was drawn under a recording head with a triangular tip not unlike an acetate cutting stylus.

In the absence of modulation the stylus would scribe a clean line through the opaque layer into the transparent under-layer, producing an optically uniform track. However, with modulation, the head drove the triangular stylus tip more deeply or less deeply into the lacquer, producing a variable width track reminiscent of a variable area track on an early sound movie film.

George remembers the Philips-Miller as a genuine high fidelity system, but a "monster of a thing, with multiple racks of equipment and huge spools, large enough to dominate a complete room". His summation: "It produced a high quality recording, but in a very laborious way".

In fact, the ABC bought it at precisely the wrong time: the war interrupted the supply of tape from Holland and substitute tape from America proved unsatisfactory. So the system remained largely unused — ending up, to the best of his knowledge, in a Melbourne museum.

In the interim, broadcasters had glimpsed the less daunting and more practical magnetic wire and tape recorders being developed by Magnecord, Pyrox and others.

George said that he worked for some years in the underground Master Control room, on a roster covering 24 hours per day.

While radio stations in those days broadcast from 6am to 11.30pm, the roster ensured that one man was on duty each night outside those hours.

They were there in the event of an

emergency, but they also had to record overseas news broadcasts, particularly those emanating from the BBC. These were fed to Forbes Street over lines from receivers at Liverpool ('Snake Gully'), west of Sydney, the Receiving Centre at La Perouse (NSW) and Mont Park (Melbourne). The job of George and his colleagues was to select and record the best channel on the night, for subsequent re-broadcast.

He recalls that there was ready access from the Forbes Street complex to the news room and studio at 91 William Street, via a small bridge across Premier Lane.

In fact, said George, the ABC had studio facilities "all over the City" at the time. Included was the King's Cross facility (for the Orchestra); Broadcast House, Pitt St (Variety); Piccadilly Arcade (Childrens' sessions); two studios at Burwood; and a special 'Emergency' studio in the basement of Broadcast House. From the last named there were lines to the studios of all commercial stations, in case the ABC was required at any time to initiate a 'blanket' broadcast.

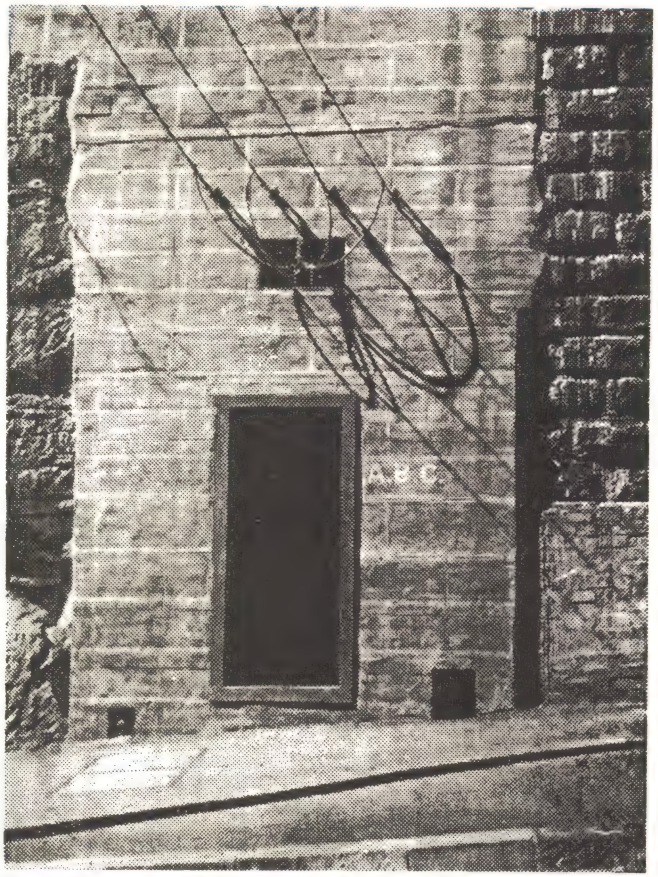


Fig.6 From the 'ABC Weekly' for April 27, 1946, the blast proof door opening onto Forbes Street. The pattern on the stonework is created by shadows cast by the incoming power supply cables.

What George found surprising in all this was a noticeable lack of security. "People just seemed to come and go as they pleased. To be sure, a visitor might find a commissionaire in attendance at Forbes Street, but his main role seemed to be to answer the question 'Where might I find so-and-so?'... or this or that!"

After the war, some of the rock separating the underground complex from Forbes Street was blasted out, and the facilities extended to provide an extra control room and several tape recording rooms at an intermediate level.

Last but not least, a multi-storey building was erected over the lot, so that the underground installations became a virtual basement. 'Upstairs' they built extra studios, a new Master Control room and administration offices. That was apparently the building into which several of we old-timers were conducted a few years back to be interviewed for the 'Bright Sparks' series.

A more pretentious building was planned for the area, but never got past the architect's drawing stage.

And that's about where George Paterson's story comes to a close. As he says, his recollections of the era stand out fairly sharply, but it is 50-odd years ago and he could have confused some of the details. So also could a couple of contacts who worked with him in the same surroundings: John Warren (VK2QX) and Dave Capp, whose call-sign at the time was VK2AO.

One memory that does stand out is that George, John, Dave and the rest of the crew were referred to as 'troglodytes' — cavemen, or cave dwellers!

The ABC's resident Document Archivist, Geoff Harris, is well aware of the broad facts surrounding the Forbes Street centre but is unsure of how much is available by way of historical records, where they may have been stowed and how long it may take to unearth them — if at all!

In recent times, the ABC has been fully occupied in moving to its new complex in Ultimo, Sydney, and they're far more concerned with the implications of tomorrow rather than of yesterday. Meanwhile, I gather, the Forbes Street premises have been virtually abandoned, with history presumed to become bulldozer fodder!

With a touch of nostalgia, George says that he would love to explore the historic site, but he isn't holding his breath! These days, it may not be accessible. If the Seidler building goes ahead, it may well involve an even bigger hole where residents will park their cars!

Fortunately, Geoff Harris' efforts were not entirely in vain. He came up with a photostat of page three of *The ABC Weekly* for April 27, 1946. Under the tagline 'The story can now be told' it carried an article headed 'A.B.C. Secret War-Time Plans To Carry On Radio Services'.

It is immediately apparent from the article that my early remarks about the authorities being 'aware' of a potential problem fall well short of reality. I quote:

The story of Australia's secret war-time plans for carrying on broadcast services to the Nation, in the event of bombing attacks or invasion can now be told.

It is a dramatic story of emergency studios, of special staffs standing by, of mobile units ready to speed to any spot and of properly equipped regional centres.

The action was taken by the A.B.C. (sic) in common with the P.M.G.'s Department and with the approval of the Defence Authorities. It had a priority place in the greatest of national emergencies.

Responsible for providing a reliable news and program service, and maintaining public morale, the A.B.C. was fully mobilised for action.

One of the early initiatives in Sydney was to set up an air raid shelter in the basement of Broadcast House in Pitt

Street. Incorporated was an emergency studio and control room, complete with its own power supply. As mentioned in George Paterson's tape, it also had on-line access to all local stations and was a key response facility pending the Forbes Street installation.

According to the *ABC Weekly*, the construction of the underground studios was 'massive'. Hewn from solid rock, the chamber had walls of reinforced concrete 3'6" (1m+) thick and longitudinal dividing walls 24" (0.6m) thick, cutting the interior into pill-box like compartments.

The roof had a 2'6" (0.76m) layer of reinforced concrete, with an overlay of concrete and boulders 7' (2.1m) thick. Entered by a narrow bomb-proof door, the interior was bomb-proof, gas-proof and 'scientifically' ventilated. It had its own internal power supply.

At the time of publication in 1946, the war had come to an end but the Forbes Street complex remained fully operational as a key source for the distribution of programs to the ABC National Network.

As a measure of the extremes to which the system was prepared to go, the article mentioned precautionary measures adopted in other capitals and regions:

- In Melbourne, in the then-new ABC block in Lonsdale St, a Switch (Master Control) room was installed underground.
- In Brisbane, an especially strengthened studio was installed on the third floor of Penny's Building. It was used in its emergency role during a couple of alerts during in 1942.
- In Adelaide, an emergency studio was set up in the suburb of Prospect, while work proceeded to strengthen the main studio complex.
- Similar arrangements operated in Perth, where an emergency studio was set up in a private building in South Perth. As in Sydney, all of these emergency installations were provided with supplementary phone circuits and staffed for 24 hours per day.

Wherever possible, supplementary phone circuits were provided by the PMG's Dept to maintain a network feed to regional and other isolated transmitters. Mobile teams were also organised such that personnel could be rushed to any transmitting centre that had been cut off from the system feed, or access by the Defence Authorities.

When I mentioned the above measures to George Paterson, they stirred a chord of memory. He couldn't remember exactly when, but he had been summoned from the control room and instructed to report to what was then 'the bush' on Sydney's western fringe.

At the time, the 2BL transmitter was sited at the beach-side suburb of Coogee. Realising its vulnerability, someone had decided that it should be moved to Kingswood. So a motley team erected two 120ft (36m) masts in the designated area. The lower half of each was a 'bush pole' and the top half a metal framework, with appropriate supporting guy wires.

Other members of the team erected a shed for the transmitter — but not before misreading the ground plan! But no matter, they installed the transmitter anyway. "She'll be right, mate!"

George said that, out of curiosity, he drove by the site a few months back. The masts and transmitter have long since disappeared, but the shed is still there — now a carpenter's shop. "And I mean, right where it always shouldn't have been: nowadays, an otherwise straight road skirts around it!" ❖

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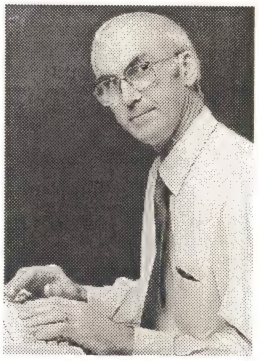
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READER INFO NO. 9

FORUM

Conducted by Jim Rowe



CD players on aircraft, rumble on CDs, and how imports effect local manufacturing...

We're not starting any new arguments this month, but presenting instead some interesting responses to some of the topics we've discussed here recently. There's more on that ban by some airlines on the use of CD players during flight, on the questions of compatibility and rumble in CDs, and another response to that letter from New Zealander Richard Williams regarding the impact of imported products on the local manufacturing and servicing industries.

You may recall that in the April issue, a reader in Brisbane raised the question of why airlines like Qantas and Ansett banned the use of portable CD players on their flights. He sent copies of letters he had received from both companies, explaining their positions and seeking to justify their positions on the grounds of aircraft safety.

The official Ansett position seemed to be that CD players were allowed during cruise flight, but banned during takeoffs and landings (like laptop PCs) in order to eliminate any possible risk of EMI interfering with instrument landing equipment or other critical systems. Qantas seemed to go even further, banning their use altogether on the grounds that airlines had found that HF emissions from a CD player caused interference in the frequency bands used by aircraft radio and navigation systems.

I guess many of us found the technical justifications given for the bans rather unconvincing, and there were quite a few rather skeptical responses which I published in the July column. But we also had a bit more clarification regarding the real reasons behind the bans, especially from a CAA engineer I'd managed to contact.

Anyway, more recently I've had another contribution to this topic. It came as a fax from Mr Anthony Chidiac of Bundoora in Victoria, who is apparently managing director of a recording company known as Opulent Music Entertainment, and also executive producer of a TV programme called 'Rhythm Nation Television'. Mr Chidiac believes that in our previous discussion, we technical types were side-tracked by the somewhat vague justifications given by the bans, and as a result we missed the *real* reason — which is much more prosaic:

I read with bemusement your Forum column in July's EA. The reason why I found it quite funny was that the articles contributed to this column were written by people with undeniable technical knowledge, but little practical knowledge of why airlines try to ban the use of PED's, in particular CD players and tape recorders, during flight.

I was recently en route to the United States when the Captain announced that we may be experiencing turbulence shortly, as we were passing around cyclonic activity close to Honolulu. He then switched on the 'seat belt' sign. A person who sat three seats away from me had his CD player with him and I could hear his 'Nirvana' CD playing, as it was that loud.

A minute later the plane lost 500 feet of altitude in about (what felt like) a second. That person was ejected from his seat, hit the ceiling, but luckily only sustained minor head and neck injuries. The passengers either side of him also were injured to a lesser extent, from his 'ejection'.

Had this person not used this CD player, he would have heard the Captain's message to fasten his seat belt and the incident would not have occurred. Though he did have his seat belt on, it was loosened to the extent where he could have easily slipped out of it, so in this instance the seat belt accentuated the injuries because it had not been fastened properly.

Due to rapid changes in technology, portable CD players these days have enough amplifier drive effectively to shut out the outside world to the listener. In this instance, the Captain's message had been unintentionally ignored, and the result became frighteningly obvious.

I note also that similar restrictions apply for mobile phones and PED's in a car, so that the driver is not distracted and is aware of any oncoming ambulance/fire engine/police car.

If these technical types who write to your Forum spent more time on working up a solution, such as inventing a simple 'automatic switch' to plug in between a CD Player and the aircraft's PA system, that way when important announcements are made, the CD music cuts out and the announcement is heard. I think that solution would comfort the airlines more than their unsubstantiated excuse as trivial EMI radiation from a CD player/tape recorder which, as all your contributors note, is negligible compared to other outside factors.

Well, there you are. It's a somewhat more down to earth explanation, to be sure, but it probably makes more sense than a lot of the other explanations that have been offered, don't you think? The PA/entertainment systems on most aircraft seem to be designed to always give announcements priority over entertainment programme material, and as Mr Chidiac points out this is certainly a very sensible arrangement for optimising everyone's safety. Private CD players and the like certainly don't allow this, and that's a clear disadvantage.

Of course the same problem exists with compact cassette players and recorders. These too have sufficient audio output to 'drown out' external sounds, as anyone can testify if they've tried to communicate with someone listening to one. It isn't just portable CD players — yet it's these that the airlines seem to have singled out, apart from



obvious sources of significant EMI like cellular phones.

Still, I suspect that Mr Chidiac has drawn our attention to at least *one* of the real factors behind the bans, and I thank him for his interest. His fax also commented on one of our other topics, and I'll come back to him shortly.

Before we leave this topic, I should note that there were also quite a number of other letters seeking to explain why cellular phones and CB transceivers are also banned on aircraft. However I'm not proposing to present these here, as there's really no argument on this score; most technical people would agree that using such obvious 'transmitting' devices inside an aircraft in flight would be inviting trouble, and even our original correspondent wasn't arguing otherwise.

But there's a big difference between the RF energy deliberately emitted by a cellular phone or CB transceiver and that which may 'leak' from a portable CD player, isn't there? That was the point we were all making...

Quietly changed

Incidentally, you may remember that in the April column, we reproduced a letter from Jen le Gassick, Qantas' Manager of Corporate Customer Relations. This in turn quoted Ken Lewis, the Head of Safety and Environment, making it clear that Qantas banned the use of both cellular phones and portable CD players on all of its aircraft. Not just during takeoffs and landings, like Ansett, but completely...

Well, it seems that despite what this letter said, Qantas has quietly changed its official attitude in the intervening months. A couple of days ago, a colleague in the industry who flys rather more often than I do noticed the following small item in the September/October issue of Qantas' *Frequent Flyer* in-flight publication:

NOW YOU CAN PLAY CD'S

Portable CD players may now be used on board Qantas flights — once the aircraft has reached cruise. This is similar to the conditions for the use of laptop computers. There is no change to the ban on the use of other devices such as mobile telephones.

Hmmm — interesting, isn't it? I'm not big-headed enough to think that the mighty Qantas could conceivably have softened its ban as a result of our little discussions here in *EA*, but perhaps we may have played some sort of small role in getting them to reconsider their official attitudes.

One way or another, then, and for whatever reasons, both Ansett and Qantas will now apparently allow you to use a CD player during cruise flight. That's not too bad, is it? I suspect most people will accept it as a reasonable compromise between safety and convenience, anyway.

CD 'rumble'...

Moving on, you may remember that in the July column I presented a letter from Dr S. Frank of Berwick in Victoria, reporting that since he had added a subwoofer to his hi-fi system he had noticed 'rumble' or at least a similar low frequency noise, present on some of his higher-priced 'DDD' recordings. All of which was rather puzzling, because the digital recording and playback technology used for CDs is largely immune to artifacts such as the rumble that could be present with earlier analog recordings.

My only suggestion at the time was that since the low frequency noise concerned seemed to be present only within the tracks — i.e., when the programme material itself was present — it was perhaps caused by problems in analog

microphone preamps, or was some kind of intermodulation distortion.

Well, I've had a couple of responses to this, one of which came from Mr Chidiac. I'll present this in a moment, but before I do let's look at the other response. This came from long-time reader Mr Alan March, of North Turramurra in NSW, who offers the following comments:

As a regular reader of EA and its predecessors for about 50 years, it is obvious that I hold the magazine and its production team in high regard.

Forum is one of my favourite features, and Dr Frank's comments on low frequency noise in CDs caught my attention. I incorporated Rob Evans' subwoofer design (June 1992) into a pair of full range four-way, active crossover units which have a useful output down to about 25Hz. The overall response is as near flat as I can get.

Out of the 100-odd CDs that I have, some of the reissues have extraneous noises (such as traffic) but, with one exception, the 'DDDs' are uniformly quiet. The exception is a 1989 recording of Ginastera's harp and piano concertos and his ballet suite 'Estancia', played by the City of Mexico Orchestra on the ASV (Academy Sound and Vision Ltd) label. My suspicion is that the rumbling noises are the result of inadequately isolated floor-mounted microphones for the harp and piano, because there is no evidence of the noises in the ballet suite.

Furthermore, the rumbles seem to coincide to a degree with the pedalling in the piano concerto and with the glissandi in the harp concerto. The rumble is clearly visible on an oscilloscope attached directly to the CD player, as an approximate sine wave of between 10 and 20Hz.

Many years ago a friend of mine complained about an intolerable rumble in a recording of Brahms' Deutsche Volkslieder, by the great team of Schwarzkopf, Fischer-Dieskau and Moore. The recording is at a somewhat low level, but I was able to demonstrate to him that the recording, for those days, was virtually noiseless and that the problem lay in his turntable. He bought new sound equipment soon afterwards.

I have noticed with some CDs that, if an excess of bass is used, a very low and distressing pulsing effect can occur, I suspect along the lines of the 'intermodulation phenomenon' that you mention, and this could easily be mistaken for rumble.

With respect to Dr Frank, therefore, my suggestion is that either he has a bit too much bass boost in his setup or that a re-evaluation of the subsonic response of his sub-woofer will cure his problem. While one can argue with the artistic merit or the sound balance or the studio acoustic of modern quality recordings, it is very rare for there to be any serious shortcoming in the purely technical aspects of a recording.

Thanks for those comments, Mr March. Your experiences are interesting, as is your suggestion that an effect like that described by Dr Frank can be produced if there's an excess of system gain in the bass region. It's hard to be sure if something like this could be responsible for Dr Frank's problem, but at least it's worth investigating.

As it happens, our second response to Dr Frank's contribution also seems to throw some additional light on this. And here's where we return to the fax from Mr Chidiac, who as you'll recall runs a recording company:

With regard to your article on 'Low Frequency Noise', another possible contributing factor that you may want to be appraised of is the mastering and duplication process. Some CD plants around the world (including Australia) still convert the Master Recording to analogue before converting it back to digital for 'burning', possibly due to 48kHz to 44.1kHz conversion.

I found it a problem when I pressed a local release of our first batch of CD's by a Canadian group. The first batch had a 50Hz sinusoidal wave, not apparent in the Master, which may match the 'rumble' that Dr Frank is talking about.

The CD was recorded in analogue, mastered in digital, but converted back from digital to analogue before the glass master was 'etched'. Due to this the first batch was discarded; the new batch was derived from a CD pressing sourced from the first batch of the original CD pressing made in Canada, and was free of any anomalies, except from the original analogue recording.

With DDD recordings, it seems that some may not be kept totally in the digital domain, due to factors which are beyond the control (and knowledge) of record companies. I think record companies themselves should have in-house technology to pick up such anomalies, as other trades effectively use machinery to 'quality check' their products. Playing it on a CD player is not enough, as some sound systems (and ears) cannot reproduce all frequencies. Record companies should invest in a spectrum analyser, specifically 'tuned' to anomalous frequencies.

I note that ever since we changed our disc manufacturer to Disctronics (Melbourne), I have not experienced any problems of the sort again. It's really nice knowing that an Australian firm can do the job better than some overseas manufacturers, even though it is more expensive to press here. To date, there are now four disc manufacturing facilities in Australia. One is owned by Sony; another by EMI/Warner; an independent facility exists in Adelaide; and Disctronics in Melbourne which is owned by Showads Omega.

Thanks for those comments too, Mr Chidiac. It's interesting that even some DDD recordings apparently go through a digital-to-analog conversion and then back again, before the glass digital master is 'etched' — presumably in order to convert between sampling rates, as you say. Certainly this would create an additional opportunity for 'analog' anomalies like rumble and hum to sneak in, wouldn't it? Especially if an analog tape was being used for intermediate storage...

It also seems very relevant that Mr Chidiac could report having had direct experience of an extraneous 50Hz signal (sounds like old-fashioned hum, doesn't it?) creeping into one of his recordings, forcing his company to discard the complete batch. If this sort of thing could happen with one company's recordings, it could presumably happen with others as well. Perhaps some of the other recordings aren't quite as zealous as Mr Chidiac seems to be, in monitoring the quality of his final CDs.

...and compatibility

By the way, do you recall the letter I published in last December's column from Mr Gerard Lawrence of Bateman's Bay, regarding problems some of his customers had playing some CDs on some CD players? There was a follow-up letter in the March column from Mr Fred Thorpe of Narrabeen in NSW, reporting similar problems.

Well, as it happens my own parents have just struck the same problem. Their Akai CD player — less than a year old — will play any of their existing collection of CDs perfectly, but refuses to even recognise a new one they recently bought. As far as the player is concerned, this CD may as well be a plastic place mat, because it doesn't even regis-

ter as a disc when the drawer is closed. Yet the same new CD will play normally on the CD players of other family members! It's all very curious, and gives further support to the theory that there's some kind of compatibility problem — perhaps caused by variations in key performance parameters for the discs and laser pickups.

In this connection reader Justin Hammond also left the following message on the *EA* Computer BBS recently:

CD Tolerances:

I remember reading recently about problems with certain CD players playing certain CDs. I currently own a Technics SL-P555 CD player, that was one of the top of the line models when it was released. I have the same problem in that it refuses to play certain CDs.

Sometimes if I press Play and leave it, after a couple of hours of skipping all over the CD it eventually finds the start, and plays the CD correctly. The offending CDs work without a hitch on other players. Can you tell me if I can somehow rectify this problem? If I was to return it to Technics, would they be able to do anything about it?

Well, Justin, we can't tell you what you can do to rectify the problem, because no one seems really clear on what causes it. It's possible that returning the player to the local service centre *might* result in it being fixed, but it's also possible that it mightn't...

As I mentioned back in the March column, one suggestion I've heard is that some CDs have their innermost 'table of contents' or TOC tracks very close to the centre of the disc, and that possibly due to slight misalignment of their laser pickup mechanism, some players may not quite be able to 'find' the TOC information as a result. Whether or not that's true I haven't been able to find out; perhaps someone from one of the CD player manufacturers may be able to enlighten us all on this one.

Imports vs manufacture

And now, for our final revisitation to a topic this month, let's return to the one opened up by New Zealand reader Richard Williams, in the May column, about the impact of imported products on that country's local manufacturing and servicing industries. You may recall that I published a number of responses to it in the September issue — including one from Mr Angus Tait, the founder and MD of Tait Electronics, the well known NZ-based manufacturer and exporter of two-way radio equipment.

Well, here's an interesting further response that arrived recently as a message on the EA Computer BBS, from Mr Tony Brown of Craigie in WA:

I really cannot allow poor Richard Williams (EA May issue) to be the lone voice in the wilderness, with regard to his point of view on the dreadful way our respective governments in the Western world have encouraged our domestic manufacturing bases to be wiped out by unfair competition from the developing world.

The reply by Angus Tait (EA September issue) makes a couple of valid points, but totally misses Richard's main argument, that the destruction of the manufacturing base of a country has had very dire consequenses for all of the 'West', and that economic policy cannot be totally separated from social, health

NOTES AND ERRATA

New improved Flexitimer Mk2 (September 1995): Fig.4 on page 70 shows Q1's emitter arrow facing in the wrong direction for a PNP transistor — it should of course, be pointing towards the base connection. Also, the text on page 72 mentions that transistors Q2, Q3 and Q4 have extra pads so that PNP transistors can be installed in place of the normal NPN types — as can be seen from the PCB and overlay diagrams, this in fact, applies to Q1, Q2 and Q3.

PC controlled Sweep Analyser (September 1995): In three places the text on page 61, and again on page 62, incorrectly refers to the Maxim ADC device as a MAX121, when it is of course, a MAX191. The schematic diagram and parts list are correct.

Model Train Controller (November 1995): The PCB coded 95tc10 and the UB3 (130 x 65 x 40mm) plastic case were erroneously omitted from the parts list.

LED Battery Voltage Indicator (September 1995): The schematic on page 77 has the bipolar LED's cathode labels reversed. This will result in the LED glowing green instead of red for a drop in supply voltage. Both the PCB and parts overlay diagram are correct, however.

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READER INFO NO. 10

and crime policy. After all, what sort of country do we really want?

Bruce Stevenson (EA September issue), makes an argument that somehow because the imported goods take a little bit of handling, the jobs involved in that activity will in some way compensate for a full-blown manufacturing plant. The stupidity of this idea astounds me. As for his comments about the dollar, the only way our dollar's (or anybody else's) exchange rate is set is by the basic rules of good housekeeping — you import only what you can pay for, and if your manufacturing base is destroyed, you can't pay for much.

When I started in this industry, sets were locally produced, and retailers had a 33.3% markup on brown goods. Most of that was plowed back into the service department to pay for the installation, warranty breakdowns and service overheads. When resale price maintenance was discarded, that was the beginning of the end of the service industry. Without that money, service departments could no longer afford to allow experienced technicians to spend valuable time to look after apprentices. Thus, the quality of the technical base of the country became eroded, and proper apprenticeships became an anachronism.

At the same time, salaries were squeezed in the service sector relative to other sectors, as accountants took over and service departments had to pay their way. Concurrently chain stores throughout the country were falling over each other to sell TV's at a loss, to preserve market share.

I just hope that as time goes on and there are fewer and fewer real technicians left, that their wages will once again reflect their true worth.

The major problem is in the removal of tariff barriers. Angus Tait says that it lets in the 'real world', and he is right. But that real world includes slave labour by Chinese children and others in the third world, and we are doing a real disservice to those unfortunates by buying the fruits of their slave labour.

Angus Tait says let free competition rule, but it certainly is not free for those poor workers in third world countries. How can an Australian or New Zealand worker possibly compete with their appalling conditions and miserable wages?

The only solution is to re-impose selective tariff barriers, to bring the cost of the imported goods up to where it would be if decent wages and conditions were imposed on third-world employers, and then direct the proceeds straight back to improve conditions and environments where the goods originated.

This could obviously not be done by Australia and New Zealand alone, but if the developed nations could work together, it would be a great way to resurrect home grown industries and bring the actual real cost of brown goods up to something approaching normality. At the same time, it would revitalise the service sector, and immeasurably improve the lot of third-world workers.

Thanks for those comments, Tony. I think a lot of us can see the logic in what you say, especially about the way it can be very difficult for local manufacturing to compete against imported products made in countries where employees are working in almost 'slave labour' conditions.

I think I can also see what you're driving at, with the claim that service departments tend to be the first areas cut back, when price discounting reduces retail profit margins down to little more than bare survival level. This would certainly explain why service departments seem to have either 'shrunk' dramatically or closed down, and why there seems to be somewhat less emphasis on in-house training than there used to be. And like you, I certainly find this a worrying trend — not just for New Zealand, but for Australia as well.

But I guess I for one find it hard to share your belief that we'd ever see the world's developed nations prepared to work together, foregoing the lure of cheap imports and quick profits for the altruistic aim of raising the standard of living of people in developing countries. It's a wonderful thought, but I fear it would need a pretty major change in human nature...

That's about all we have space for this month, folks — and for this year, as well. My thanks to everyone who has contributed to Forum this year, and I hope you'll join me here again next time. Hopefully even a few of those radio amateurs who wanted to string me up from the nearest Yagi array will have forgiven me by then, and be prepared to begin the new year with a modicum of good will.

In the meantime, have a pleasant and safe Christmas and New Year! ❖

EA'S COMPUTER BBS

As part of its service to readers, *Electronics Australia* now operates a Reader Information Service Bulletin Board System (BBS). This makes available a wide range of useful information, for convenient access and rapid downloading by readers equipped with a personal computer and modem.

Here's an idea of what's currently available on the BBS:

- Software needed for recent PC-based EA construction projects
- Index files for EA and ETI projects
- Recent notes and errata, both published and as-yet unpublished
- Useful public domain and 'shareware' software for electronics and amateur radio
- General interest shareware utilities, such as the commonly-used compression and decompression utilities.
- The ability to upload Letters to the Editor, and/or contributions to our Forum and Information Centre columns (send them as plain-text ASCII files, please!)
- An on-line 'Discussion Forum' facility, allowing readers to exchange useful technical information directly.

The BBS is ANSI-compatible and is currently operational for virtually 24 hours each day, seven days a week, on (02) 353 0627. Your modem can be set to any standard speed from 300 to 28,800b/s full duplex, with a data format of '8-N-1' (eight data bits, no parity and one stop bit).

So feel free to call up the *Electronics Australia* BBS. Your only outlay will be the usual cost for a phone call to Sydney...

NEW KITS FOR EA PROJECTS

FROM DICK SMITH ELECTRONICS:

Active Indoor Antenna for HF (December 1995): The DSE kit is complete with case, PCB, telescopic rod antenna and all specified components and hardware. Both front and rear case panels are of powder-coated steel, pre-punched with all holes. The front panel has silk screened lettering while the rear panel is supplied with a label. The kit has Cat. No. K-6102 and is priced at $89.95.

FROM JAYCAR ELECTRONICS:

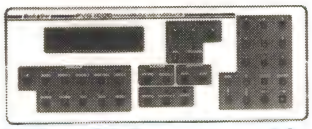
Train Controller with Simulated Inertia (November 1995): The Jaycar kit is complete as described (no transformer or plug pack), with PCB, case, ferrite rod and all specified electronic components. It has Cat. No. KA-1780 and is priced at $29.95. Jaycar can also supply a suitable transformer rated at 1A, MP-3026, for $21.50.

NOTE: This information is published in good faith, from information supplied by the firm(s) concerned and as a service to readers. Electronics Australia cannot accept responsibility for errors or omissions.

Black Star

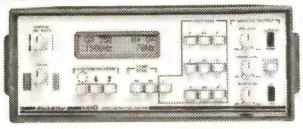
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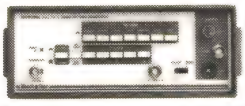
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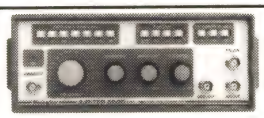
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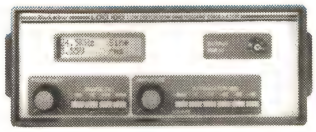
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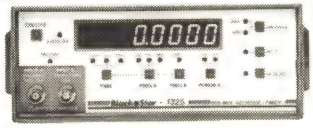
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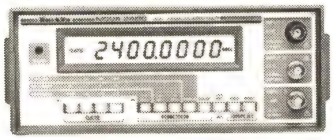
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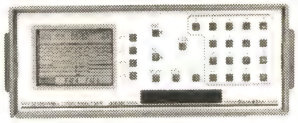
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THE SERVICEMAN

Wrestling with some decidedly unfriendly audio and video equipment!

People often complain about the 'user unfriendly' nature of many computer systems, but some consumer equipment isn't all that easy to use either. A few weeks ago I had to do battle with an audio/visual system containing a particularly unfriendly CTV and VCR, after some kids had fiddled with their programming. However that was only part of the story...

This month I'm going to talk about an exercise that isn't really a 'service' job, since I didn't once have to lift a soldering iron or screwdriver. In fact, for the most part it was the sort of job any competent hi-fi salesman should have been able to do for his customers.

Nevertheless, it was typical of the sort of tasks we servicemen are often landed with — and to cap it all, there does appear to have been a technical breakdown of some sort, that's left me completely puzzled and totally unable to explain what was going on.

The story concerned an elaborate audio/visual setup comprising top line Telefunken (video) and Sony (audio) equipment, set up for the entertainment of a bedridden elderly gent.

As it was told to me, the old chap had been hospitalised for several weeks and on his return, the equipment would not select any of the video channels but would only play FM radio. It appears that his grandchildren had been allowed into the room during his absence, and had upset all the tuning and other settings on the video recorders and TV.

Since I had worked on his gear several times in the past, he turned to me for help in restoring sanity to the mass of electronics lining one wall of his bedroom.

My first task was to retune the television, so that he could at least watch the off-air channels while I sorted out the rest of his problems. The set was a Telefunken model 816, a top-of-the-line 26" model with stereo sound, teletext and every other feature you could imagine.

All settings and tuning were conducted with the remote control — there were only minimal switches on the set itself — and when I first approached the beast, it would not respond to any command. The remote control carried about 30 buttons, each labelled with an obscure symbol that meant little or nothing to my untutored eye.

Fortunately, the owner had carefully retained his copy of the user manual, although I had to rummage through a large accumulation of other papers before I could find and make use of it.

Resetting the tuning proved to be one of the most frustrating jobs I have ever tackled. First up, finding the channels is a slow, tedious job that involved waiting while the set automatically searches through the three main bands (VHF low, VHF high and UHF), and then through 60-odd cable channels.

As far as I can tell, the search is only in one direction — so if you pass the wanted channel, there is no option but to wait for the set to continue on up through the rest of the off-air channels and all the cable channels before it comes back to the band you are interested in. This can take as much as five minutes, allowing for stops at all the unwanted channels and incidental non-TV transmissions that the set comes across.

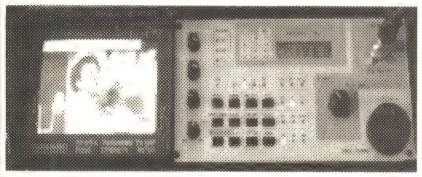
After half a dozen unsuccessful trips round the bands, I was close to putting a boot through the screen. It was all I could do to keep my cool, with the owner sitting up in bed and repeating over and over "I'm sorry to put you to all this trouble!"...

Then, even after I had found the channel that I wanted, locking it into memory was another complicated process. It involved pressing one of the labelled buttons, then the channel number, then the desired programme number — all within six seconds.

If you forgot the sequence, or pressed the wrong button by mistake, the process was aborted and the set reverted to the last channel you had been watching.

That six second limit was the killer. It did not allow enough time for one to refer to the procedure in the manual, and then find the appropriate button. The only thing to do was to commit the whole sequence to memory, then go through it by rote. It took me all morning to enter four television channels and two video channels. There must be an easier way, surely — but I couldn't find it.

My next problem was to retune the video recorders. One was an NEC hi-fi machine, but this didn't offer any serious problems. I had to read the manual to be sure of what I was doing, but the process only required the pressing of one button at a time, and there was no time limit that I was aware of.

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The Telefunken video, on the other hand, was just as villainous as the television had been. It could tune any of 99 channels, (33 of them cable channels) but could only display 49, plus one audio/video channel. The trouble was that somehow or other the children had cancelled all the off-air channels and in the process had locked in four cable channels. But of course, there was no programme on these; just a blank spot to which the video kept returning every time I made a mistake with the tuning procedure...

Anyone who has had experience with these European sets may be laughing at my discomfort. But I assure you, the first time YOU try to tune one of these monsters you will have as much trouble as I did.

Eventually, I had to take the VCR home with me, to continue my struggles with that villainous tuner in private. I was sick and tired of the owner saying "I'm sorry to put you to all this trouble!"

Sufficient to say that I eventually got the machine set up. I don't really know what I did, because the process appears to be different to that for the television. The manual instructions are quite dissimilar and I succeeded in getting the four channels where I wanted them, not by design but by pure accident.

Only a prelude!

So, it was back to the sick room to reconnect all the equipment and check that it was working to the owner's requirements. But in fact, all that had gone before was only a prelude to what was to come!

The heart of the system was a Sony STR-AV1070X amplifier. A full description of this device would take the rest of this column, but it's probably enough to say that it has all the bells and whistles, and then some. It has AM and FM tuners built in, inputs for CDs, tape decks, phono decks, auxiliaries, and no less than three video inputs.

The video channels are not only but also. Each input is matched by a corresponding output for both composite video and stereo audio.

(I didn't mention that it had four audio channels — left, right, front and rear — and included a fully fledged Dolby surround sound decoder. As I said, all the bells and whistles, and then some! And since it weighs something over 20kg, it's not to be moved about unnecessarily...)

As you can imagine, reconnecting all of this was a nightmare. The back panels looked like spaghetti junction!

Since the NEC video was the simplest item, I connected that first and had no trouble working out which lead went where. Then came the Telefunken unit, but this was made most inconvenient by having a SCART socket for all connections. The connecting lead provided had a suitable SCART plug on one end, but six unmarked RCA plugs on the other!

Can you imagine trying to sort out inputs from outputs, video from audio and left from right — all without knowing if the equipment you are plugging into is working properly or not?

At this point I ignored the Sony amplifier and patched the video across to the television. I soon had this working OK with an RF input, but the picture was not as good as it would be using a composite video input.

I could have left the job at this point, because the owner had always used the RF input and wasn't aware of the difference. However, I had made the mistake of telling him that he'd get a better picture from a composite video input, as well as being able to switch video sources through the Sony amplifier with his remote control. So then he HAD to have just that.

The composite video input to the Telefunken TV was via another SCART connector, and the old chap didn't have a second lead. So I had to go off and buy one. Happily this one came with all the RCA plugs neatly labelled, so connecting it was a breeze. So the two VCRs were plugged into the Sony inputs, and the television was plugged into the Sony outputs, then the owner sat up in bed with his four remote controls (two VCRs, Sony audio and the TV) in front of him.

He pressed play on one VCR remote, then selected the appropriate video channel on the Sony, then turned the TV on with the third! Everything came up roses and I was looking forward to getting home for tea. But it wasn't to be.

As a final check, I tried the off-air channels on the TV. They were OK. Then I tried to select the same sources on the NEC and Telefunken video recorders. Neither of them worked.

I switched back to videotape and the pictures came through loud and clear. But when I tried the EE mode, nothing! First up, I made sure that there was a suitable antenna connected to the VCRs, and I checked that they would record properly. Both machines would record off-air, and would then play back through the Sony amp. But nothing would allow EE direct through the Sony.

I tried swapping the inputs and outputs on the amplifier, but to no avail. No matter what combination of plugs and sockets I tried, tape would play well but off-air was a blackout. Oddly enough though, the off-air *sound* content was perfect, changing from tape to off-air and from machine to machine as required.

Eventually, I concluded that the video switching system in the Sony amplifier was faulty, so I simply patched the VCR video output directly to the television. After that, the system worked well enough and the owner was immensely impressed with the improved picture quality.

The only disadvantage was that he could not use the Sony unit to switch from the NEC to the Telefunken VCR or vice-versa. This had to be done by changing the patch link behind the amplifier. However, this was not an insurmountable problem since his wife had to come in to change tapes for him anyway.

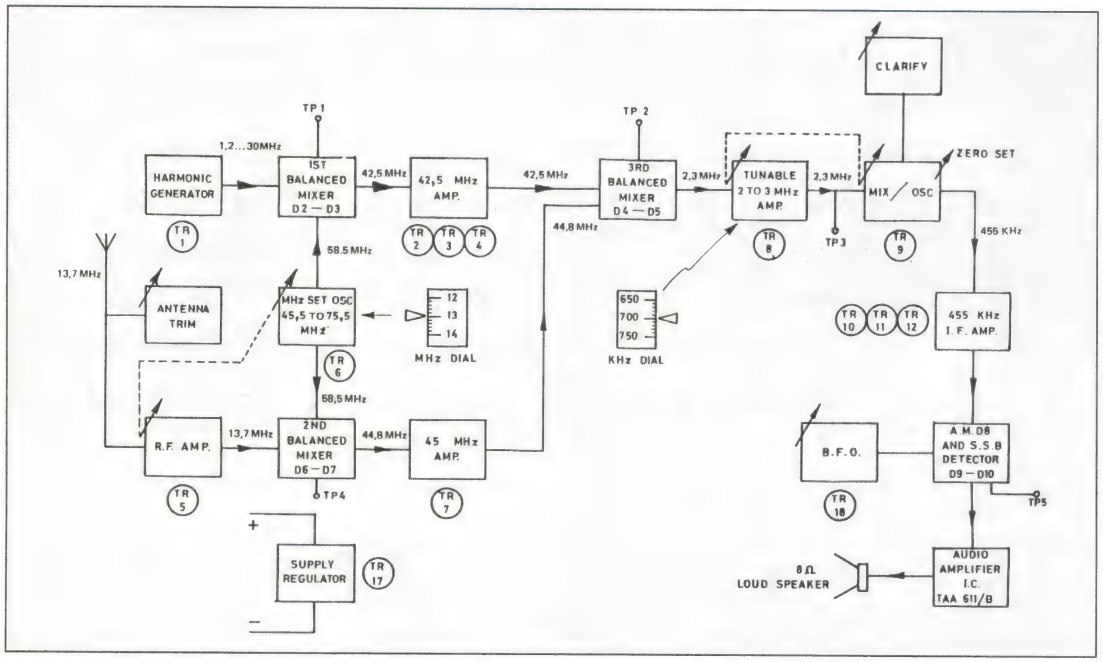
So, after a day and a half, I got most of the system working to my client's satisfaction.

But what I still can't work out is how the Sony system knew the difference between off-tape and off-air programme material. As far as I could see, the composite video input was the same whether the source was tape or the antenna! There was no doubt that the VCRs were delivering video to the Sony inputs — a check with a test monitor proved that.

The system would pass off-tape video, but not off-air video. And it was the same on all three input/output channels. But I'm afraid it will have to stay that way — I have no desire to get inside the Sony STR-AV1070X to find out! And as I said earlier, all of the foregoing was accomplished without once lifting a screwdriver or soldering iron.

Lucky break

Now it's contributor time again and to start with, we have a story from William Linton, of Zillmere in Queensland. Mr Linton has appeared in these pages before this, most recently with a story about TV-loving ghosts in an English country pub. This



Here is the block diagram for the Barlow-Wadley XCR-30 receiver, which forms the subject of this month's contribution from Peter Laughton. This shows the functional complexity of the receiver rather better than the schematic.

time his story is closer to home, and the only thing supernatural about it is a reference to the lady most of us would like as a companion at casinos and race-tracks.

Here's how William tells it...

I've had my share of the capers of Murphy over the years, so it was nice to have Lady Luck smile on me the other day when I was stuck with a bit of a stinker. This is how it happened.

As I've stated before, I am retired but like to keep my hand in by taking in an occasional appliance to oblige a friend.

This time it was a Thorn VCR, a model ATV20 and the complaint was an intermittent buzz in the sound. I had it switched on and the old grey matter was working overtime, trying to decide just where to start. Then suddenly, the picture and sound both disappeared.

After checking the cables etc. and finding nothing amiss, I decided to go off on another tack. The video output on this machine is available on either channel three or channel four. It had been set to channel three and I wondered what might happen if I changed it to channel four. At this point I wasn't sure if the loss of picture and sound was due to the VCR or the TV.

The easiest test would have been to change the TV from channel three to channel two. This would have shown me if the TV was working properly. However, it was at this point that Lady Luck smiled on me, because I started to change the output setting on the VCR first — but didn't get as far as doing anything.

As soon as I touched the switch, the picture flashed on the screen and the sound returned, minus the buzz.

It was all quite plain sailing then. All that a dirty switch needs is a good squirt from a can of contact cleaner. And I didn't even need to open up the VCR. Now my friend thinks I'm a wizard, but I put it all down to Lady Luck.

The second part of my story is something of a family confession. You see, I have a brother who holds the view that a good handyman is capable of doing any repair, if he puts his mind to it.

If being proficient at wielding a paint brush, replacing a fuse or a tap washer, or doing running repairs on the family car constitutes a good handyman, then my brother is one of this breed. But when these handymen try to repair electronic gear, they usually come horribly unstuck.

The other day a cassette got itself stuck in the brother's ageing VCR, a Sharp VC486X, and he, being on his own admission a good handyman, had a go at getting the thing out. He certainly got it out, but in the process left the cassette carrier horribly mutilated. It looked as though he had used a hammer and chisel on the job...

The wreck was passed on to me, with the advice that he would pay for any parts needed. But my brother blanched when I told him that I had been quoted $144 for a new cassette carrier — IF there was one available.

I am now hoping that it has cured him of the curious idea that "...any good handyman can fix anything!"

Thanks, William. It's nice to hear from someone who starts with a tricky job and then solves it quickly and easily. It happens all too rarely in this business, doesn't it?

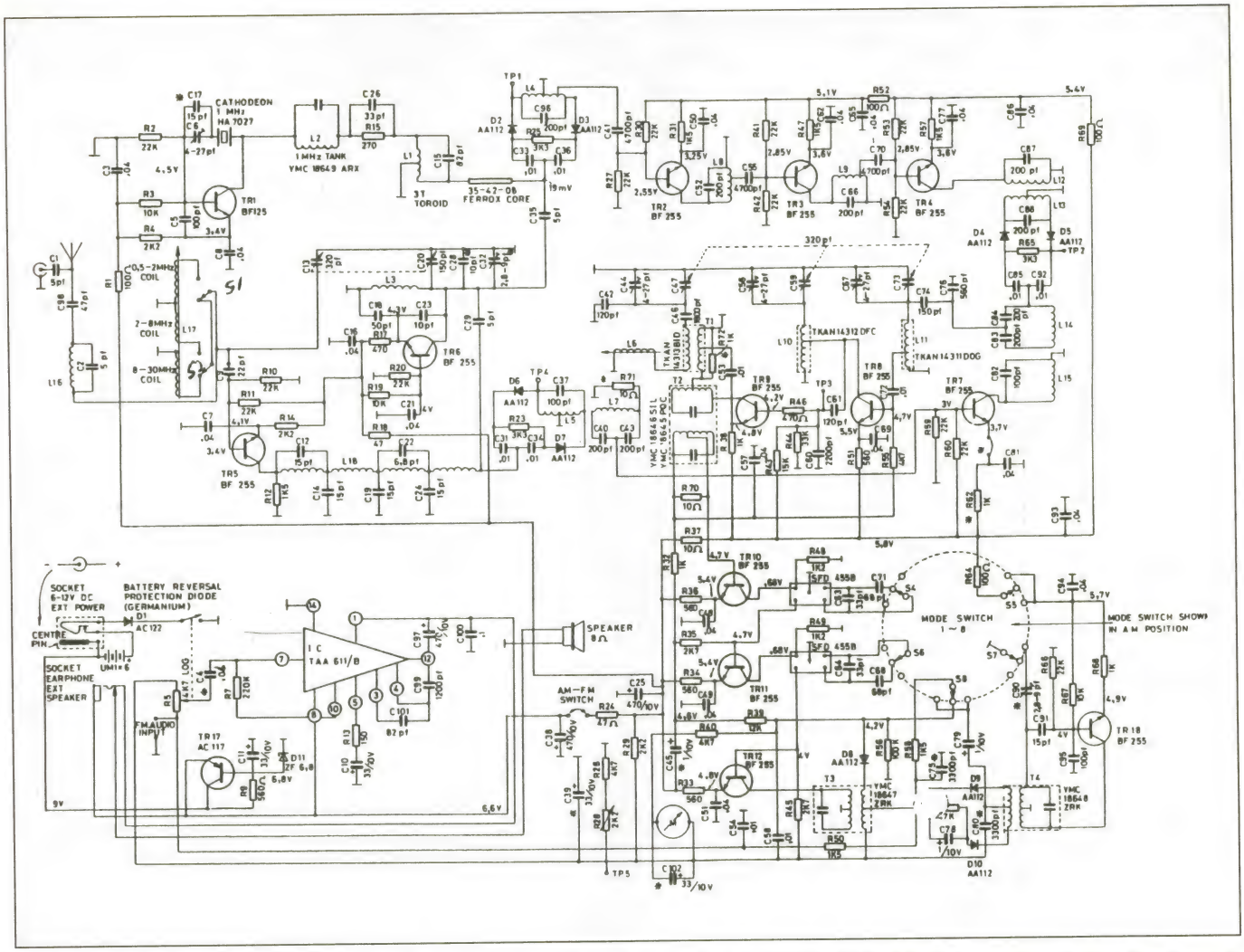
Thanks too for the 'Family Confession'. I've often seen home repairs done by someone like your brother, and the result is usually just as catastrophic. I once had a VCR that had been 'repaired' by a DYI owner. He had only wanted to clean the heads, but in the process dropped a screw into the works.

While trying to get it out again, he blew up the power supply and somehow wrecked one of the video heads when his screwdriver slipped. A simple head clean finished up costing him well over $200!

Thanks again, William. I'll look forward to more of your stories in the future.

Transistor, or SCR?

Our next story this month comes from a frequent contributor, Peter Laughton of Albion Park in NSW. Peter has previously given us stories about country power supplies, but this time he is onto more familiar subjects.



The schematic for the Barlow-Wadley receiver doesn't look nearly as complex as the block diagram might lead you to expect. The fault turned out to be in the 455kHz IF section, at lower right.

Here is what he has to say...

Our family runs a farm, so we need to keep our eyes on the weather more than most people. To help with this, I purchased a kit for the weather fax unit from Tom Moffat. This works very well and enables us to look for potential rain fronts, electrical storms, etc. The radio receiver that I use for this purpose is a Barlow-Wadley XCR-30, rather dated now but still an excellent performer, with single sideband etc.

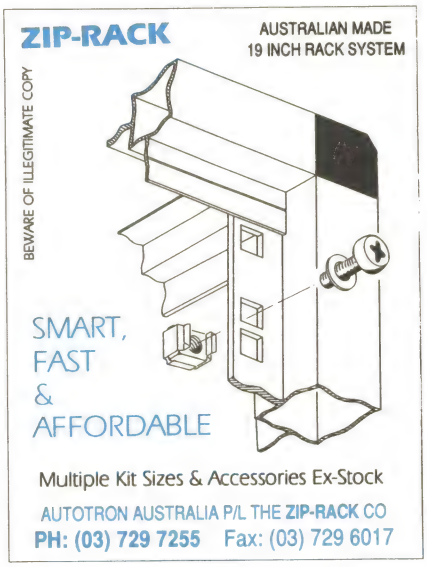
After the last rather violent electrical storm, I wanted to download the latest weather map, but when I turned it on the radio had literally 'dropped its bundle'. The local AM station was barely audible, even at full volume. It was time for some action.

Ten minutes work with the multimeter showed me that there was no voltage at the base of TR11. As this is one of the three transistors in the 455kHz second IF stage, I used my trusty old (1940's vintage) University signal tracer/VTVM unit. This indicated heaps of signal at the base of the transistor, but none at the collector.

However, while touching the probes in that general area, the set suddenly burst into life. When I removed the front cover I found a classic dry joint on the base of TR11. In fact, no solder had ever been anywhere near the joint. 25 years, uncounted numbers of beach excursions, camping trips, bus rides and DX-peditions had never revealed any trace of a fault!

Talking about this fault brings to mind the only other problem that this radio has ever had. Several years ago, the radio wouldn't start up when switched on. If it was turned on and off several times, it would eventually work but finally, no amount of playing around would get it to come on. So off came the rear panel.

Even though these radios seem complicated, due to multiple oscillators etc, in reality once the 1MHz oscillator is running, the rest of the radio can be checked using signals



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from that source. All you really need is a multimeter capable of measuring up to 10 volts DC.

We confirmed that all the oscillators were working, as was the RF amplifier and the audio stages. This left the 2 - 3MHz tunable amplifier and 455kHz amps. When the multimeter test probe was placed on the base of TR10 the set burst into life. No amount of prodding, etc., would cause it to fail.

It took several more weeks before the set played up again, but by now I was ready for it. This time the fault seemed a bit more permanent, and I discovered that once the transistor was 'triggered' it would work properly until switched off for a couple of minutes.

As all voltages were normal (I double checked them using a digital meter that didn't seem to upset the circuit), we seemed to have something like a 'silicon controlled transistor' (or could that be a silly-con-trolled transistor?). It wouldn't amplify until its base was pulsed, and yet it was conducting normally as all the voltages were OK.

I removed the transistor and as BF255's were hard to get at the time, I used a BC108 in its place. That worked perfectly and fixed the problem once and for all.

I later had some time to investigate the old transistor and, on a curve tracer, it showed no amplification until its base was switched momentarily positive or negative. Then it worked OK — but had a very high leakage that self-biased it to amplify with no external base bias!

Once the collector voltage was removed, it would reset; but not immediately. It needed a few minutes to do so. I suppose that the professional serviceman rarely has time to investigate strangely faulty components, but this was an interesting malfunction and I was curious to know just what went on.

Thanks for that story, Peter. You are just the most recent reader to come across the 'never-been-soldered joint' syndrome. If you recall, a month or two back we had a story from a New Zealand contributor who found a radio with 100% unsoldered joints! But thanks anyway. Every faulty joint delivers different symptoms, so there is always something to be learned.

That last part of your contribution, about the silly-con-trolled transistor, is not all that uncommon. I have several times come across transistors that work more like an SCR than an amplifier. In circuit they can look as though they're shorted, but out of circuit they test quite OK. It seems that they develop base-collector leakage that can self-bias them into saturation, once supplied with sufficient base current. A multimeter doesn't supply enough grunt to get them started, but a proper transistor tester usually turns them on.

In your case, Peter, I would suggest that the leakage was not quite enough to saturate the transistor, but was probably a lesser version of that particular type of fault. Again, thanks for the story.

That's all for this month. I still have a lot of contributions to type in, and that job will be got around to in the next month or so. Even so, there is always room for more. ❖

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AUTOMOTIVE ELECTRONICS

Continued from page 16

purpose sensor is $428.00 plus tax. But trade prices vary, so it's worth shopping around for the best deal.

Useful tool

Earlier this year I had the task of resetting the mixture and base idle settings on an Audi 2.0 with KE Jetronic — i.e., a mechanical/electronic hybrid system that uses an electro-magnetic actuator to vary the fuel pressure in response to the oxygen sensor.

Having reset the ignition timing and base idle speed 'by the book', it was just not possible, using the prescribed factory method, to achieve anything like an acceptable result for smoothness combined with low emissions. Finally, in desperation, I used my 'New Age DEFIA' to inject 0.45 volts into the ECU (after first disconnecting the oxygen sensor), and I was then able to set the correct mixture values and idle speed.

When the vehicle's own oxygen sensor was reinstated, the ECU seemed quite happy with the result and the Audi left the shop running smoothly and cleanly without the 'ramping' effect.

This procedure, of course, raises the prospect of testing the integrity of the EFI system in still more detail. When the mid point oxygen level is injected into the ECU, the resultant exhaust gas emissions should be in the stoichiometric 'window' before the catalyser.

Referring to Fig.3, it will give you an idea where the gas levels should be if the injectors and spark plugs are clean, the fuel pressure is perfect and all the relevant filtration and ignition timing is OK. From that standpoint, it shouldn't be too difficult to figure out which ingredient is causing the problems in the resultant gas mix.

Well, that's about it from me for another month. Hopefully the new *EA* O_2 Sensor Tester/Injector project won't be too far away. Cheers for now! ❖

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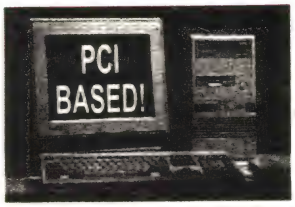
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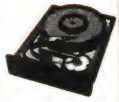
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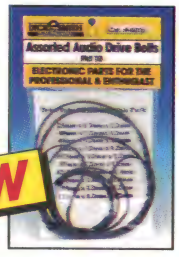


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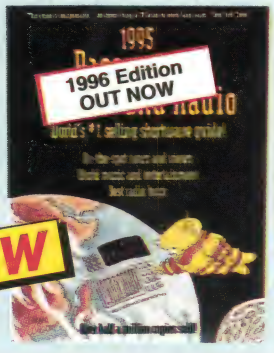
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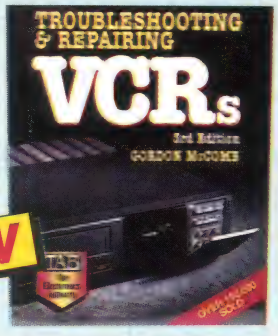
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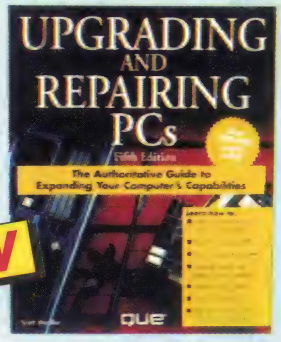
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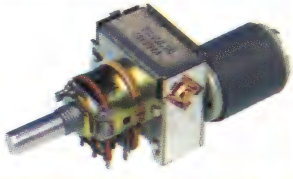
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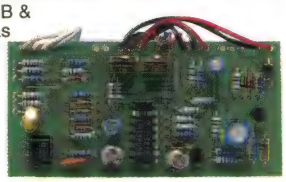


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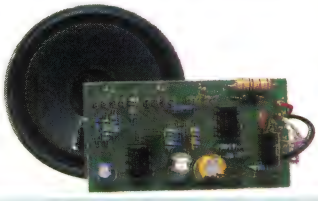


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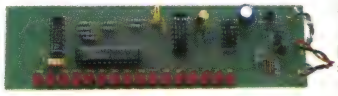


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Construct your very own exciting game of patience, co-ordination and skill. Featuring 16 LEDs which operate in sequence, the game requires you to 'climb' the ladder of LEDs by pushing a button. Sound easy? Well, wait until you try it! It has automatic power cut-off and is powered by 4 x AA batteries (not supplied). Comes in short form with all components, solder-masked and silk-screened PCB plus, it's designed to fit into optional Dick Smith Electronics zippy box (H-2851).

Cat K-2800

$19.95

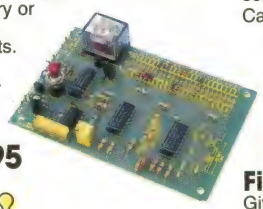


Multi-Timer Module

A handy low-cost timer that can be programmed for a total cycle time between 0.1 sec and 19.4 days. It can be programmed and configured for single cycle operation or for continuous repeat until reset. Consisting of a relay, timer circuit and diodes, it runs on a battery or any power supply with a voltage range of 9-12 volts. The kit comes complete with silk-screened solder-masked PCB, components, and relay.

Cat K-2807

$24.95



Roulette Wheel

Just like running your own mini Casino! The wheel has two zeros (0 & 00) and 36 numbers (like a real one) and you simply press the button to set the ball in motion - it even makes a click as each number is passed, imitating a ball rolling over pockets. A set of game rules are provided, listing ways to place bets and what odds should be paid. The kit operates from a single 9V battery (not included) and is supplied in short form with all components, silk-screened & solder masked PCB & necessary hardware such as mini speaker.

Cat K-2804

$29.95

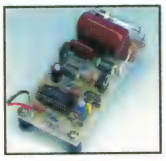


Xenon Flashing Light

Compact and inexpensive to run, this Xenon flashing light makes a handy bike or hazard lamp. Great as an emergency beacon, strobe for parties or just something to impress your friends. For an even brighter light, an optional torch reflector can be used. Operated via a battery or DC plugpack, it has reversed power supply polarity protection. (Case and battery not supplied.) Comes complete with all components, PCB & hardware.

Cat K-2809

$34.95

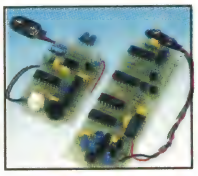


Four Channel Infared Remote Control

Build your own handy infrared remote control! It includes a small transmitter that can be constructed to fit in your hand, and a receiver with five outputs, all of which can directly drive relays. Both the transmitter and receiver have a selectable security code to prevent false triggering and operation by other transmitters. Comes complete with all components & PCBs. Case and batteries not included.

Cat K-2810

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Parallel Port Interface

Into computers? With this kit connected up to your parallel centronics printer port, your computer can sense data, process it and use the results to control relays, solenoids, motors etc! The kit operates via a 9V battery or DC supply, can monitor 10 analogue voltages, drive 8 digital outputs, and generate 2 variable voltages. Designed to fit the Dick Smith Electronics zippy box (H-2851), the kit includes sample programs that can be manipulated to suit your needs, PCB, components and 25-pin 'D' type socket for connection to parallel port.

Cat K-2805

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Fibre Optic Audio Link

Given the ability of fibre optics to deliver interference-free sound at the speed of light, it's fast taking over copper wire as the new standard for communications technology. Now's your chance to learn all about fibre optics! This kit is perfect for installing in devices that have noise problems, static etc. Powered by two 9V batteries, it makes a significant difference to sound quality, allowing you to listen to interference-free transmissions. Comes in short form with a length of optic fibre cable, a pair of transmitter and receiver devices, electret microphone and all components.

Cat K-2803

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Availability: Our kits consist of many different parts from numerous suppliers. Whilst we have consulted closely with them and are satisfied with their ability to supply, sometimes problems can arise in obtaining all of the parts. This means there is a slight chance that availability may be delayed. Rainchecks are available, however, if you'd like to check beforehand, don't hesitate to contact your local store.

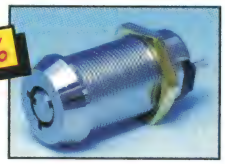
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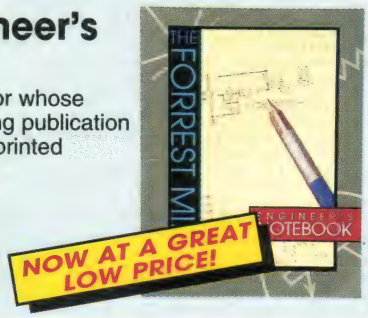


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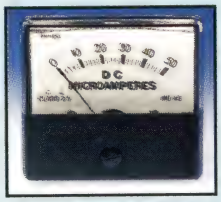
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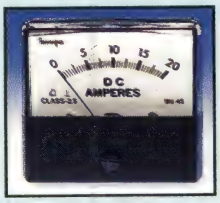
0-50uA
3,500 ohm internal resistance.
Cat Q-2021
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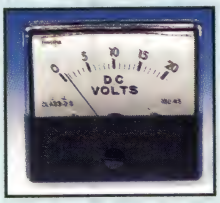
0-5A
0.02 ohm internal resistance.
Cat Q-2031
$19.95



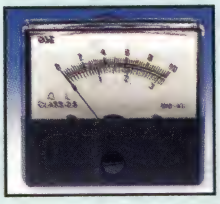
0-20A
0.005 ohm internal resistance.
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B 2187

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.

Personal emergency alarm

This alarm is based on the Single Channel UHF Remote Control Receiver published in *EA* April 1989. The user wears the transmitter (on a cord around the neck) and in an emergency has only to press the transmit button to sound piezo alarms in the house to alert anyone present. If there is no response within one minute, an outside siren and strobe are activated and neighbours, previously informed of the installation, will be alerted.

The circuit given here doesn't include the UHF receiver section. For this and a general description of the operation of the receiver, refer to the original article.

When the transmitter button is pressed, RL1 operates via Q5 and RL2 operates via Q4.

The timing circuit around Q4 holds it on for about one minute, so RL2 is turned off after this delay. When both relays are on, the internal alarms connected to RL2 will sound, but as RL2 disconnects the 12V(B) supply from RL1, the siren and lamp connected to RL1 will not operate until RL2 is turned off.

The delay is determined by the values of R26, R27 and C20, a low leakage electrolytic capacitor. This capacitor can have a value from 100uF to 330uF, depending on the required internal alarm period.

Switch S1 (MUTE) isolates the supply to all alarms while the receiver is being tuned. Components Q6, R31, R32 and LED2 form a tuning indicator. The independent 12V supplies eliminate spurious effects which can occur when loads are switched.

To build this circuit using the original PCB design, replace LED1, R31, D6 with wire links and add a link between RL1 and RL2. Use link A (toggle).

Omit components ZD1, D2, D5, D6, Q3, C12, C19, R24, R25, R28 and the buzzer. The component changes are Q4 (BC559), C20 (330uF low leakage) R27 (470k) and R26 (56k). Additional components are S1, D7, LED3, R31 and R33, Q6, LED2 and R32 (I mounted the last three components on a scrap of PCB).

I experienced trouble with a plug pack supply, hence the different power supply circuit. This may be an overkill, but it solved the problem. It also allowed the removal of original components LED1, ZD1, C12 and R31.

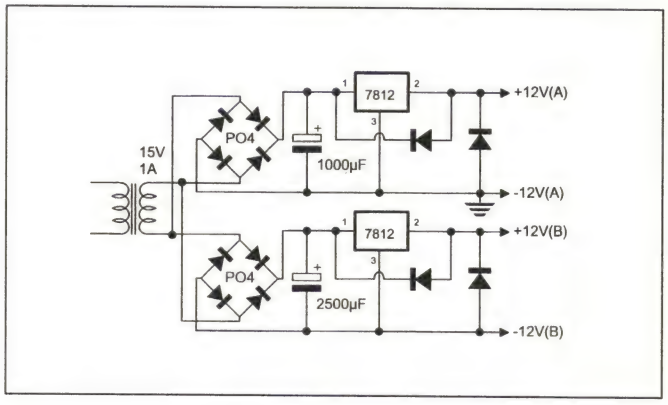
I built the complete unit into a 180 x 110 x 60mm PVC box, with an external stiff wire antenna approximately 240mm long. This should be mounted near the ceiling for best reception, situated in the middle of the house. Make sure the power-on LED is clearly visible.

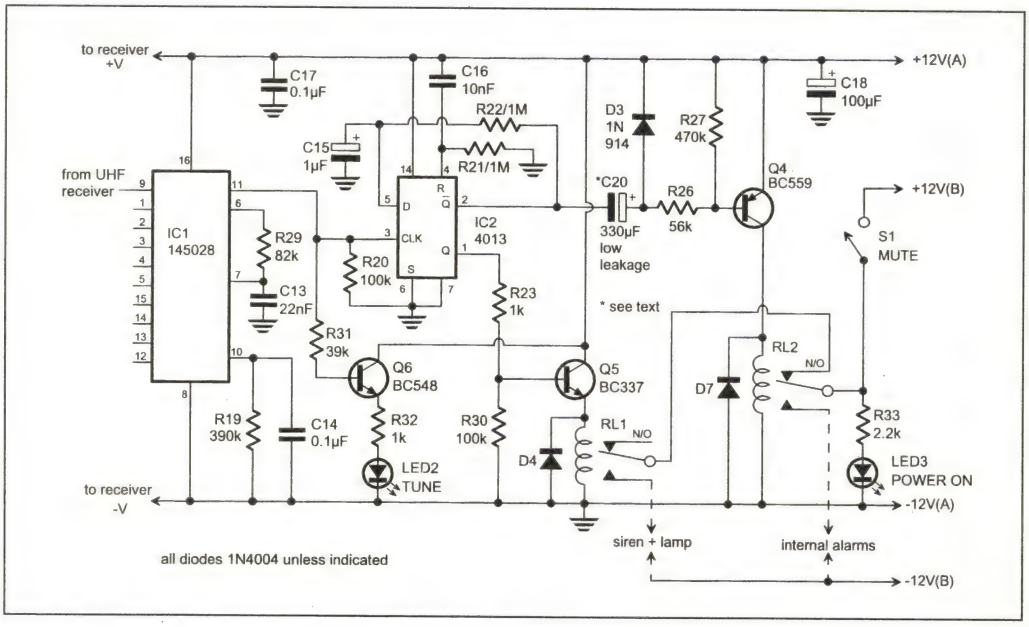
The operating range can be increased by lightly coupling a single length of bell cable to the receiver antenna. I ran a length of cable in the ceiling roof space, suspended above the ceiling. From this a short lead is dropped through the ceiling and two turns wound around the tip of the antenna to provide a small amount of capacitive coupling. This should allow the alarm to be activated from anywhere in a normal size building block.

The siren and strobe light are mounted outside, so they can be seen, but protected from the weather.

To be effective, I suggest testing the internal alarm every day and the external alarm each week. As well, the transmitter should be worn at all times (except under the shower).

John Symons,
Woodend, Vic. **$40**



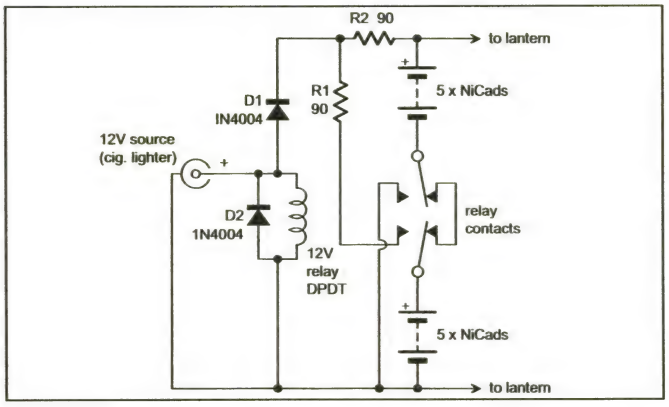


Charging 12V NiCads from a 12V battery

This circuit was developed to charge a 12V fluorescent lantern fitted with 10 sub C-size NiCads from a car battery. The circuit eliminates the need to disassemble the lantern to charge each cell individually. All components, including the NiCads are soldered in position inside the lantern.

When the 12V charge voltage is applied, the relay energises and connects the 12V NiCad pack into two separate 6V packs. These are charged via D1, R1 and R2. When the charge voltage is removed, the relay de-energises and the battery pack is connected as a single set of 10 series connected cells.

Phil Noyes,
Homebush, NSW. **$25**



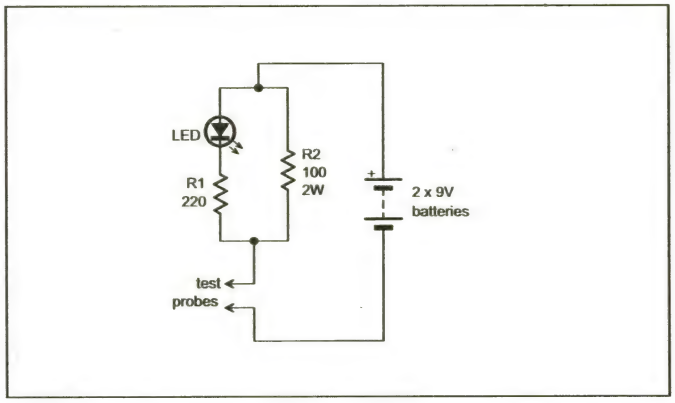
Microwave HV diode tester

When a microwave oven appears to function normally but without heating, it's often the high voltage diode that has gone faulty. Rated at 9kV 350mA, these diodes cannot be tested with a typical digital multimeter as they need at least 10V forward bias.

This circuit, although simple, is a worthwhile tool for the workshop. To use it, disconnect one end of the diode to be tested and connect the probes across the diode. Then reverse the probes across the battery.

The LED should light for one polarity, and not the other. Make sure the probes are not touching each other when storing the tester, as the battery will soon become flat.

John Aylmer,
Chelmer, SA. **$25**



Reaction timer

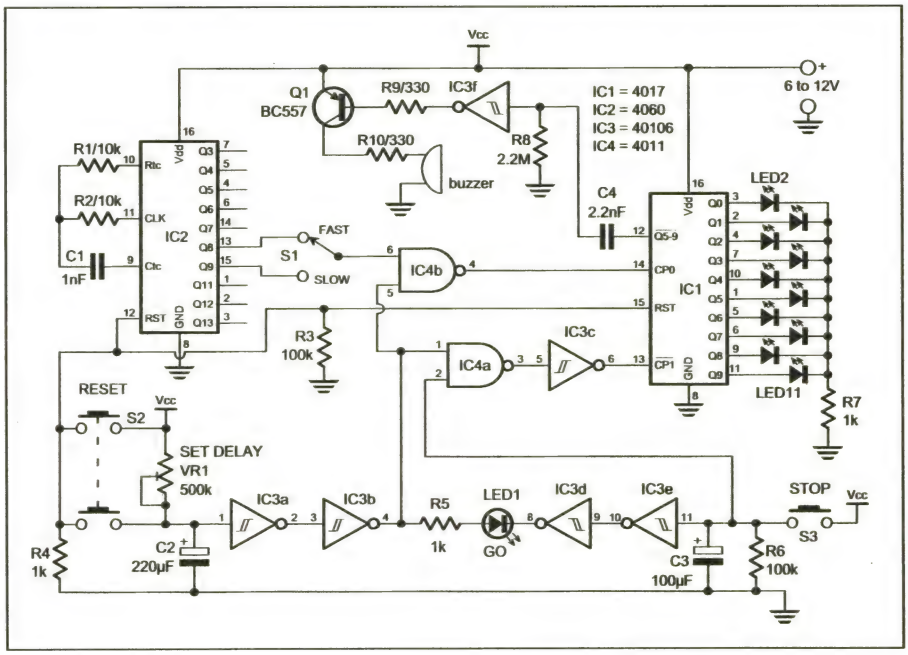
This circuit will test your reaction time. After a delay as set by VR1, LED1 (GO LED) lights up. Your job is to press S3 (STOP) as fast as you can, to stop counter IC1 from counting. Your reaction time is indicated by LEDs 2 to 11.

The clock signal is provided by IC2, with a frequency determined by the values of R1 and C1 and the position of S1. The clock frequency on the SLOW setting is half that of the FAST setting. While pin 5 of IC4b is high, the output of IC4b will be the selected clock signal, which is applied to Johnson counter IC1. While pin 13 of IC1 is low, the counter will advance, causing LEDs 2 to 11 to light in sequence. Each time the counter completes a cycle, the buzzer is sounded by the low from pin 12 of IC1.

When S2 is pressed, C2 is discharged by R4 and the output of IC3b goes low. As a result, the output of IC4b is held high, holding pin 14 of IC1 high and preventing the counter from advancing. As well, both IC1 and IC2 are reset. Capacitor C2 charges through VR1 and when its voltage reaches a logic 1, the clock signal from IC2 to IC1 is enabled, the GO LED lights and the counter advances.

Pressing S3 (STOP) causes C3 to quickly charge from the supply voltage, applying a logic 1 to pin 2 of IC4a. This gives a logic 1 to pin 13 of IC1, which disables the counter, and freezes the display. Anticipating the GO LED is prevented by IC3d and IC3e, as pressing S3 before the GO LED lights will cause it to remain off until C3 discharges through R6.

Jock Mackenzie
Cohuna, Vic. **$40**



Construction Project:

ACTIVE ANTENNA FOR HF RECEPTION

Here's the design for a low cost, really easy to build unit which can provide surprisingly improved reception up to 30MHz, using either a telescopic rod, a few metres of wire draped from a picture rail or dangling from a window, or an indoor dipole. It can also be used to improve the performance of elderly shortwave receivers, in terms of both sensitivity and selectivity.

by JIM ROWE

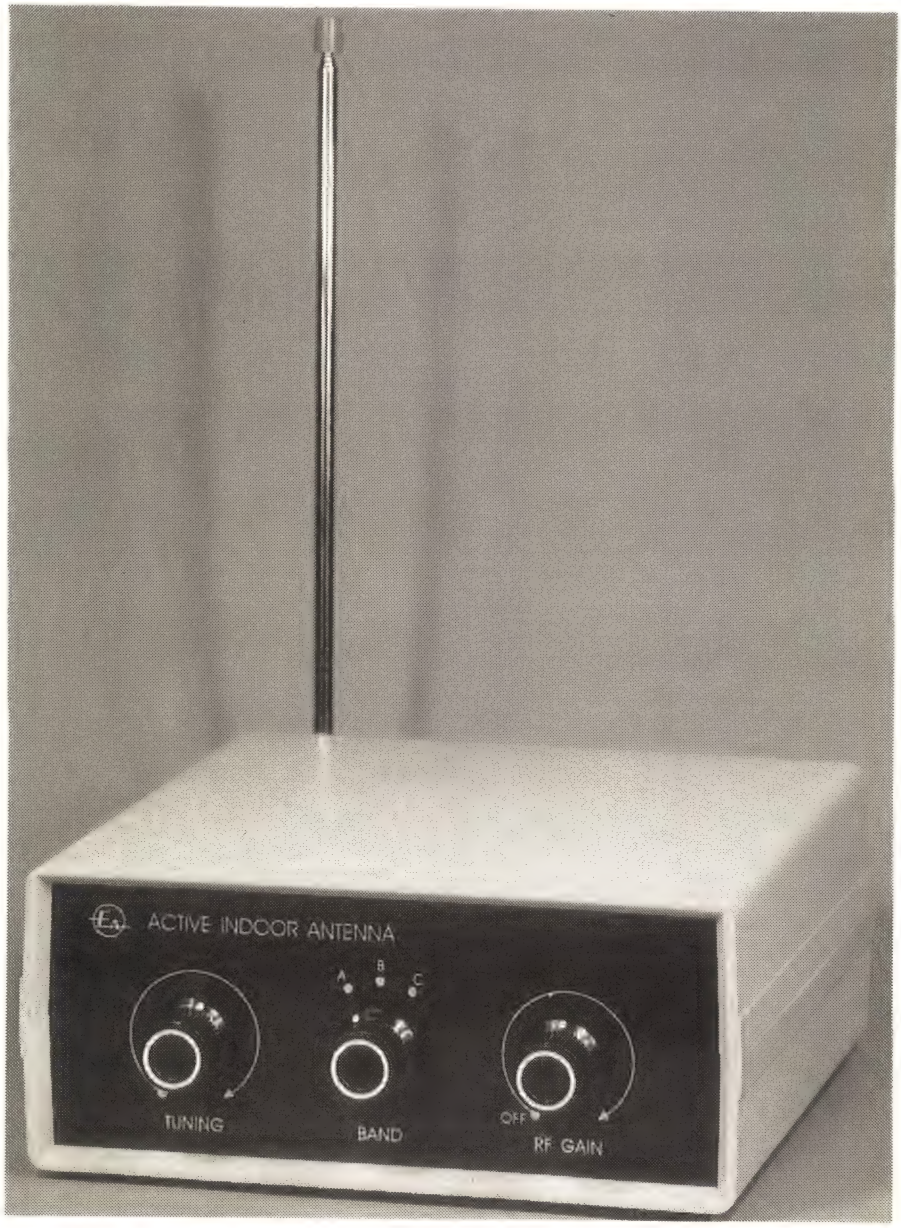
Nowadays many people live in fairly crowded urban and suburban situations, where setting up an efficient antenna for shortwave reception — or even broadcast band 'DX' — either isn't easy, may not be practical because of restricted space, or is possibly even 'not allowed' by the body corporate. As a result it's often a matter of having to settle for either a modest telescopic rod antenna or a few metres of insulated hookup wire, either poking or dangling from a window, or draped around the inside of a window frame, etc.

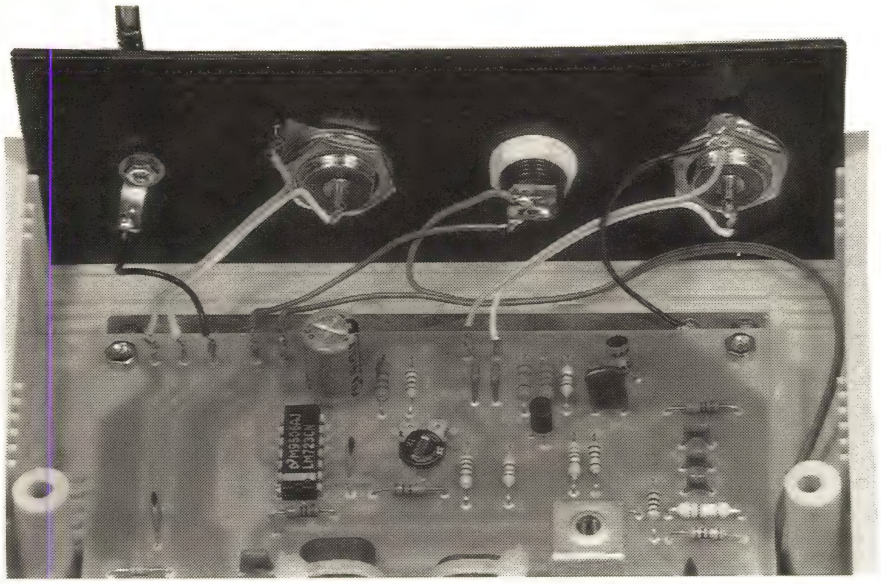
Of course there's no real substitute for a good outdoor antenna, suspended at the appropriate height and ideally balanced with respect to ground, so it picks up the least possible noise and interference.

But if such an antenna really is out of the question, as it often is, an alternative approach which can often deliver quite reasonable reception is to couple the small antenna you *can* use up to a small RF preamplifier and preselector unit like the one described here. The gain of the preamplifier boosts the relatively low signal levels delivered by the small antenna, while the additional selectivity provided by the preselection tuned circuit helps minimise interference and cross modulation from strong signals nearby.

Ideally the gain of such an 'active antenna' unit should be adjustable, to prevent receiver overload when the signal you're trying to receive turns out to be quite strong already. In fact smoothly variable gain is very desirable, allowing you to achieve the best compromise between gain, overload margin and interference rejection, whatever the level of your desired signal.

The unit described here has been designed to provide all of these facilities, in a compact and low cost form. It's also quite easy to build, with all of the parts readily available from normal stockists.





Use this view of the inside of the case, looking towards the rear panel, as a guide when wiring up the various connectors and also the rear section of the PCB. Note the use of PCB pins for the off-board connections.

Housed in one of the standard small plastic instrument cases, and with most of the components on a small PC board to simplify construction, it provides tuneable selectivity and a healthy but smoothly adjustable gain, from 500kHz (below the bottom of the AM broadcast band) right up to 30MHz, at the top of the HF shortwave band.

And it's designed to work with either a small telescopic rod antenna, as shown in the photo, or a short length of wire. In fact it also has an optional low impedance input, so that if you have the room to put up a small balanced antenna, this can also be coupled to the unit via a wideband balun. More about this later.

The preselector circuitry tunes smoothly over the frequency range in three bands, and the preamp has a maximum gain which varies from about 32dB at the low end down to about 20dB at the top end.

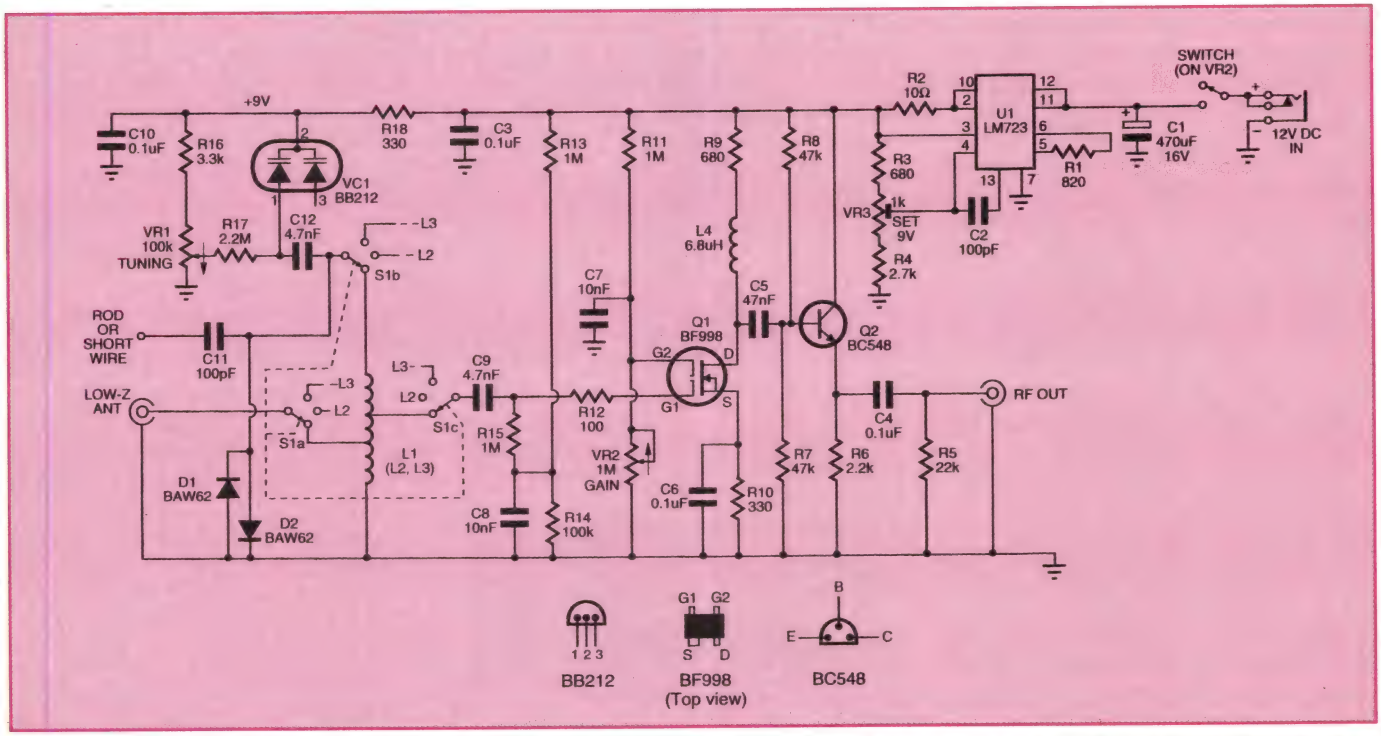
This is more than enough gain for the job, and provides a very noticeable boost in reception — especially with older or simpler receivers.

A dual-gate MOSFET is used as the main gain element in the preamp, and this has some important advantages. One is that these devices have far better overload and cross-modulation characteristics than bipolar transistors or ICs. Another is that they provide very stable gain, because of the very low signal feedback provided by their internal 'cascode' structure. Yet another advantage is that the gain of a dual-gate MOSFET can be adjusted very smoothly from maximum down to virtually zero, by simply varying the DC bias voltage on gate two.

The complete unit is operated from a nominal 12V DC supply, which can be provided by either a battery or a small plugpack. The current drain is very modest, at typically less than 10mA.

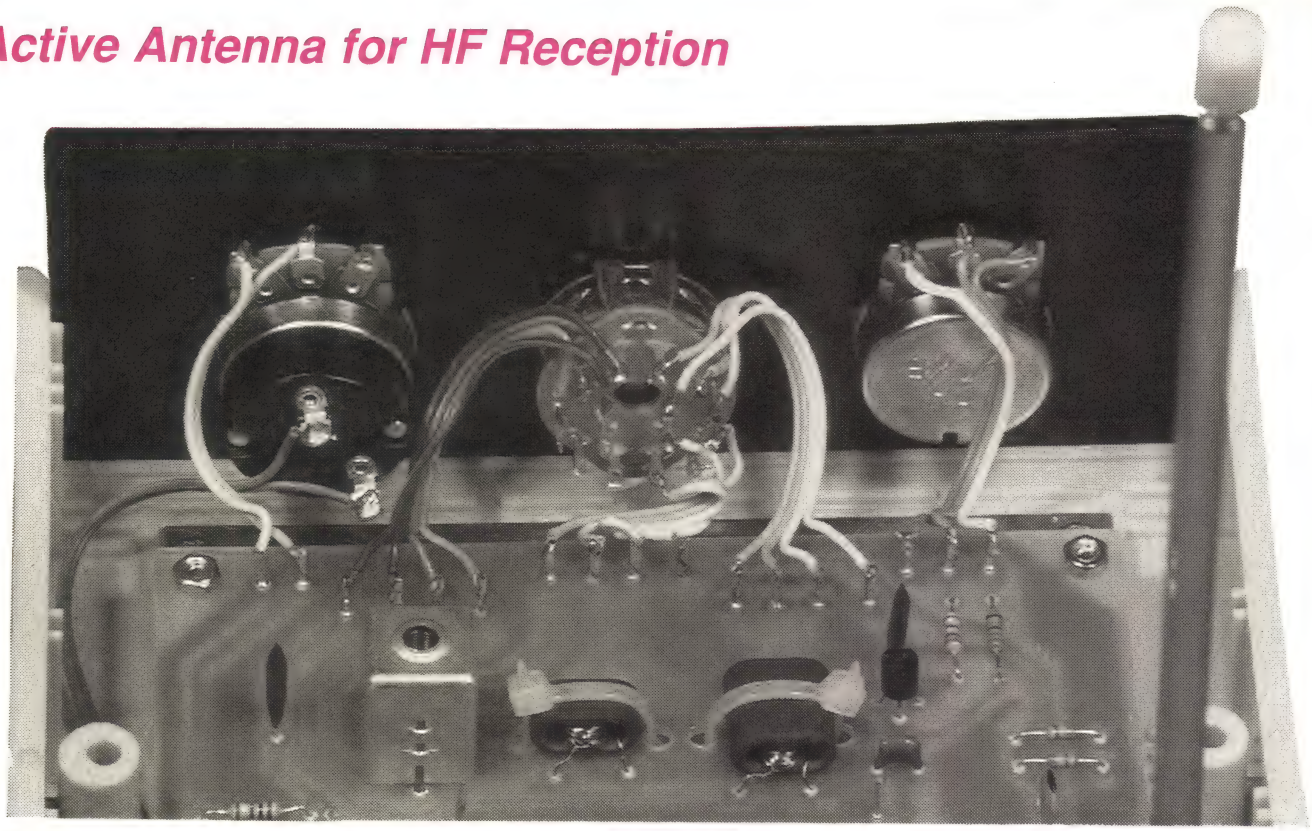
Incidentally, this project is in many ways an updated and redesigned version of a similar unit I described in the November 1991 issue. Although it offers a few less 'frills' than the earlier design, it is considerably cheaper and easier to build, and still offers virtually all of the most useful features of its larger predecessor.

In any case the earlier unit is now obsolete, as some of the key parts it used are no longer available.



Dual gate MOSFET Q1 and output buffer Q2 form a wide band amplifier, while coils L1-L3 are tuned by varicap VC1 to form the preselector section. U1 provides voltage regulation for the circuit's 9V supply rail.

Active Antenna for HF Reception



Looking towards the back of the front panel, this second internal photo can be used as a guide when you're winding and mounting the coils, and also when you are wiring between the PCB and the front panel controls.

Circuit description

As you can see from the schematic, there isn't a great deal of circuitry involved. Dual-gate MOSFET Q1 is the heart of the RF preamp, providing the wideband gain, with emitter follower Q2 used to provide output buffering so that the preamp can develop full gain but still drive a low impedance receiver input.

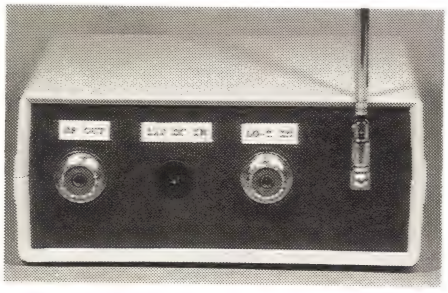
Q1 is a Philips type BF998 surface-mount device, because familiar leaded parts like the MFE131 or BFR84 used in previous designs are no longer available. The BF998 comes in a tiny four-tab SOT143 package (3.0 x 2.5mm overall), and is made for applications such as VHF-UHF TV tuners and cellular radios. Despite its tiny size it offers internal static charge protection, high gain, very low feedback capacitance and very low noise.

Stable biasing of Q1 is achieved by means of source resistor R10, in conjunction with a small amount of forward bias applied to gate 1 via the voltage divider formed by R13 and R14. (The bias is actually injected into the gate circuit through R15, to reduce loading on the tuned circuit.) Resistor R9 forms the drain load, with RF choke L4 providing a small amount of gain lift near the top end of the frequency range.

Variable resistor VR2 allows adjustment of the DC voltage applied to G2 of the MOSFET, from zero to about +4.5V. This provides a very smooth control over its gain, from maximum at the +4.5V end (fully clockwise) to a very low figure at the 0V end. In fact the gain of Q1 near the bottom end is less than one — i.e., it attenuates the input signal rather than amplifying it. This gives a very wide range of control over the signal level fed to the receiver.

Capacitor C9 couples the incoming RF signals to gate 1 of Q1, with low-value resistor R12 used as a 'stopper' to ensure that the MOSFET remains stable even at maximum gain.

As you can see, three pole switch S1 is used to select one of the three input tuning coils which form the heart of the preselector circuit. Only one of these coils, L1 (which covers from 500kHz to a little over 2MHz) is shown in the schematic, but the other two are wired to the switch in the same way. Whichever coil is selected is tuned within its frequency range by means of varicap diode VC1, a readily available BB212 dual type — although here we are only using one half.



This rear view of the unit shows the RF and DC connectors, and also the base of the rod antenna.

(In the old days we would have used a traditional air-dielectric tuning 'gang' capacitor in this sort of unit, but these are so difficult to obtain nowadays that we're forced to use a varicap.)

Switch section S1c selects the coil output taps, S1b selects which coil 'top end' is connected to the varicap diode (via DC blocking capacitor C12), while S1a selects the low-impedance coil input taps for the optional low-impedance antenna input. The rod antenna or 'short length of wire' is lightly connected to the 'top' of the selected coil, via coupling capacitor C11. Diodes D1 and D2 are used to limit the amplitude of 'enormous' input signals, and hopefully minimise any risk of gross overload damage.

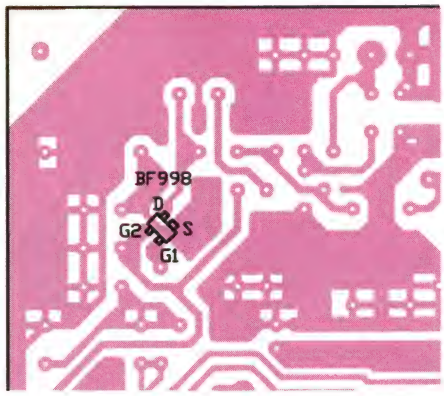
Varicap VC1 is tuned in the usual way by varying its reverse DC bias, via pot VR1. Decoupling resistor R17 is again used to prevent loading of the tuned cir-

cuit, to achieve maximum 'Q' and selectivity. As the varicap is effectively connected between the +9V supply rail and the rotor of VR1, maximum reverse bias and hence minimum diode capacitance is achieved when the pot rotor is at the 'earth' end. This therefore corresponds to the 'top' end of each frequency range, when RV1 is turned fully clockwise.

To ensure that the tuning remains stable, the +9V supply rail for the varicap — which is also the supply rail for the preamp as a whole — is regulated quite 'tightly' via regulator chip U1. This is a time-proven LM723, connected in the standard way with preset pot VR3 used to allow its output to be set to exactly 9.0V. It's U1 that allows the circuit to be powered from virtually any nominal 12V DC source.

The incoming unregulated DC is controlled by a switch fitted to the rear of gain pot VR2, so the complete circuit is turned off when the pot is turned fully anticlockwise.

Incidentally, if you wish to protect the circuit (especially U1) from damage due to accidental polarity reversal of the incoming DC supply, this can easily be achieved by connecting a 1N4001 power diode (or even a 1N4148 signal diode) in series with the unregulated DC input. The only thing to remember if you do this is that the diode's voltage drop will reduce the input voltage reaching U1 by about 0.7V. As the LM723 requires an input voltage at least 3.0V higher than its output, this means that your plugpack or battery will need to provide a minimum of 12.7V for correct operation of the circuit.



Use this supplementary overlay diagram as a guide when you're fitting the surface mount BF998 to the underside of the PCB.

Decoupling components R18 and C10 are used to ensure overall stability of the preselector-preamp circuit, by preventing any signal coupling via the +9V supply line.

Construction

As noted earlier, the complete circuit is housed in a standard small plastic instrument case. This measures 153 x 158 x 64mm, and is stocked by most of the popular suppliers. Inside all of the components except the three front panel controls and the various input and output connectors (along with the rod antenna) are mounted on a small PCB, measuring 120 x 91mm and coded 95aa12.

As you can see from the photos, the three front panel controls are VR1 the tuning control pot, S1 the band switch and VR2 the RF gain pot (combined with the power switch). On the rear panel, running left to right from the rear are the RF output socket, the DC input jack, the optional low impedance RF input socket and the rod antenna.

For the prototype unit, the rod antenna I used came from Dick Smith Electronics. It has recently been added to DSE's 'spare parts' stock (Cat. No. ZA-4692), and is available from the Kit Department at North Ryde for $3.50 — plus postage if applicable.

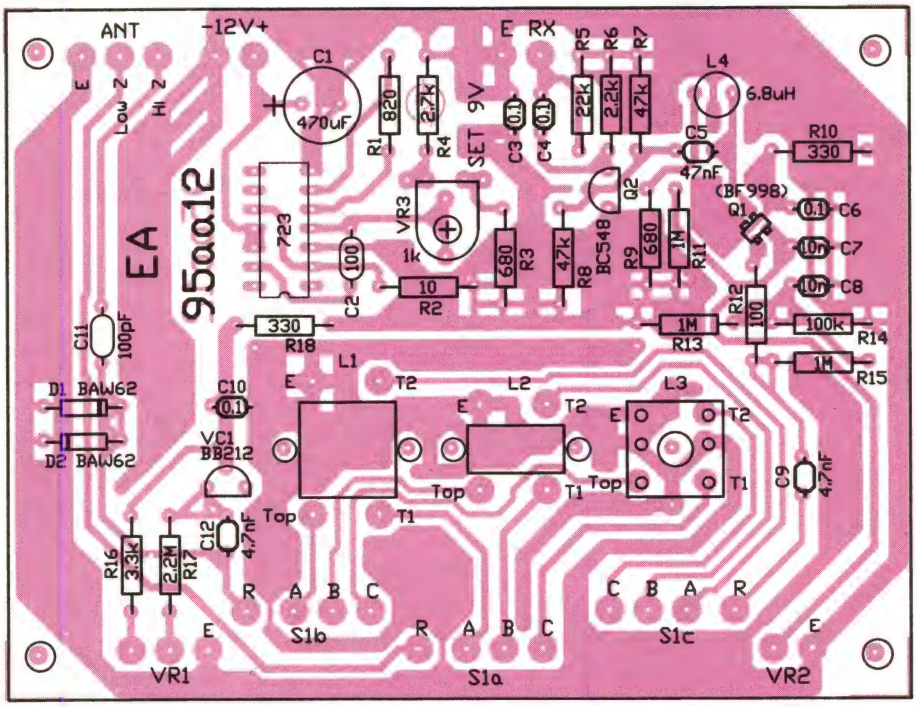
It extends to 600mm, has a fold-down 'hinge' about 25mm from the base end and also a milled 'flat' at this end, with a 3.5mm hole to allow convenient mounting. I mounted it to the back panel with a 3mm x 12mm long machine screw, using a nut and star lockwasher to attach the screw to the rod base (and also space it away from the panel), and then a lockwasher, solder lug and final nut on the inside.

The PC board is not mounted directly inside the lower half of the plastic case, but on a combined mounting/shield plate. This is both to adapt the PCB to the somewhat wider-spaced mounting pillars in the case, and also to provide a worthwhile measure of shielding against noise and EMI. The plate measures 110 x 120mm, and can be made from either 1mm aluminium sheet or unetched PCB laminate. As you can see from the photos, it's connected electrically to the 'earth' lug on the RF output socket.

The PCB is supported about 5mm above the plate by mounting it via four 3mm x 12mm long machine screws, with multiple nuts for spacing.

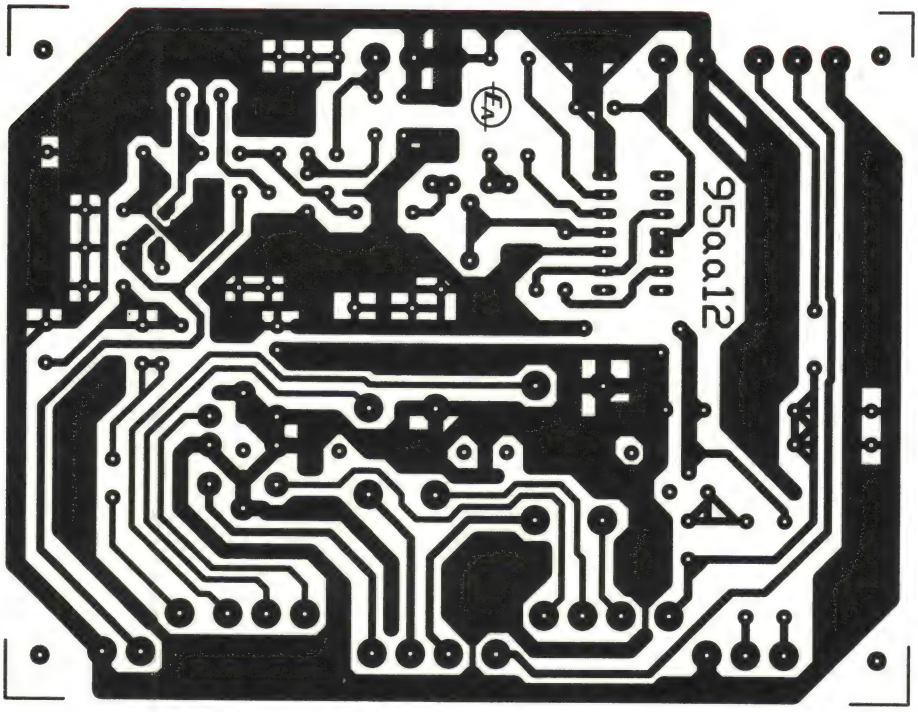
The location of the smaller components on the PCB should be fairly clear from the photos, and in particular from the overlay diagram. Most are fitted in the usual way, and probably need very little explanation.

I suggest that you begin assembly of the PCB by fitting the terminal pins first, followed by the resistors, capacitors, RF choke L4, diodes D1 and D2, preset pot VR3, varicap diode VC1, transistor Q2 and regulator chip U1. These parts should all be quite straightforward, with little to watch apart from the polarity of the diodes and electrolyt-



And here is the main overlay diagram, showing where all the other components are fitted on the top of the PCB. Also shown are the connections for the three preselector coils L1, L2 and L3 (see text).

Active Antenna for HF Reception



For those who like to etch their own boards, here is the actual size pattern.

ic cap (C1), and the orientation of the varicap and transistor.

Next I suggest that you wind the coils. These have been designed to be relatively easy to wind, so they should involve a minimum of hassle. All three are wound using 0.25mm enamelled copper wire, with the low band coil L1 wound on a two-hole F14 balun core measuring 13.2 x 13.5 x 7.4mm, the middle band coil L2 wound on a two-hole F29 balun core measuring 13.2 x 6.5 x 7.4mm, and the top band coil L3 wound on a standard miniature coil former (nominal 5mm) fitted with the usual six-pin base and shield can. L3 is also fitted with an F29 slug, to allow adjustment of its exact tuning range.

The connections for the three coils are indicated on the PCB overlay diagram, to guide you when winding them and bringing out their taps. All taps are produced by bringing out a loop of wire at the appropriate stage of winding, and then carefully twisting it into a tight 'double thickness lead' before continuing with the coil. Then when the coil is complete and ready to mount on the PCB, the twisted tap leads can be scraped bare ready for soldering, in the same way as the end wires. (Most wire nowadays has enamel which melts during soldering, and acts as a flux — so you generally don't have to be too thorough with the scraping.)

Coil L1 has a total of 15.5 turns, where I'm defining one turn as 'down one hole in the core, and back up the other'. Its first tap T1 is at 2.5 turns, with the second tap T2 at seven turns. So if you start winding at the 'E' end, each tap can be brought out at the position needed to line up with the holes in the PCB.

The same applies for coil L2, which actually has more turns: a total of 16.5 (because of the lower permeability core), with the L1 tap again at 2.5 turns and the T2 tap at eight turns.

Coil L3, wound on the six-pin former, has a total of only eight turns, with the T1 tap at 1.5 turns and the T2 tap at four turns. All of these turns are tightly wound in a single layer, hard against the base end cheek of the former.

Note that coil L3 is attached to the PCB in the usual way, held in position by both the soldered base pins of the former and the pins of its shield can (which also solder to the PCB). However the other two coils wound on balun cores must be mounted a little differently. As you can see I've provided for 3mm holes in the board on each side of the two former positions, so after you've fitted them they can be held in position using carefully fitted nylon cable ties. This works out fairly neatly, and they're clamped quite securely.

The remaining component to fit to the PCB is the BF998 MOSFET, and I've deliberately left discussing this until now because I recommend that you leave it as the very last part to be fitted to the board. As a surface mount component it must be mounted on the copper side of the board (i.e., underneath), and since it's so tiny it needs special care.

To help you in orientating it correctly on the PCB pads, I'm providing a separate 'closeup' overlay diagram. Note that the SOT143 package has one tab that's wider than the other three, as shown in the small drawing at the bottom of the schematic. (The drawing

PARTS LIST

Resistors

All 1/4W 5% carbon:

R1	820 ohms
R2	10 ohms
R3,9	680 ohms
R4	2.7k
R5	22k
R6	2.2k
R7,8	47k
R10,18	330 ohms
R11,13,15	1M
R12	100 ohms
R14	100k
R16	3.3k
R17	2.2M

Capacitors

C1	470uF 16VW RB electrolytic
C2,11	100pF ceramic
C3,4,6,10	0.1uF monolithic
C5	47nF mono or met. polyester
C7,8	10nF monolithic
C9,12	4.7nF mono or met. polyester

Semiconductors

D1,2	BAW62 or similar
Q1	BF998 dual gate MOSFET
Q2	BC548 NPN silicon
VC1	BB212 varicap diode
U1	LM723 voltage regulator

Pots & switches

VR1	100k linear pot
VR2	1M linear pot with switch
VR3	1k preset pot, horizontal mount
S1	Three pole, 4 position rotary switch

Miscellaneous

PCB, 120 x 91mm, coded 95aa12; plastic case, 160 x 155 x 65mm; shield plate, 110 x 120mm (1mm aluminium sheet or unetched PCB laminate); 2 x SO239 coaxial sockets, single hole mounting; coaxial DC input socket; 600mm telescopic rod antenna; 3 x control knobs; 6.8uH RF choke (L4); F14 two-hole balun core, 13.5mm long; F29 two-hole balun core, 6.5mm long; 4.8mm miniature coil former, six-pin base, shield case and F29 tuning slug; 2 x nylon cable ties; 24 x PCB terminal pins; 3m length of 0.25mm enamelled copper wire, for winding coils; 5 x 12mm x 3mm machine screws; 14 x 3mm nuts; 2 x solder lugs; 6 x 3mm star lockwashers; hookup wire, solder, etc.

shows the device as seen from its TOP, with the tabs bent down and away from you.) The wider tab is the source connection, and as you can see from the small overlay diagram, the device is orientated on the board with its axis at about 45° to the PCB sides, and with this wide tab soldered to the largest of the four copper pads.

To do this job without damaging the BF998, you're going to need a soldering iron with a very fine chisel-pointed bit — well tinned, and very clean. The iron should also be reliably earthed, to ensure that there are no leakage currents to damage the device when you solder it in place.

I suggest that you *very lightly* tin the PCB pads first, if they haven't already been pre-tinned by the manufacturer. Then place the BF998 carefully in position, and hold it place using a toothpick while you quickly tack-solder the source tab to its pad. Then you can solder the remaining tabs, and finally resolder the source connection if you're not entirely happy with it.

The main things to ensure are that (a) you don't overheat the BF998, during the soldering process; (b) you don't apply too much solder, and create 'bridges' to short between the pads or device tabs. The space between the pads is very small, so you need to be particularly careful.

Once the BF998 is in place, your PCB assembly should be complete and ready to mount in the case (assuming you've already fitted the shield plate, with its PCB mounting screws). Then, once you've mounted the controls on the front panel, and the connectors on the rear panel, the final step is to make the various connections between all of these off-board components and the PCB. You should find these all pretty straightforward from the internal photos and the PCB overlay, which has labels for all of the terminal pins.

Adjustments

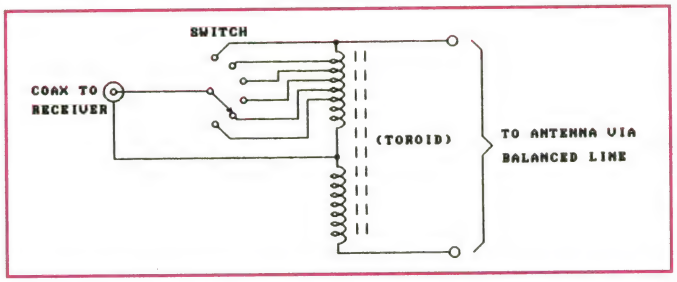
Once the unit is complete, there are really only two adjustments to be made. One is the setting for preset pot VR3, which is simply adjusted until the regulated supply rail measures as close as possible to +9V. A DMM can be used to monitor the voltage for this adjustment, connected between say pin 3 of U1 and the earthy side of the RF output socket.

The other adjustment involves the tuning slug of L3, the coil for the 8 - 30MHz band. It's the position of this slug that determines the bottom limit of this top band, and hence whether or not it correctly overlaps (slightly) the top of the middle band.

The best way of setting the slug is to use an RF signal generator, set to 7.8MHz. The output of the Active Antenna — switched to the top band (C) and with the tuning pot turned fully anticlockwise — is then fed to your receiver, which is also tuned to 7.8MHz. The output of the generator is then increased until the signal can be heard, and the slug in L3 adjusted until you achieve a 'peak', indicating that resonance has been reached. (You may need to reduce the generator output as the peak is reached, to prevent receiver overload.)

If you don't have access to an RF generator, an alternative approach would be to set the Active Antenna to the top of the middle (B) band, and tune your receiver to an easily recognisable station close to 8MHz.

Then switch the Active Antenna to band C, turn VR1 down almost fully anticlockwise, and adjust the slug in L3 until the signal reaches a peak again. In the absence of a generator, this should give the best result possible.



If you would like to use a balanced antenna, here is the schematic for an adjustable ratio balun transformer. The text explains how to wind one.

Balanced antenna

As mentioned earlier, a balanced antenna tends to give the best results in a noisy urban environment, especially when used with a 'balun' or balanced-to-unbalanced matching transformer. So if you have the room to use one, the results are generally worth the additional effort.

The basic idea is that you use *two* lengths of wire, arranged so that they assist each other in terms of picking up the wanted signals, but at the same time can be connected to the balun so that they cancel out each other's noise pickup.

The key points are that the two wires should be of the same length, be at close to the same height above the ground and share close to the same axis, but ideally run in opposite directions away from the balun. In other words, they should form a small dipole, with the balun in the centre. A short length of coaxial cable then runs from the balun to the low impedance input of the Active Antenna.

A loop of wire can be connected to the balun in the same way, to form a 'folded' dipole.

As the impedance of a small balanced dipole or loop will vary quite widely over the HF spectrum, for the best results the balun should be adjustable in terms of its primary to secondary ratio.

Tom Moffat described a suitable multi-tapped adjustable balun in the May 1991 issue, and its schematic is shown in the diagram. Tom used a 500mm length of 24SWG enamelled copper wire, bent into a 250mm bifilar pair and carefully wound on a small HF ferrite toroid. They were then cut apart at the 'bend' end, and connected head-to-tail to form a centre-tapped balanced winding. He then made taps on one side, as shown, and wired the taps to the switch so that when receiving, it is possible to select the tap that gives the best reception at any particular frequency.

Tom used a small toroid measuring about 10mm OD, but is no longer able to supply them. DSE has a somewhat larger and more expensive toroid, available in its D-5350 Balun Kit, while Jaycar has a 20mm OD toroid (LF-1241) which would probably be suitable although we haven't tried it.

The balun can be housed in a small plastic utility box, with the switch fitted with a suitable knob for convenient adjustment. If you can't fit the balun at the centre of the antenna and still get easy access for adjustment, you can have the balun near the Active Antenna unit and couple its input to the antenna using a short length of 300Ω ribbon cable (as used for TV antennas).

In fact you could even make a small loop antenna out of the same cable, if you wish — soldering the conductors together at the far ends, just as if you were making an indoor folded dipole for TV or FM reception. The only difference is that in this case, you don't need to cut the dipole to any specific length; just make it as long as you can, for the best HF reception.

Happy listening! ❖

DSE 'Discovery Series' Construction Project:

FOUR CHANNEL IR REMOTE CONTROL

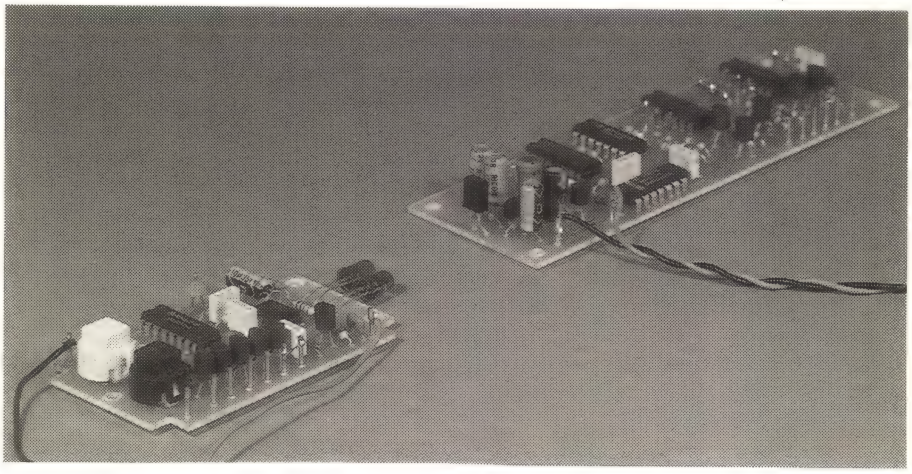
Latest release in the Discovery Series of learning kit projects from Dick Smith Electronics is this K2810 four channel infrared remote control system, which comes in two parts — a small infrared transmitter that can be made handheld, and a companion receiver. The kit for both parts is available from DSE's stores as Cat. No. K-2810, priced at $39.95.

Both the transmitter and receiver modules in this low cost four channel IR remote control system can be programmed with a selectable security code, to give immunity against false triggering and to prevent operation by other transmitters. Each channel can be operated either by a pushbutton switch or by direct connection to terminals on the transmitter. Two button switches are provided with the kit, and can be mounted directly on the PCB. An extra two can be connected by wires to the PCB.

An additional input on the transmitter called 'transmit enable' permits the channels to be combined, for controlling up to 16 different functions.

The receiver module has five outputs, which are all capable of directly driving relays. There is one output for each channel and an extra one called a 'valid data' output, which indicates when a correctly coded signal is being received. By altering straps on the receiver PCB, the data outputs can be made to operate in either a momentary or 'toggle' (push on/push off) mode.

The transmitter PCB will fit into the smallest DSE zippy box (Cat. No. H-2855), and the receiver into a larger zippy box (Cat. No. H-2853). For portability the transmitter can be operated, for example, from a typical 12V remote control battery (DSE Cat. No. S-3335) or a 216-size 9V battery — although batteries and cases are not provided with the kit.



Transmitter operation

The transmitter communicates with the receiver by sending 1us (one microsecond) pulses of infrared light, at a maximum rate of one every 30us — i.e., at a frequency of 33kHz. The infrared light is transmitted by LED2 and LED3, and has a spectrum with peak intensity at a wavelength of 940nm and a half-power bandwidth of 100nm.

These LEDs operate in the same way as ordinary visible LEDs — i.e., they emit light whenever they are forward biased, and the light intensity increases with increasing current. To achieve the maximum possible range they are pulsed here at a high current of about 1A, but a low duty cycle of 1us 'on' to 30us 'off'. This keeps the average current and power dissipation within acceptable limits.

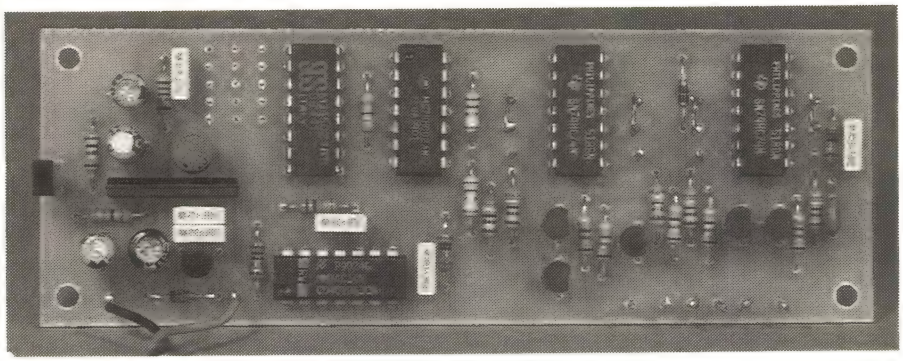
The current through the LEDs is controlled by transistor Q6, which is switched on when the output (pin 3) of pulse generator IC2 goes low. The peak LED current is determined by the value of resistor R10 (here 2.7Ω) and the supply voltage, according to the approximate formula:

$I = (V+ - 5)/(R10 + 2)$

The immediate source of the current pulses drawn by the LEDs is capacitor C6, which is capable of supplying the short heavy current surges without caus-

SPECIFICATIONS

Transmitter	
Supply voltage	(V+) 8 - 12V DC
Supply current	0mA quiescent 15mA (@ 9V) with a button pressed
Code combinations	243
Output wavelength	940nm
Input voltage range	0V to V+
Input current	15mA (out of the terminal)
Receiver	
Supply voltage	8 - 12V DC
Supply current	7mA
Range	15m typically, indoors
Output current	sourcing 40uA typ @ 3V sinking 100mA typ @ 1V



Use this photo in conjunction with the overlay diagram, when you are wiring up the remote control receiver board.

ing the supply voltage to drop excessively. After it has delivered each pulse it is 'topped up' by a much smaller charging current from the power supply, during the intervening 30us intervals.

Pulse generator IC2 is a CMOS 555 general purpose timer. The width of the LED pulses is determined by the time it takes to discharge C3 from 2Vcc/3 to Vcc/3 via R9 and the discharge pin of IC2 and is given approximately by $t_{ON} = (0.693 \times R9 \times C3)$ seconds

The minimum interval between LED pulses is determined by the time it takes to recharge C3 from Vcc/3 back to 2Vcc/3 from the supply via R8 and R9, and is given approximately by $t_{OFF} = (0.693 \times [R8 + R9] \times C3)$ seconds

The 33kHz signal that IC2 generates is known as a 'carrier' signal. It is detected by the receiver, but has to be *modulated* — i.e., modified by the information we want to send — before the receiver can produce any output.

The job of modulating the carrier is performed by IC1, a trinary encoder. It does this by switching IC2 on and off, at predetermined intervals that represent the state of each of the address (code) and data inputs.

The address (A1-5) and data (D0-3) inputs to IC1 have three possible states, which is why it is called a *trinary* encoder instead of a binary encoder. The first state is called 'one' and is the condition of having the input connected to Vdd, which is marked (+) on the code strapping solder pads. The second state is called 'zero' and is the condition of having an input connected to Vss, which is marked (-) on the code pads. The third state is called 'open' and is the condition of having an input not connected to anything.

IC1 converts the state of each input to a serial binary pulse code, which appears at its data output (pin 15). When the output is logic 0, the discharge input (pin 7) of IC2 is clamped low via diode D1, preventing C3 from charging, and so stopping the pulse generator. When the output is logic 1, D1 is reverse biased and the pulse generator operates normally.

The serially encoded output of IC1 is basically a 1.6kHz square wave, with nine consecutive groups of eight cycles allocated to represent each of the five address and four data inputs. The frequency of the square wave is determined by the values of R6, R7 and C2 according to the formula

$f = 1/(2.3 \times Rtc \times Ctc)$ Hz

where Rtc is here equal to the sum of R6 and R7, and Ctc is C2. This formula is true for frequencies between 1kHz and 400kHz.

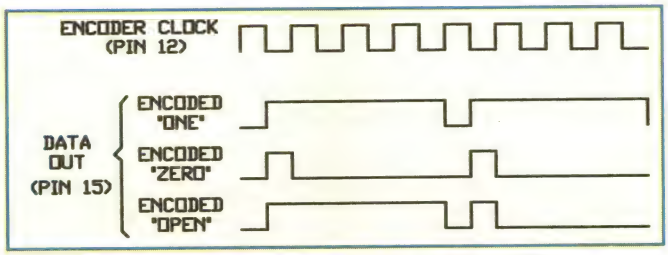


Fig.1: How a group of eight cycles of the 1.6kHz square-wave is modified to represent the three trinary states.

The diagram of Fig.1 shows how a group of eight cycles of the 1.6kHz square wave is modified to represent the three trinary states.

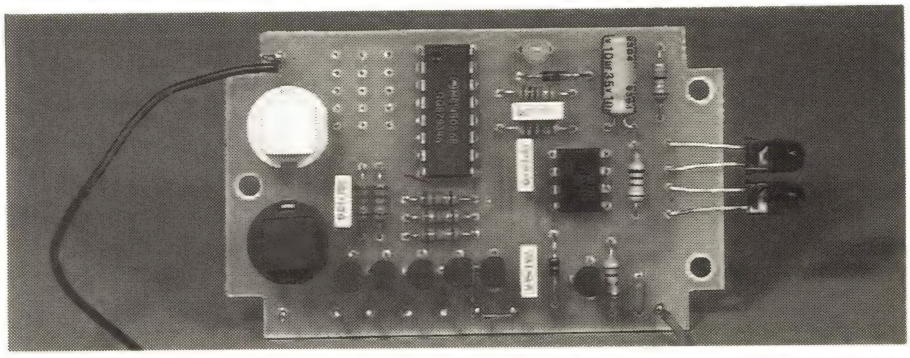
There are two ways to operate the transmitter. One is to have the transmit enable input (pin 14) of IC1 permanently enabled, by inserting strap J1. In this mode, data is transmitted whenever one or more of the four data inputs are connected to 0V. The data is transmitted continuously until the 0V is removed.

The second method of transmission is to have the transmit enable input disconnected and then set up the required code on the data inputs. 0V must then be applied to the transmit enable input to cause transmission. In both modes a minimum of two words (each word containing the address and data) will be transmitted, otherwise the transmission will continue for as long as the data is applied.

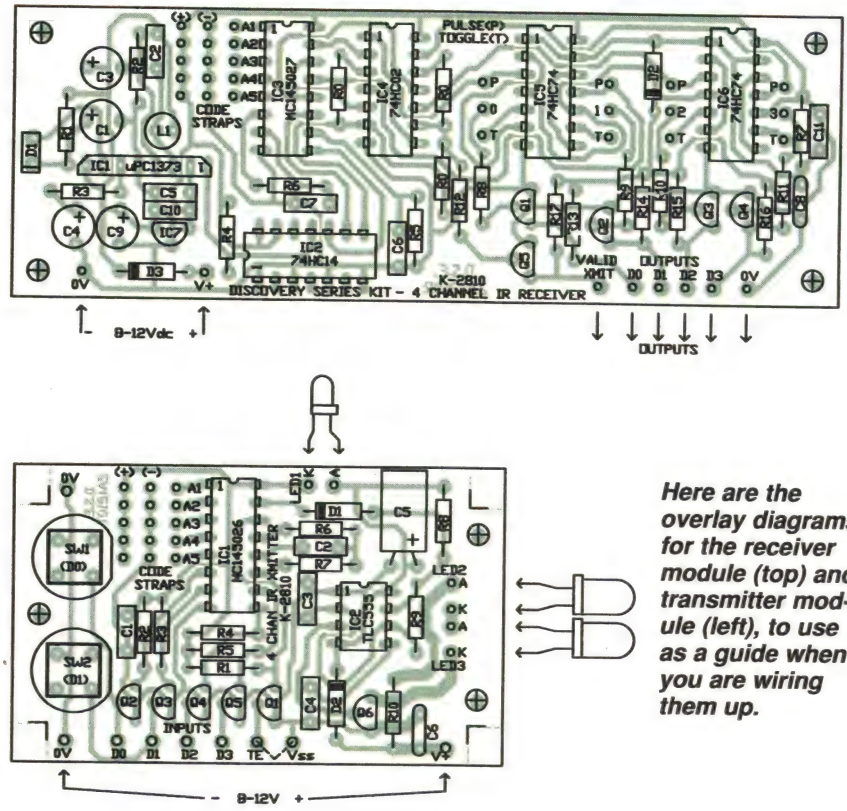
The purpose of the transistors at the transmit enable and data inputs is to simultaneously apply power to the circuit and logic 0's to the encoder inputs when 0V is connected. Each transistor acts as two back-to-back diodes, with the base being the common cathode. When 0V is connected to the base of the transistor, the circuit ground (Vss) is connected through the collector-base diode to 0V and the encoder data input is connected through the emitter-base diode to 0V.

The security code is set by connecting each of the five address inputs A1-5 to either Vdd ('one'), Vss ('zero') or left disconnected ('open'). Although the data inputs D0-3 are also trinary, the data decoder in the receiver interprets both the 'one' and 'open' states as a 'one'.

Resistors R2-5 ensure that the data inputs are either at an 'open' or 'one' state unless they are connected to 0V by



Here is a close up view of the transmitter PCB, which can be used as a guide to its assembly, along with the overlay diagram.



Here are the overlay diagrams for the receiver module (top) and transmitter module (left), to use as a guide when you are wiring them up.

the appropriate transistor.

As an indication to the operator that power is applied to the circuit, LED1 has been placed in series with the supply current to IC1. Capacitors C1 and C5 provide filtering for the IC1 and IC2 supplies.

Receiver operation

At the receiver front end is D1, a PIN photodiode ('PIN' being an acronym for P-type, Intrinsic and N-type semiconductor layers) which has a maximum sensitivity at 950nm in the infrared region. The diode is reverse biased and the incident light causes it to pass a current that varies with light intensity.

IC1 is a preamplifier/detector chip with automatic gain control (AGC), that is specifically designed for infrared remote control receivers. The amplifier in IC1 is tuned to the 33kHz carrier by C2 and L1, and the output at pin 1 is an open-collector transistor which conducts whenever a 33kHz signal is detected. The data input to the decoder IC3 requires an active-high signal, which is provided by inverter IC2a.

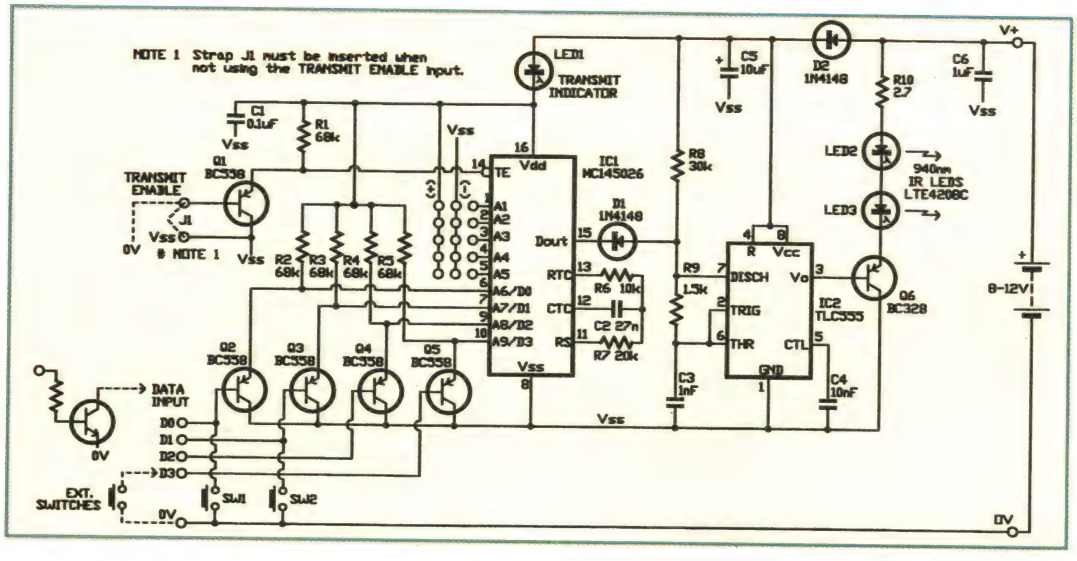
IC3 is a MC145027 trinary decoder IC, designed to complement the MC145026 encoder in the transmitter. It has the same five address inputs A1-5 as the encoder, and these must be strapped with the same code as the encoder before the transmitted data will be accepted.

When a word is received which has the correct address, the data is stored but not transferred to the output. If the next word received has the same address, then the data is compared with the stored data from the last word and transferred to output D0-3 if it is the same. At the same time as the data appears at the output, the valid transmission (VT) output also goes high to indicate that the data output has been updated. When the transmission stops the VT output goes low again but the data remains at the D0-3 outputs.

To make the receiver output momentary, i.e. to make the output return to normal once the transmission ceases, the IC3 data outputs are gated by VT via a NOR gate. When there is no transmission, the logic 0 VT output is inverted by IC2b and applied to one input of each NOR gate, forcing all the NOR gate outputs to Logic 0. Assuming all the P/T straps are set to pulse mode (P), output transistors Q1-4 will then all be switched off and the final D0-3 outputs will all be at +5V.

This configuration means that the receiver output data is a non-inverted copy of the transmitter input data. Transistor Q5 however is switched on when there is no transmission, and so the final VT output is normally at 0V. The output pull-up resistors R13-17 can be removed if the load connected to the output has its own pull-up resistors.

Some applications require toggle



Here is the circuit schematic for the remote control transmitter. IC1 performs the channel encoding, while IC2 generates the supersonic carrier to drive the IR LEDs via transistor Q6.

December 1995/January 1996

EMONA News
EA Edition

Test equipment & software for industry, education & enthusiasts.

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- Handheld Scope Guide

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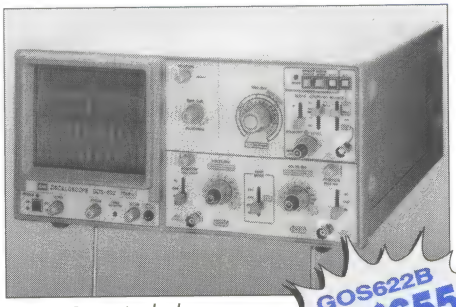
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Analogue Scopes

Modern 20MHz Oscilloscope

DEC/JAN SPECIAL

GW offers unbeatable quality, performance and value in this modern 20MHz, 2 channel scope. From the advanced front end amplifiers to the excellent triggering and display facilities, the GOS-622B has the facilities to be able to keep up with your future needs.



GOS622B ~~$725~~ $655 + 22% Sales Tax

** Price includes 2 professional scope probes.*
Warranty is 12 months.

GOS-622B's Professional Scope Facilities include:

- The advanced **Auto Trigger Level Lock** providing hands-free trigger setting;
- **Alternate Trigger Mode,** a great time saver when troubleshooting. The user can compare and view directly a good and a bad waveform on each channel, without having to switch the trigger source between the two channels.
- **Variable Hold-off** allows stable viewing of complex waveforms;
- **DC Trigger Coupling** for stable viewing & triggering of low frequency signals.

GOS-622B Basic Specs

Sensitivity	5mV to 5V/DIV, DC to 20MHz 1mV/DIV, DC to 5MHz
Timebase	**20ns/DIV** to 0.5s/div
Sweep Modes	**Auto**, Normal, Single Shot
Trigger Coupling	**DC**, AC, HF-rej, **TV-H, TV-V**

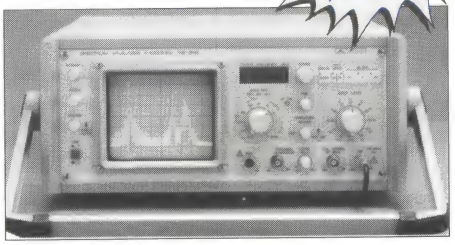
GW

RF Test Instruments

Affordable Spectrum Analysers !

AE-366 $5,015 + 22% Sales Tax

Promax, a specialised European manufacturer of test equipment, offers 2 professional RF spectrum analysers, with frequency ranges of up to 1.75GHz.



AE-566 pictured

Promax spectrum analysers are outstanding for their simple operation, their great on screen dynamic range of 80dB and their ability to even display from 1MHz to 1000MHz in a single sweep.

The AE-566's facilities include:

- automatic selection of optimum resolution bandwidth;
- log (dB) and linear (DIV) display modes;
- switchable 50ohm and 75ohm input;
- 120dB total dynamic range;
- normalisation function to correct for effects of cables , connectors, etc;
- in-built 100MHz calibrated reference;
- a complete range of accessories.

The model **AE-566** is a high performance 1GHz analyser with 1GHz Tracking Generator. Price, ex-tax, is only $7,311.

The 1GHz **AE-366** is a more basic analyser, without tracking generator and other advanced features. It is ideal for TV and CATV applications.

The **CV355 option** is a converter for extending the input range of the AE-366 and AE-566 to 1.75GHz. The excluding tax price is just $536.

PROMAX

TekTools DMM Range

Pen Multimeter

The compact DMM 150 Pen Meter is great for one-handed operation in tight places.



DMM150 with CMM150 attached

- **DC Volts Ranges** 300mV to 600V
- **AC Volts Ranges** 3 to 600V
- **Resistance** 300 to 30Mohm
- Continuity Check
- Diode Test
- **AC Amps OPTION** 0.1A to 300A AC Requires CMM150 Clamp Probe. CMM150 price is $70 + 22% sales tax

DMM 150 $90 + 22% Sales Tax

Tektronix

Pocket DMM

The DMM 155 Pocket Multimeter is designed for fast, efficient equipment service and maintenance.



- **DC Volts Ranges** 200mV to 600V
- **AC Volts Ranges** 2 to 600V
- **AC/DC Current** 2mA to 10A
- **Resistance** 200 to 20Mohm
- Continuity Check
- Diode Test
- Includes Holster

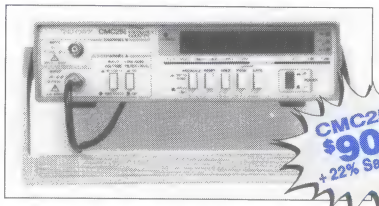
DMM 155 $110 + 22% Sales Tax

Tektronix

TekBench Range

1ppm Counter

A high performance 8 digit, 1GHz Universal Counter, 1ppm timebase.



CMC251 $905 + 22% Sales Tax

CMC251 Basic Specs

Frequency Range	1Hz to 1.3GHz
Stability	±1ppm
Sensitivity	5mV to 35mV
Measuring Functions	Frequency, Period, Period Average, Totalise & Pulse Width
Input Functions	Switchable Attenuator & LPF
Electrical Safety	IEC1010 & CE Marked

TekTools DMM Range

Personal DMM

The DMM 247 delivers great quality and performance at a low price.



- **DC Volts Ranges** 300mV to 1000V
- **AC Volts Ranges** 3 to 750V
- **AC/DC Current** 300µA to 20A
- **Resistance** 300 to 30Mohm
- Continuity Check
- Diode Test
- Includes Holster

DMM 247 $225 + 22% Sales Tax

Tektronix

Professional

The DMM 254 is a professional, full function TRMS & ±0.1% DMM.



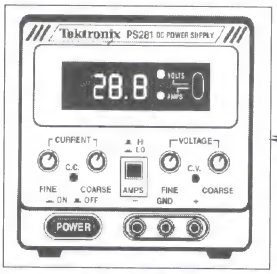
- **DC Volts Ranges** 400mV to 1000V
- **AC Volts Ranges** 400mV to 750V
- **AC/DC Current** 4mA to 10A
- **Resistance** 400 to 40Mohm
- **Capacitance** 4nF to 40µF
- **Frequency Range** 100Hz to 1MHz
- Continuity Check
- Diode Test
- Includes Holster

DMM 254 $370 + 22% Sales Tax

Tektronix

30V DC Supply

A robust, highly reliable DC power supply, with very low noise of <0.5mV rms and excellent load regulation of <0.01% + 3mV.



PS281 $640 + 22% Sales Tax

PS281 Basic Specs

Output Voltage	0 to 30V
Output Current	0 to 3A
Display	3 digit, LED
Controls	Fine & Coarse for voltage & current
Electrical Safety	IEC1010 & CE Marked

Tektronix

PRIORITY ORDER FORM

Please enter my Priority Order:

Qty	Model	Unit Price	Total Price
		Subtotal	
		22% Sales Tax	
		Freight	**$10.00**
		Total	

FOR TAX EXEMPTION, PLEASE INCLUDE OFFICIAL ORDER WITH SALES TAX EXEMPTION NUMBER.

Enclosed is my cheque/money order for $ _____ or

Please debit my ☐ Bankcard ☐ Mastercard ☐ Visa

Card No. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Signature _____ Expiry Date ___/___

Name _____

Organisation _____

Address _____

_____

Suburb _____ Postcode _____

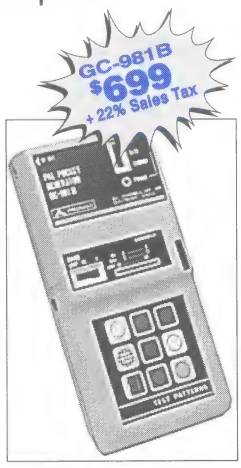
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Pattern Generator

Handheld TV Pattern Generator

The Promax GC-981B is a pocket sized generator with RF output, providing 9 TV test patterns.



Designed as a cost effective instrument for the testing of PAL colour and B/W TV sets, the GC-981B's output signals comply with very rigorous norms. Each test pattern also includes a large on-screen circle for geometry adjustments.

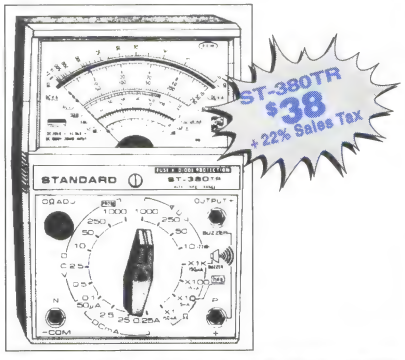
Video carrier frequency is continuously adjustable from 47MHz to 860MHz, in 3 ranges. Mono sound is internally FM modulated at 5.5MHz.

PROMAX

Analogue Multimeter

8 Function Multimeter

SEW's ST-380TR includes a buzzer for continuity, a transistor checker and a mirror scale for reading accuracy.



ST-380TR Basic Specs

V DC	0 to 0.1, 0.5, 2.5, 10, 50, 250, 1k
V AC	0 to 10, 50 250, 1k
A DC	0 to 50µ, 2.5m, 25m, 250m
Ohm	R x 1, R x 10, R x 100, R x 1k
dB	-10 to 50dB
Transistor Checker	Iceo 150µ, 15m, 150mA
h_{FE}	0 to 1000
Continuity Buzzer	
Dimensions	106 x 149 x 55mm

SEW

Bench-Top Instruments

Four-In-One Instrument

DEC/JAN SPECIAL

The LAB4 is a multifunction instrument which incorporates four full function test instruments in one space saving case. The LAB4 is ideal for education & small labs!



The four instruments cover: **DC Power Supply** triple output (5V, 15V and 0-50V); full function, autoranging **Digital Multimeter** with AC A, DC A, AC V, DC V and ohms; **Function Generator** 0.02Hz to 2MHz with sweep; and **Frequency Counter** 1Hz to 100MHz input range.

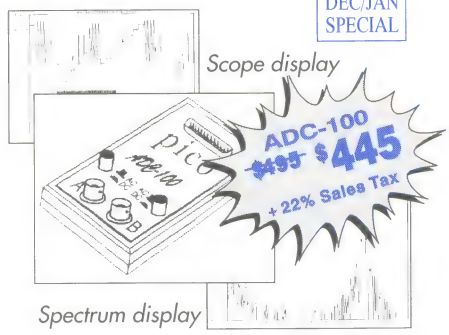
EMTEK

Virtual Instruments

Low Cost PC-Based Instrument

DEC/JAN SPECIAL

The ADC-100 offers 6 instruments in one hardware/software package, requiring a PC with a free printer port.



The standard software included with the ADC-100 turns your PC into an -

- **Oscilloscope • Spectrum analyser**
- **Frequency counter • TRMS DVM**
- **Chart Recorder • Data Logger**

ADC-100 Basic Specs

Inputs	2 channels, 12 bits, 100kS/s per ch
Bandwidth	DC to 40kHz single shot
Interface	parallel printer port

pico

Engineering Software

Easy Circuit Simulation

DEC/JAN SPECIAL

Test your circuit ideas with a full compliment of test instruments & electronic components at your disposal !



Analog, Digital & Mixed Circuits
Electronics Workbench Version 4 is an extraordinarily easy to use electronic circuit simulator. Just as in real life, it allows both analog and digital parts to be mixed in any combination.

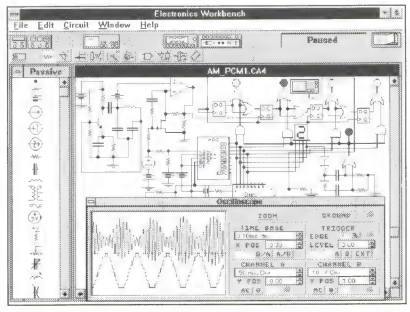
Electronics Workbench's simple, direct interface helps you build circuits in a fraction of the time. Try "what if" scenarios and fine tune your designs painlessly.

Professional Version 4:
Offers the full mixed-mode simulation power of Electronics Workbench, with integrated schematic capture, simulator and graphical waveform simulator.

Educational Version 4:
Same as Professional V4, plus a Troubleshooting feature for teaching environments.

Windows: requires MS Windows 3.1, mouse & 4MB RAM.

DOS: requires PC with min. 386, hard disk, 4MB RAM, mouse, VGA.



True mixed-mode simulation: Simultaneous AM transmission, digitisation & pulse code modulation of a signal.

INTERACTIVE

Battery Operated Scopes

Handheld Digital Storage Scopes

100MHz TekScope



True 100MHz single shot bandwidth on both channels.

- Exceptional LCD display - **very bright** with a **very fast** update rate.

A high performance 100MHz scope with dual, fully isolated & differential inputs and 21 in-built measurements, plus a TRMS DMM with data logger capabilities. In-built comm's & printer port.

Tektronix

5MHz TekWaveMeter



A TRMS, autoranging DMM with instant waveform display.

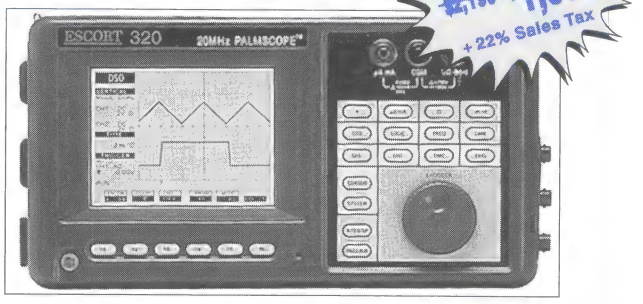
- Finds problems that would be missed using just a DMM.

Single 5MHz channel, sampling at 16MS/s, plus a TRMS DMM. An affordable, high performance autoranging DMM which will clearly reveal waveform distortion, glitches & intermittent failures.

Tektronix

DEC/JAN SPECIAL

20MHz PalmScope



4-in-1: DSO, DMM, Frequency Counter and Logic Analyser.

- Four of the most commonly needed instruments in one package.

20MHz dual channel scope, sampling at 20MS/s. Autoranging, TRMS, 4000 count DMM with V, A, R, diode & continuity. 20MHz, 7 dig counter. 8 ch, 20MHz logic analyser. Comm's & printer ports.

Escort

5MHz TekMeter



Solve electrical problems you could never see before.

- A compact test instrument package for mains & motor applications.

Dual 5MHz channels, sampling at 25MS/s, plus a TRMS DMM. Specialised automatic measurements for 3 phase systems, power & power factor, detecting noises & spikes, THDF, motor triggering.

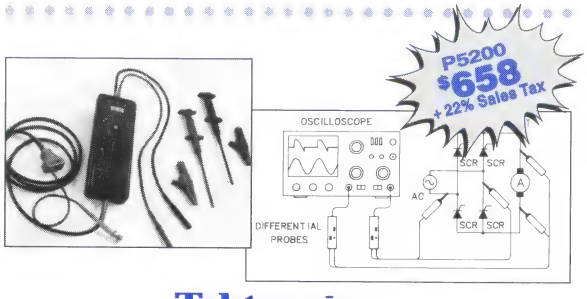
Tektronix

Tek Scope Accessories

Differential Scope Probe

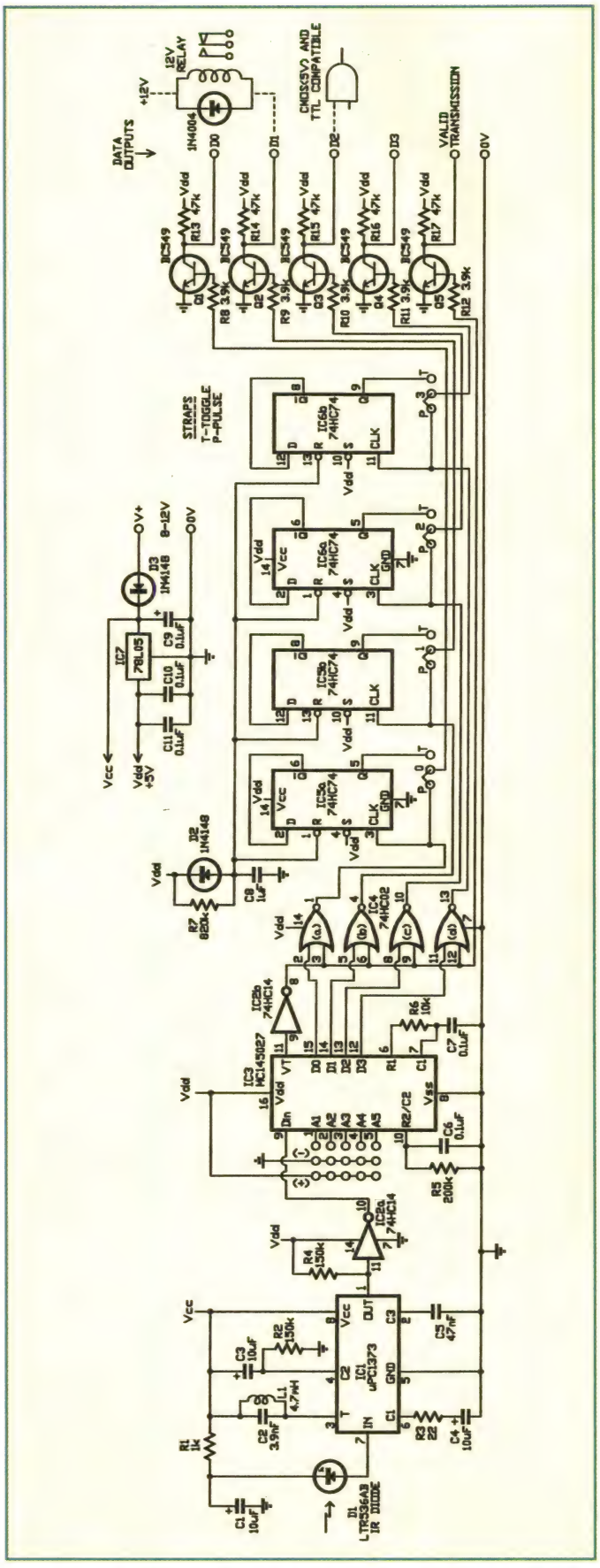
The P5200 is a probe that provides any general oscilloscope with a high voltage differential input.

By connecting directly to any oscilloscope's input channel, the P5200 allows the user to simply, safely and accurately display in-circuit voltage measurements across components without requiring a reference to ground. Maximum input voltage is 1,300V, with a 25MHz bandwidth. Risetime is 14ns and input C is 3.5pF.



Tektronix

E&OE Prices and specifications subject to change without notice. Price specials, as marked, are available till 31st January 1996 or while stocks last, direct from Emona.



Here is the schematic circuit for the receiver module. Each channel can be set up for either pulsed or toggle operation.

operation of the remote control, meaning that each press of one of the transmitter buttons alternately switches the particular receiver data output on and off. To achieve this, there are four flip-flops (IC5,6) which are set up to toggle by having their Q-bar outputs connected to their D inputs.

Whenever one of the data outputs from IC3 changes state from 1 to 0, the corresponding NOR gate output changes from 0 to 1 and causes the flip-flop output to change state. With the P/T straps set for toggle mode (T), the data output transistors are connected to the flip-flop Q outputs instead of the NOR gate outputs.

To ensure that the flip-flops are reset when power is first applied, all of their reset inputs are tied together to capacitor C8. Because of the time it takes C8 to charge up via R7, the capacitor holds the reset inputs at logic 0 until the supply voltage has stabilised and so resets the flip-flops (i.e., each Q output is logic 0 and each Q-bar is logic 1.

Except for IC1, the whole receiver circuit uses a +5V supply which comes from regulator IC7. Apart from providing immunity from power supply noise, the 5V regulator is used because the 74HC series CMOS devices have an operating voltage range of 2-6V and the regulator allows supply voltages higher than 6V to be used. The operating voltage range of IC1, the uPC1373, is 6-14.4V and so it is tied to the main supply via reverse protection diode D3. The MC145027 (IC3) has an operating voltage range of 4.5-18V and so can be operated from the 5V supply. Capacitors C9-11 are used to filter the supply and ensure the stability of IC7.

Construction

To mount the components on the PCB's, start with the low profile components first and then work your way up to the larger components.

To place the components, look at the overlay diagram and the photo, which show how the components and wire links actually appear on the PCB. Read the label of the component, e.g. C2, from the overlay and then look up the description next to that label in the parts list. For example, C2 in the transmitter is an MKT type capacitor and has the value 27nF; this may be marked either 27nF, .027uF or 273pF. Occasionally one of the supplied capacitors may be marked with a voltage rating greater than that which is shown in the parts list, which is acceptable. But if the voltage rating is *less* than that shown in the parts list then advice should be sought.

Begin construction by installing the resistors. Resistors have their values marked on them as a colour code, which is given in the parts list. The last band of the colour code gives the tolerance value and is the one that is farthest from the others. Resistors can be mounted in either direction, but it is good practice to mount them with their colour codes all in the same direction for ease of reading the values.

Next mount all the diodes except receiver IR sensor diode D1. The standard diodes have a band on them close to one end, and this must be mounted in the direction shown on the overlay.

Now mount the IC's.

CAUTION: All of the IC's (except IC1 and IC7 in the receiver) are CMOS types, which are sensitive to static electricity. Take the following precautions.:

- Do not remove them from their protective foam until you are ready to install them.
- Avoid touching the pins with your fingers.
- Make sure that your soldering iron is properly earthed.
- Solder the power and earth pins to the board first.

There are three different IC package types used. The most common is the DIP or 'dual in-line' package, which has two

parallel rows of pins. These packages have a dot or notch at the end closest to pin 1.

IC1 on the receiver PCB has a SIP or *single* in-line package, with only one row of pins. Looking at the chamfered side with the pins at the bottom, pin 1 is on the left. Finally, IC7 is a three pin device in a TO-92 package the same as the transistors. The overlay shows where the flat side should face.

Next mount the capacitors. The electrolytic capacitors are polarised types, which will have a negative (-) or (+) sign printed on them (normally the negative lead is marked). On the overlay these capacitors have a (+) sign to indicate where the positive lead goes. Note that capacitor C5 is laid flat on the PCB.

The choke L1 on the receiver PCB can be mounted in either direction. The transistors all have a flat side, which in each case must face in the direction shown on the overlay.

PCB pins have been provided as connecting terminals for both PCBs, and also for the P/T strap connections on the receiver.

For the LEDs in the transmitter, and D1 in the receiver, it is probably best to solder them in with their full lead length until the final mounting position is determined. D1 is sensitive to noise pickup and should be mounted directly on the PCB rather than with wires. The infrared LEDs on the transmitter should also be mounted directly on that PCB, because the high current and short duration of the pulses means they can be severely attenuated by the resistance and inductance of connecting wires.

When the assembly of the board is complete, carefully check all the soldering. Look especially for any dry solder joints, and for solder bridges which may be shorting tracks together.

How to test it

At this stage there is no need to put any code straps onto the PCBs. Set all outputs on the receiver to pulse mode by connecting a wire from each centre pin (numbered) to the corresponding P pin.

If you have a multimeter or current meter, then before connecting any of the transmitter inputs or the receiver outputs to anything, check the supply (V+) currents. For the transmitter there should be no current at all until a button is pressed, and then the current should be about 15mA and LED1 should glow. For the receiver the current should be about 7mA.

If the supply currents are OK, then try connecting a load to the VT output of the receiver. A good test load is an LED in series with a resistor of about 2.2kΩ, connected from V+ to the output (the cathode of the LED to the output terminal). With no signal the voltage at VT should be less than 1V and the LED should be on. When a button is pressed on the transmitter it should turn off.

If the VT output works OK, then connect a load to each of the data outputs in turn. The LED should be off until the relevant transmitter button is pressed (or 0V connected to the particular data input).

Now change all the P/T straps to toggle mode by connecting the wire from the centre pin to the T pin. When the power is first applied, all four outputs should be off; they should then toggle between on and off each time the corresponding button is pressed.

Code setting

The security code is set by wire links connected between the three rows of five holes near IC1 on the transmitter, and similarly near IC3 on the receiver. Exactly the same combination of links must be placed on the receiver as on the transmitter.

Each of the five pads closest to the IC can be either left 'open' (disconnected), or connected to the 'zero' (-) terminal in the next column of pads, or to the 'one' (+) terminal in the outside column. ❖

PARTS LIST

Transmitter

Resistors

(1/4W 1% metal film unless otherwise stated)

		Colour Code 4 band	5 band
R1-5	68k	blu-gry-org—brn	blu-gry-blk-red—brn
R6	10k	brn-blk-org—brn	brn-blk-blk-red—brn
R7	20k	red-blk-org—brn	red-blk-blk-red—brn
R8	30k	org-blk-org—brn	org-blk-blk-red—brn
R9	1.5k	brn-grn-red—brn	brn-grn-blk-brn—brn
R10	2.7 ohm	red-vio-gld—gld (5% carbon film)	

Capacitors

C1	0.1uF (100n/104) 100VW MKT
C2	27nF (0.027/273) 100VW MKT
C3	1nF (0.001/1000/102) 100VW MKT
C4	10nF (0.01/103) 100VW MKT
C5	10uF 25VW RB electrolytic
C6	1uF 25VW monolithic

Semiconductors

IC1	MC145026 9-bit trinary encoder
IC2	TLC555 CMOS timer
Q1-5	BC558 PNP transistor
Q6	BC328 PNP transistor
D1,2	1N4148 small signal diode
LED1	3mm round red LED
LED2,3	LTE4208/CQY89A IR LED

Miscellaneous

SW1,2 SPST momentary pushbutton switches

PCB, 71 x 43mm, coded ZA1210T; 9 x PCB terminal pins; battery snap connector.

Receiver

Resistors

(1/4W 1% metal film unless otherwise stated)

		Colour Code 4 band	5 band
R1	1k	brn-blk-red—brn	brn-blk-blk-brn—brn
R2,4	150k	brn-grn-yel—brn	brn-grn-blk-org—brn
R3	22 ohms	red-red-blk—brn	red-red-blk-gld—brn
R5	200k	red-blk-yel—brn	red-blk-blk-org—brn
R6	10k	brn-blk-org—brn	brn-blk-blk-red—brn
R7	820k	gry-red-yel—brn	gry-red-blk-org—brn
R8-12	3.9k	org-wht-red—brn	org-wht-blk-brn—brn
R13-17	47k	yel-vio-org—brn	yel-vio-blk-red—brn

Capacitors

C1,3,4	10uF 25VW RB electrolytic
C2	3.9nF (0.0039/392) 100VW MKT
C5	47nF (0.047/473) 100VW MKT
C6,7,10,11	0.1uF (100n/104) 100VW MKT
C8	1uF 25VW monolithic
C9	100uF 25VW RB electrolytic

Semiconductors

IC1	uPC1373 IR receiver preamplifier
IC2	74HC14 hex Schmitt inverter
IC3	MC145027 9-bit trinary decoder
IC4	74HC02 quad 2-input NOR gate
IC5,6	74HC74 dual D type flip-flop
IC7	78L05 5V positive regulator
Q1-5	BC549 NPN transistor
D1	LTR536AB/BPQ50 IR sensitive diode
D2,3	1N4148 small signal diode

Miscellaneous

PCB, 120 x 42mm, code ZA1210R; 20 x PCB terminal pins; battery snap connector.

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With colour option	$529
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DX4-100 CPU installed ... $289
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Configuration: ● Quad-Speed CD-ROM drive ● 4 MEG RAM ● 850 MEG Hard Disk Drive ● 1 MEG Video Card ● 14" SVGA N.I. Monitor- 1024 x 768mm 0.28mm Dot Pitch ● 1.44 3.5" F.D.D ● Ritron Mouse Pad ● Mouse & Joystick ● 101 High Quality Keyboard ● 16-bit Sound Card ● Magnetically Shielded Speakers ● Workgroups for Windows 3.11 or Windows 95 ● ***INCLUDE 5 FREE CD SOFTWARE TITLES:*** MS Works/Ms Encarta' 95/MS Money & MS Sampler and Yellow & White Pages Phone Disc ● ***20 Mbytes FREE SHAREWARE GAMES.***

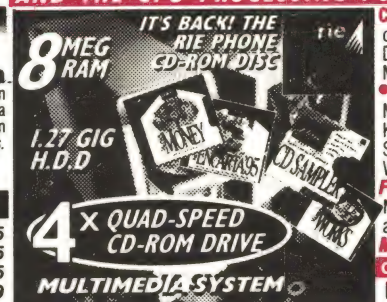
CPU CHOICES	TAX EX	TAX INC
DX2-66	$1599	$1799
DX2-80	$1629	$1829
DX4-100	$1650	$1890
Pentium™ 60	$1625	$1865
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Pentium™ 90	$1990	$2290
Pentium™ 100	$2090	$2390
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This range of systems offer higher perfomance levels with 8 Meg of RAM, a huge 1.27 GIG hard disk drive and the Quad-Speed CD-ROM drive. Video or animation files will play more smoothly than ever before, off this CD-ROM drive. Internet connection is child's play with these powerful systems.

Configuration: ● Quad-Speed CD-ROM drive ● 8 MEG RAM ● 1.27 GIG Hard Disk Drive ● 1 MEG Video Card ● 14" SVGA N.I. Monitor- 1024 x 768mm 0.28mm Dot Pitch ● 1.44 3.5" F.D.D ● Ritron Mouse Pad ● Mouse & Joystick ● 101 High Quality Keyboard ● 16-bit Sound Card ● Magnetically Shielded Speakers ● Workgroups for Windows 3.11 or Windows 95 ● ***INCLUDE 5 FREE CD SOFTWARE TITLES:*** MS Works/ Ms Encarta' 95/MS Money & MS Sampler and Yellow & White Pages Phone Disc ● ***20 Mbytes FREE SHAREWARE GAMES.***

CPU CHOICES	TAX EX	TAX INC
DX2-66	$1879	$2129
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DX4-100	$1940	$2190
Pentium™ 60	$1900	$2150
Pentium™ 75	$2120	$2420
Pentium™ 90	$2290	$2590
Pentium™ 100	$2390	$2740
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Capacity	Av.Access	Tax Inc.	Tax Ex.
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1M x 9-70 With Parity	$69	$67	$57
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Pentium™ 90*		$1535	$1872
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*External 256K Cache

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DC Current: 0-500µA-10mA-250mA
Resistance: Rx10, Rxl k (centre 3.6)
Battery Test: 1.5V 9V
Sensitivity: 2k ohms/volt DC/AC
Power: Requires 1 x AA battery

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Q13060

DIGITAL MULTIMETER



The ideal meter for technicians with a full 3½ digit LCD readout. Requires a 9V battery either alkaline or carbon. Expected life of carbon battery is 100 hours and 200 for the alkaline.

SPECIFICATIONS

DC Voltage: 200mV-2-20-200-1000 volts
AC Voltage: 200-750 volts
DC Current: 200µA-2000µA-20mA-200m A-10A
Resistance: 200Ω-2000Ω-20kΩ-200kΩ 2000kΩ
Diode Test: Measures forward resistance in kΩ with a test current of 1.5mA max
Power: Requires 1x 9V battery

Q13070
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DIGITAL MULTIMETER



The ideal meter for technicians with a full 3½ digit LCD readout. Requires a 9V battery either alkaline or carbon. Expected life of carbon battery is 100 hours and 200 for the alkaline.

SPECIFICATIONS

DC Voltage: 200mV-2-20-200-1000 volts
AC Voltage: 200-2-20-750 volts
DC Current: 200µA-2mA-20mA-200mA-2A-20A
AC Current: 200µA-2mA-20mA-200mA-2A-20A
Resistance: 200Ω-2kΩ-20kΩ-200kΩ-2MΩ-20MΩ
Diode Test: Measures forward resistance in kΩ with a test current of 1.5mA max
Power: Requires 1 x 9V battery

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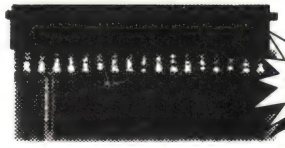
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R19010	Resistor 1/4W carbon	250	$5.95
T90804	BC 548 Transistors	100	$9.95
T90802	BC 547 Transistors	100	$9.95
T90806	BC 549 Transistors	100	$9.95
T90808	BC 558 Transistors	100	$9.95
T90800	Mixed Transistors	-	$13.95
R19020	50V-100V ceramic capacitor	50	$6.95
R15120	Mixed polyester capacitor	100	$12.95
R19030	Mixed polyester capacitor	50	$6.95
Z10106	Diode 1N4004	100	$5.95
Z10114	Diode 1N5404	100	$12.95
Z10135	Diode 1N4148/1N914	100	$3.95
S15994	M205 fuses (Mixed)	50	$8.95
S15992	3AG Fuses	50	$8.95
S15995	Mixed fast action fuses	10	$1.95
Z10136	Mixed 5mm LED	100	$14.95
Z10138	5mm red LED	100	$11.95
P10546	Mixed IC sockets	100	$24.95

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1 FARAD at 5.5V
YES 1 FARAD!
R15620
$6.95



BNC CRIMP RG59 75oHM



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BNC plug- black finish- brass pin ID 1.2mm crimp type- suits RG58C/U Ethernet cable with 5.3mmø

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Specifications:

Voltage range:	220-260 vac
Maximum current:	10 amp continous
Frequency range:	40-64 Hertz
Clamping voltage:	275 volts RMS
Energy absorption rating:	640 joules
Surge current:	26000 amps 8/20 Useconds
Response time:	8nsec
Earth leakage:	<1.2 mA
Filtration systems:	Passive system Common & Differential mode suppresion
Attenuation:	-55 dB at 200 Mhz

LN-712 GEIGER MULLER TUBE

The tube assembly for our Gieger Counter kit no. K10715. The passage of alpha, beta particles or gamma photon cause the Geiger Muller tube gas to ionise and produce a brief discharge.

Tube Specifications:
Gas content: ***Neon & halogen***
Operating temperature: ***-40° C to +75° C***
Window material: ***Mica***
Recommended resistor: ***10MΩ***
Starting voltage: ***325V***
Operating voltage range: ***450-600V***
Minimum dead time: ***90µs***
Minimum alpha particle energy for detection: ***2.5MeV***
Minimum beta particle energy for 25% absorption in mica window: ***30MeV***



E90000 **$119**

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Cat No.	DESCRIPTIONS	PRICE
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P39344	1M HONDA 50M/DB25M	$49.95
P39346	1M HONDA 50M/HONDA 50M	$59.95
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X15699	HONDA 50M Terminator (Active)	$39.95



X15699 NEW
HONDA 50M Terminator (Active)

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Stepdown Transformers are designed to allow appliances designed for 110V to 120V to be operated from 240V mains

MODEL 2166-ST 250 WATT

INPUT 240V 50Hz
OUTPUT 115V AC 250VA

FEATURES:

- Protective earth carried through to output
- Earthed 3 pin output socket
- Replaceable fuse for overload protection
- Carry handles
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M21073

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INPUT 240V 50Hz
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WITH CONTINUITY BUZZER



Ideal for technicians with full 3½ digit LCD readout & continuity buzzer. 9V alkaline battery supplied. Expected life of battery is 200 hours.

SPECIFICATIONS:

DC Voltage:	200mV/2/20/200/1000V
Basic accuracy:	+/-0.5%
Input Impedance:	1M
Maximum output:	1000V DC
AC Voltage:	200/750V
DC current:	200A/2000A/20mA/200mA/10A
Resistance:	200Ω/2000Ω/20kΩ/200kΩ/2M
LCD Display:	15 x 46mm
Outer case size:	125 x 77 x 28mm

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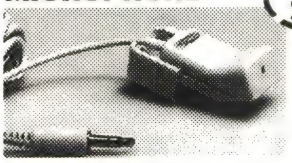
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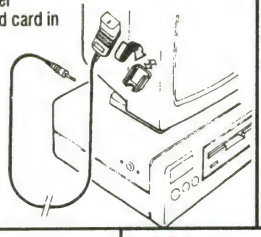


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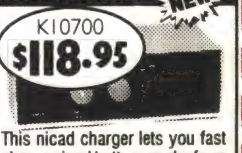
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System Memory • 4 x 72pin SIMM module • flexible memory size from 2MB to 128MB Cache • Support 0/128/256/512KB secondary cache on board with either Write Back or Write through mode

On-board IDE • Support 4 IDE Device and Enhanced IDE Function

Green Function • Enter Doze mode from 15 second to 8 min. CPU Clock down to 1/2 of normal speed for SMI CPU or 8MHz for non-SMI CPU • Enter stand-by mode from 2 minutes to 512 min. CPU Clock down to 1/4 of normal speed for SMI-CPU or 8MHz for non-SMI CPU and turn off screen and IDE HDD power down if set • Enter suspend mode from 2 minutes to 512 min. Stop CPU clock (Only for Intel SL Enhanced & Cyrix CPU)

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Board Size -220 x 220mm

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Construction Project:

REMOTE VOLUME CONTROL - 1

How often have you wished someone would invent a simple, inexpensive add-on remote volume control that can be fitted to a TV set or an audio amplifier! This project does all this and much more, as you'll read. In this first article we look at how it all works; next time we'll describe how to build it.

by PETER PHILLIPS

The most basic adjustment of any sound producing equipment is the volume control. Various systems that allow volume to be adjusted remotely have been around for years, with the two most popular systems being the solid state type and the motorised potentiometer.

Solid state controls use a dedicated IC that contains a resistive attenuating network, plus electronic switching to vary the attenuation over a range of steps. While quite functional, a disadvantage is that the volume setting needs to be displayed electronically, usually on a TV screen, as there are no mechanical parts, and therefore no easy way of showing the setting.

This, plus the perception that this type of volume control can adversely affect sound quality, has meant most remote controlled audio amplifiers are fitted with a motorised potentiometer as the volume control. Although these were once quite expensive, mass production has brought the cost down to a realistic level, making this project possible.

However while the motorised pot is important, the control system that operates it is just as important. In fact, another reason this type of project hasn't appeared before is the expense and complexity of the remote control system.

This project comes from Oatley Electronics, and much of the design has been done by Robert Reide. The idea for the project came about after Oatley Electronics purchased a number of UHF remote control transmitters that were originally designed as part of a satellite dish tracking system.

The transmitter, shown in the photos, has two buttons conveniently labelled UP and DOWN, and operates at 304MHz. This unit, coupled with a pre-built UHF receiver that has featured in other UHF remote systems from Oatley Electronics and some relatively simple decoding electronics, gives the remote system which directly controls a motorised 100k dual gang potentiometer. But wait — there's more...



Add remote controlled volume to any radio equipment, with this simple project. The UHF transmitter has a range of up to 100 metres and the volume control is a motorised 100k dual gang potentiometer.

Optional extra

Realising that the purchase of the transmitters would allow a range of possibilities, Oatley Electronics decided to include the necessary circuitry so the transmitter could either control a motorised potentiometer, or a number of relays. The relays can then be used to control an actuating arm, a high power motor or any device within the contact rating of the relays.

The PCB design is therefore in three parts: the remote control decoder section, the section for the motorised pot, and the section for the relays. Unwantwanted sections can be cut off, leaving only the parts you need. Or, the relay or motorised pot sections can be cut off from the decoder section, and then joined to it with wires. This way the control electronics can be mounted away from the section it's controlling, giving considerable versatility.But what does all this cost? A complete remote volume system is around $60, which includes everything except a 12V DC power supply. Prices are given next month, but as you can see this is not an expensive project. So having introduced the project, now let's look at how it all works...

Overview

The UHF transmitter operates at 304MHz and transmits a different tone

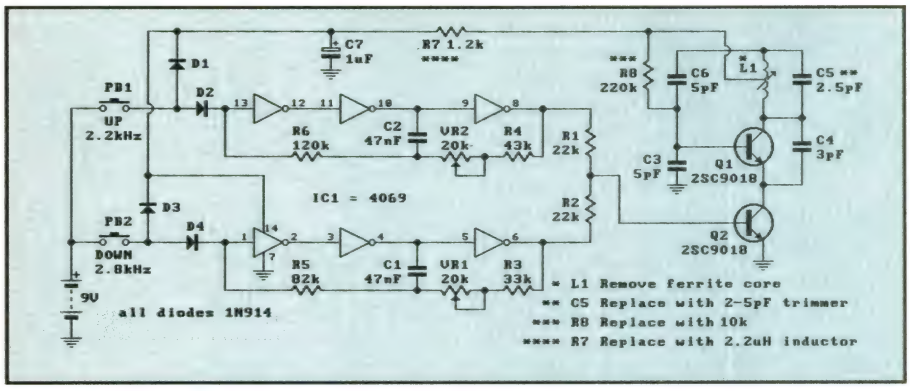


Fig.1: The circuit for the transmitter unit. The transmitter section itself is around Q1 and associated components, and is modulated by Q2 which is switched by either of the two tone oscillators around IC1.

for each of the two keys. These tones are around 2kHz and 3kHz, and directly modulate the 304MHz carrier. The UHF receiver module picks up the transmission and the transmitted tone is produced at the output of the receiver. The operating range of the transmitter is around 100 metres, depending on the operating environment.

The output of the receiver is fed to two LM567 tone decoder ICs, tuned to each of the transmitted tones. From here, driver transistors controlled by the outputs of the LM567s supply power to two terminals on the PCB, labelled A and B. If these terminals are connected to the motorised pot PCB, then pressing the UP key of the transmitter causes the motor to turn the pot clockwise, while pressing the DOWN key makes it turn the pot turn anti-clockwise.

The third section of the PCB has four single pole double-throw (SPDT) 12V relays. The relays are connected so two always operate together, effectively giving two double pole double-throw (DPDT) relays. This arrangement can then be used to operate a motor via the relay contacts. This board also connects to terminals A and B on the receiver PCB.

Of course, the relays are not limited to driving a motor, but this is the most typical remote control application like a motorised gate, an antenna rotator or any motorised actuator. We'll have more to say about motorised applications in Part 2.

Other uses are limited to your imagination. Incidentally, because the system is UHF, it can be operated from another room, or out of sight of the receiver, unlike an IR system.

Now for the details, starting with the transmitter.

Transmitter

The transmitter comes ready built, although there are four easy-to-do modifications needed to give it a suitable operating range. As the lead photo shows, it's completely self-contained. It is powered by a 9V battery, is housed in a black plastic case and measures 123 x 38 x 25mm.

The circuit diagram is in Fig.1. The transmitter section itself is around Q1 and Q2, tuned to 304MHz by L1. As you'll read later, a tuning capacitor is added to the circuit to allow the transmitter to be fine tuned to suit this project.

The signal tones are produced by two oscillators formed by IC1 and associated components. If PB1 is pressed (UP), power is supplied to the circuit via D1 and a logic 1 is fed to pin 13 of IC1. Feedback action from C2 causes the circuit to oscillate at a frequency set by C2, VR2, R4 and R6. This signal modulates the 304MHz carrier via R1 and Q2.

Pressing PB2 does much the same, except that this time a logic 1 is fed to pin 1 of IC1, causing the other oscillator section to respond. Notice that the timing components in this section have slightly different values.

Receiver-decoder

This is the heart of the project, and the circuit is shown in Fig.2. The UHF transmission is received, amplified and demodulated by the ready-built UHF receiver module (which needs no adjustments). The module includes a Schmitt trigger that squares the demodulated signal, and the resulting output from the Schmitt trigger is fed via RC

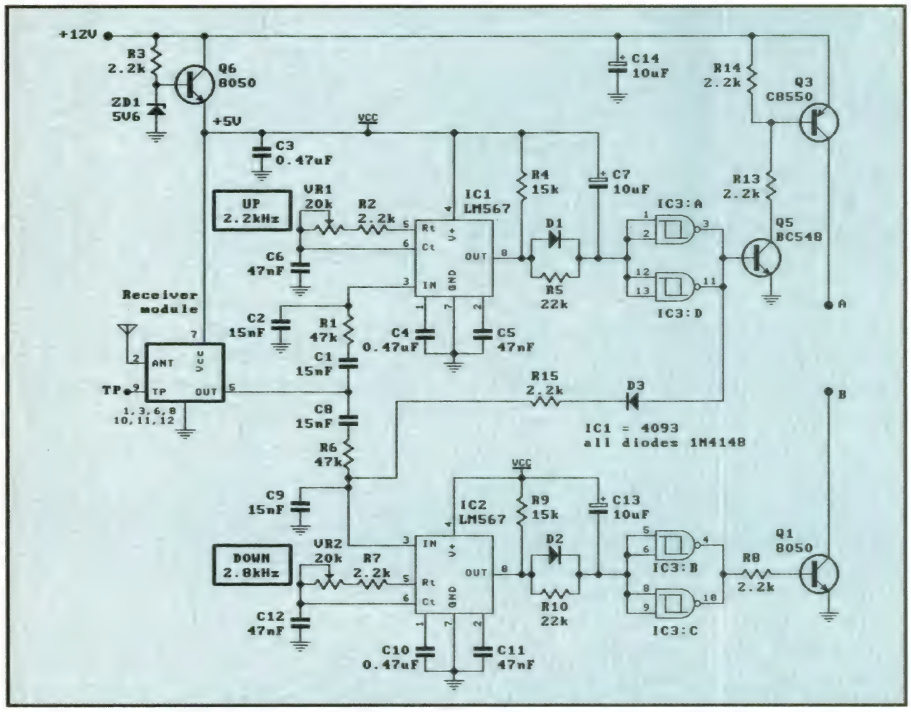


Fig.2: This is the decoder circuit. The UHF transmission is received by the UHF receiver module, whose output signal is fed to tone decoders IC1 and IC2. Depending on the frequency of the tone, the output of one IC or the other goes low, activating output terminal A or B.

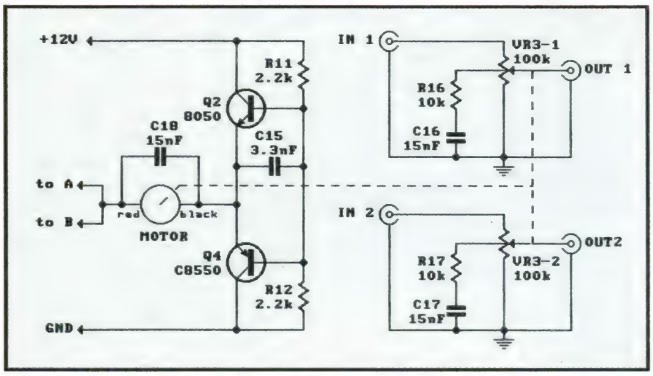


Fig.3: This is the circuit of the motor PCB. Terminals A & B are joined, giving an input of either 12V, 0V or an open circuit. When the input is 12V, motor current flows via Q4, or through Q2 when the input is Ov. The RC networks give a loudness control, if required.

networks to two independent tone decoder ICs, type LM567.

The LM567 is a relatively simple eight-pin IC that produces a low at its output (pin 8) when the input signal is within the passband of the IC, as determined by external components. The IC has two detectors (called the I and the Q detector) driven by a voltage controlled oscillator, which determines the centre frequency of the decoder.

In the circuit, both IC1 and IC2 have identical components. For IC1, the free running frequency is set by R2, VR1 and C6. The bandwidth is determined by the value of the input signal applied to pin 3, and by the value of C5. The input voltage to each IC is purposely attenuated, for IC1 by C1, R1 and C2. The lower the input voltage, the narrower the bandwidth. The specified maximum input signal is 200mV RMS.

If the output from the receiver is within the passband of IC1, its output goes low, giving a high at the output of IC3a and d. This turns on Q5, which gives base current to output transistor Q3, causing it also to conduct and giving about +12V at terminal A.

When the output of the receiver is within the passband of IC2, its output goes low, giving a high at the output of IC3b and c. This turns on Q1, pulling terminal B to ground potential. IC2 is effectively operated by the DOWN pushbutton of the transmitter, while IC1 responds to the UP button.

To prevent transients and pulses affecting the circuit, a time delay is included between the outputs of IC1 and IC2, and the inputs of IC3. For IC1, this is achieved with R4, R5, C7 and D1. Normally C7 is discharged, and it charges through R5 when the output of IC1 goes low. This gives a short time delay before the inputs to IC3a/d reach a logic 0. When the open collector output of IC1 is off, the voltage is pulled high by R4, and the capacitor discharges through D1 and R4.

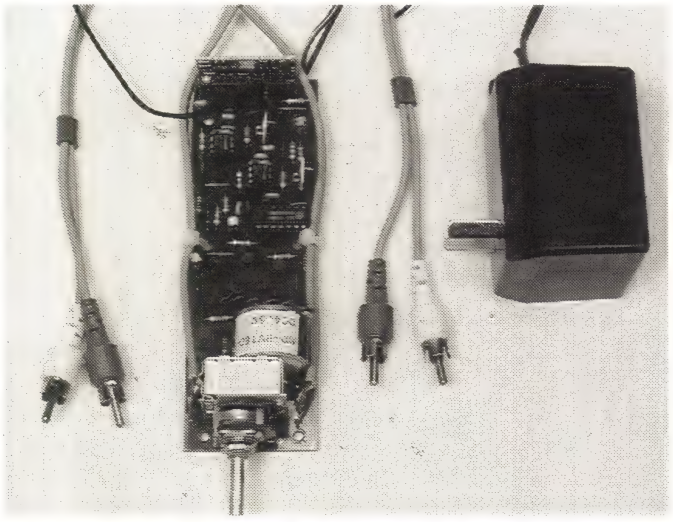


Fig.4: This shot shows the complete assembly for motorised volume control. The decoder PCB has been left attached to the motor PCB. Audio in and out is through the RCA connectors, and power is supplied with a 12V DC plugpack.

Under normal operation, it is impossible for both IC1 and IC2 to both respond to the one signal, as their centre frequency is different by at least 600Hz. However this could happen during adjustments, giving +12V at terminal A, and ground at terminal B.

Because these terminals are joined together on the motorised potentiometer PCB, there could be a short circuit across the 12V supply. To prevent this, when IC1 is on, a DC voltage is applied to the input of IC2, via D3 and R15. This DC voltage will `swamp' the AC signal at the input, causing IC2 to remain off.

The supply voltage to the circuit is 12V, regulated to 5V by R3, ZD1 and Q6. This circuit could be replaced by a more expensive three terminal regulator, but to no advantage.

Motor PCB

The circuit of the PCB section for the motorised potentiometer is shown in Fig.3. Notice that terminals A and B are joined together, so the potential at this point is either +12V or 0V. If the voltage is 12V (UP signal), current flows through the motor to ground via Q4, which is biased on by R12. The motor therefore turns the potentiometer clockwise.

When the input is 0V, current can flow through Q2, from the 12V supply, through the motor to ground via Q1 on the decoder PCB. The motor now turns the opposite way, turning the potentiometer anti-clockwise. Capacitors C15 and C18 get rid of any interference caused by sparking at the motor commutator.

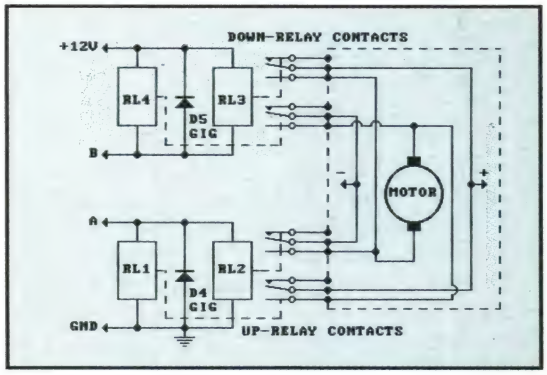


Fig.5: The relay PCB contains four relays connected to give two DPDT relays. The section within the dashed lines shows how to connect a DC motor to the relays to get momentary forward or reverse.

A photo showing the decoder and motor PCB is in Fig.4. The pot-motor assembly is very compact and because there's a clutch in the gearing, the potentiometer shaft can be turned independently of the motor.

An unexpected bonus with the brand of motorised pot used in this project is a centre-tap to each 100k resistance element.

This terminal is used in commercial audio equipment to give a 'loudness' control, achieved here with R16 and C16, and R17 and C17. A loudness control gives enhanced bass at low volumes, to compensate for the apparent loss of bass we hear when the volume is low.

When the wiper is close to the ground terminal (giving a low volume), the effect of C16 (C17) is more significant than when the wiper is towards the top of the pot. At full volume, these capacitors have no effect. These components are optional.

Relay PCB

This section of the PCB, shown in Fig.5, contains four SPDT relays. The relays are connected with two each in parallel, giving in effect two DPDT relays. A diode is connected across the relay pairs to protect the transistors in the decoder PCB against the back EMF caused by the relay coils when they are de-energised.

When the UP key of the transmitter is pressed, terminal A of the decoder PCB becomes active (+12V), and relays RL1 and RL2 operate. Pressing the DOWN button causes terminal B to drop to 0V, turning on RL3 and RL4.

When neither key is pressed, terminals A and B are open circuit, and the relays are de-energised.

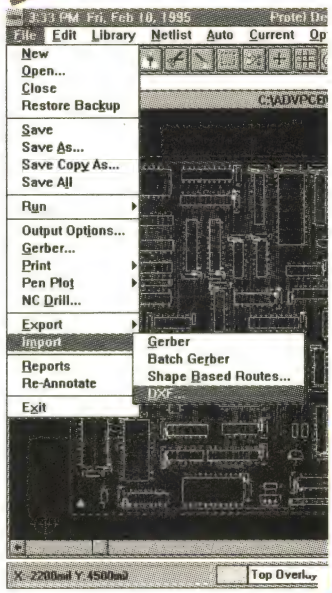
These relays can be connected as shown in Fig.5 to control a DC motor. If RL3 and 4 are on, current flows from the positive external supply, through the now closed RL3 contacts, through the motor and back to the negative terminal of the external supply via the RL4 contacts.

When RL1 and RL2 are on, current now flows through the motor in the opposite direction, reversing the direction of the motor. When all relays are off, the motor is stationary.

As you'll read in the second of these articles, there are a lot of very useful applications for this part of the project. That's all we have space for now, though. Full constructional details follow next time. ❖

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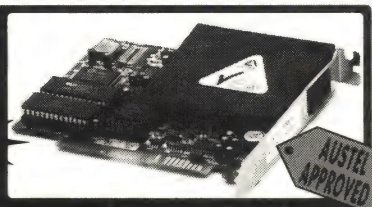
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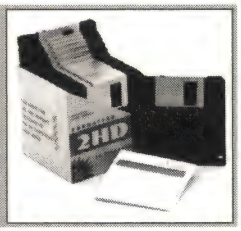
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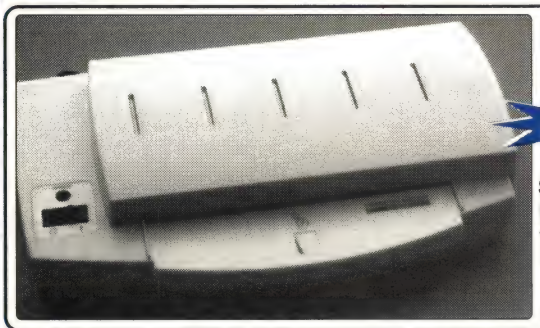
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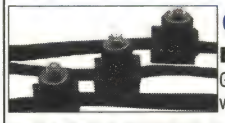
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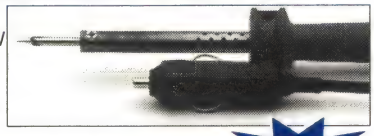
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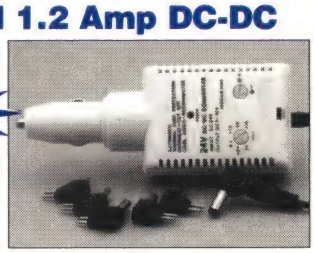
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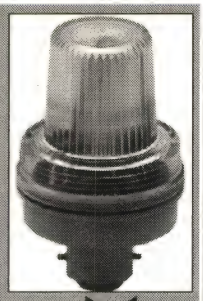


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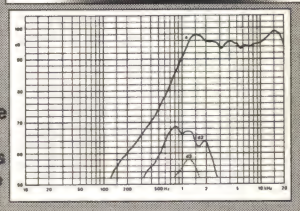
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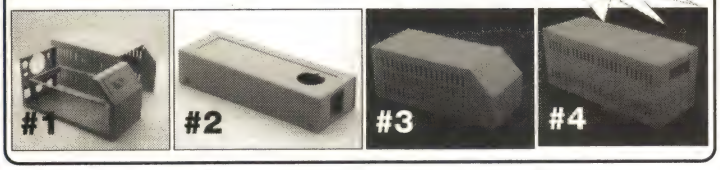
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Benefits are: •improve your cardiovascular function & fitness at any age or level of personal conditioning •effectively and efficiently reach your hearts target heart rate and warn you of under or over exertion •compare the effectiveness of different exercise activities •attain rapid aerobic expansion. Kit includes: owners manual, wrist monitor/watch, chest strap and transmitter unit.

Cat. QM-7240 **$99.95**

LA Acoustic Car Alarms



Features: •Remote control •complete protection •engine kill •not secure warning •remote lock/unlock •emergency panic system •double protection •auto door locking •alarm memory. See 1995 catalogue page 80.

Cat. LA-8901

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Don't know what a Leatherman is? This pocket multitool when folded looks like a pocket knife. Simply open it up, and fold the unit back on itself to reveal a pair of pliers. There is also some typical pocket knife attachments, which include: •large knife •small knife •bottle opener •slot screwdriver •Philips head screwdriver •can opener •file. Supplied in a black case with belt clip for easy carrying. Folded size: 100(L)x30x20mm.

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Cat. TH-1900

LEATHERMAN SELLS FOR AROUND $110.00

OUR TOOL IS ONLY $19.95

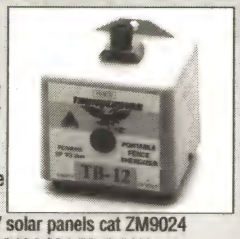
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ELECTRIC FENCES & ACCESSORIES

JAYCAR NOW HAVE AVAILABLE A NEW RANGE OF AUSTRALIAN MADE ELECTRIC FENCE ENERGIZERS & THE MOST COMMON ACCESSORIES.

2KM ENERGISER



This energiser is ideal for small runs including the vege patch etc. Its portable, so can easily be moved when required, and its unique construction allows it to actually mount on the live wire if required. It features Dual Power levels - low power to reduce battery consumption and high power for peak output. Its high performance gives over 8000 volts output and will power up to 2km of fence and low battery consumption, drawing only 15mA. To run from solar power we recommend one of our 2W 12V solar panels cat ZM9024 $37.95 and a 4AH or 6.5AH lead acid battery. 4AH cat SB2484 $34.50, 6.5AH cat SB2486 $43.50 and you need a diode connected in series with the solar panel to stop discharging the battery at night. use IN5404 cat ZR1014 0.35¢

Cat. DE-6010 **$129.50**

NEW 10KM ENERGISER



This energiser will power up to 10km of fence line. If your fence has two live wires then the paddock can be as big as 1.25km x 1.25km!! Its also ideal for long runs of strip grazing and can be used in a tempory or permanant situation. Current drain is 45/48mA and output voltage is 6200-6400 volts. To run from solar we recommend our 4W 12V solar panel cat ZM9026 $67.95 and you need a battery of 30-50AH. You can use a car battery. Use a diode in series to prevent battery discharge at night. Use IN5404 cat ZR1014 0.35¢.

Cat. DE-6015 **$179.50**

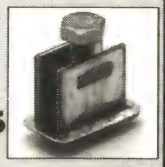
ELECTRIC FENCE TESTER



If you have an electric fence you need to be able to tell if its working OK or not. Digital or analogue testers start at $100 and add significantly to set up costs. This unit will test all electric fences and it has a series of neons that illuminate to show what voltage is present. Neons light up at 1500V, 3000V, 4500V and 6000V. A very handy low cost tester.

Cat. DE-6020 **$29.95**

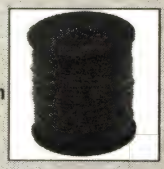
WIRE JOIN CLAMP



These are needed to run live wires around corner posts and to join/tap wires. **Cat. DE-6040**

Pkt 10 $6.95

POLIWIRE

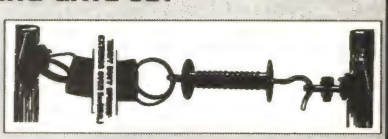


Poliwire is much more visible than normal fence wire. especially useful with horses. Consists of orange nylon interwoven with 6 strand stainless steel wire. UV stabilised. Can be reused for strip grazing.

Cat. DE-6060

200m roll $26.95

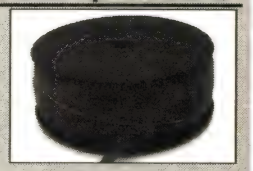
SPRING GATE SET



This is the easiest way to have a gate in an electric fence. Consists on the gate handle and large spring and anchors. Extends up to 5 metres.

Cat. DE-6055 **$12.95**

HOT TAPE



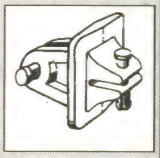
A more heavy duty version of Poliwire. Its also much more visible to horses. It is made by flat nylon woven with stainless steel wire. Height is 13mm. UV stabilised and can be reused for strip grazing.

Cat. DE-6065

200m roll $39.95

ACCESSORIES

STAR POST INSULATORS



These hold and insulate the fence wire on a star post. **Cat. DE-6030**

Pkt 25 $8.95

WOOD POST INSULATORS



These hold and insulate the fence wire on a wooden post.**Cat. DE-6032**

Pkt 25 $9.95

BULLNOSE INSULATORS



These terminate the live wire at the end of a straight run.**Cat.DE-6036**

Pkt 10 $6.50

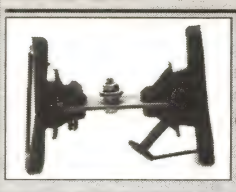
GATE HANDLE



Just the gate handle only. Insulated - use with Hot tape instead of spring.

Cat. DE-6050 **$4.95**

GATE ANCHOR



Includes the 2 anchors when using the gate handle with polytape.

Cat. DE-6052

$2.65

ELECTRIC FENCE MANUAL

A 10 page manual which explains all about electric fences. A must if you are new to electric fences.

Cat. BE-8300 **$3.95**

THUNDERBIRD electric fencing components

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Size 115 x 71mm
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Two D25 cutouts
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FM Autoscan Mini Radio

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See cat page 184.

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What a great idea! You simply take out one of your reversing globes and replace it with this. Its the same size as a normal globe, yet incorporates a 20W halogen lamp and a beeper. Allows everybody around you know instantly that you are reversing. You could save a serious accident for $20 and 5 minutes of your time.

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Mini Construction Project:

FLEXIBLE DUAL POWER SUPPLY MODULE

Need a dual polarity DC power supply for a project you're building? Here's a compact and simple little module that could easily fill the bill. With the appropriate choice of transformer, regulators and capacitor ratings, it can be built to supply either +/-5V, +/-9V, +/-12V or +/-15V.

by JIM ROWE

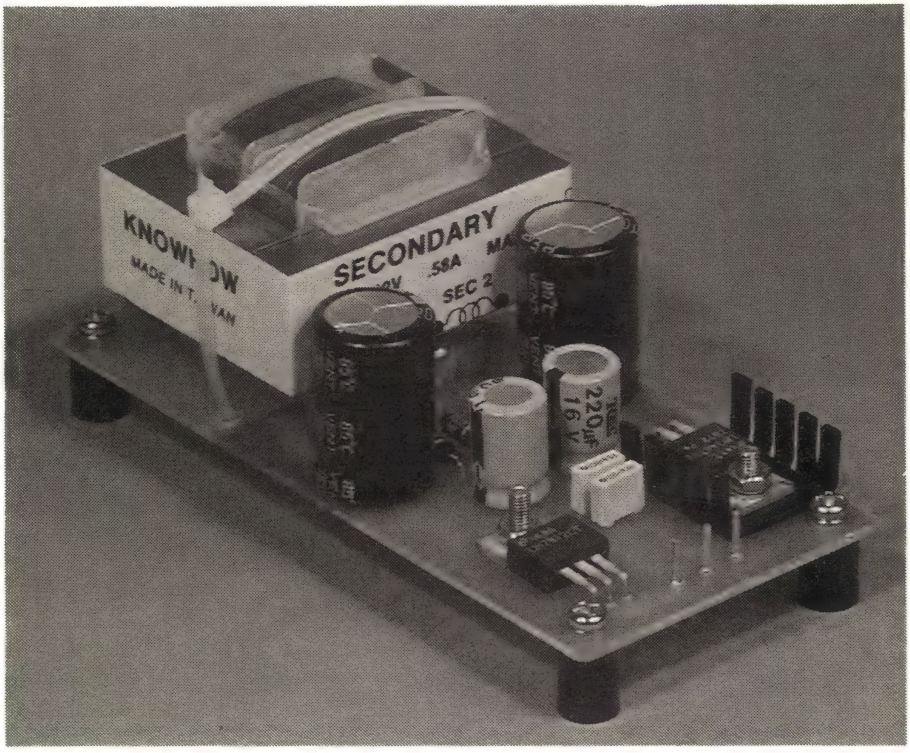
Oh no, I hear you exclaim — not *another* power supply module! Well, yes, it certainly is; and I make no excuses. I don't know about you, but whenever I need a power supply for a project I'm building, somehow none of the existing designs seems to be suitable. They're either too big, or too complicated, or not capable of doing exactly what's needed; there's always some reason why I have to come up with a new one.

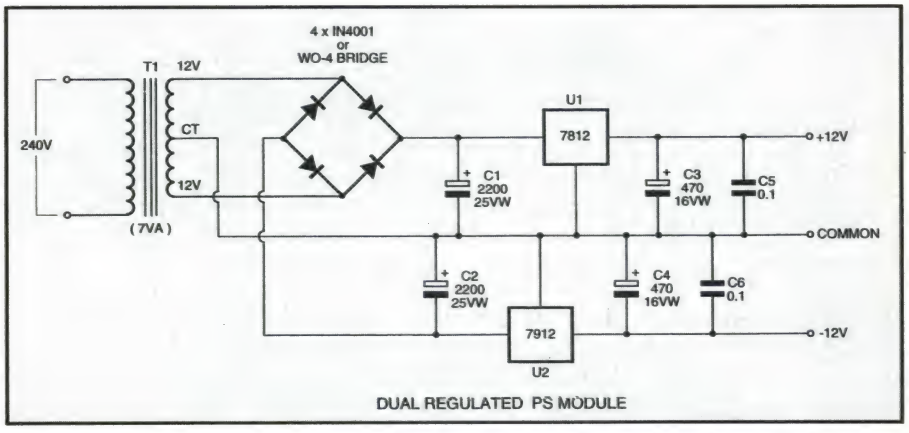
This happened all over again only a few weeks ago, when I needed a power supply to go with the new PC-Controlled Audio Sweeper project. The supply had to be as compact as possible, able to provide +/-12V, and be capable of sourcing at least 250mA from the positive output. And you guessed it — none of the existing general purpose supply modules would do the job. So it was back to the drawing board, to design a module that *would*...

The module you see here is what I came up with. It's quite compact, being based on a PCB measuring only 110 x 51mm, with an on-board miniature power transformer rated at 7VA. These transformers are readily available nowadays, with secondary voltages of 9V+9V, 12V+12V or 15V+15V.

The 7VA rating of these transformers means that the maximum current that the module can deliver (without overheating) will be around 390mA with the 9V+9V transformer, 290mA with the 12V+12V and 230mA with the 15V+15V transformer.

As you can see from the schematic, the circuit of the supply is quite conventional. The secondary of the transformer is connected to a dual full-wave rectifier, made up from either a small bridge or four discrete power diodes, and then the resulting 'raw' DC fed through a pair of





The circuit uses four diodes or a low cost bridge in conjunction with the centre tapped transformer secondary, to provide both positive and negative full wave rectifiers. These then feed a pair of three terminal regulators.

three-terminal regulators to produce the final pair of regulated outputs. A total of four electrolytic capacitors and two MKT units provide the necessary filtering and ensure regulator stability.

The main features of the module are its compact physical form and flexibility. For example if you use a 12V+12V transformer and the regulators shown in the schematic, with capacitors having the voltage ratings indicated, the supply will provide +/-12V at up to about 290mA. But if you use say the 9V+9V transformer and a 7809/7909 regulator combination, it would deliver +/-9V at up to 390mA. Similarly with the same 9V+9V transformer and a 7805/7905 regulator combination, it would deliver +/-5V — again at about 390mA maximum, although the regulators would certainly need heatsinks if you need this order of current.

If you instead used the 15V+15V transformer and a 7812/7912 regulator combination, you would have a supply capable of delivering +/-15V at up to about 230mA. The regulators would again need heatsinks if you need this order of current.

Apart from selecting the transformer and regulator combinations to suit the output voltages you need, the only other components that may need to be selected are input reservoir capacitors C1 and C2 — in terms of their voltage rating. For example if you use the 15V+15V transformer, it would probably be wise to increase the rating of these capacitors to 35VW, to ensure that they're not vulnerable to damage from high mains voltage and/or switching spikes.

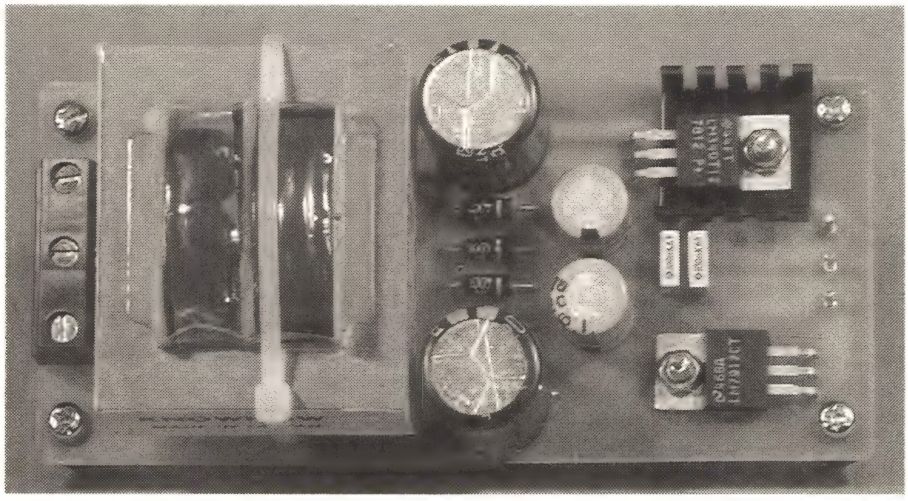
For the 12V+12V transformer, the values shown should be fine, while if you use the 9V+9V transformer you could probably use 16VW electros in all four positions.

The PCB has been designed carefully around the 7VA board-mounting transformers. Although these transformers attach to the board via seven fairly sturdy connection lugs, I've also provided a pair of 3mm holes in the PCB just under the sides of the transformer, to allow the use of a long nylon cable tie as a 'wrap around', to provide additional security against it coming adrift.

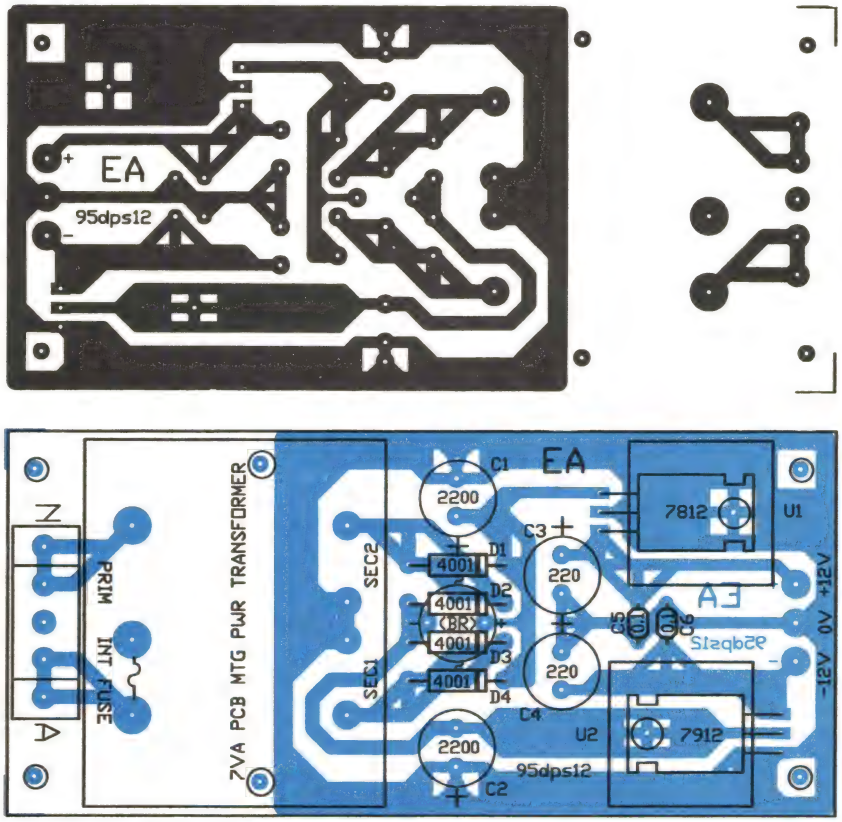
The transformer primary connections are kept well away from the low voltage wiring, and are brought to pads that will take board-mounting three way mains terminal blocks. Since these blocks are available in both 5mm and 10mm-spaced varieties, and sometimes only one or the other is available, I have arranged the pads to accept either type. Note that in either case the centre terminal of the block is not used, and only serves to increase the separation between the active and neutral terminals.

The secondary windings are connected in series, with the ends connecting to the rectifier. The PCB will accept either four of the usual 1A power diodes — 1N4001 or similar — or a small integrated bridge such as the low cost WO-4. It is designed to accept the vertically mounting 'RB' electrolytics for C1-4, with additional space provided for C1 and C2 to allow for their higher capacity and voltage rating.

The board is intended to accept regu-



Use this top view of the module as a guide when you are placing the components on the PC board, along with the overlay diagram. Note that a rectifier bridge can be used in place of the discrete diodes.



Top: The actual size PC board pattern, for those who wish to etch their own. Below: The overlay diagram, showing where all the parts go. The TO-220 regulator chips may need to be provided with heatsinks, depending on the drain.

Continued on page 95



INFORMATION CENTRE

by PETER PHILLIPS

Baud and bits/s, braid breakers and insults

It's the holiday season, and this month we offer a variety of letters and topics — including comments on a digital radio link, the real meaning of baud, and more about NTSC-PAL VCRs. As well, there's one of the most insulting letters yet presented in this column. And of course, we pass on our best wishes to you for the Christmas season.

When I recently asked the meaning of the term 'interdigitated', I was surprised to find quite a few people knew. I came across the term in a press release about a new transistor, and I wondered whether the term was the invention of an advertising agency. But no, it's an industry specific term that describes the interleaving of multiple 'fingers' of semiconductor material and/or metallisation, in the construction of a transistor or FET.

New words specific to electronics keep cropping up from time to time, sometimes promoted by advertising agencies and sometimes by the technical press. Some years ago, the then editor of *ETI* tried to popularise the use of the term 'buss' as an alternative to bus, as in data bus. This didn't get far, as it was soon pointed out that 'to buss' means 'to kiss'.

But there are some words that popular usage is getting wrong. Perhaps the best example is 'baud'. The term comes from Baudot, the inventor of a basic five-bit code for teletype machines. A baud (not Baud by the way) is defined in various ways, but essentially means 'changes per second'. In the good old days of 300 baud modems, each digital bit of the code represented a change, so the baud rate and the bits per second (bps) are the same.

As far as I know, the maximum baud rate for conventional modems is 3200, a limit imposed by the bandwidth of the phone lines.

This is still a speed of 3200b/s, so up to this speed, baud and bits per second are synonymous. To get a higher speed (or more bits per second) for a fixed baud rate requires bits to be grouped, giving rise to the terms *dibits* (group of two bits) and *tribits* (three bits). A 2400 baud modem operating on dibits works at 4800b/s, and a 3200 baud modem working with tribits has a speed of 9600b/s.

To get a higher data transfer speed again requires the transmitted data to be compressed while it's being sent, (compression 'on the fly'). This is how speeds of 14.4kb/s and 28.8kb/s (thousand bits per second) are possible. But notice that the baud rate is still a much lower figure.

Of course, popular usage will win out, and eventually baud and bits per second will probably be taken as meaning the same thing. But for now, it's worth pointing out the difference, given our increasing use of the term since we introduced our bulletin board.

Staying in communications mode, here's our first letter, which is perhaps one of the shortest you'll read in this month's column...

Phone radio link

How would I go about putting a radio link, with a digital interface, between my phone and the plug on the wall? (Kevin Evans, Kerang, Vic.)

If you have been reading Forum lately Kevin, you'll have seen that mucking about with your phone in the way you describe is likely to land you in a lot of trouble. The fact is, Austel has almost complete power over who does what to the Australian telephone communications system. If you are caught with a non-approved device connected to the phone system, then look out. However there's no law to stop us theorising about your question. Concerning a digital interface, I think the simplest way is to use a 304MHz UHF radio system. For instance, I have developed a simple system in which the code from an infrared remote control handpiece keys a 304MHz carrier (on-off), for reception by a UHF receiver module located in a box on a wall facing the equipment I want to control.

When a button on the IR remote control unit is pressed, the code for that button is transmitted as pulses of UHF carrier. At the receiver end, the transmission is received and the original code appears at the output of the receiver module. This code then modulates an IR LED, which points towards the remote controlled equipment, giving a system to control my sound gear from another room.

While you don't mention what it is you want to do, because you mention digital I assume an on-off system such as I've just described is all you need. We have described a number of UHF receiver/transmitter projects, including a four-channel system in March '94, a 12-channel system in March '93, a single-channel UHF receiver in April '89 (transmitter in January '89) and a 16-channel system in January '89 and March '89. These projects were from Oatley Electronics.

There are various ways of keying the UHF transmitter in any of these projects, including switching its power supply, or via the base of the output transistor. But how you interface this with a phone is another matter, and a topic we won't pursue.

NTSC-PAL video

Last month I discussed the differences between the NTSC and PAL colour systems, prompted by letters seeking this kind of information. Here's another letter on the topic that lets me clarify a point I was previously unsure of.

I've been reading a lot lately about VCRs that can convert an NTSC recording to a PAL signal. A friend of mine has a VCR that offers NTSC playback, but it seems the video signal from the VCR is

still NTSC, requiring a TV set that can work with such a signal.

So, are there any VCRs on the market that actually deliver a signal converted to PAL at the video out terminal, or is this just a little too much to expect? If such a machine is available, I hope it has audio dubbing facilities, but definitely not G-Code! (Neil Forbes, Stockton, NSW.)

Yes Neil, such a VCR is available. The only model I know is a Sharp unit, model WD1, but there are probably others on the market. Unlike most multi-system VCRs, the Sharp unit can be used to convert an NTSC video tape to a PAL tape, and vice versa. For example, it can be used to make an NTSC tape from a PAL tape for playback by an NTSC-only VCR in the US. Naturally, you need two VCRs, one to play the PAL tape, and the Sharp (or equivalent) VCR to do the conversion and to make the NTSC tape.

The quality of the conversion is excellent, although it depends on the quality of the original recording. The VCR also incorporates hifi sound recording and can deal with SECAM recordings. The price of the unit three years ago was about $2500, and it was available through any large retailer.

However, you're quite right in that most multi-system VCRs don't do any actual conversion. Because it's unlikely that a shop assistant will know the difference, I suggest you ask to see the manual to confirm if the VCR actually converts between systems. As for G-Code, Neil, while I don't use it, I wonder why you are so opposed to it — given that it simplifies VCR programming for those unable to decipher the VCR manual. And there are lots of people in that category!

Braid breakers: the truth!

The next letter is probably one of the rudest we've ever received. I'm including it here to prove we don't limit our coverage to those that compliment us:

I stopped reading EA and ETI some years ago due to the lack of good constructional and technically informative articles by qualified, technical people. But I was given a copy of EA August 1995 and read your article on braid breakers. I must say I found it rather humorous to read the letter on page 93 where one of your readers spouts "First my credentials — next to God etc etc — then says at the end of the letter, "but that is little more than a guess." (!)

Mr Phillips, your comments in the sixth paragraph of column two (page 93) also brought a smile. "It's difficult to say" then "it seems reasonable" and finally "it seems you have come up with a simple answer to what has turned out to be a most perplexing problem... congratulations". We even have diagrams! (Fig.1 page 92) to support our maybe seems to work, don't know why, thing.

Congratulations Mr Phillips, technical journalism, RF engineering and being accurate and informative IT AIN'T.

Well I can assure you I won't bore you with my credentials, and I don't guess. Braid breakers (RF transformers) have been around for many years and as was stated they prevent or limit undesired low frequency signals, AC and DC components, on the outer of the coax cable. This is done primarily by DC isolating the outer shield from the receiving device, but other factors too numerous



to relate here also come into play.

One major use for these devices is in large CATV systems. Equipment in such systems can be spread over large areas and over various power phases. This can result in all kinds of earth loops and stray voltages between the outer coax sheath and the remote rack sites. I have found using a braid breaker to be invaluable in eliminating such problems.

I am amazed that a 'qualified' MATV/CATV installer has not responded to your queries on these devices as one only has to look to suppliers of RF gear to find the answers. The catalog from the Sydney company Matchmaster (page 09.5) shows clearly that they are commercially available. In the Clark and Severn RF designers guide, pages 146-150, there are a hundred or so RF transformers, most providing shield isolation — yes, braid breakers.

One of these braid breakers consists of a small single-hole ferrite bead of F29 material, bifilar wound with six turns for the primary and six for the secondary, with each winding having a small chip capacitor of 1-2pF in parallel, to balance the coil inductance. Spectrum analysis shows an insertion loss of only 2dB over 100MHz to 1000MHz.

So Mr Phillips why not buy one, investigate, and actually learn something technical. That may seem sarcastic, but that is why many technical and even hobbyist people don't read EA any more. One has only to compare the content of EA with the high quality content of many of the European and USA magazines to see what I mean.

It would appear EA has lost direction over the years (I bought my first copy back in the 60s). A technical magazine should lead people, show the answers, actually teach something, show why it works. Well, it used to. You shouldn't have people outside the magazine giving your writers 'guess how it works' material so it can be printed and mislead others. If your writers don't understand technical 'stuff' don't employ them, they just end up misleading and confusing people.

"The needs of the one should not outweigh the needs of the many." (Gary J Gray, VK4ZPU, Burleigh Waters, Qld.)

So Gary, you think people don't read EA because of my technical limitations. Well, if we can find someone who knows all about all aspects of electronics, and if we can afford him or her, I'll gladly hand over my job. In the meantime, I guess you'll just have to stick with the overseas magazines.

I don't intend responding to your letter, as I consider your comments to be so offensive that I'll let readers make up their own mind.

But thank you for being one of the many to offer information about braid breakers. If you were a regular reader, you would have seen that this topic has been discussed in detail over quite a few issues, and that I previously included a letter from a reader about a commercially available device.

Now to more pleasant matters...

Replacement diodes

The next letter concerns replacement diodes for those used in Bell and Howell movie projectors.

I am overhauling some valve amplifiers for a Bell and Howell Model 8D-

652 and am seeking replacements for diodes type 1S448 (used as a bias rectifier) and 1S396 (power diode). Are these of Japanese origin? I can't find any information about them. (J. Nairn, Leongatha, Vic.)

According to my 1973 Diode and SCR D.A.T.A. book, the 1S448 is a germanium diode with a PIV of 110V and a maximum forward current of around 30mA. At a forward current of 3mA, the voltage drop across the diode is specified as 1V. The manufacturer is Fujitsu, Japan.

Unfortunately the book doesn't include any data on the 1S396 device. I suggest you try a 1N4004 diode (or similar) as a replacement, as its 400V PIV and 1A forward current rating should be adequate for a valve amplifier. If the amplifier has a centre-tapped rectifier circuit, use a 1N4007 which has a PIV of 1000V.

While it's tempting to consider using a germanium diode like the OA90 (etc) as a replacement for the 1S448 diode, I suggest a better choice is also a 1N4004. A 1N914/4148 signal diode might do the job, but it has a lower PIV of 75V compared to the specified 110V. The forward voltage of all these diodes is around 1V (same as the 1S448), and they all have a higher forward current rating.

ETI-162 power supply

In the September issue, I included a letter from W. Brain (Sunbury, Vic) who, by a later admission, was suffering from a 'bad week' when he wrote complaining about the magazine, our dry cell battery charger and, of all things, the ETI-162 power supply. This supply is a 1982 design, and it seems is well regarded, as this letter explains...

I am writing to comment on the ETI-162 power supply. I built one of these in 1982 and found it easy to build and most useful, so useful that it is still on my bench as the main power supply, 13 years later. I did research in Biomedical Engineering for five years and used the ETI-162 in the lab. So did a number of other people, and as far as I can remember we had four of these supplies in use at the time.

So I don't think there is much wrong with the ETI-162. (Chris Henderson, Exmouth, WA.)

I've since received other letters about this supply, including one with a copy of the original article. All the letters are complimentary of the design, and like yours Chris, point out the supply is still in use.

35A battery charger

We get a lot of requests for projects, like this one...

I read with interest your recent article by a contributor about a golf buggy he had designed. As the circuit used high power MOSFETs, I wondered if EA intended developing a high capacity battery charger based on MOSFETs.



Ideally we would like to be able to set the voltage at either 14.5V or 28.5V and the charge current anywhere from 40mA to 35A, thus allowing for all sizes of batteries. The terminal voltage limit would allow the charger to operate without monitoring.

I'm glad EA now includes articles related to the automotive electrical industry, having been self-employed in this industry since 1951. (J. Mooi, Beaudesert, Qld.)

At this stage we don't have any plans for a high power battery charger. Although not suitable for your needs, we are currently developing a project called an Auxiliary Battery Manager, which is a high current MOSFET switch to allow a second battery to be charged from a vehicle's charging system. This project will appear soon.

A commercial product that might suit your needs is the Statpower Truecharge 10 battery charger, reviewed by Rob Evans in May 1994. Its maximum charge current is 10A, but it has all the features you could ever need.

Space saver software

We don't normally describe software in this column. However I'm making an exception here as the developer is Mark van der Eyden, whose work on a Teletext decoder-computer interface was described in EA June 1993. Mark also developed software for this interface, as described in the article.

Mark's new software is called Infinite Space. He describes the software as an hierarchical storage manager adapted to suit the needs of personal computer users. It allows you to release space on your hard disk by 'spacing out' or moving files to any kind of removable media supported by DOS (floppy etc). The software automatically recovers 'spaced out' files, so a program trying to access these files is unaware that they were not on your hard disk.

It maintains a database of when a file was last accessed and by which program. Hence it also knows which programs and files have not been accessed. This enables you to identify files that are good candidates to be 'spaced out'. It can backup files and retain multiple generations so any version of a file can be recovered.

The program compresses files as they are moved from your hard disk, and knows which backup disks your files are backed up or 'spaced out' to, and will call for the disk by number when it is required. Infinite Space requires DOS 5 or 6 and has no specific processor requirements. It is Windows 3.1 compliant and provides windows for the SpaceIn process.

Mark goes on to say that the bigger your hard disk, the more difficult it is to keep track of the files on it, used or unused. Therefore the bigger the hard disk, the more you need Infinite Space.

The software is priced at $35. For further information write to Mark van der Eyden, PO Box 467, Mt Waverley 3149, or phone (03) 541 5930 during business hours, or (03) 888 1983 after hours.

Hot plate recharger

In August I presented a letter describing how the writer had successfully rejuvenated dry cells by putting them on a hot plate. The following letter offers an explanation as to why the cells appeared to have been recharged, while in fact they were not...

The writer may very well have been misled by oxidised contacts in his electric clock. Most clocks have a single cell, and the battery clip contacts frequently develop a high resistance, which needs to be removed by rubbing with a dry cloth. I also find that in many cases rolling the cell around once or twice will give the clock a new lease of life.As a student, I too used the 'heating in the oven treatment' to reactivate batteries, but this method only produced enough current to cause a torch globe to glow very weakly.

When I was in the Radio Research lab at RMIT, my boss (who wrote the specs for government school PA systems) after a trip to Mildura found that oxidised contacts in a 240V 2A switch had caused a speaker circuit to fail. From then on all switches used in such a circuit had to have PGS (platinum, gold, silver) precious metal contacts.

I also recall a large TV manufacturer using gold plated contacts in the channel changer to minimise warranty claims. (Syd Clark VK4CST, Alexandria Hills, Qld.)

Thanks for this information, Syd. I suppose few of us have not been a victim of the 'bad contact' and I fully agree with you that this is a possible reason for the batteries appearing to work after being heated.

Phone transfer system

As it happens, I'm well placed to be able to answer the next letter:

I want a device that will allow me to take a call on any phone and to transfer the call to any other phone in the house. We currently have a cordless phone, a speaker phone, a touch phone and an answering machine and find it's a problem when a call is meant for someone else in the house.

Would it also be possible to make internal calls between phones, like an intercom system? To be practical it would need to have provision for five phones. (Darryl Ross, Eudunda, SA.)

While a project is now out of the question (see Forum October 95) there is a commercial device called the Easy-Transfer that will suit you perfectly. I am currently using one of these devices, and can assure you it works reliably and does all the things you ask for, Darryl.

The device is a small black box that turns a single-line phone system into something like Telstra's Commander phone system, but without the extra wiring. Outside calls can be transferred from one phone to another and you can make an 'internal call' between phones. It will work with all the phones you mention (I know, as I have a similar setup), and it doesn't interfere with the normal operation of the phones.

For more information, contact National Communications, PO Box 6473, Gold Coast Mail Centre 4217; phone (07) 5596 5128.

Up a semitone

The next letter is about taped music and the problem of musical pitch.

I have always enjoyed EA since the early 60s, and still try to read most of it. Unfortunately time and technology have won in the race to keep up with the many articles, but your column is always of interest.

I am now retired and have time to start learning a musical instrument. I find it useful to try and play along with tapes on my tape recorder. However the recordings are not always in the key I want. Perhaps you could suggest a simple means of raising and lowering the pitch of the recording by a semitone or so. (Clarrie Frencham, Cringila, NSW.)

Thanks for your kind comments about the column, Clarrie. The problem of tape speed and its effect on musical pitch is not understood by many people. I used to play piano for the choir at local primary school, and often had to make tape recordings to cover an absence. I used to insist on borrowing the tape recorder that would be used to replay the recording, to ensure correct pitch. However, many choir teachers thought it didn't matter what tape recorder was used , and a pitch change of several tones was typical, from C to E for instance.

To get around the problem of playing along with a pre-recorded tape, I use an Akai three-head tape deck, model GXC-570D. This unit has a front panel pitch control, something you rarely find. It is at least 12 years old, possibly more, but is virtually indestructible. You might be able to pick one up second hand.

Pitch is varied by changing the speed of the tape, but unfortunately this is difficult to do on most tape decks. The reasons are either the complexity of the motor speed control system, or because the motor has an in-built mechanical governor.

What??

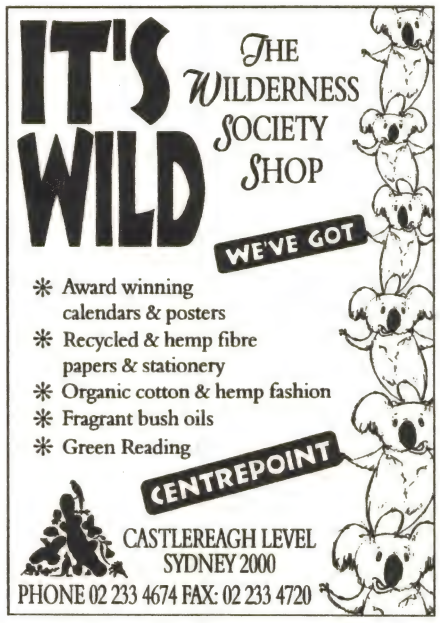
This month's teaser is not about electronics, but after 70 or so technically based questions, we're running out of them. So this time, put your mathematical hat on — although the contributor offers two solutions, one purely mathematical, the other somewhat lateral. Yes, there is a simple way of solving the problem. It comes from Derek O'Beirne, Montmorency, Vic:

Two trains are approaching each other on a straight level track. They are 50km apart and are both travelling at 20km/h. A bird takes off from the front of one train and flies at 60km/h towards the other train. When it meets the train, the bird immediately flies back towards the first train, also at 60km/h. When it reaches the first train, the bird turns around and flies back to the second train.

The bird continues to fly between trains until the trains meet. How far has the bird flown?

Answer to November's What?

The answer is a mere 2π metres. The circumference of a circle (C) = πd, where d is the diameter of the circle, so $d = C/\pi$. If C = 40,000m, d = 12732.4m. After raising the lead by one metre all round, the diameter is now 12734.4m. This gives a circumference of 40,006.28319, or $40,000 + 2\pi$. I'm sure there's a more definitive way to prove this. Any offers? ❖



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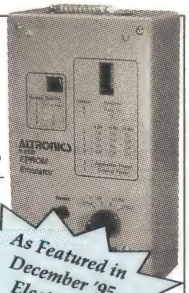
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To All Our Valued Customers

From the staff at Altronics we thank you for your patronage and wish everybody a Merry Christmas and a Happy New Year!
Regards Jack O'Donnell



EPROM Emulator Kit



(See EA Dec '95) This EPROM emulator allows you to do away with EPROM's whilst in the prototyping stage of product development. The emulator is connected to a spare parallel port on your computer and also the 'target' board. The EPROM file (that is normally downloaded into the EPROM), is then transferred into the emulator by copying the file to the parallel port. This process saves repetitively "blowing" new EPROM's with each modification to the program. Emulates 2764, 27128, 27256 and 27512 EPROM's.

K 9530 ***Just*** **$149**

As Featured in December '95 Electronics Australia

Model Train Control Kit with Simulated Inertia



(See EA Nov '95) This simple, low-cost model train controller uses a very efficient phase control system to regulate the speed of your model train, giving better load-speed regulation. It also simulates inertia and momentum, making the train run much more realistically. A worthwhile addition to almost any model railway layout. Operates from a 6-18 V AC plug pack or from your existing AC train supply.

K 8010 **$29.95**

Guitar Headphone Amplifier Kit

(See SC May '95) Now you can practice your guitar at any time by using this low cost amplifier. It provides ample power for headphones so that you can play to your heart's content without disturbing the rest of the household or your neighbours. Simply plug in your guitar, headphones and a 12V AC power supply (not included).



K 5537 **$29.95**
M 9120 12V AC Plugpack to Suit **$12.95**

Sub-Woofer Controller Kit



Add Incredible Bass to Your Hi-Fi or Home Theatre System!

(See SC Dec '95) A very exciting subwoofer adaptor design published in Silicon Chip Magazine. ***High level inputs*** enables simple parallel connection to either left or right stereo speaker. ***Low level inputs*** allows connection to surround sound subwoofer output or standard stereo signal. eg CD, VCR etc. ***Other features*** of this excellent design includes: • Variable filter output frequency • Inbuilt compressor/limiter prevents over-drive clipping • Subsonic filter (below 15Hz) • Auto input signal sensing and 24V power up facility for external sub power amplifier • "In Phase" and "Out of Phase" outputs enable bridge mode output if desired. Very compact, only 200W x 160D x 70H mm. Two versions available, PCB and components kit only (K 5562), or complete with a case, power supply and PCB (K 5563).

K 5562 Short Form Version (PCB & Parts Only) **$49**
M 9120 12V AC Plugpack to Suit K 5562 **$12.95**

K 5563 Full Version (Includes PCB, Components, Case & Power Supply) **$99**

5 Band Graphic Equaliser Kit

NEW!! Featured in this month's Silicon Chip



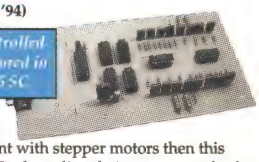
(See SC Dec '95) Liven up your keyboard, guitar or music system with this 5 band graphic equaliser. It uses only a few low cost parts and parts and will vastly improve the versatility of your sound system. Bands are centred at 63Hz, 250Hz, 1kHz, 4kHz and 16kHz, with a ±12dB boost/cut adjustable level on each band.

K 5305 **$39.95**

Parallel Port Stepper Motor Controller Kit

(See SC Jan '94)

Suits PC Controlled Robot as Featured in Nov/Dec '95 SC



If you have ever wanted to experiment with stepper motors then this kit is ideal. It plugs directly into any standard printer port and can control two stepper motors as standard, but can be cascaded to control up to eight stepper motors. Requires external 12 Volt DC power supply at up to 1.5A depending on motor used.

K 2830 **$49.95**
K 2832 Software to Suit 3.5" Disk **$14.95**

50W Mosfet Amp Module Kit



Ultra Compact Design!

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 amplifier. Requires ±50V DC supply.

Power Output: .....50W into 8Ω
Freq. Response:.....25Hz-20kHz,±1dB
Input Sensitivity:....1V RMS
T.H.D.:.....0.05%

K 5115 **$54.95**

Impedance Meter Kit



Measuring a transformer with a standard ohm meter will not give accurate results because it is measuring with a DC signal, not AC. This invaluable unit is fantastic for checking transformers and speaker impedances. For those people dealing in PA equipment, the built in tone generator enables an entire PA system to be checked before the amplifiers are connected. Uses one 9 Volt battery. (Not supplied). Three ranges enable accurate measurement of 2 - 20,000 ohms. Accuracy mid range typically ±5%.

Great for measuring: • Speaker impedances • Line transformer / audio transformer impedance and reflected impedance etc • Speaker circuit total impedance & more.

K 2550 Kit Version **$99**
K 2551 Fully Built & Tested Version **$159**

Ignition Killer Kit



NEW! Featured in this month's Silicon Chip!

(See SC Dec '95) There are many ways of theft prevention for your vehicle. Disabling the ignition is perhaps one of the better methods, as it can totally immobilise the car. This ignition killer will help prevent your car from being stolen by producing erratic behaviour in the ignition system. The thief will suspect a problem with the car and leave it.

K 4380 **$29.95**

Digital Announcement Recorder Kit



1000's Uses Include Car Warning Alert, Alarm Systems, Door Bell etc.

(See EA Feb '95) This kit is an extremely flexible microprocessor controlled eight channel digital voice recorder. Requires no battery back up for memory. Will record up to 8 different messages, with a total time up to 16 seconds. Each message can be individually triggered. Features chime function, an on-board 2 watt amplifier, negative or positive trigger, once only or recycling announcement function etc.

K 9580 **$109**

Auxiliary Battery Manager

NEW! Featured in this month's EA!

(See EA Dec '95) Ideal for four wheel drives, trucks or any lead acid battery application. This is a 'smart' manager for an auxiliary lead acid 12V battery. Charges the auxiliary cell after the main cell has been recharged. Unit features controlled current charging for flat auxiliaries and full current charging when its terminal voltage rises above 11V. Also, this unit isolates the auxiliary battery from the electrical system when the ignition is off.



K 4330 **$49.95**

High Efficiency Fluro Inverter Kit

(See SC Nov '93) Ideal for camping, fixing cars etc. This circuit will drive a standard 40 Watt fluro tube from a 12 volt source. Being a fluro light, it draws less current than an incandescent globe. Features flicker free starting/running, reverse polarity protection and faulty tube protection. Globe and housing not included. Requires 11 to 14V DC power source. Suitable for 18, 20 36 and 40W globes. Low EMF radiation.



K 6370 **$69.00**

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Why Pay A Commercial Security Firm A Fortune To Wire Your House or Office?



No Wiring or Holes to Drill - Can Easily be Taken with You When You Move - Ideal for Those Who Rent

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.

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 External Siren and Enclosure (wired) • 1 x 240V AC adaptor • 1 x 10m wiring harness for external siren • Includes cable clips and fixing hardware • 1 x 1.2Ah Backup Battery

S 5262 Complete System

$499

Car Voltage Adaptor

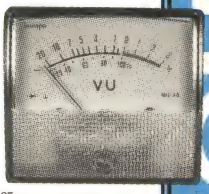


This handy unit simply plugs into your car's cigarette lighter socket and presto! Gives you switchable 3, 4.5, 6, 7.5, 9 and 12V DC at up to 800mA. Includes a range of output plugs. Reversible polarity. Great for pocket TV's etc.

M 8150 Normally $16.95

This Month Only $10

VU Panel Meters



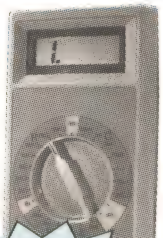
These quality meters are ideal for amplifier projects or replacement units. MU45 quality class 2.5.

Q 0528 Normally $19.95

This Month Only $15

At Last - An Accurate

Digital LCR Meter



In the past multimeters including inductance and capacitance ranges have been relatively mediocre in their performance. This new model will measure inductance, capacitance and AC resistance with great accuracy! Ideally suited for speaker crossover design and transformer/coil manufacture. Supplied complete with two sets of leads and inbuilt sockets for direct measurement of inductors, capacitors or resistors. Includes integral bench stand.

Free Carry Case This Month!!

Resistance Ranges: 20, 200, 2k, 20k, 200k, 2M, 20M
Capacitance Ranges: .....200pF, 2nF, 20nF, ...200nF, 2µF, 20µF, 200µF
Inductance Ranges: 2mH, 20mH, 200mH, 2H, 20H, 200H
Accuracy: .....Better than 5%

Q 1010 $199

Inner Ear Phones



In our opinion, these very rugged, brilliant reproduction earphones compare very favourably with the Sony yet at a fraction of the price. The set comes complete with gold plated right angle 3.5mm plug and "wind up" carry case. Fantastic for personal stereos, video cameras etc.

C 9005 Normally $19.95,

This Month Only $10

Mini Personal Alarm



A great little personal security device. This device has a very loud 100dB siren. Small enough to fit in a pocket or handbag or can clip onto a belt. Simply activated by pulling out the pin. Unit is disarmed by re-inserting the pin. A must for those travelling at night.

S 5330 $12.50

1.2Ah Lead Acid Battery Bargain!

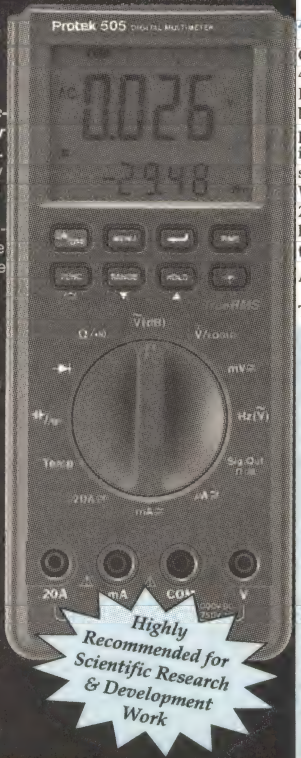


This Month Only $19.95 ea or 2 for $35 Save Over 50%
Limit 4 per customer

We have scoop purchased a limited quantity of 1.2Ah 12V lead acid batteries, and can offer them at a super bargain price. These units have a variety of applications including alarm system back-up power supplies, UPS's, emergency lights, etc.

SA5065 Normally valued at $39.95

True RMS Digital Multimeter



Supplied with high quality hard carry case and silicon test leads. This 3.75 digit 4000 count digital multimeter would have to be one of the best meters we have seen. Features include menu driven functions (no complicated instructions to remember), large backlit display, timer function, 20 amp current scale and many more.

Other Features: • True RMS mode • Large display includes main and sub displays with bargraph • 10 Location memory • Stop watch/pre-settable count down timer • Minimum, maximum, average and relative modes • Decibel measurement • Capacitance and inductance measurement • Temperature mode (°C and °F) • Pulse signal generator for logic and audible testing etc • Continuity and diode test • Logic test • Auto power "off" and "keep on" mode • 20A current range • Warning buzzer sounds when leads are incorrectly inserted in the 20A current mode • Back lit display • Data hold and run mode • Low battery indication • Overload protection • Safety design in compliance with UL 1244 and VDE0411

Specifications & Ranges Available:
DC Volt: 400mV, 4V, 40V, 400V, 1000V
AC Volt: 4V, 40V, 400V, 750V
DC Current: 400µA, 400mA, 20A
AC Current: 400µA, 400mA, 20A
Frequency: 10kHz, 100kHz, 1MHz, 10MHz
Resistance: 400Ω, 4kΩ, 40kΩ, 400kΩ, 4MΩ, 40MΩ
Capacitance: 100µF
Inductance: 100H
Temperature: .....-17° - 1093° C (0° - 2000° F)
Display: .....3.75 digit, 4000 count LCD

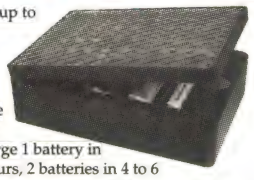
Q 1091 $229

Q 1092 K Type Temperature Probe to Suit **$21.00**
Q 1093 Protective Carry Holster to Suit **$13.50**

Highly Recommended for Scientific Research & Development Work

AA Solar Charger

Charge Your Batteries Free From the Sun!
Ideal for camping, boating, travelling etc. Simply insert the batteries and place in direct sunlight. eg on your car dashboard.



Charges up to 4 AA Nicads by simply placing in the sunlight. Will charge 1 battery in 2 to 3 hours, 2 batteries in 4 to 6 hours, 3 batteries in 7 to 10 hours and 4 batteries in 10 to 14 hours with full sunlight.

A 0230 Normally $16.95,

This Month $10

Multi-Purpose Solar Charger



Charges 2 AA, AAA, C or D size batteries at the same time. Will charge in 10 to 14 hours with full sunlight.

A 0240 Normally $29.95,

This Month $25

24 Hour Timer

These Timers Are Made by the Same Manufacturer as Those Sold by Major Hardware Stores & Super Markets!



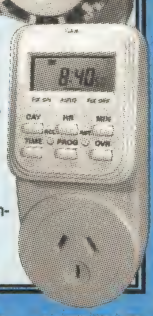
Programming is done by simply inserting the supplied pins into the appropriate time slots. On and off times are in multiples of 30 minutes. Includes manual on/off switch.

A 0301 Normally **$26.50**, **This Month Only $16.50**

These Timers Can be Used for Security, Pool Pumps & Heaters, Electric Blankets, Lights, Radios, Reticulation etc.

7 Day Electronic Timer

This Month Save 30%



Excellent for home security. 6 different programs can be set to activate any specified day of the week. All 6 programs operate independent of each other. With normal operation the in-built LCD digital display clearly shows the current time and day of the week. Internal rechargeable backup battery will maintain all program settings and current time for up to approximately 100 hours in the event of a power failure. Simple to program. Includes manual on/off/automatic control. 16 amp at 240V AC maximum current rating.

A 0303 Normally **$49.50**, **This Month Only $34.50**

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Doc.JH376

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Multi-Function Remote Car Alarm

Protect your car from theft. Save hundreds $$$ on comparable systems!

Easily the Best Car Alarm We Have Ever Evaluated!



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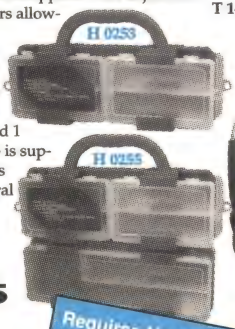
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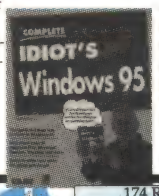
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Frequency Response: 100Hz-15,000Hz
Sensitivity: .....-80dB @ 1KHz
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Idiots Guide to Windows 95



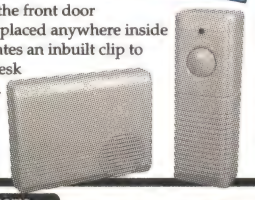
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Doc.JH376

SHORTWAVE LISTENING

with **Arthur Cushen, MBE**

Early Belgian broadcasts from Africa

This year Radio Vlaanderen is celebrating 50 years of broadcasting, but the history of the station goes back to 1937. Part of its early wartime broadcasts also originated from Africa. In 1937 a transmitter was inaugurated, broadcasting to the Belgian Congo, now Zaire, and was operated by the Belgian Government using material derived from its national network. In May 1940, the German invasion resulted in the destruction of the shortwave transmitters. In the meantime, a new high powered facility was constructed in the Belgian Congo at Leopoldville, using the power of 50kW.

Our records show early reception on OTC in 1944. The broadcasts had the slogan, 'Goodwill Station', and were the voice of the Belgian Government in exile. Across the Congo River in French Congo a similar station had been set up in Brazzaville, broadcasting the voice of the French Government in exile.

The Belgian Congo station continued to operate after the war and our reception log includes reports in 1947.

By this time they were broadcasting in eight languages as well as Dutch and French.

As well as the Belgian Congo broadcasts, the BBC also carried special programmes for the Belgian population during the war years in Flemish, and were credited with the introduction of the V symbol in Morse code. This stood for 'V for Victory', a symbol still used by the BBC today.

Within the Belgian state, Flanders obtained far reaching cultural and political autonomy, and its own broadcasting system, the BRTN, of which Radio Vlaanderen International is an integral part.

After the war, shortwave installations were completed in Belgium and an international service commenced. Originally there were two networks, French and Dutch, but now only the Dutch network operates on shortwave. Today, despite budget cuts, broadcasts from Brussells continue to be heard world wide using three transmitters — one of 200kW and two of 100kW.

These days, the main service from belgium is in Dutch to listeners in Africa, while English transmissions are beamed to other parts of the world.

Vanuatu changes

Broadcasts from Villa have been noted on a new schedule, as Radio Vanuatu has been carrying its broadcasts on the one frequency using two 10kW transmitters in parallel. Broadcasts are 1900 - 2100UTC on 3945kHz, 2100 - 0600 on 4960kHz and 0600 - 1115 on 3945kHz.

This month the station plans to replace 4960kHz with the higher frequency of 7260KHz.

When we look at the history of broadcasting from this country (the former New Hebrides), our first reception was from the Armed Forces Station which operated on 1045kHz with the call of WVUR and reception was on the 25th March 1945. The New Hebrides was again heard in the late 1960's, and in 1971 the Australia Government donated a 2kW transmitter which operated as YJB4 on 3960kHz and YJB7 on 7260kHz.

In 1980 the station was known as Radio Vila and operated on the same frequencies as used today. Transmitter power was increased to 10kW and a second transmitter was installed last year.

Today, Vanuatu is well received on 3945kHz with English news at 0900UTC. When opening at 1900 after the National Anthem a recording of Yellow Bird is played and this includes many bird calls and this is a very delightful recording to start the day's broadcast. ❖

AROUND THE WORLD

CANADA: RCI, Montreal's new schedule up to March 31st 1996 shows the use of three new frequencies: 5925, 9645, and 9805kHz.
The schedule that we are monitoring is 0200 - 0400UTC on 9755kHz, 0400 - 0430 on 9505 and 9645kHz; 0600 - 0630 Monday-Friday on 6050, 6150, 9760 and 11,905kHz; and 2100 - 2159 on 5925, 9805, 11,945, 13,650, 13,690, 15,150 and 17,820kHz. All these broadcasts are in English.

ECUADOR: HCJB Quito, broadcasting in English to Europe, has made a frequency change and now uses 6050kHz from 0700 - 0830UTC. The SSB transmission on 21,455kHz uses 1500W and now broadcasts 24 hours a day.

IRAN: Tehran is heard opening at 2130UTC on 6175kHz with a short English announcement. Then follows a programme in French to 2145 with the English programme to 2215UTC sign off. The station suffers some interference from Deutsche Welle on the same channel.

IRELAND: Dublin was heard with a special sports relay recently when they used two BBC 250kW transmitters for the broadcast at 1400 - 1600UTC. Two frequencies carried the programme, 5875 and 9805kHz, and following the success of this test other relays are scheduled. The address of the operators is: Irish Overseas Broadcasting Ltd, PO Box 4950, Dublin 1, Ireland.

ISRAEL: The External Service in English, published for the period to March 2nd, 1996 shows only two news programmes daily. They are 0500 - 0515 on 5895 and 17,545kHz and 2000 - 2030 on 7415, 7465, 9435, 9845 and 13,750kHz, all in English.

JAPAN: Radio Japan, Tokyo has few changes in their new schedule. English to Oceania is 0700 - 0800 and 0900 - 1000 on 11,850kHz, while other programmes to this area are: 1900 - 2000 on 7140 and 11,850kHz, 2100 - 2200 and 2300 - 2400 on 11,850kHz. On Sunday at 2130UTC Media Roundup is broadcast. This is a special programme for shortwave listeners.

MONACO: TWR, Monte Carlo, has a new schedule and this is 0740 - 9520 on 7110kHz.

NORWAY: Oslo's latest schedule beams to New Zealand at 0700 on 7180kHz, 1300 on 7315, 1900 on 6195 and 2200 on 6170kHz. These frequencies carry English on Sundays for 30 minutes. Other frequencies beamed to this area are: 0800 on 9590kHz, 1200 on 7295, 2000 on 6195 and 2100 on 6170kHz. To Australia English is heard on Sundays at 1300 on 15,605kHz. Other broadcasts are at 000UTC on 7275kHz, 0800 on 13,800, 0900 on 15,175kHz, 1200 on 15,605kHz, 1400 on 11,730kHz, 2100 on 7315, 2200 on 5960 and 2300 on 7275kHz.

QATAR: QBS, Doha's latest schedule shows English only on medium wave. On shortwave they broadcast in many languages with Arabic from 0245 - 0706 and 1707 - 2139 on 11,785kHz and 0707 - 1706 on 15,345kHz.

SUDAN: Radio Omdurman was heard on 9200kHz with French at 1755UTC and English at 1800, after the time signal. The English programme continued until 1830 and this was followed by music, and at 1858 a short French and English closing announcement. At 1900 the service continued in Arabic.

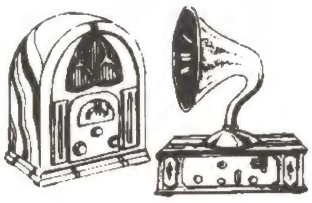
THAILAND: Bangkok has been heard in its International Service opening at 1100UTC with a short English announcement on 7250kHz. The announcement referred to the frequency as 7285kHz which is an error; transmission continued in Vietnamese using the high powered transmitter of 500kW at Udon.

USA: The Voice of America has been faced with a budget cut. US$355 million is the present allocation, and this is to be cut by $45 million during 1996. A VOA feature for shortwave listeners is 'Communication World', broadcast on Saturday at 1030UTC on 5985, 11,720 and 15,425kHz; its compere for the last 11 years Gene Reich has recently retired. The session continues with Andrew Kim Elliot at the microphone, and he is well known to VOA listeners as their audience research officer. ❖

This item was contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Eastern Daylight Time and 13 hours behind New Zealand Daylight Time. ❖

Vintage Radio

by PETER LANKSHEAR



Who really DID invent the Superheterodyne?

The invention of the superheterodyne is one of the most important developments in the history of radio, and is basic to the operation of virtually every receiver and many transmitters in operation today. Without the 'superhet', modern electronic communications would not be possible. Yet for all its significance, its exact origins have been controversial.

The basic principle of the superheterodyne is simply that any two signals can, when mixed together, create other signals that have a mathematical relationship to the original pair. For centuries musicians have known of this effect, called beating, in which two notes will appear to the ear to produce a third. In the superhet, the equivalent beat note is, of course, the intermediate frequency.

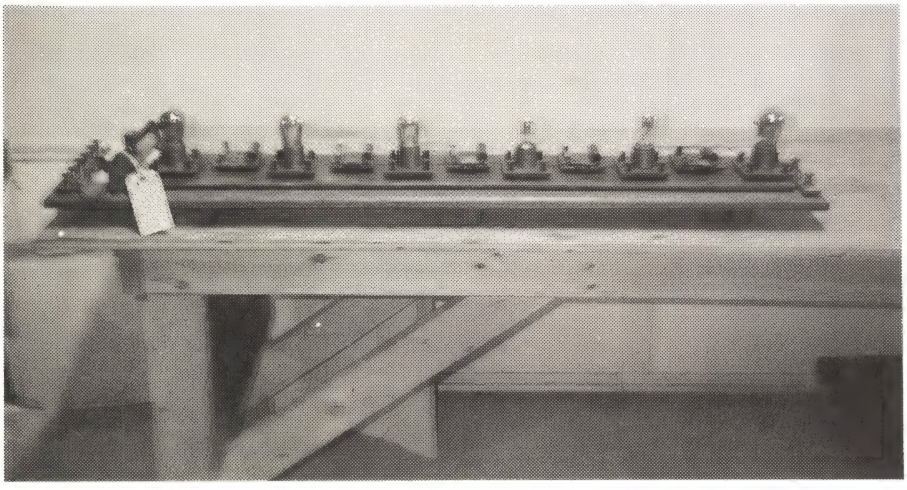
Although radio matured during the 1920s, with the TRF the dominant type, the superhet is the older technology, having been around for the best part of 80 years. But who invented it? Many Americans give the credit to Edwin Armstrong, but others recognise the work of Lucien Levy.

A few years ago, there was some correspondence in *EA* on the subject, and the 'When I Look Back' column for July 1990, which described the accomplishments and tragedy of Edwin Armstrong, put into perspective the part played by the Frenchman Lucien Levy in the invention of the superhet.

At about that time, Winston Muscio (a retired STC engineer) provided me with some interesting data, including a copy of the Levy patents, which made the events a little clearer to me. However, as we shall see, recently significant information about the French involvement has become available and clearly throws some doubt on Levy's integrity.

Early radio was often marred with patent claims and sometimes bitter litigation (more than once involving Lee de Forest). Depending on the source of writing, significant developments are attributed to different inventors and piecing together the true story can be a time consuming but fascinating task.

Radio is of course not the only field where this has occurred. Morse and the electric telegraph, Edison and the electric lamp and the phonograph, Bell and the telephone have all achieved immortality for their inventiveness, but in each case their work was closely paralleled by that of other researchers.



One of the world's finest, largest and longest established collection of vintage radio equipment is at the Antique Wireless Association's Museum in the charming little New England style village of East Bloomfield, in New York State. Among their many priceless and historically significant acquisitions are several pieces of equipment constructed by Edwin Armstrong. This is a resistance coupled IF amplifier strip, built to demonstrate his superheterodyne receiver. The device with the label attached is the filament rheostat!

Fessenden's heterodyne

Marconi's transmitters, based on the experiments of Hertz, used high voltage discharges across spark gaps to excite tuned circuits and aerials into oscillation and thereby generate RF signals — which were, in effect, modulated by the individual sparks. Progressive engineers, among them the Canadian Professor Reginald Fessenden, realised that spark transmissions were inefficient and crude and that real progress lay in using continuous waves; but he realised that existing detectors would produce very little audio output from an unmodulated signal.

A further problem was lack of sensitivity, in the coherers and magnetic detectors of the period. Fessenden had observed that by far the most sensitive instrument available was the standard telephone earpiece — but of course this could not be used to receive radio signals directly.

His solution, patented in 1902, was the simultaneous transmission of two signals with a small difference in fre-

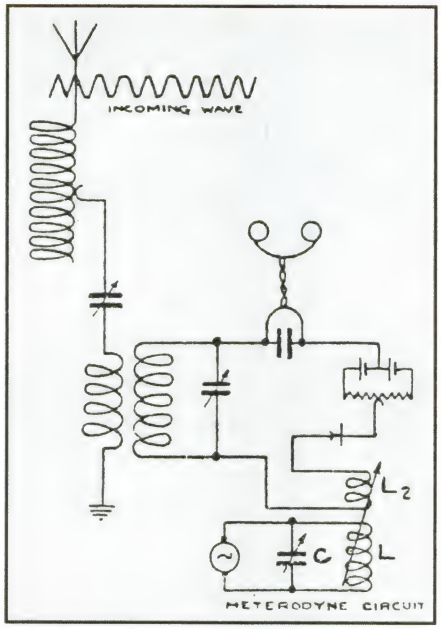
quency. These supersonic signals were each fed to individual windings of a special headphone and an audible difference beat was registered by the operator's ear. Thus, if the two signals were separated by a difference of 1kHz, a note of that frequency would be heard in the earpiece.

Fessenden also realised that only one transmitter would be necessary if the second signal was generated by a local oscillator. This was the origin of the *beat frequency oscillator* or 'BFO', and for the note produced, Fessenden gave us the term 'heterodyne' from the Greek meaning 'other force'. Heterodyne reception had the advantage too of improving detector efficiency, by in effect adding energy to the audible signal.

Ahead of its time

Valves did not exist in 1902, and it was not until after the invention of the valve oscillator a decade later that the heterodyne detector came into its own. Until then the local signal had to be generated by a miniature arc transmitter, or even a high frequency alternator! Obviously these were unwieldy methods, and a classic example of a system being in advance of technology.

The invention of the valve oscillator was a landmark in radio history, and a classic example of simultaneous effort in different countries. In September 1912, whilst still a student at New York's Columbia University, Edwin Armstrong demonstrated the regenerative detector and the closely related valve oscillator. Meanwhile, in Germany the Telefunken engineer Alexander Meissner and in England, Marconi engineers Franklin and Round had been successful in producing valve oscillators.



This diagram of a receiver using Fessenden's heterodyne principle is taken from the 1925 Admiralty Handbook. Before the advent of the valve, the source of heterodyne oscillations was an arc generator or a high frequency alternator.

As an indication of the closeness of the race, in 1913 Meissner took out his patent on April, Franklin's patent dealing primarily with regeneration was registered in June and Armstrong's patents were filed in October.

Armstrong was an impecunious student who, with more resources, could have applied for his patent earlier. History has credited Armstrong as being first to make a valve oscillate in his discovery of the regenerative detector, although De Forest eventually won the legal battle on the dubious strength of getting audio feedback between a microphone and telephone earpiece. Regardless of the true inventor, the oscillator enabled the heterodyne receiver to become a practical device, and was widely used by various navies during the first World War.

WW1 spurred development

The period 1914-18 saw considerable radio development on both sides. From an erratic curiosity which Lee de Forest, the nominal inventor, did not fully understand, the triode valve was made into a stable and practical device.

By 1917, when America entered the War, radio was an integral part of warfare, and Armstrong, by now an acknowledged authority on reception, was soon given a commission and sent to France to research military radio applications.

On his way to France, in October 1917, Armstrong had been able to visit London, and called on Captain Henry Round of the Marconi Company. The two 'hit it off' immediately, and Round was able to demonstrate his 14-stage RF amplifier, which had been used for direction finding by eavesdropping on the German Fleet's low powered inter-fleet communications while they were stationed in Heligoland. The Royal Navy was alerted to movements of the German ships in harbour, and the outcome was the Battle of Jutland.

Round's amplifier illustrates the difficulties of the time in obtaining useful RF amplification. Although he developed a special low capacitance valve, the baseless V24, he could only achieve a stage gain of two. However, given a sufficient number of stages, sufficient amplification to reach to the noise level of the aerial was possible.

By all accounts, the Round receiver was extremely difficult and time consuming to set up and tune. For practical

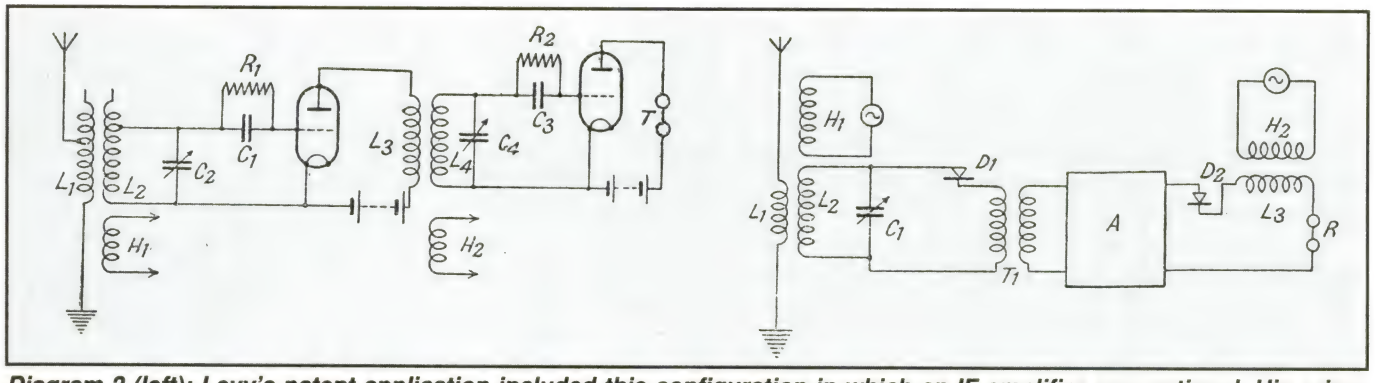


Diagram 2 (left): Levy's patent application included this configuration in which an IF amplifier was optional. His prime claim was for interference cancellation, with the superheterodyne principle almost as an afterthought. Diagram 3 (right): Armstrong's ideas were much clearer than Levy's, and this diagram from his superheterodyne patent application shows a practical and recognisable configuration using an IF amplifier labelled A.

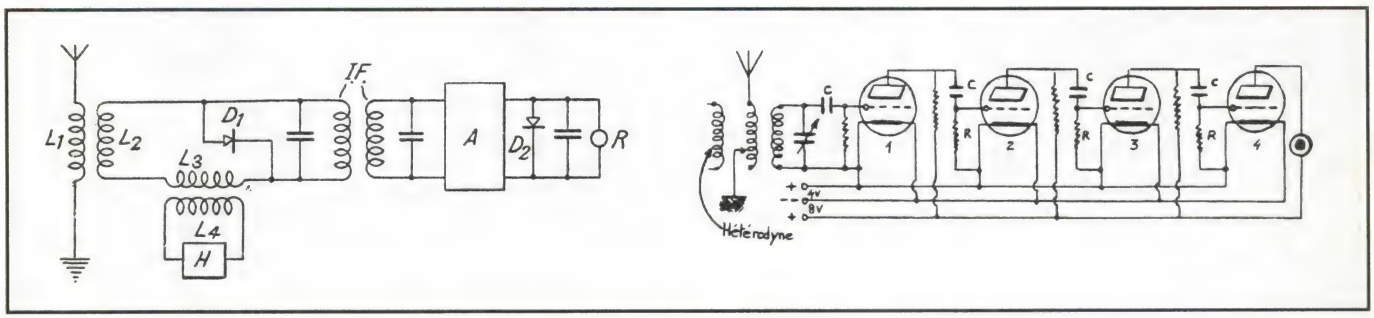


Diagram 4 (left): Schottky's proposed receiver was essentially identical to Armstrong's, a remarkable example of how the same invention can originate at the same time from two completely independent sources. Diagram 5 (right): The diagram that accompanied Laut's February 1, 1917, report to Ferrie suggesting the use of supersonic heterodyne signals. This is a practical circuit, although some tuning ahead of the resistance coupled IF amplifier would be of considerable benefit.

work, simpler methods of amplification were needed.

The next part of the story has become part of the folk lore of early radio. At this time, most radio communication was carried out at frequencies below 1MHz, but there was a belief that the Germans were using much higher frequencies where valves could not be made to amplify.

Sensitive as it is, the regenerative detector has a lower limit to signal strengths to which it will respond, and the only remedy is pre-detection amplification, which was not possible with valves of the type then used by the military. Armstrong gave thought to this impasse, and is said to have thought of the solution while watching a night time air raid on Paris.

It occurred to him that it might be possible to locate aircraft by tracking the high frequency radiation from their ignition systems, but considerable amplification would be necessary.

To obtain the necessary amplification, he proposed to use a receiver with a heterodyne detector to produce a supersonic rather than audible beat signal — which could be amplified, using existing technology, to a level suitable for conventional detection. His name for the new system was the *super(sonic)heterodyne*.

Armstrong developed and just as the war ended, demonstrated a working eight-valve 'super heterodyne' receiver. The first patent was filed in Paris on December 30, 1918. His American patent, which even allowed for multiple frequency conversion, was filed on February 8th 1919, and was issued on June 8, 1920.

The French connection

During World War One, the French set up a radio research organisation under Colonel Ferrie, one member of the team being engineer Lucien Levy. Levy's chief interest seems to have been in noise cancellation, a common enough research subject in the days of low frequency transmissions with their heavy static background. In August 1917, he made a long and somewhat rambling patent application dealing with problems in radio transmissions: 'atmospheric disturbances, confusions between the different emissions, and the lack of secrecy'.

Finally, after several obscure pages describing what seems to be interference reduction, and almost as an afterthought, he mentions what has been identified as the superheterodyne principle stating:

A method as claimed in Claim 1 permitting of the selective reception of the ordinary radio-telegraphic or radio-telephonic sustained-wave emissions, characterised by the fact that ultra-acoustic beats are produced by the combination at the receiving station of the current coming from the transmitting station with the current from a first local generator of high frequency current, followed in the case of radio-telegraphic reception, by the production of beats of acoustical frequency, by the combination of the ultra-acoustical beats with a second oscillating local generator of ultra-acoustical frequency.

When compared with Armstrong's precise wording and his working receiver, it is understandable that Levy's claim to have invented the superheterodyne has been questioned. It is significant that the French Government recognised Armstrong's patent, and according to his biographer, presented him with a medal. However, in another of Armstrong's disappointments, Levy later claimed that Armstrong had stolen the superhet concept from him. Several years later, in an implied recognition, American Telephone and Telegraph bought Levy's US patent application for $20,000. Of the nine claims in Armstrong's 1919 patent, all were lost in later interference proceedings in the US Patent office.

We will never know whether or not Armstrong was influenced by ideas from Levy, or developed his invention completely independently. But it is certain that there was no contact with W. Schottky of the Siemens laboratory in Germany, who applied on the 18th June 1918 for a patent that was almost identical to the application that Armstrong made six months later. Clearly, there could have been no communication between Armstrong and Schottky; so it is apparent that here was a classic case of simultaneous invention. However Schottky's work was purely theoretical — he did not build a working example.

To summarise, the generally accepted situation has been that Levy, Schottky and Armstrong were all granted patents for the superheterodyne receiver. Levy was first, but his ideas were somewhat obscure, concentrating more on interference reduction, with the supersonic heterodyne principle almost an afterthought. Schottky's patent application was next, with a clear description of a workable system,

but his work was theoretical only. Finally, Armstrong delayed his patent application until he had a working receiver with advanced and detailed concepts of its potential.

Levy may have been first to the patent office, but Armstrong was considered by his peers to be the father of the superheterodyne. Given the nature of the man, and his ability, proven by his later achievements in developing super-regeneration and pioneering FM transmissions, it is highly unlikely that he needed to or would have stooped to stealing Levy's ideas, as the latter at one time suggested.

Twist in the tale

Until recently, that was where the story ended. But all good tales have an unexpected turn at the end, and this one is no exception.

The 1991 *Review of the American Antique Wireless Association* (AWA!) has a translation of a French article, originally published in 1979 in *Liason des Transmissions* by Robert Champeix. In the article Champeix wrote that in 1968, he was involved in setting up the French Radio and TV's museum, when an elderly but dapper and alert man introduced himself as Paul Laut. Laut had a very interesting story to tell.

As an electrical engineer, Laut had been a member of the radio research team set up in August 1914 under Colonel Ferrie at the Eiffel Tower, for development of equipment using the new TM valves. Laut's specialist research subject was heterodyne reception. As we have already seen, another member of the team was Lucien Levy.

In 1916, Laut was hospitalised with tuberculosis, but was able to continue his theoretical work on heterodyne reception. In the process, it occurred to him that the beat note, although at an inaudible frequency, could still be readily amplified. On February 1st, 1917, Laut presented a report on this to Colonel Ferrie — who, as was normal practice, distributed it to other team members.

Later in 1917, Laut returned to the team, but was surprised and upset to find that on August 4th Levy had taken out a patent application, part of which was Laut's idea for heterodyne amplification. Laut protested to Colonel Ferrie, whose response was that as they were at war, disagreements between team members would be out of place.

Now it would be easy to assume that the accuracy of Paul Laut's recollections had suffered from the passage of 50 years; but there is unexpected confirmation.

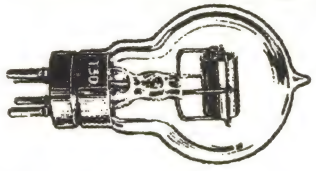
At the end of 1925, and into the following year, Lucien Levy carried on a heated debate with several radio personalities via the correspondence columns of the magazine *L'Antenne*. (Compared with some of these exchanges, the arguments that Jim Rowe 'buys' in his Forum column are models of politeness and affability). The debate descended to personalities, and one protagonist was unsporting enough to introduce the subject of Paul Laut's report on the heterodyne receiver to Colonel Ferrie.

Following some more acrimony in which Levy tried to play down the event, the Editor of *L'Antenne* waded in with a transcript of the Laut report which had been kept and made available by one of the Eiffel Tower team. *Touché Monsieur Levy*!

As Winston Muscio commented after reading the Champeix article, "When everyone gets their just deserts in the hereafter, it will be Laut who gets the superhet medal". ❖

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READER INFO NO. 19

Flexible Dual Power Supply Module

Continued from page 83

lators in the standard TO-220 package, laying down on the board and fitted with small finned 'U' heatsinks if and when these are needed. The module shown in the photos is the one for the PC-Driven Audio Sweeper, and in this case it only needed a heatsink for the positive regulator as the negative regulator is very lightly loaded.

Capacitors C5 and C6 are mainly to ensure regulator stability, and should be either MKT or metallised polyester types. By the way you could use the very small TO-92 package regulators instead of TO-220 types, if you are using the module in a situation where it will always be loaded very lightly — e.g., a few tens of milliamps.

The final regulated outputs from the supply are bought to three terminal pins at the end of the board. As the module will generally be built into equipment, rather than used as a 'stand alone' unit, this should be quite acceptable.

Insulated standoff pillars can be used to mount the module in a larger piece of equipment, as shown in the photos. The PCB is provided with 3mm mounting holes for this purpose. I used 10mm pillars, as these are the shortest that are readily available.

If space is very tight, you could alternatively use two nuts underneath each screw to pack the module up by 4mm or so — enough to ensure adequate clearance between the solder joints and the mounting surface.

So there you have it: a small dual polarity regulated power supply module which can be built up to provide various voltage levels, and to suit a variety of applications. Hopefully it will meet your needs as well as mine, at least *some* of the time! ❖

PARTS LIST

Capacitors

C1,2 2200uF 25VW RB electro
C3,4 470uF 16VW RB electro
C5,6 0.1uF 100V MKT or met. polyester

Semiconductors

U1 7812 or other positive regulator*
U2 7912 or other negative regulator*
D1-4 1N4001 (or WO-4 bridge)

Miscellaneous

T1 7VA PCB mount transformer*
PCB, 110 x 51mm, code 95dps12; three-way PCB mount mains terminal block, 10mm or 5mm spacing; three PCB terminal pins; two finned 'U' shaped heatsinks for TO-220 packages; two 3mm x 10mm machine screws and nuts; insulated standoff pillars for module mounting; long nylon cable tie for securing transformer.

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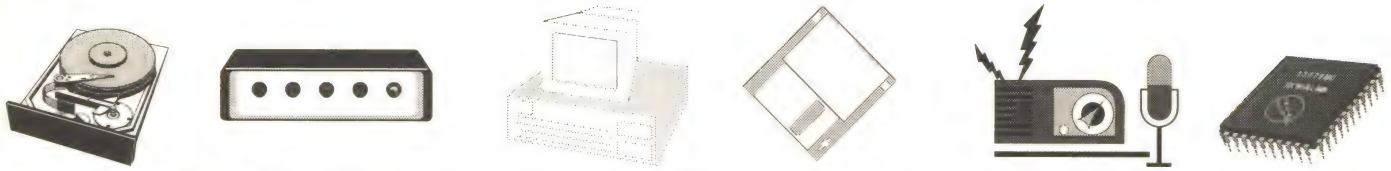
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50 and 25 years ago...

'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.

December 1945

Television in full colour: The transmission of pictures in full colour over New York City was disclosed on October 11, before the Federal Communications Commission.

Paul W. Kesten, executive vice president of the Columbia Broadcasting System, said that three weeks ago he saw the pictures in 'magnificent colour' in a laboratory over a closed circuit.

"Although nominally 525-line pictures, each completed picture contained 1575 imperceptible lines of beautifully detailed colour — and the circuit was complete from the scanning device to the actual receiver."

"Only yesterday, October 10, I saw these pictures successfully broadcast across the crowded New York skyline and received many blocks away with superb clarity demonstrating the actual use of the ultra high frequencies and the modulation of a ten megacycle video band — two of the things so many were so sure could not be done."

Walkie-talkie taxis: Formation of a fleet of radio equipped taxis is proposed by the Guild of Taxi Cab Owners.

The Guild was formed early this year, and the secretary, Mr L.Earle, said it would attempt to end the racketeering which has brought the industry into disrepute during the war. Radio equipped cabs would enable prompt and efficient service to be given, Mr Earle added.

December 1970

New diode data display unit: A new development in solid state data displays has been produced in the UK by the Marconi Company's research labs. Using tiny slices of glass ceramic and a matrix of gallium arsenide phosphide light emitting diodes, the display provides a pattern of bright red dots which make up letters, numbers of symbols.

A feature of the new display is its small size, only 32.5mm long by 8.5mm high and 5mm thick. It also requires s simpler hookup to the generator which determines the character to be displayed.

New memory module: Monolithic circuits are now replacing the conventional magnetic core memory banks in new IBM computers. Using a silicon memory chip, each unit contains more than 1400 circuit elements to make up 174 complete memory circuits on each chip.

Stereo 'radar' gives space sense to blind: A new miniaturised version of the well known ultrasonic blind aid, worn in the same manner as a pair of spectacles, has been designed in New Zealand by Prof Leslie Kay, of the University of Canterbury. Professor Kay's system uses two receiving channels to provide an individual signal to each ear. The object is to provide a sense of space, as well as to indicate obstacles in the blind person's path. Range is up to 20 feet. ❖

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ACROSS

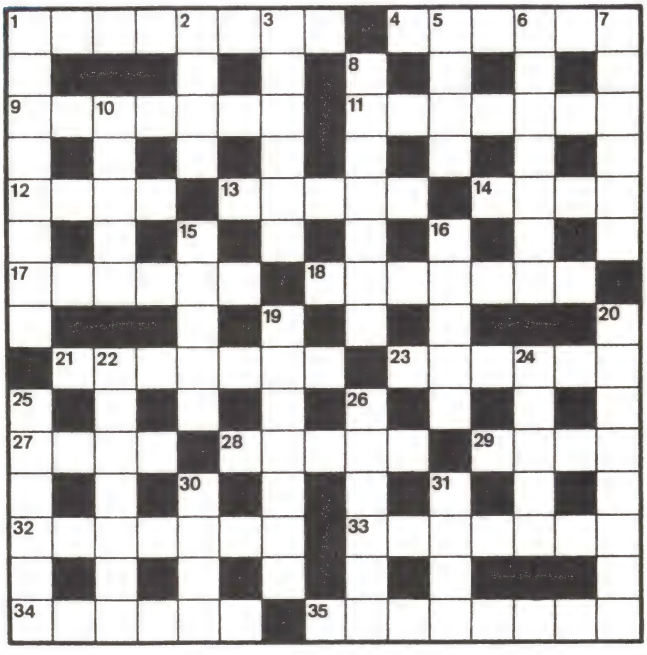
1. Produce currents, etc. (8)
4. High gain devices (abbr). (2,4)
9. Result of atomic exchange of electron. (3,4)
11. Space vehicle. (7)
12. Counter effect, a ---- emf.(4)
13. Faces of meters. (5)
14. Traditional navigational object, the ---- star. (4)
17. Summing. (6)
18. Make use of. (7)
21. Act of electronic eavesdropping. (4-3)
23. Make signal unintelligible. (6)
27. Such poles repel. (4)
28. Name of positive particle. (5)
29. Lower frequencies. (4)
32. Moving element of meters. (7)
33. Small current. (7)
34. Grid pattern in TV. (6)
35. A stopwatch is an ---- timer. (8)

DOWN

1. Potential applied to a value.(4,4)
2. Use cellular phone in different area. (4)
3. Particular coil. (6)
5. Connector. (4)
6. Objects moving in atmosphere. (7)
7. Home of Ericsson organisation. (6)
8. Remove source of potential. (7)
10. Type of cell. (5)
15. Designation of a computer key. (5)
16. A ---- switch is used in a sump. (5)
19. Part of fluorescent light circuit. (7)
20. Cinematic presentation of information. (8)
22. Basis of imprinting of some printers. (3,4)
24. Flight recorder, the ---- box. (5)
25. Said of process in making semiconductor devices. (6)
26. Quantum of electromagnetic energy. (6)
30. Neutral colour code. (4)
31. Device used by Franklin. (4)

SOLUTION TO NOVEMBER 1995

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R	■	L	■	B	■	S	■	L	■	U	■	E	■	O
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NEWS HIGHLIGHTS

SYDNEY BRANCH FOR RICHARDSON ELECTRONICS

As part of its international expansion, US electronic components distributor Richardson Electronics has opened a sales office and stocking location in Sydney. Headquartered in Lafox, Illinois, the company now has 55 locations worldwide, including 22 outside the USA.

Richardson specialises in the distribution of electron tubes, RF/microwave/power semiconductors and related components, to the industrial and telecommunications markets.

The company is an authorised distributor for many of the leading manufacturers, and offers value-added services such as special testing, modification and sorting, private labelling and custom packaging.

The Sydney branch is being managed by Michael Ryan, formerly a sales and marketing manager with GEC Australia. It is located at Unit 6, 40 Carrington Road, Castle Hill 2154; phone (02) 894 7288, or fax (02) 894 7481.

PHOTONICS EXPERT WINS ATERB MEDAL

The 1995 ATERB Medal has been awarded to Associate Professor Arthur J. Lowery, of the Department of Electrical and Electronics Engineering at the University of Melbourne. Professor Lowery also manages the 'Photonic CAD' and 'Soliton and High Speed Systems' areas of the Australian Photonics Cooperative Research Centre.

Born in the UK in 1961, Professor Lowery obtained a PhD from the University of Nottingham and joined the University of Melbourne in 1990 after emigrating to Australia.

The award citation describes him as being internationally recognised for his contributions to the theory and development of semiconductor lasers and photonic communications systems — and in particular, for his work on computer-aided design software for these systems. He is a regular speaker at major conventions and has published extensively.

Awarded since 1988, the medal is awarded jointly by the Australian Telecommunications and Electronics

ARMY CONTRACT TO ROHDE & SCHWARZ

The Australian Army has placed a major contract with Rohde & Schwarz (Australia) for the supply of 154 Radiocommunications Service Monitors, type CMS-53.

Termed 'Radio Test Set CMS-53 Composite Test Equipment' by the Army, the CMS-53 will replace a large inventory of discrete items used presently in the repair and alignment of field communications and other electronic equipment operating in the frequency range 1Hz to 1GHz.

The CMS-53 is, in essence, a complete general purpose maintenance workstation in a single portable package, capable of operating from AC and DC sources. The contract was won against strong competition from a number of prominent test equipment suppliers.

This latest contract continues the success of Rohde & Schwarz in supplying advanced test equipment to the Army. The company supplied 300 SMS-25 and SMS-27 Signal Generators and a total of 90 CMT-52 Radiocommunications Testers to satisfy contracts awarded during the 1980s.

The CMS-53 was designed to meet the Army's specific needs. For the first time an RF millivoltmeter is included in a CMS model. Transmitter and receiver measurement ranges have been extended and a rigorous environment specification met.



A demonstration of the CMS-53 is given by the Regional Manager of Rohde & Schwarz Eric Lawson to Colonel Rick Nevile (left), Lieutenant Colonel John Trevivian (centre rear) and Brigadier Grahame Hellyer (centre front). Looking on are Andrew Bean (Managing Director) and Graham Higgs (Sales Manager Measuring Instruments), of Rohde & Schwarz, and Luke Douma, Project Manager - Army.

NOWRA FIRM WINS JAYCAR DEALER AWARD

Haven Electronics, of Nowra NSW has won the inaugural 'Dealer of the Year' award from Jaycar Electronics. Haven won the award against tough competition from the 140+ network of Jaycar dealers around Australia.

According to wholesale manager Troy Weight, Jaycar made the award to Haven because it had provided 'outstanding' sales and service support for the Nowra/NSW South Coast area. Mr Weight suggests that any electronics enthusiast living or working in this area who has not visited Haven Electronics should do so, because he feels confident that they'll be very pleasantly surprised.

The full address is Shop 1, 90 Worrigee Street, Nowra; phone (044) 21 5552. The accompanying photo shows Haven staff (back row, L to R) Ron Hansen, Trevor Gordon, Brendan Knowles, Ilsa Hansen, (front row) Judy Hawksworth, David Hawksworth and Norm Day.



Research Board (ATERB) and the Australian Academy of Technological Sciences and Engineering. It recognises outstanding contributions in the field of communications by a young Australian. The award consists of a silver medal and $2500.

STANILITE ELECTRONICS WINS EXPORT AWARD

Stanilite Electronics has been awarded the Telecommunications Exporter of the Year Award from the Australian Electrical and Electronic Manu-facturers' Association Ltd (AEEMA).

This is the second year that Stanilite has won the award. In the year 1994-95, the company achieved considerable export success in countries such as Russia, Argentina, Papua New Guinea, South Africa and Tonga with its wireless telecommunications systems.

Exports exceeded 50% of the company's telecommunications turnover this year, as against 30% last year and orders received in the past year totalled nearly $60 million.

A significant part of Stanilite's success is attributed to the company's commitment to continued research and development, and examining market opportunities abroad.

The Award was presented to Stanilite's Executive Director, Mr Barry Nicholas by the Victorian Minister for Business and Employment, Mr Phil Gude, at the AEEMA Annual Dinner on Tuesday night at the Sheraton Towers SouthGate, Melbourne.

$100M CONTRACT TO VISION CABLES

Philips has awarded contracts worth more than $100M to Vision Cables, the newly formed joint venture between Olex Cables (a division of Pacific Dunlop) and CommScope Inc. of the USA. The contracts are for supply of locally manufactured co-axial cable for Telstra's optical fibre and coaxial broadband network.

Philips is the prime vendor for all the equipment used in this Telstra network.

Deliveries of the cable were planned to commence in November this year, initially with imported cable. A new factory is under construction at Olex Cables Tottenham site, with local production commencing by the end of 1995.

In Sydney the chairman of Philips Electronics, Mr Justus Veeneklaas said that the Vision Cables joint venture, locally headed by Pacific Dunlop's Olex Cables, has made a substantial commitment and investment in local manufacture. He said that Pacific Dunlop's local expertise and commitment clearly showed in the bid for the contracts, where they demonstrated ample evidence of professional project management and the right technology background.

A special feature of the manufacture process for this type of cable is that it requires a draw line of nearly three quarters of a kilometre.

WINNERS OF VIRUS BUSTERS

In the April 1995 issue, we offered 15 free copies of the Virus Buster computer virus protection package as prizes in a telephone quiz competition sponsored by Leprechaun Software. Here are the lucky 15 readers who won the packages:

Colin Leonelli, of Ingham Qld.
Michael Crowe, of Waramanga NSW.
Pablo Machuca, of Rowville Vic.
Sammy Isred, of Traralgon Vic.
Mr Nedic, of Kensington Gardens SA.
Gary Smith, of Moree NSW.
Robert Nietske, of Port Lincoln SA.
Bruce Moe, of Mildura Vic.
David Harrison, of Kilmour Vic.
Jason Walton, of Gumdale Qld.
Mark Ditchum, of Kerang Vic.
Peter Moss, of Dundas Valley NSW.
Peter Alias, of Lalor Vic.
Robert Hunt, of Surry Hills NSW.
Roger Parks, of Townsville Qld.

Our congratulations to these winners, and we trust that they are now experiencing virus free computing.

HP EXPANDS ITS WEB SITE

Hewlett-Packard is now using the World Wide Web to pioneer new ways of communicating with its world wide test and measurement customers.

By offering a separate directory within HP's Web home page, Access HP, HP's Test and Measurement Organisation (TMO) gives its global customers instant access to information about HP test and measurement

HP test and measurement products and services. Some TMO information is available in five languages, with most information expected to be available in multiple languages in the future.

"We are fundamentally changing the way we make information available to our customers," said Nyna Casey, electronic commerce manager for TMO.

"In the past, we have always controlled the flow of information. Our ultimate goal is to give customers complete control over when, where and how they receive information on our products and services."

TMO's first Web offering became available in December 1994, when customers were provided with interactive lists of sales offices, service centres and call centres, a history of HP's test and measurement business, and the ability to order hard copies of the test and measurement product catalog on-line. To date, more than 5000 catalogs have been ordered through this service.

The English version of *Test & Measurement On-Line*, a quarterly newsletter, became the first test and measurement industry newsletter on the Web in February 1995.

TMO product data sheets are the latest addition to the Web. Data sheets are listed by model as well as product type and contain a colour photo, a product summary, a list of feature specifications, and ordering information.

The TMO directory can be accessed via HP's home page at **http://www.tmo.hp.com.**

UNSW BREAKS THIN SOLAR CELL RECORD

Yet another world record in silicon solar cell efficiency for researchers at UNSW has opened up further opportunities for the university's joint venture with Pacific Power to capture the lion's share of the global renewable energy market.

On 22 August, Sandia National Laboratories in New Mexico confirmed that a thin solar cell made at UNSW from crystalline silicon had achieved an efficiency of 21.5%. This shattered the 1994 record of 17%, set by researchers at the Australian National University.

The UNSW record was achieved by Dr Aihua Wang and her husband, Dr Jianhua Zhao, postdoctoral researchers working with the Centre for Photovoltaic Devices and Systems that is directed by Professor Martin Green. Announcing the result, Associate Professor Stuart Wenham, Associate Director of the centre, said: "It is an extraordinary improvement."

"We have been hoping for 20% but this 21.5% result opens up important new dimensions in thin film technology," he said.

"Years ago, crystalline silicon had almost been written off as a thin film candidate. This result, even though obtained with our conventional cell technology, has certainly proved the viability of thin film silicon. This has also vindicated our faith in, and our concentration on, this technology."

To qualify as a 'thin' device the cell had to be less than 50 microns thick — about the thickness of a human hair. The cell tested by Sandia was about 47 microns thick.

Pacific Solar, the $64 million joint venture between Unisearch Ltd and Pacific Power, is committed to developing the technology to produce thin film solar panels with an efficiency of 15% by 2000.

Pacific Power has committed $45 million to Pacific Solar and Unisearch, UNSW's wholly owned R&D, technology transfer and professional education company, has contributed the intellectual property rights generated by the research of Professors Green, Wenham and others.

The techniques used so successfully by Dr Wang and Dr Zhao to produce their great leap in efficiency will all be relevant to the Pacific Solar technology. Foremost among these is 'light trapping'.

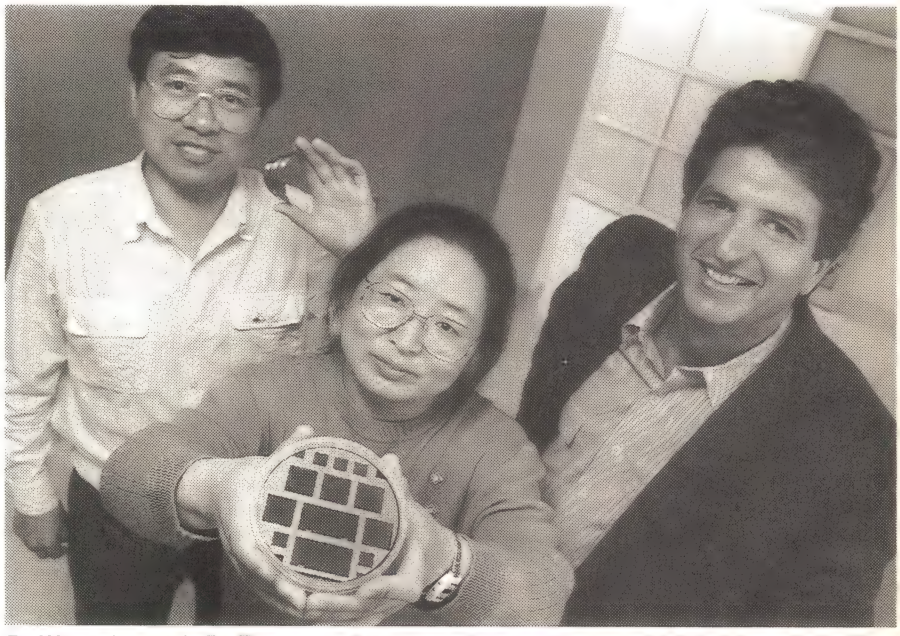
The distance a photon travels through silicon before it dislodges an electron to produce the photo-electric current is more than 47 microns for much sunlight, so that light has to be trapped inside the cell.

This is done by a combination of effects such as coatings and special surface structures that increase the photon's probability of entering the cell and decrease its ability to escape.

Many other physical and electronic effects also have to be juggled, inside the silicon and on its top and lower surfaces to achieve maximum efficiency.

The UNSW team also holds the record for the most efficient conventional silicon solar cell: 24%. At over 400 microns (0.4 millimetres) thick, these cells require nearly 10 times as much silicon as the present 21.5% efficient devices.

The cells being developed for global markets at Pacific Solar will be only 10 to 20 microns thick — thick enough to give high efficiency and thin enough for one litre of silicon to make 500 to 1000 square metres of solar panels.



Dr Wang (centre), Dr Zhao and Professor Green with their 21.5% thin cell. Dr Zhao is bending another cell to show how thin it is. The efficiency leap opens new possibilities.

SKANDIA TO DISTRIBUTE STARNET

Melbourne firm Skandia Electronics has won the exclusive Australasian distribution contract for STARnet, the hardware arm of Rupert Murdoch's Star TV (Hong Kong). The deal gives Skandia exclusive rights to sell and distribute cable TV equipment, satellite receivers and dishes, and other related equipment in Australia, New Zealand, New Guinea and the Pacific Islands.

STARnet is an on-ground network of business partners, including leading manufacturers, prominent distributors and professional dealers and installers throughout Asia. These firms are to develop and manage the distribution of equipment recommended by Star TV for the carriage of its programming. It is claimed that STARnet has the potential to become the largest distribution network of its kind in Asia, offering significant revenue and growth opportunities.

NEW DSTO LASER IS HIGHLY EFFICIENT

Australian defence scientists have developed a high efficiency laser which can outperform all others of its kind and is expected to have broad defence, medical and industrial applications. The new laser, which is a diode pumping laser, has the potential to operate at 50 times the efficiency of conventional lasers and also is more efficient than other new generation diode pumped lasers.

The device, known as a Co-planar Pumped Folded Slab or CPFS laser, has been developed and patented by Dr Jim Richards and Alasdair McInnes of DSTO's Land, Space and Optoelectronics Division.

Dr Richards said that one of the key features of the laser was its versatility, in that it could be configured to emit continuously, or in short pulses of a few nanoseconds long, in the infrared. The laser also can be easily converted into visible or 'eyesafe' wavelengths.

The secret behind the CPFS laser lies in the way in which the laser crystal is pumped by the laser diodes. The use of high powered diode pumping is a relatively new technique and can replace flash or arc lamps that have been used in the past to excite laser crystals.

Because laser diodes emit at only one wavelength, or colour, and most laser crystals only absorb energy in a narrow wavelength band, diode pumping is much more efficient than lamp pumping. The improvement ranges from about 10 times for pulsed systems to about 100 times for continuous systems.

The CPFS laser has outperformed other similar lasers from around the world in terms of pulse width, laser output and efficiency. This applied to lasers operating in pulsed mode at peak output powers from about 10 kilowatts up to 10 megawatts.

Future plans for the technology include scaling to higher powers, use of laser crystals that allow operation in the eyesafe region of the electromagnetic spectrum (1.5 to 1.8 micrometres) and wavelength conversion into the ultraviolet, the visible and the mid-infrared.

PHILIPS, AWA TO DEVELOP 'SCATS 2'

Growth in the export of traffic management systems is one of the outcomes expected to follow a new jointly funded R&D project, according to Justus Veeneklaas, chairman and CEO of Philips Electronics. Together with AWA, Philips has signed an agreement with the NSW Roads & Traffic Authority to anticipate in a project with the aim to produce the next software generation of the Sydney Coordinated Adaptive Traffic System (SCATS).

The RTA first developed its SCATS software in 1974, and since then it has become the most widely used system for multi-intersection road traffic management throughout Australia.

Philips Traffic & Engineering Systems at Moorebank, near Sydney, is the company's international centre of expertise for road traffic management and is currently the largest manufacturer of hardware for the SCATS software. This Philips activity is also a profitable exporter of traffic management systems, and Philips believe that an upgrade of SCATS would considerably increase Australia's competitiveness in this market.

"While the next generation (SCATS 2) is vital for the local utilisation of 'intelligent traffic systems', it is also essential if Australia is to maintain and expand a viable export activity with future traffic management technology," Mr Veeneklaas said in Sydney.

REMOTE TRIAL OF JINDALEE RADAR

Senior representatives of participants in the Jindalee Project have witnessed a milestone demonstration of the ultra-long range radar's capability — remote operation of the Defence Department's 1RSU Over the Horizon Radar (OTHR), north of Alice Springs, from the Jindalee Control Centre (JCC) at RAAF Base Edinburgh, outside Adelaide.

"The visitors to the JCC witnessed tracking of commercial aircraft on north bound routes similar to that currently being done at 1RSU (Radar Surveillance Unit)," said Barry Hibble, Telstra Applied Technologies Jindalee Project Director.

"1RSU was established by the Defence Science and Technology Organisation (DSTO) in 1976 as a stand alone. This is the first time an Over the Horizon Radar radar sensor and control unit has been networked and operated by a remote control unit."

"The entire Jindalee Operational Radar Network with its remote transmit-receive sites in WA and Queensland will be operated out of the JCC. So Defence's cooperation and the RAAF's insight into the importance of enabling Telstra Applied Technologies, as prime contractor, to use 1RSU to speed development, is a big step forward."

Attending the milestone event were AIRCDRE Max Brennan and Mr John Gordon of Defence Jindalee Project Requirements Office; Mr Les Morrison and Mr Barry Hibble of Telstra Applied Technologies; Dr Malcolm Golley of DSTO High Frequency Radar Division HFRD) and Mr Frank Wroe of Digital Equipment Corporation. ❖

NEWS BRIEFS

- ***Megatron Electronics*** has been appointed as the distributor for the German video and audio manufacturer Vivanco.
- Mr Sean von Banchet has been appointed applications manager WA Perth for ***M.B. and K.J. Davidson***.
- The ***1996 Australian Cable & Satellite Television Conference and Exhibition*** will be held at the Sydney Exhibition and Convention Centre at Darling Harbour, February 6-8 1996. For details phone (02) 210 5700.
- Harman International has appointed ***Jands Electronics*** as the exclusive distributor of the dbx brand in Australia.
- Mr Gerald Van Wyngen and Mr Richard Stone have been appointed non-executive directors of ***Stanilite Pacific***.
- Mr William Spelman has been appointed president of ***Delco Electronics Asia/Pacific***.

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

ADC suits DBS

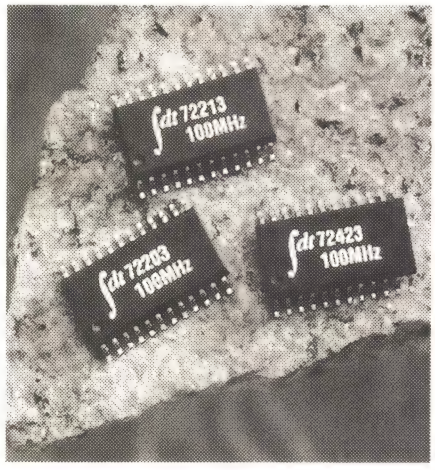
The AD9066 is aimed at the direct broadcast satellite (DBS) market, in which high quality digital compressed video is broadcast to homes directly from satellites. This device is a high performance low cost dual ADC, which is required for quadrature phase shift keying (QPSK) demodulation in the set-top box.

According to David Duff, product manager for the new Analog Devices Communications Division, "DBS is real, and it is a huge opportunity. Much of the world will never see a coax cable; DBS delivers everything cable can without the need for wires. The problem has been the cost and complexity of the receivers; with the AD9066 we've been able to solve that, and our future products will go even further in reducing demodulator cost, through higher integration and system design. This combination of demanding digital communications for consumer applications is something we are ideally positioned to address."

The Communications Division of Analog Devices was formed in May 1994, and is addressing a limited number of high growth segments, concentrating on 'difficult' areas that require a combination of analog, digital and mixed signal expertise.

For further information circle 271 on the reader service coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970.

100MHz serial FIFO



Integrated Device Technology has announced its new family of synchronous serial 1-bit FIFOs, claimed to be 67% faster than similar devices. Offering cost reductions of up to 30% over wider FIFO solutions and depths of up to 512 bits, 1-bit FIFOs provide serial data buffering at extremely high data rates.

"Previously, designers needing to buffer high speed serial data streams had to use four to eight-bit wide FIFOs, thereby wasting board space, and paying for unnecessary data lines", said Eric Cheong, IDT's Asia Pacific sales manager. "IDT is offering 1-bit wide FIFOs that operate at 100MHz, with access times of 7ns, providing a more efficient solution."

Applications for the devices include token ring networks, digital telecommunications systems, teletext transmission systems and modems.

The devices are available in capacities of 64, 256 and 512 bits, and feature programmable flags and output enable on all versions.

Functionality is enhanced through almost full and almost empty flags, which are programmed through a bus which is isolated from the data path. These flags can be individually addressed using separate signal pins.

For further information circle 272 on the reader service coupon or contact GEC Electronics Division, Locked Bag 29, Rydalmere 2116; phone (02) 638 1888.

Amplifier suits variable speed driver

Hewlett-Packard has released a new analog isolation amplifier that is designed to replace open loop Hall effect sensors currently used in variable speed motor control applications.

FET input programmable gain amplifiers

The PGA206 and PGA207 from Burr-Brown are triple op-amp instrumentation amplifiers with digitally selected gains. The PGA206 provides gains of 1, 2, 4 and 8 and the PGA207 has gains of 1, 2, 5, and 10V. Their fast settling time makes the devices suitable for multiple channel data acquisition systems, scientific, laboratory and test instruments, and PC controlled analog input boards.

The amplifiers feature FET inputs that eliminate errors produced by multiplexer series impedance. Their settling time of 3.6us to 0.01% (all gains) allows fast polling of many channels. The bandwidth is 5MHz (G=1) and 600kHz (G=10), and analog inputs are protected up to +/-40V. Key specifications include offset voltage of 1.5mV max (all gains), 0.0002% and 18nV/√Hz noise. Gains are accurate to 0.05% and distortion is 0.005% at 20kHz. The devices are available in 16-pin plastic DIP and SOL-16 surface mount packages, and are specified over the -40°C to +85°C extended industrial temperature range.

For further information circle 274 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 878 2700.



The HCPL-7840 high common mode rejection analog isolation amplifier is used to provide an accurate and isolated representation of current or voltage to microcontroller based control systems. Performance features include 0.20% non-linearity, 1.2mV input offset voltage, minimum 10kV/us common mode rejection at 1000V, 9.9us propagation delay and +/-5% gain tolerance.

The HCPL-7840 and associated components, consisting of a shunt resistor, voltage regulator, output operational amplifier and related discrete components, are all compatible with automatic insertion assembly equipment. The entire circuit takes up approximately 20% less board space than a Hall effect sensor.

All components, with the exception of the shunt resistor, are the same for a wide range of motor sizes. Hall effect devices must be selected for each specific application. For further information circle 275 on the reader service coupon or contact Avnet VSI Electronics, 6-8 Lyon Park Road, North Ryde 2113; phone (02) 878 1299.

3V quad op-amp

The AD824 quad amplifier features a low input current, low power consumption and a rail-to-rail output. It suits a wide range of low voltage applications which demand high values of accuracy and source impedance. Among the amplifier's key specifications are a 12pA input bias current, 16nV/√Hz noise, 1mV offset, and 2MHz bandwidth. CMOS op-amps have comparable bias current but require more power, have lower accuracy, and higher drift.

Typical applications for the AD824 include battery powered medical equipment, photodiode amplifiers and high impedance transducer amplifiers. The amplifier's rail-to-rail output capability makes it well suited for multi-stage filters in single supply systems, while maintaining a high signal to noise ratio.

The device operates with supply voltages of +3 to +/-15V and consumes 600uA per amplifier. Except for minor electrical differences and a superior speed power ratio, the AD824 is a quad version of the dual AD822.

For further information circle 278 on the reader service coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970.

Undervoltage monitor IC

The new ZM33064 undervoltage monitor from Zetex provides a dependable means of detecting supply voltage excursions and gives a reliable reset pulse when the supply voltage falls below a preset threshold.

Operating at threshold of 4.6 volts, the IC suits 5V applications and is available in a choice of PCB space saving packages, including surface mount SOT223 and SO8 styles and a TO92 through hole version.

Over the supply voltage range from one to 4.6V, the monitor holds its output low, giving a direct reset to microprocessor circuits. Should the established 5V supply drop below the threshold, the output will again pull low, resetting the microprocessor until the supply is re-established. To accommodate the possibility of noise and glitches in the supply voltage, the chip monitor also features a comparator circuit with built-in 2mV hysteresis.

The ZM33064 has a current limited open collector output capable of sinking at least 10mA. It consumes a standby current of 135uA.

For further information circle 280 on the reader service coupon or contact GEC Electronics Division, 38 South Street, Rydalmere 2116; phone (02) 638 1888. ❖

SCSI terminator in SSOP package

The REG5601E 18-line SCSI bus terminator from Burr-Brown comes in a 28-lead fine pitch SSOP package. It is electrically equivalent to industry standard '5601' terminators, but requires only half the circuit board area.

Designed for portable and compact designs, it provides an internally regulated 2.9V supply, 110 ohm termination resistors and switches to connect to the SCSI bus.

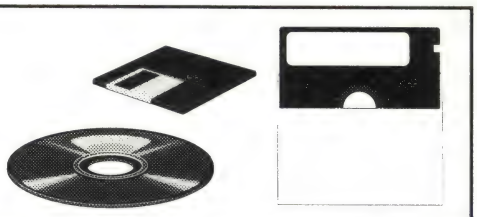
All termination resistors can be disconnected from the bus with a single logic command. Thermal performance of the SSOP package is equivalent to the standard 28-lead SOIC package.

For further information circle 277 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 878 2700.



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SPOTLIGHT ON
SOFTWARE



Spectra Plus V.3.0 — Professional Edition

Even more so than with earlier versions, this edition of Spectra Plus turns a '386 or better PC, running Windows 3.1 or later and with a compatible sound card (preferably 16 bit) into a high performance audio DSO and spectrum analyser. Many aspects of the package have been enhanced, along with the addition of THD measurement utility and a signal generator facility.

by JIM ROWE

A little over a year ago, I reviewed version 2.0 of Spectra Plus and found it very impressive. Developed by Pioneer Hill Software, based in Poulsbo, Washington USA, it did a very commendable job of turning a '386 or better PC into a very useful audio scope and spectrum analyser. A purely software package, it relied on the 16-bit codec in a standard 16-bit sound card to provide the necessary DSP hardware. The only other requirement was that the PC had to have Windows 3.1 or later installed, as Spectra Plus was designed to run under Windows.

Well, it appears that version 2.0 of the package received such a good reception from the market that Pioneer Hill were encouraged to produce an upgrade and enhanced version. The new V3.0 is also designated the 'Professional Edition', indicating that some of the new enhancements are designed to increase its value for professional audio testing.

As with V2.0, the new edition runs on an 80386DX or higher IBM compatible PC with a maths coprocessor, at least 4MB of RAM, 2MB of free hard disk space and a VGA video card/monitor combination ideally running 256 colours. It should be running Windows 3.1 or higher, and also be fitted with a Windows-compatible sound card — a 16-bit card for optimum results, and with the appropriate Windows drivers installed. Spectra Plus V3.0 Professional comes on a single 3.5" HD floppy disk and installs in the usual way using a SETUP.EXE program on the disk.

Like the earlier version, V3.0 uses the sound card to digitise audio signals fed into the card's normal microphone or line inputs. It then uses the computer's CPU and coprocessor to perform all further processing, including calculating a fast Fourier transform (FFT) to derive its components in the frequency domain.

There are again two basic operating modes. You can either operate in real-time mode, processing the incoming audio directly and continuously, or record it on the hard disk as a .WAV file and then replay and post-process it later. Needless to say the time duration of the signals you can record and post-process will depend upon the free space on your hard disk.

In either mode, you again have the choice of a number of signal analysis 'views'. These include the 'Time Series' (signal amplitude vs time) view, as on a DSO; the 'Spectrum' (frequency domain) view, as on a spectrum analyser; the 'Spectrogram' (the spectrum components, with either colours or a gray scale representing amplitude, against time) view; or the '3D Surface' (the spectrum component plots against time, as a cascaded surface) view. This latter view is virtually the same as that used to produce the 'waterfall' spectral decay plots which display the transient performance of speaker enclosures.

With V3.0 there's now also a fifth view: the Phase view, which shows the signal phase plotted against frequency (and mainly used for comparing the phase of the two stereo channels).

Each view is displayed in its own window, and you simply enable the ones you want — although as the processing is fairly processor intensive, things work rather faster if you don't have too many of the views 'open' at once. Each view's window has its own control buttons, allowing you to zoom in on areas of special interest, adjust the display settings and so on. You can also perform measurements on some of the views, simply by clicking the mouse cursor on the plots themselves.

In addition, the program itself provides a range of more 'global' controls for things like sampling rate and format (8/16 bits, mono/stereo); the FFT sample size; the smoothing window (Bartlett, Blackman, Hamming, Hanning, Kaiser, Parzen, triangular or uniform/none); the decimation ratio; and the averaging block size. There's considerably more flexibility here than with V2.0, by the way, with four additional smoothing window options and the decimation ratio option now available. This uses the averaging technique, to achieve low-pass filtering and also lower effective sampling rates than the sound card itself may provide.

Similarly V3.0 gives you a wider selection of FFT sample sizes to choose from, to adjust the spectral line resolution. Instead of the five sizes formerly available, you now have a choice of 10 sizes from 32 to 16,384 (increasing in multiples of two). This together with the decimation ratio facility gives a lot more functional flexibility.

There's also more flexibility than before when it comes to plot scaling. For amplitude you can choose either linear or log scaling, while for frequency there's now a choice of linear, log or 1/3 octave scales. You can also program up to five marker lines, at designated frequencies, and there's also a choice of built-in weighting filters: flat (none), A, B or C curves.

If that's still not enough, you even

have the ability to load in a microphone compensation curve, from a suitably prepared data file.

As you'd expect, Spectra Plus V3.0 can be calibrated in terms of either an absolute or relative input reference level, or alternatively told to calibrate itself against a known input level to the sound card. And once set up in this way, its calibration for any particular setup can be saved as a file, and then any calibration file reloaded to restore that calibration. It's these new features that are clearly designed to make the new version more suitable for the professional user.

Other general setup features of V3.0 include the ability to set up its triggering as a DSO, including parameters like trigger threshold, right or level channel triggering, pre-triggering or post-triggering, and programming the trigger delay (in milliseconds). This could be very handy for testing of speaker systems, using noise impulses; presumably pre-triggering with a delay could be used for setting up the recording and analysis 'window'.

Finally there's a data logging option, allowing measurements to be taken either repetitively at full speed, or periodically at programmable intervals.

Apart from these features of Spectra Plus V3.0 itself, there are also two new and very handy accompanying 'utilities' — a THD (total harmonic distortion) measuring utility, and an audio signal/function generator program which can be run quite separately from Spectra Plus if you wish. In fact with many sound cards it can *only* be run separately...

The THD measurement utility can be called up at any time from the 'Utilities' menu, and presents a window of its own showing a table with the level of both the signal's fundamental and the first six harmonics, together with the calculated THD figure — for both the left and right channels, if you're set up for stereo measurements. You don't seem to be able to print this window out separately, but you *can* save the screen with it to the Windows clipboard, as we did to produce the screen dump shown.

The signal generator utility/program offers a choice of six different waveform options: sinewave tones (up to 10, separately programmable in terms of frequency and amplitude); square wave (adjustable frequency and duty cycle); sawtooth (adjustable frequency and slope polarity); single pulse (adjustable width, and either single shot or adjustable repetition rate); a sweeping sinewave tone (adjustable start and stop frequencies, linear or log sweeping); and a noise signal (either white or pink). Each option is set up by clicking on a 'Details' button, which opens the appropriate dialog box.

Whether or not the signal generator function can be used at the same time as Spectra Plus itself depends upon the sound card fitted to your system. Some do allow the two halves of the card's audio codec to be accessed simultaneously, but most don't. In the latter case when you try to run the signal generator utility when Spectra Plus is running, you get a Windows error message to the effect that 'the sound card is in use by another application'.

By the way, just as with the previous versions of Spectra Plus, the useful dynamic range, signal to noise ratio and THD measurement 'floor' that can be achieved using V3.0 depends largely on the sound card in your computer, and to a lesser extent on the computer itself. The theoretical dynamic range achievable with 16-bit sampling is 96dB, but in practice the range will be somewhat less than this even with the highest performance sound cards.

Trying it out

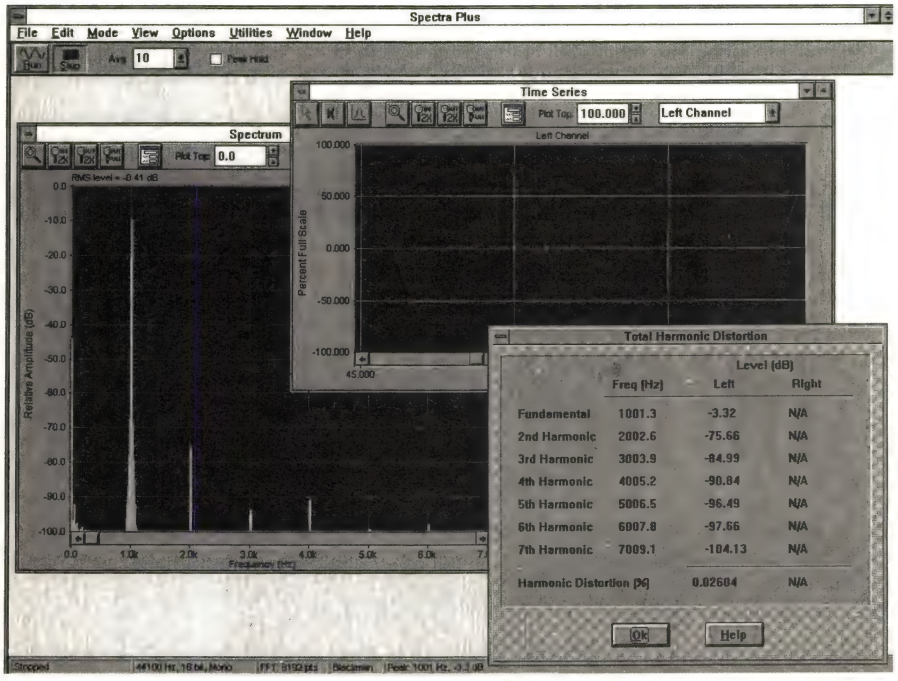
We were kindly loaned a review sample of the new package by ME Technologies, the Australian distributor for Pioneer Hill. To try it out we installed it on a 90MHz Pentium, fitted with a standard 16-bit Sound Blaster card. Installation proved to be fast and trouble free, and we were soon using the package to look at audio signals from various generators and other sources.

Generally speaking we found the new package both easier to use than V2.0, and of course a lot more flexible in terms of its ability to allow 'fine tuning' and optimisation of your signal analysis and display. We also found that on the Pentium, even stereo 16-bit analysis with high FFT sample size was updated very quickly in 'real time' mode. The overall effect was very close to that achieved by a dedicated hardware-based audio DSO and spectrum analyser — except that here we could call up the THD utility, and also get printouts of our plots.

However we did strike a problem when we tried printing out the spectrum plots. Although calling for a printout would make the program go through all of the motions, and a sheet would emerge from the printer, it would contain only the spectrum plot's graticule and labelling — the actual spectrum plot itself wasn't included!

This turns out to be a bug in V3.0, which will only print out correctly if your Windows graphics display mode is set to 256 colours or less. We had ours set up in a hi-res 64K colour mode, for CAD and DTP work, and this caused the

Continued on page 110



A screen dump from Spectra Plus V3.0, showing a spectrum plot on the left, a 'time series' or DSO plot at upper right and the total harmonic distortion summary window at lower right. As you can see, it's very informative.

Special Feature:

MODEMS & DATA COMMS PRODUCTS

Fibre optic RS-232 multiplexer

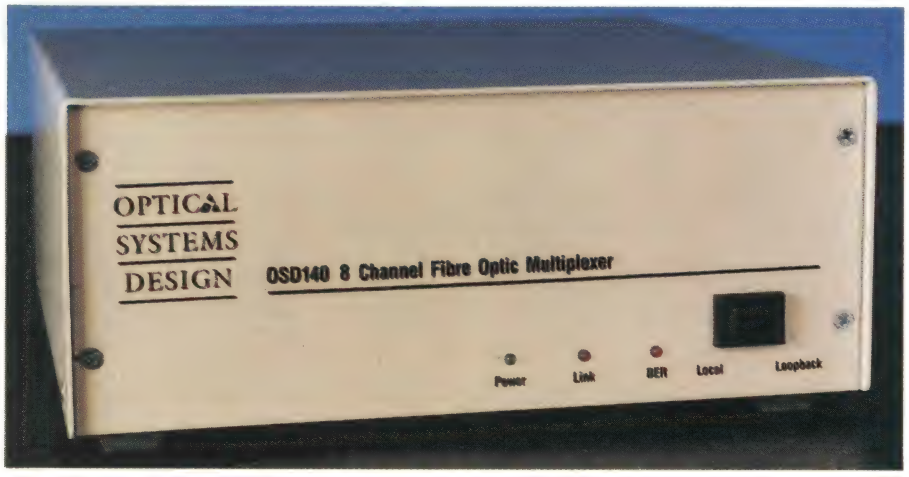
Optical Systems Design has announced the release of two versions of its OSD140 series RS-232 fibre optic multiplexer.

The first version, the OSD140D, transmits eight RS-232 channels, each consisting of a high speed (up to 100kps) data line and two lower speed (up to 20kpb) control lines. Each channel is connected to an external computer, printer, etc., via a 25-pin female D connector.

The second, the OSD140RJ, transmits eight individual high speed channels and sixteen lower speed channels. Each channel is data only and interfaces to external equipment via an RJ12 connector.

Both units have built in bit error rate monitoring, link status and fault finding indicators and will operate over up to 5km of commonly available multi-mode fibres. Units capable of spanning up to 20km of single mode fibre are available on special order.

For further information circle 201 on the reader service coupon or contact Optical Systems Design, 1 Vuko Place, Warriewood 2102; phone (02) 913 8540.



PCMCIA data interface cards

The new Quatech range of PCMCIA interface cards includes communications and data acquisition cards. The communications interface cards include parallel port, asynchronous and synchronous serial communications. The data acquisition modules include digital input/output and analog input/output.

The SPP-100 module is a bi-directional enhanced parallel port configurable to

Remote data logging

Data Electronics has a new tool called the Modem Manager (MM-01), designed to automate the monitoring of remote Datataker data loggers. The device is plugged between the RS-232 serial ports of the Datataker and the modem at the remote site, and is powered by the Datataker or any 6-15V DC source. The Modem Manager has three main functions:

- To store Datataker alarms and ensure they are brought to the user's attention via the user's paging service, host computer or both.
- To ensure that communication is reliable in both directions. It does this by removing the switching transients that typically occur at the beginning and end of modem communication, and by using error correction protocol (if the modem supports this).
- To monitor the Datataker, the modem and itself for operational faults and to alert the user in the event of a fault.

The unit comes in a steel case measuring 130 x 200 x 35mm, with provision to mount the Banksia IG-5500 modem on its lid.

It can store up to 30,000 characters from the Datataker,



and a lithium battery maintains the contents of the alarm memory during reset and loss of power.

For further information circle 202 on the reader service coupon or contact Data Electronics, 7 Seismic Court, Rowville 3178; phone (03) 764 8997.

any base address or available interrupt. The asynchronous serial cards include single and dual channel versions and optional RS-232, RS-422 and RS-485 interfaces. The MPAP-100 is a single channel RS-232 synchronous module supporting asynchronous, monosync, bisync, HDLC and SDLC protocols. It uses the Zilog 85320 serial communications controller IC. The IOP-241 is a 24 line buffered I/O module that allows each line to be configured as an input or output.

The DA8P-12 is an eight channel 12-bit resolution analog output card with eight digital I/O lines. The DAQP-12 and DAQP-16 are 12-bit (100kHz) and 16-bit (50kHz) analog input boards.

These boards are equipped with a 512 sample FIFO ensuring full speed data acquisition under various operating platforms, including DOS and Windows. All cards in the range are Type 2, and come with PCMCIA card services.

For further information circle 210 on the reader service coupon or contact Interworld Electronics and Computer Industries, 1000 Glenhuntly Road, Caulfield South 3162; phone (03) 9563 5011.

Internet package

The 'Internet all in one 144' and the 'Internet all in one 288' packages from Banksia Technology are aimed at people with all levels of Internet experience.

The packages include the 14.4kb/s Banksia MyModem or the 28.8kb/s MyFastModem, and Internet Chameleon V4.5 by NetManage. The Windows based software consists of 18 Internet access tools such as Web browser, E-mail, News, Telnet, Gopher, Archie and FTP.

Included in the package is over $200 of free Internet on-line



READER INFO NO. 21

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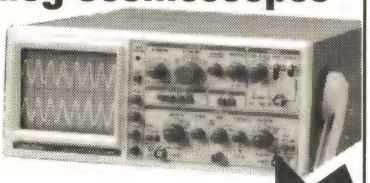
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Record Length/Channel	2k	2k	2k
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Cursor Readout	Yes	Yes	Yes
B Sweep Function	Yes	Yes	Yes
RS-232C Interface	Yes	Yes	Yes

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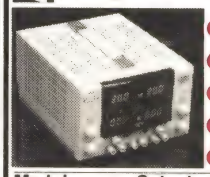
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3303	30V	3A	6306	±30V	6A	5V	from 5A
3601	60V	1A	6603	±60V	3A	5V	3A 5A
3306	30V	6A					
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READER INFO NO. 23

Modems & Data Comms

time, and an Internet address book with over 2000 Web sites. The RRP of the packages are $449 for the 144 package, and $549 for the 288 package.

For further information circle 209 on the reader service coupon or contact Banksia Technology, 25 Sirius Road, Lane Cove 2066; phone (02) 418 6033.

Win95 compatible comms software

QModemPro for Windows 95 offers a range of features, including file transfers, 35 terminal emulations, TAPI and OLE 2.0, all using 32-bit multi-threaded technology. Terminal emulations include ANSI, Ripscrip, VT220, VT320, IBM 3270 and WYSE 30 to 185. The program includes a phone book, a programmable toolbar and graphics file viewer that can display GIF, BMP and JPEG formats. The viewer can be configured to display graphics files during download, and has a zoom facility.

New features include TAPI (telephony API) support, for sharing between multiple applications like Microsoft Exchange Fax system, and MAPI (mail API) support for transferring text, images and files to many of the major electronic mail programs. For further information circle 207 on the reader service coupon or contact Banksia Technology, 25 Sirius Road, Lane Cove 2066; phone (02) 418 6033.

V.34 data/fax modem

The new Ellcon 28.8kb/s V.34 fax/modem from Taiwanese manufacturer Welltronixs has a number of features, including ITU-TV series protocol for data and fax functions, MNP-10 protocol, a line quality monitor and auto sensing/retrain. It also has compression facilities enabled through MNP-5 and ITU-T V.42bis, which is claimed to optimise data throughput up to 200% (MNP-5) or 400% (V.42bis).

The modem also has MNP-4 and ITU-T V.42 error correction and inbuilt

Spotlight on Software

Continued from page 107

problem. Changing temporarily to a 256-colour mode allowed us to get correct printouts.

We contacted Pioneer Hill to find out if this bug has been fixed, and were advised that it has been remedied in the even newer V3.5, which was due to be released in the USA at the end of October.

Apparently V3.5 will also have additional options such as THD+N (THD plus noise), IMD (intermodulation distortion) and SNR (signal to noise ratio) measurements. It will also have the signal generator option fully integrated with Spectra Plus itself. We're told it will also be a true 32-bit program, and capable of almost twice the speed of V3.0.

A few remaining comments about V3.0. The user manual for V2.0 was rather brief and sketchy, but the new manual is considerably better. It even gives some applications examples at the rear, to show how to use the package — and these are fine, although a few more would be even better.

We compared the THD readings obtained using Spectra Plus V3.0 with those produced for the same generator signals using three different distortion meters (including our Sound Technology 1700B system), and the figures compared quite well. Our impression was that with the particular Sound Blaster 16 card we used, Spectra Plus was capable of giving quite accurate readings down to THD levels of around 0.02% — making it quite useful.

About our only remaining remaining criticism is that when you set up Spectra Plus V3.0 for single channel operation (which is faster when you're only looking at a single signal), it can only be set to use the *left* channel of the sound card. We found this frustrating, because in tests with a single low distortion signal fed into both channels, it was clear that our particular sound card had noticeably lower distortion and noise in its *right* channel.

It would therefore be nice if Spectra Plus could be set up to use *either* of the two sound card channels, to allow you to achieve optimum operation for single channel measurements. Perhaps this will have been fixed with V3.5, too. By the way, with the Sound Blaster 16 card, we *couldn't* run the signal generator utility at the same time as Spectra Plus V3.0.

The quoted retail price for Spectra Plus V3.0 Professional is $599 — not cheap, but still much less than you'd have to pay for an audio spectrum analyser/DSO/THD meter of equivalent performance. So if you already have a PC and sound card, it's worth considering.

Further information is available from ME Technologies, of PO Box 50, Dyers Crossing 2429; phone (065) 50 2200, or fax (065) 50 2341. ❖

diagnostic testing, which includes a digital/analog loopback test, power-on self test and PPT test facilities. Other features include NVRAM directory and stored profile, speed buffering, auto-format/speed sensing, auto retrain, V.8, V.13 and V.54 signalling. The fax/modem is Austel approved and has a two year warranty.

For further information circle 208 on the reader service coupon or contact Skandia Electronics, 183 Burwood Road, Hawthorn 3122; phone (03) 9819 2466.

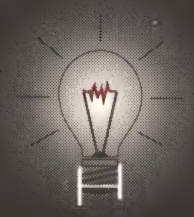
PCMCIA data acquisition cards

IOtech has released two PCMCIA data acquisition cards that feature extensive software and signal conditioning support. The 12-bit Cardaq/ 112B and the 16-bit Cardaq/216B both provide 100kS/s A/D conversion and have eight differential or 16 single-ended analog inputs.

Over 20 expansion and signal conditioning options are available for expanding the cards with up to 256 inputs of any type, including thermocouples, RTDs, strain gauges, accelerometers and 4-20mA current loop. The cards feature a 512 location scan sequencer that allows the user to randomly select the analog channel scan sequence and associated amplifier gain. The interval between the completion of one scan and the start of the next can be programmed from 10us to 100s.

The cards provide three levels of software support: Windows-based setup and acquisition applications, DOS and Windows programming language drivers and VBX (Visual Basic eXtension) custom controls; and drivers for third party icon-based software.

For further information circle 206 on the reader service coupon or contact Scientific Devices, 2 Jacks Road, South Oakleigh, 3167; phone (03) 9579 3622. ❖



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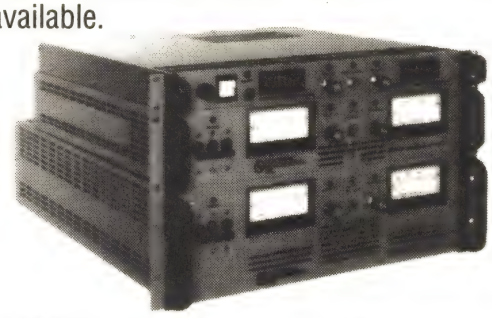
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READER INFO NO. 24

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The EMS Series from Electronic Measurements Inc is a constant current/constant voltage programmable switch-mode DC supply with ratings up to 5kW.

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READER INFO NO. 25

NEW PRODUCTS

Clamp on harmonic meter

The AEMC model 725 harmonic meter is designed to measure power quality directly.

It performs true RMS current and voltage measurements and provides immediate readings of total harmonic distortion, distortion factor, crest factor, and displays the peak of distorted currents and complex voltages. It also gives minimum, maximum, maximum peak and average measurement values that can be recorded over 24 hours to monitor daily fluctuations.

The meter can also measure frequency through the voltage or current functions, at any time. The 10,000 counts LCD built into the instrument is a combination digital/analog unit that displays all functions, modes and data. Outputs are provided so current waveforms can be displayed on an oscilloscope or fed to loggers and recorders.

The meter measures currents up to 1000A RMS (1500A peak) with an accuracy of better than 2% at line frequencies, and up to 600V RMS (1500V peak) with an accuracy of 1.5%. The frequency range for all functions is 0.5Hz to 5kHz except for distortion factor. Crest factor measurement is from 1 to 10 and frequency measurement is possible up to 20kHz.

For further information circle 245 on the reader service coupon or contact Obiat, PO Box 37, Beaconsfield 2014; phone (02) 698 4111.

Hand tools



Scope Laboratories has released the first two hand tools in its CADIK range of semi-professional tools. The tools are electronics technician's side cutters (105mm long) and long nose pliers (115mm).

Both tools have a trade list price of $9.95 excluding tax. Features include spring loaded self-opening jaws, narrow profile jaws, soft cushion grip handles and a robust semi flush-cut jaw design.

For further information circle 243 on the reader service coupon or contact Scope Laboratories, PO Box 63, Niddrie, 3042; phone (03) 9338 1566.

Photocopier is remote controlled

Fuji Xerox has released a new range of photocopiers for the mid-volume market. Called the Vivace range, the range includes the model 675, which features highlight colour editing facilities and a cordless remote control option.

A special feature of the 675 is a colour touch-screen control panel which provides instructions through graphical icons and one-touch operations. Highlight colour editing facilities allow red, blue, green or brown to be added to a black and white document. Other features are automatic job programming, 67 copies per minute (cpm), monthly volume of up to 70,000 copies and double-sided copying.

Other models in the range include the 230 (23 cpm), the 330 and the 336 (both 33 cpm).

Options include 10 bin stapler sorter, automatic document feeder, reduction and enlargement facilities.

For further information circle 242 on the reader service coupon or contact Fuji Xerox Australia, 970 Pacific Highway, Pymble 2073; phone (02) 391 5300.

Switching regulators

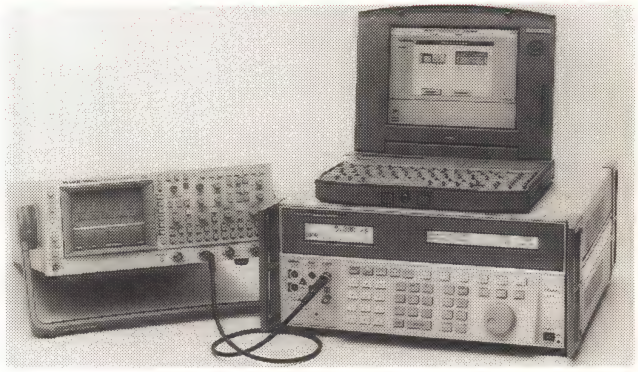
Melcher has released the PSA family of non-isolated switching regulators. Developed from its PSR family, the units feature optimised performance specifications to suit applications where high quality and reliability are important, but where broad input ranges and high temperature specifications are not required.

With outputs from 5V, 5A up to 24V, 2.5A, the units feature input ranges from eight to 60V DC and are suited to distributed bus, battery backed, or sec-

Scope option for Fluke calibrator

Fluke Corporation has released an oscilloscope calibration option for its 5500A multi-product calibrator, which was reviewed in *EA* for August 95.

The 5500SC option is a single circuit board that plugs into a slot inside the 5500A calibrator. The option consists of a levelled sinewave generator with a frequency range up to 250MHz for verifying bandwidth, a squarewave generator for calibrating voltage gain, a fast edge risetime pulse generator (less than 1ns) for checking pulse response, and a timemark generator for verifying horizontal deflection characteristics. The scope option can be purchased with, or retrofitted to a 5500A calibrator.



For further information circle 241 on the reader service coupon or contact Philips Scientific and Industrial, 34 Waterloo Road, North Ryde 2113; phone (02) 888 8222.

ondary switched applications, including alarm systems, ticket machines, displays, instrumentation, light industrial apparatus, and test equipment.

The units are mounted in an aluminium die-cast enclosure, and are fully rated to 50°C. Suitable for both PCB and chassis mount, the units measure 50 x 70mm with a profile of 25mm. An additional DIN rail mounting kit is also available.

For further information circle 248 on the reader service coupon or contact Scientific Devices, 2 Jacks Road, South Oakleigh 3167; phone (03) 9579 3622. ❖

Fax has digital answering machine

Panasonic has launched two new facsimile machines that feature a hands free speakerphone. The New KX-F2500 and KX-F2710 are similar in appearance except for their different colour. Both have a footprint of 362 x 287mm, making them ideal for a small working area.

Thee KX-F2710 includes a digital answering machine, where both the outgoing message and the incoming message are recorded digitally, eliminating the need for cassette tapes. The digital answering machine includes three personal password protected mailboxes. By entering an access code each caller can be directed to the relevant mailbox.

Both machines have an automatic paper cutter, 64-level half tones for excellent photo reproduction, paper curl reduction and a 50 metre paper roll. Standard thermal paper can be used as well as 'super thermal' paper which is a thick, extra white grade of paper that resists fading and accepts highlighting. A paper save mode is also available which reduces the size and therefore cost of incoming documents by 50%.

The faxes have a recommended retail price of $849 for the KX-F2500 and $999 for the KX-F2710.

For further information contact Panasonic's Customer Care Centre on 132 600.



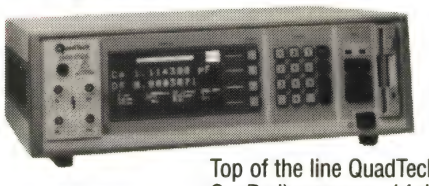
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ELT/LOG/000

Kit review:

EPROM emulator kit

Altronics has recently developed a new EPROM emulator, capable of emulating a wide range of EPROMS — from the 8KB 2764 up to the huge 64KB 27256. We thought that we'd have a look at this kit for the benefit of our readers, and we found it of high quality. Considering the complexity of the circuit, it's also surprisingly simple in construction.

by GRAHAM CATTLEY

An EPROM emulator is a device that is used in place of an EPROM, primarily in the prototyping and software development stages of a system's design. The required code is loaded into the emulator (in this case via the parallel port on a PC), where it is stored in a couple of RAM chips.

Once loaded, the emulator can be used in place of an EPROM in any system, using a cable terminated in a 28-pin DIL plug to physically take the place of the EPROM. By using an emulator in place of an EPROM, one eliminates the time consuming procedure of erasing the EPROM with UV light and then re-programming it each time a change is made to the code.

The Altronics EPROM emulator replaces byte-organised EPROMs with a capacity of 8KB (2764) to 64KB (27512). Note that the emulator is not suitable for EPROM types 2716 and 2732, as the unit is designed for the larger 28-pin EPROMs.

Also, up to four emulators may be connected in parallel 'attack' systems with a bus width of 32 bits — this makes the emulator suitable for use in even the largest of computer systems. To use this EPROM emulator you will need the following:

- A computer (with parallel port)
- Assembler software for writing the required code needed in the EPROM.
- An interconnecting cable (with DB25 female for connection to the EPROM Emulator). Note that a shielded cable is recommended for this purpose.
- A 9 to 20 volt DC plugpack (Altronics M-9102 12V/300mA or similar). Alternatively, under some conditions, power can be derived from the 'target' device.

Circuit overview

The full circuit diagram for the EPROM emulator is a bit to to big to reproduce here as it runs to two pages, but a quick overview of the block diagram may help to put you in the picture.

The emulator's circuit consists of four main blocks:

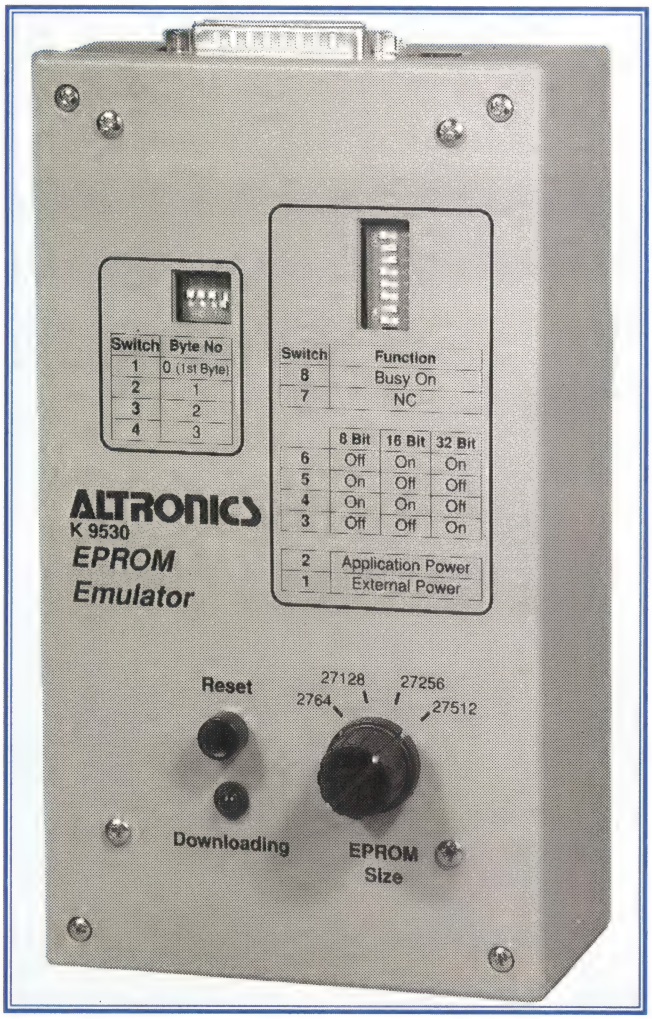
1. A control section: Based around a 74HCT123 and 74HCT74, which serve to ensure the proper bus timing to the Centronics interface and generate a number of internal signals. This section also supplies the RESET signal for the application circuit.
2. A byte selection circuit: Incorporating a 74LS590 and one half of a 74HCT139, which arranges the distribution of the bit data between parallel emulators in 16-bit and 32-bit applications. This part of the circuit is required only if a 16-bit or 32-bit extension is envisaged.
3. A RAM address and load address generator: Consisting of a pair of 74LS590 counters that supplies the RAM addresses during loading, a 74HCT574 latch for intermediate storage of Centronics data, and three 74HCT541 drivers that interface to the EPROM socket in the application circuit.

Depending on the mode of operation of the circuit (loading or emulating), either the counter/latch combination or the EPROM socket interface are in control of the EPROM addresses and data.

4. A power supply, employing a step down switch-mode control IC (MC34063A) for low power dissipation and compact size.

A rather comprehensive description of the circuit is given in the eight page manual, along with over three pages of circuit, timing and wiring diagrams, as well as the usual component overlay diagrams. There is even a troubleshooting guide to help you out if you are experiencing problems.

Since 64K x 8 bit RAMS are not easily obtainable at reasonable prices, the emula-



tor is based on two 32K x 8 RAMs. These offer a total storage capacity of 64KB and allow the emulator to mimic EPROMs up to and including the 27512. When smaller EPROMs are being emulated, address lines A15 (27256), A15/A14 (27128) or A15/A14/A13 (2764) are switched to ground.

Constructing the kit

As you might expect, the circuit for the Emulator is rather complex, and Altronics have decided to go for a double-sided printed circuit board. The board is of a very high quality plated-through-hole construction, fully solder masked on both sides, and sports a silk screened component overlay printed onto the top side of the board.

There are only three components mounted off the board (a LED and two switches), making construction simply a matter of installing the components on the board.

'Installing the components on the board' is all very well to say, but with 14 ICs to solder in place (and two of those weighing in at 28 pins each), not to mention a DB24 plug and 26-way IDC header, you are looking at a fairly long session at the soldering iron. Add to this the fact that most of the ICs are static sensitive, and that the plated-through holes make the removal of any misplaced components difficult, and you'll soon see that this kit is not one for the novice constructor.

On the other hand, the printed circuit board is of a high quality, and the solder mask prevents the odd bridged track common with boards of this density (in some places two tracks run between adjacent pairs of IC pins!), so you shouldn't have too much trouble putting it together.

The manual supplied with the kit only briefly covers the order and placement of the components on the PC board, but there's nothing that a reasonably experienced constructor wouldn't be able to handle (the plated-through holes eliminating both 'feed through' links and the need to solder components on the top side of the board).

The last parts to go onto the board are two sets of DIP switches, which are mounted on wire wrap IC sockets to give them sufficient height to be accessed from the front panel. These sockets are soldered onto the top of the PC board, and a bit of dexterity with the old soldering iron is needed here as the pads are quite close to other components and it would be easy to melt the odd IC or capacitor.

EPROM socket header

The header plug is perhaps the most used (or abused) part of the emulator, having to be plugged and unplugged each time the device is used in a different application. To this end Altronics have come up with a fairly robust design incorporating a small double-sided PCB, two lengths of header pins, a box header and two 28-way IC sockets (one machined, one standard).

These are all soldered together with the two IC sockets held together with some two-part epoxy glue.
This stops the sockets from coming apart when removing them from the target board. A wire is connected to the header board, and this is used to connect (with the supplied IC test clip) to the reset point on the target board. The completed header board is connected to the emulator by a length of IDC cable terminated in a pair of 26-way IDC header sockets.

Putting it together

On the mechanical side of things, the emulator is straightforward in its construction. Four tapped spacers support the main PC board below the pre-punched front panel, which is silk screened to show the function of the various DIP switches.

One point worth mentioning here is that while the manual gives at least some description of how to construct the electronic side of the project, there are virtually no details on how the kit fits together mechanically. However you can work out what goes where on the front panel by looking at the photograph reproduced in the manual.

Since all holes are already cut in both the panel and the box, the whole assembly fits together quite neatly, and after the knobs and screws etc., have been installed, the emulator is ready for use.

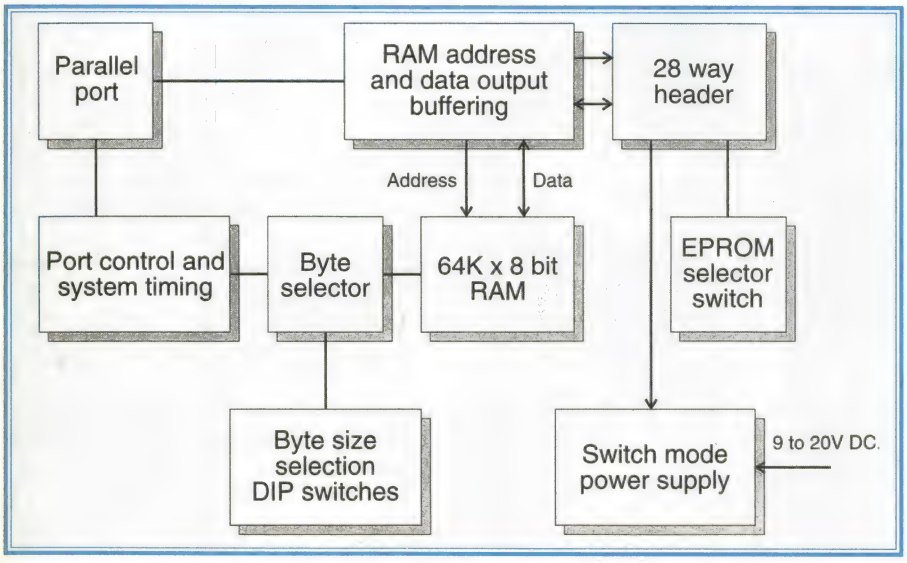
Software

Special software is not strictly required to control the emulator. The emulator RAM can be loaded with the aid of any system utility capable of dumping binary files in binary form via the parallel port.

This means that the EPROM emulator can be used with any virtually computer sporting a Centronics compatible printer port. Also there is no need for special Intel-Hex or Motorola file formats, as the emulator only needs the binary code that would normally be programmed into the EPROM. The file is simply 'downloaded' into the emulator from the computer, using say DOS's COPY command.

Once loaded, the emulator can be used in place of an EPROM, in almost any piece of equipment. Its novel daisy-chain system allows you to use it alone in a small home-brew project, or linking four together in a giant 32 bit mini computer system.

All in all, this is a well presented kit which is relatively easy to put together. While the manual may be lacking in some areas, it certainly makes up for it in others, presenting no real problems to anyone who's built up a few kits before. And as far as EPROM emulators go, you'll end up with a very advanced piece of equipment at a relatively low cost. If you're working with EPROMS, this kit should certainly be of interest. ❖



As the schematic for the emulator runs over two pages, we have produced this block diagram which shows the major functions of the circuit.

New DMMs from Jaycar

Jaycar Electronics has recently added five new handheld DMM models to its range. The new models range from a low cost 'shirt pocket' unit to a high-end professional unit offering true RMS, data storage and recall, dual digital-plus-analog display and Class II safety protection meeting the IEC 1010-1 Category III International Safety Standard.

by Jim Rowe

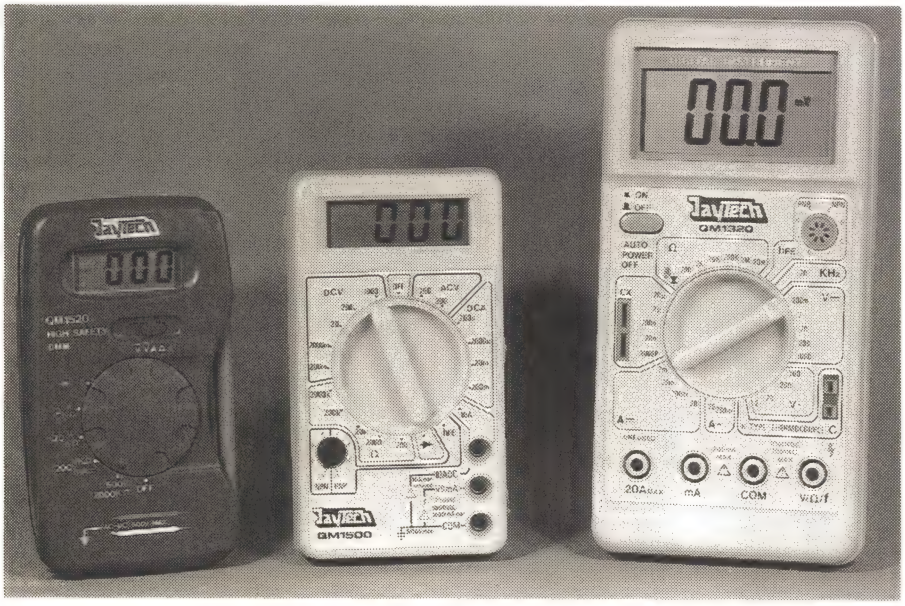
A handheld digital multimeter is a handheld digital multimeter, right? No, there's a lot more to it than that, as a quick perusal of most supplier catalogs will reveal. There's a bewildering array of instruments available, from very basic sub-$30 models right up to rugged professional units costing well over $500 but guaranteed to keep their calibration and safety rating even after dropping onto a concrete floor. Needless to say the permutations and combinations of readout resolution, accuracy, measurement ranges and safety specs are almost endless.

In general, the price you pay is a fairly good indicator of the quality and performance of these instruments. But on the other hand, there's probably no point investing in a fancy high reliability, high accuracy instrument with umpteen ranges, if you only need to measure the odd DC voltage or resistor value. That's why there are so many different models available, to cater for everyone's needs — from the student and casual hobbyist right up to the design engineer and service technician.

Well known electronics retailer Jaycar Electronics has always stocked a broad range of these instruments, but recently expanded its range with five additional models. These include a couple of compact low cost models, two midrange multi-function units and a high-end ruggedised 'professional' model offering AC+DC true RMS measurement, a high degree of measurement flexibility and enhanced operational safety.

QM1500, QM1520

Lowest in cost among the new models is the Jaytech QM-1500, a very compact 3.5-digit (1999 count) unit measuring 125 x 70 x 24mm. The digits on its high contrast LCD panel are 12.5mm high, for good readability, and although there's no auto ranging, the manual selector switch provides a surprisingly large number of measurement modes and ranges for a meter selling for only $29.95 (complete with test leads).



Three of the new Jaycar DMMs: at left is the very compact QM1520 'shirt pocket' model, with the QM1500 model in the centre and the QM1320 on the right. The latter provides capacitance ranges and a frequency range.

There are five DC voltage ranges, for example, covering from 200mV to 200V FSR plus a 1000V FSR range; five DC current ranges, covering from 200uA to 200mA FSR plus a 10A range (using a separate unfused + socket); five resistance ranges, covering from 200Ω to 2MΩ FSR; two AC voltage ranges, covering 200V and 750V FSR; a diode test range, and finally an hFE range for measuring the current gain of small signal bipolar transistors (both NPN and PNP).

The basic accuracy of the QM-1500 is 0.25% of reading +/-2 digits, for the 200mV range, with the higher ranges offering 0.5%. The AC voltage ranges offer 1.2% (+/-10d, 45 - 450Hz); the DC current ranges 1% +/-2d for the three lowest ranges, rising to 2% +/-2d for the 10A range; and the resistance ranges 0.8% +/-2d for the four lowest, rising to 1% +/-2d for the highest range.

Checked in our lab, a sample QM-1500 met these specs comfortably, and on a number of ranges was 'well inside'. Our impression of the meter is that it offers excellent value for money, and would make a good choice for the casual hobbyist or junior experimenter.

The Jaytech QM-1520 is a considerably smaller 'shirt pocket' model, with a case measuring only 120 x 67 x 18mm — including moulded-in cheeks all around, to allow the permanently attached test leads to be wrapped around it for storage, along with their probes. It's again a 3.5-digit (1999 count) LCD readout instrument, in this case with digits 10mm high, and with manual ranging.

Not surprisingly, because of its very compact size, there are a smaller number of measurement modes and ranges. In fact the QM-1520 measures only DC and AC voltage, DC current, resistance and diode/continuity, with the modes selected using a four-position slider and the ranges by a six-position rotary switch. There are four ranges for DC and AC volts, covering from 2V to 200V FSR plus a 500V range; four ranges for resistance, from 2kΩ to 2MΩ FSR, plus

he diode/continuity range; and a single 00mA range for DC current.

The rated accuracy of the QM-1520 s 0.5% +/-1d for the 2V DC range, ris-ng to 0.8% +/-1d for the higher anges; 1.2V +/-10d (45 - 1000Hz) for he AC voltage ranges; 2% +/-2d for he DC current range; and 1% +/-2d for he resistance ranges. Checked in our ab, a sample unit again met these pecs comfortably.

The QM-1520 carries a price of 34.95, which again seems very good alue for money. For those who need o carry a basic DMM around with hem at all times, and hence appreciate n 'ultra compact' model, it should fill he bill nicely.

The QM-1320

Next up in the range of new models s the Jaytech QM-1320, which is still a 3.5-digit (1999 count) meter, but some-what larger than the QM-1500 (174 x 88 x 38mm) and offering both more anges and additional modes. For example there's an additional resis-ance range, measuring to 20M; four AC voltage ranges, measuring from 2V o 700V FSR; enhanced top DC voltage and current ranges, extending to 1000V and 20A respectively; four full AC voltage ranges, measuring from 2V to 700V FSR; and two AC current ranges, with FSR readings of 20mA and 200mA respectively.

As far as additional measurement modes are concerned, the QM-1320 pro-vides for capacitance measurement, in five handy ranges from 2nF to 20uF FSR; a frequency range, reading to 20kHz; and a temperature measurement range (-50 to 1000°C), used in conjunc-tion with a matching type-K thermocou-ple probe. This gives a total of 30 ranges, including those which match the ranges of the QM-1500.

The digits on the QM-1320's LCD readout are 20mm high, and very read-able. In comes in a sturdy case of shock resistant yellow plastic, with a fold-out tilting bail at the rear. It also provides an automatic power-down facility to con-serve the battery, if the rotary switch is not changed for more than 15 minutes.

The rated basic accuracy for DC volt-age measurement is 0.5% of reading +/-1d, rising to 0.8% +/-2d on the 1000V range; for AC voltage, it's 0.8% +/-3d for the three centre ranges, rising to 1.2% +/-3d for the top and bottom ranges; for DC current, 0.8% +/-1d on the two lowest ranges, rising to 1.2% +/-1d on the 200mA range and 2% +/-5d on the 20A range; for AC current, 1.2% +/-3d on the 20mA range, rising to 2% +/-3d on the 200mA range; for resistance measurements, 0.8% +/-1d for the four centre ranges, rising to 0.8% +/-3d on the bottom range and 1% +/-2d on the top range; for capacitance, 2.5% of read-ing +/-5 digits on all ranges; for temper-ature, 0.75% +/-3° below 400°, and 1.5% +/-15°C above 400°C; and for fre-quency, 1% +/-1d.

Checked in our lab, the sample QM1320 again proved to be comfort-ably within specs on all ranges, and in most cases 'well inside' the rated fig-ures. Considering its quoted RRP of $69.95, it therefore seems to provide excellent value for money. For those seeking a good general purpose hand-held DMM with virtually all of the ranges most people are likely to need, it would therefore seem a good choice. Incidentally the matching type-K ther-mocouple temperature probe (QM-1282) costs only $12.95.

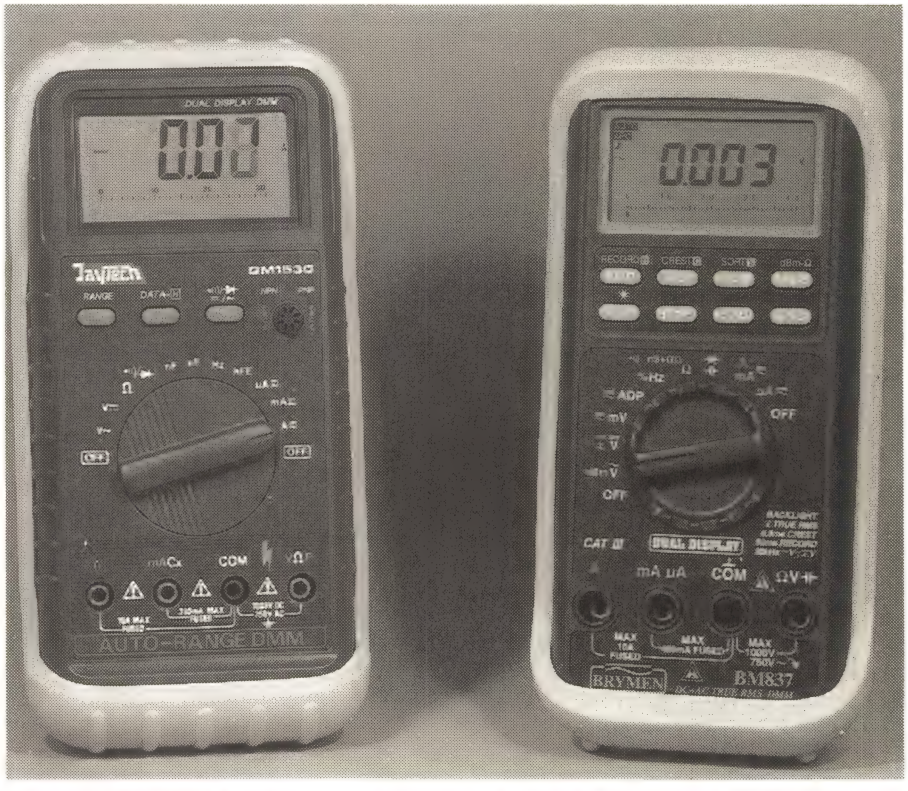
The QM-1530

The fourth of the new models is the Jaytech QM-1530, a 3.75-digit (3260 count) LCD readout unit with dual dis-play, auto ranging and data hold func-tions. This model is a little larger than the QM-1320, measuring 188 x 90 x 32mm; its sturdy case is fitted with a fold-out tilting bail at the rear, and is also compatible with Jaycar's protective 'Universal Rubber Holster' (shown fit-ted in the photo).

The QM-1530's high contrast LCD display has digits 16.5mm high, with a fast response 32-segment analog 'bar graph' display along the bottom to make circuit adjustment easier. (The analog bar graph is updated 12.5 times per sec-ond, whereas the digital readout is updated only twice per second.) The meter is designed and tested to conform to IEC safety specification 348.

The measurement functions provided by the QM-1530 include DC and AC voltage, DC and AC current, resistance, capacitance, frequency, small signal bipolar transistor hFE and diode/continu-ity test. According to the manual, it has five DCV ranges covering from 326mV to 1000V FSR; four ACV ranges cover-ing from 3.26V to 750V FSR; five DC current ranges, covering from 326uA to 10A FSR; five AC current ranges, cov-ering the same as those for DC; six resistance ranges, covering from 326Ω to 32.6MΩ FSR; two capacitance ranges, of 326nF and 32.6uF FSR; and two frequency ranges, of 32.6kHz and 200kHz FSR.

Rated basic accuracy for the QM-1530 on the three middle DC voltage



The new QM1530 (left) provides auto-ranging and a bar-graph analog display as well as the digital display, while the Brymen BM837 (right) builds on these facilities even further with true RMS measurements and 4.5 digit display.

New DMMs from Jaycar

ranges is 0.3% of reading +/-2d, rising to 0.5% +/-2d on the top and bottom ranges; for AC voltage, it's 0.8% +/-3d on all ranges; for DC current, 1.2% +/-3d on the four lower ranges and 2% +/-5d on the 10A range; for AC current, 1.5% +/-5d on the four lower ranges, and 3% +/-7d on the 10A range; for resistance, 0.8% +/-1d for the four middle ranges, 0.8% +/-3d on the bottom range and 1.2% +/-2d on the top range; for capacitance, 3% +/-5d on both ranges; and for frequency, 1.2% +/-3d on the lower range and 2.5% +/-3d on the upper range.

Tested in our lab, the sample QM-1530 again turned out to be comfortably within spec on all ranges, and well inside the limits on most. The auto ranging performs well, and only occasionally did we need to 'force it to change down' with the over-ride button. The data hold button also operated reliably.

For the quoted RRP of $79.95, the QM-1530 therefore seems to represent good value for money, especially for the more professional user who wants a meter that is fast and efficient in addition to offering many measurement ranges and rugged construction.

The Brymen BM837

Last but by no means least of the new models from Jaycar is the Brymen BM837 (QM-1460), a professional 4.75-digit (40,000 count) unit which offers DC+AC true RMS measurements over a wide bandwidth (20kHz), selectable backlighting for the LCD display, dual digital plus analog display, data storage and recall, relative zero and change measurement modes, 50Hz or 60Hz selectable noise filtering, max/min/average calculation, dBm and dB relative reading and many other features.

It also gives the option of selecting either fast response (five/second) 3.75-digit (4000 count) resolution, or slower response (1.25/s) full 4.75-digit resolution, to optimise it for different applications.

Another important feature is that the meter is designed and manufactured to conform to Protection Class II of International Safety Standard IEC1010-1, installation category III.

The high impact resistant gasket-sealed case of the BM837 measures 185 x 86 x 45mm overall, and comes with its own rubber holster and integral tilting bail/belt clip. Its main digital readout has digits 11mm high, with those of the smaller secondary readout (9999 count) measuring around 4.5mm high and a 43-segment analog bar graph display along the bottom.

The LCD panel used has slightly lower contrast than some of the other models, but is still very readable.

Offering a choice of manual or auto ranging in many modes, the BM837 provides for measurement of DC, AC (true RMS) and DC+AC (true RMS) voltages; DC and AC (true RMS) current; resistance; conductance; capacitance; frequency; extended voltage and current measurements, using external adaptors; continuity and diode testing; and of course derived measurements such as duty cycle, dBm and relative dB, for wideband AC voltage measurements.

There are six ranges for DC voltage, covering from 40mV to 1000V FSR; five for AC true RMS voltage, covering from 400mV to 750V FSR; four for AC+DC true RMS voltage, covering from 4V to 750V FSR; six for DC current, from 400uA to 10A FSR (20A for 30 seconds max); six for AC current true RMS, covering the same range as for DC current; six for resistance, covering from 40Ω to 40MΩ FSR; one for conductance, measuring to 400nS FSR; eight for capacitance, covering from 4nF to 40mF (40,000uF) FSR; six main frequency ranges, covering from 99.999Hz to 4MHz FSR, and four secondary frequency ranges, covering from 99.99Hz to 20kHz FSR; a dBm mode measuring from -11.76dBm to +54.25dBm (600Ω), with 20 selectable reference impedances (from 4Ω to 1200Ω); and a choice of either DC or AC measuring adaptor ranges, offering 10 counts per mV in each case.

The rated basic accuracy of the BM837 for the 400mV and higher DC voltage ranges is 0.08% +/-1d, rising to 0.5% +/-6d on the 40mV range. For AC voltage, it's 0.5% +/-3d on all ranges at 50/60Hz, rising to 0.8% +/-4d for the range 40Hz - 1kHz on all except the 750V range, where it becomes 1% +/-4d for the same range. From 1kHz to 5kHz it rises to 1% +/-4d for the lower ranges and 3% +/-6d for the top range, while from 5kHz to 20kHz it rises to 1.8% +/-6d on all except the top range, which is unspecified. The (AC+DC) figures are only slightly poorer than these.

For DC current, the accuracy ranges from 0.2% +/-2d on the 4mA range up to 0.8% +/-6d on the 4A range. The AC current figures vary from 0.8% +/-3d for the 4mA, 400mA and 10A ranges at 50/60Hz, up to 1.5% +/-4d for virtually all ranges up to 3kHz.

The figures for resistance measurement vary from 0.15% +/-2d on the 400Ω - 400kΩ ranges, to 1.5% +/-5d on the 40MΩ range. That for the conductance range is 0.7% +/-5d, while the figures for capacitance vary from 0.8% +/-3d on the 4uF range up to 4% +/-10d on the 4nF range, and 4% +/-5d on the 40,000uF range.

The specified accuracy for dBm measurements between 40Hz and 20kHz is 0.25dB +/-2d. That for frequency measurements is .002% +/-3d, on all ranges.

Tested in our lab, the sample BM837 proved to be well within these figures on all ranges we were equipped to verify. It also proved to be very flexible in use, providing just about every facility that most professional users would need for day-to-day measurements. It's clearly a high-end handheld DMM, and at the quoted RRP of $399 it seems to compare very favourably with leading-brand models costing considerably more.

All told then, the new Jaycar DMM models all appear to be well made products, and worth considering by any user needing an instrument at the functional levels concerned.

Further information is available from any Jaycar Electronics store, or from the head office at 8-10 Leeds Street, Rhodes 2138; phone (02) 743 5222 or fax (02) 743 2066. ❖

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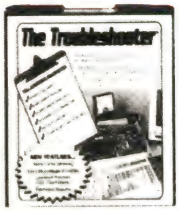
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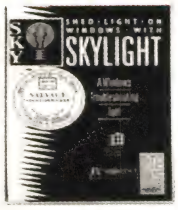
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Product Review:

Sony's 15SF digital multi-scan monitor

Makers of computer monitors continue to improve the quality of their products, achieving new levels of image quality and automatic setting-up for different graphics display modes, in addition to meeting ever-tightening specs for external radiation and energy efficiency. Sony's new CPD-15SF1 monitor is a good example of the current state of the art.

by JIM ROWE

Spare a thought for the designers of computer monitors, who are nowadays being asked to achieve more and more, with less and less. Users want monitors with bigger screens, better graphics resolution and with the ability to display an ever-increasing range of graphics display modes. They also want a monitor that is 'smart' enough to adjust itself automatically whenever the mode changes, without human intervention.

At the same time, more and more people have become aware that ambient fields and radiation pose a potential health risk. And since the traditional CRT-based monitor is the part of a computer that both (a) tends to produce most stray radiation; and (b) is generally closest to the user, it's this same component that is receiving the most attention in terms of tightening radiation specs.

If that wasn't enough, there's also mounting pressure to save energy, by reducing the power consumption of computer equipment — and of all the components in a typical computer, it's (you guessed it) the CRT-based monitor that tends to consume the most power. So monitor designers are being expected to achieve all of the above, while still coming up with monitors that use less energy...

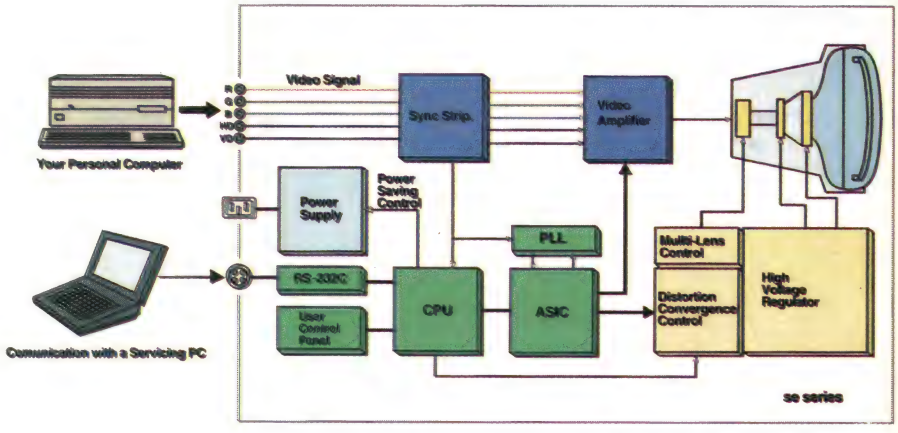
Fortunately, monitor designers have been able to achieve these goals, as their latest models testify. And Sony's new CPD-15SF1 'Digital Multi-scan' model is a good example of what they've been able to achieve, for an impressively low price.

First, let's look at image quality. As the name suggests, the 15SF has a nominal 15" diagonal screen. It uses the latest version of Sony's proprietary Trinitron tube technology, which controls the triple electron beams by means of an 'aperture grille' with an array of unbroken vertical metal strips behind the phosphor screen, rather than a traditional 'shadow mask' plate with an array of round holes. In this case the aperture grille strips are spaced at a pitch of 0.25mm, with slits only 0.056mm wide, giving exceptionally fine horizontal resolution.

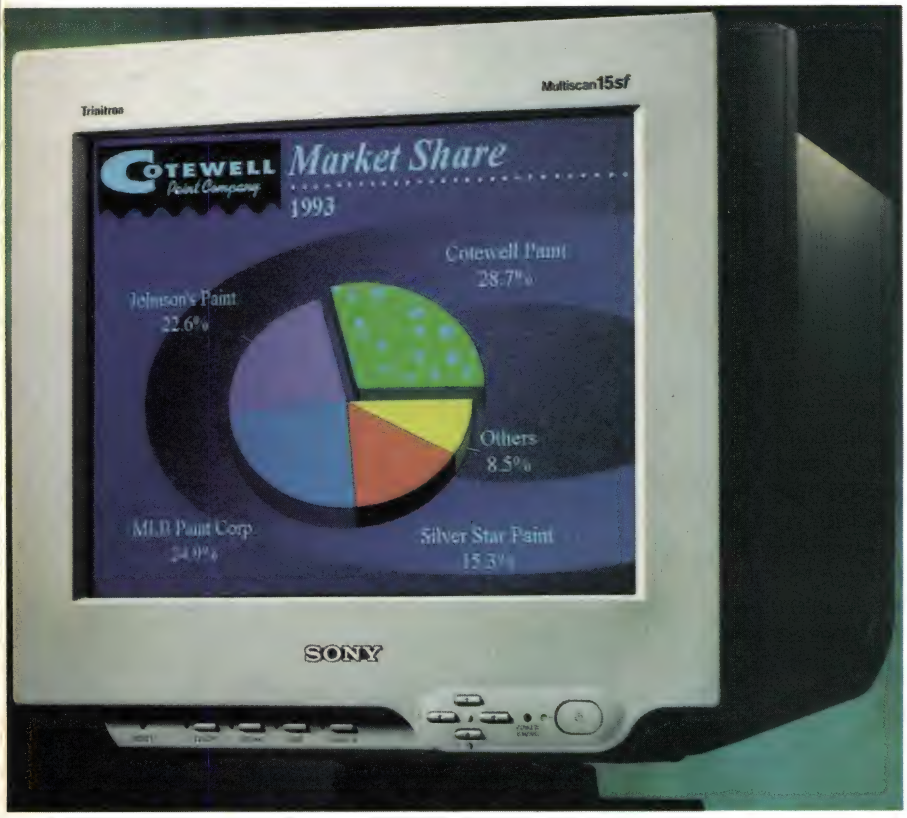
The unbroken vertical strips, in conjunction with matching unbroken phosphor stripes on the screen, also tend to allow higher electron beam efficiency, and higher brightness for a given beam current (read power dissipation).

Because of its aperture grille system, the Trinitron CRT has always provided a cylindrical screen (i.e., one that is flat vertically) rather than the double-radius spherical screen of shadow-mask tubes. The latest version of the Trinitron used in the 15SF goes one further, with the radius of horizontal curvature increased to the point where the screen is now almost flat — the horizontal edges are less than 10mm 'behind' the centre. At the same time the use of a 'dynamic quadrapole' electron gun lens system and dynamic focussing has improved the beam focussing and convergence at the corners of the screen, allowing a virtually distortion-free image right out to the corners of the 284 x 213mm effective screen.

Of course a bright, sharp image isn't enough nowadays. The monitor needs to be able to cope with a huge range of graphics display modes, with umpteen different vertical and horizontal scan frequency combinations. Like most of the latest breed of monitors, the 15SF achieves this by taking the original



Taken from the Sony monitor sales brochure, this diagram shows the complexity of a modern digital multi-scan monitor like the 15SF. The internal CPU and ASIC can be configured using an external servicing PC.



analog 'multi-scan' concept and replacing it with a fully digital system: an inbuilt microprocessor analyses the incoming video signals, identifies the vertical and horizontal scan rates and locks its sweep circuits to them. Then it programs an ASIC (application specific IC) to achieve the optimum image geometry and linearity for that mode. In addition, it memorises any changes to image size and position keyed in by the user, and automatically recalls this setup every time that particular graphics mode occurs in the future.

Additional 'smart' features provided by the 15SF include a raster rotation control, to compensate for the image rotation effects of the Earth's magnetic field, and the ability to adjust image colour temperature between 5000K and 9300K, to suit different applications. There's also an RS-232C port, so the monitor's digital control system can be set up remotely and/or automatically using an external computer.

How about energy efficiency? Well, the 15SF conforms not only to the USA Environmental Protection Agency's 'Energy Star' Power Management guidelines, but also to those of the tougher Swedish TCO92 'NUTEK' recommendations.

It implements the DPMS (Display Power Management Signalling) system, with its hierarchy of three successive power saving modes: 'Screen Saver' with 20% power reduction, 'Suspend' with 90% reduction and 'Active Off' with 93% reduction (only 7% of full power dissipation). So when used with a DPMS-compliant computer and video card, the monitor can provide a high degree of energy saving when the computer isn't actually in use.

Finally, there's the matter of controlling external radiation. Like most of the latest monitors the 15SF fully meets the internationally accepted MPR-II standards for ELF and VLF electromagnetic radiation, which means that it's as safe as the current state of knowledge demands.

Trying one out

The Computer Products division of Sony Australia kindly lent us a sample of the 15SF for a while, so we could try it out with a range of computers, graphics cards and software packages.

We found it very easy to set up for optimum performance in each situation. There are no rotary controls; a set of four main pushbuttons in a 'diamond' configuration near the on-off switch are used for the usual brightness and contrast adjustments, while four further buttons to the left are used to enter the monitor's preset adjustment modes: labelled CENTER, SIZE, GEOM and COLOR moving from right to left (note the US spellings).

As you'd expect, CENTER mode is used for fine tuning of image position vertically and horizontally on the screen, while SIZE mode is for fine tuning its height and width. GEOM mode allows you to achieve straight sides to the image, by balancing between pincushion and bowing, and also to square up the image in terms of true vertical and horizontal, by balancing raster rotation due to the earth's magnetic field. And finally COLOR mode allows you to set the image colour temperature to 5000K, 9300K or virtually any selected level between these limits.

In each case the four main 'diamond' buttons are used to make the adjustments within each mode. A timer system allows you to make the adjustments for about 15 seconds after any mode button is pressed, with one of four LEDs showing which mode is currently active. When all of the mode LEDs are dark, the current settings are stored in memory for that display mode, and the main buttons resume their normal brightness/contrast roles.

All of these controls are on the front of the monitor for maximum convenience, by the way.

We found the image quality of the 15SF to be of a very high standard. Convergence, colour purity and focusing were excellent at all brightness levels, and video definition was fine at all of the graphics resolution modes we tried. We especially like the ability to go to refresh rates as high as 80Hz for 1024x768 mode (assuming your video card can do it), as the higher refresh rates give almost no perceptible flicker and are very easy on the eyes for long sessions.

In short, then, we found the Sony CPD-15SF1 Digital Multi-scan monitor an excellent performer, and a very good example of modern 'user and environmentally friendly' monitor technology. At the quoted RRP of $857 (plus 22% sales tax if applicable) it seems to represent quite good value for money, too.

Further information on the Sony range of monitors, and on the location of dealers is available from the Computer Products Division of Sony (Australia) at 33-39 Talavera Road, North Ryde 2113; phone (02) 887 6667. ❖

Silicon Valley NEWSLETTER



China's chip market 'set to explode'

Economic growth and an improved standard of living are key buzzwords in China's latest five-year economic program, the ninth such program. Much of that improvement in living conditions will translate in the broad availability of basic consumer electronics such as TVs, stereos, and household appliances, but also business equipment such as telephones, faxes, and personal computers. The plan even details a roadmap for China to become a major force in the electronics revolution, through heavy investments in semiconductor production.

Wang Guoguang, deputy director of the Ministry of Electronics Industry said during his keynote address at the recent Semicon/China '95 trade show in Shanghai that the country's program "will create tremendous market demand for semiconductor equipment and materials."

The semiconductor roadmap calls for two new 0.8 micron-based 6" fabs, and at least three more 8" wafer fabs capable of producing chips with 0.5 micron features. The largest of these fabs will be built by Huajing Microelectronics in the city of Wuxi. When it opens in 1997, the 6" wafer plant will produce 10,000 wafers a month featuring 0.8 to 1.0 micron process technology. A second fab from Advanced Semiconductor Manufacturing Corp. (ASMC) is to be completed in 1996, and will also produce some 10,000 6" wafers a month using 0.8 micron technology.

The five-year plan projects don't even include the chip fabs that Motorola, Shanghai NEC, Shanghai Belling Microelectronics, Intel, AMD and Hyundai are planning to build in the next two years. Another $400 million worth of chip assembly operation projects are also underway by eight foreign companies. All of the planned chip production expansion will mean the Chinese chip equipment market could grow a whopping 50% from around US$300 million this year to $450 million in 1996, and close to a billion dollars by the end of the decade.





Two photos taken by our correspondent at the recent Semicon/China '95 show in Shanghai. At top is the Lam Research stand, one of the few to set up a fully functional display. Most exhibitors settled for a table top stand, like that of Metron Semiconductors Asia, visible in the lower photo.

It will also vastly boost China's chip output. In 1992, China produced a scant 120 million chips using mostly three and four micron process technology implemented on 3" and 4" wafers. By the year 2000, production is expected to swell to 700 million chips featuring 0.5 micron technology and produced on 6" and 8" wafer lines.

Samsung heads for Austin, Texas

South Korean DRAM memory chip maker Samsung may now build its first US computer chip factory near Austin, Texas. Earlier it had been announced the facility would be built at a site in Hillsboro, Oregon where Intel and Fujitsu Microelectronics also operate chip manufacturing plants.

Austin has become a centre of chip production. Advanced Micro Devices and Texas Instruments have major operations there. The city is also home to Sematech, a government-industry consortium researching advanced methods to make chips.

The new Samsung facility will cost an estimated US$1.5 billion to build and equip. It will employ up to 1600 people when production of 64-megabit DRAMs begins in 1997.

Samsung, after entering the semiconductor business in 1980, became the world's largest maker of computer memory chips in 1993. It has considered building a factory in the United States for nearly two years.

The only major concern Samsung had regarding locating the plant in Texas was water supply. The Samsung plant, like most chip facilities, will require enormous amounts of water — up to three million gallons a day. Austin officials have assured Samsung the city can meet demand up to 10 million gallons a day if the company chooses to expand.

Samsung will also benefit from a package of generous tax breaks Austin offered the company. Although the Oregon site offered greater financial incentives, Samsung apparently was concerned about the long approval process it could face there in the face of local opposition to large tax breaks —

following the recent granting of some US$62 million in tax credits to Intel.

Seagate & Conner merge operations

In another Silicon Valley high-tech megamerger, Seagate Technology has reached an agreement to merge with competitor Conner Peripherals, in a stock deal valued at US$1.1 billion. Seagate chairman Alan Shugart said the proposed merger was part of Seagate's strategy to expand.

"We've been telling everybody for a long time our objective is to grow, both in revenues and profits. We think there will be a big consolidation in the entire computer industry and not just disk drives and peripherals", Shugart said, adding that Conner's interest in disk drives, tape drives, software and media products will complement Seagate's own portfolio of disk drives.

"This really adds a lot to Seagate's bag of tricks if this thing goes through", he said. "Obviously we wouldn't be doing this deal if we didn't think we can grow revenues and profits."

Industry analysts said the acquisition would give the combined company a 35% share of the world disk drive market, making it the world's largest supplier.

Intel plant for Israel, Sumitomo in Phoenix

Intel has announced plans for yet another mega chip production plant, this time in Israel, while silicon wafer maker Sumitomo moved to ease fears of future wafer shortages with plans for a major new facility in the United States.

Intel said it was very close to signing an agreement with the Israeli government to invest US$1.5 billion in a new chip production facility in southern Israel. This would be the largest investment by a foreign company in Israel. Intel plans to build the facility near Kiryat Gat, in the Negev desert. Intel already has a production plant in Jerusalem and a research and development facility in Haifa.

Final details of the agreement, involving the size of a government grant, are expected to be resolved soon. According to Israel's law for the encouragement of capital investment in developing areas, Intel would be entitled to a 38% grant, or about US$540 million.

Such a large sum, however, would strain the Israeli government budget at a time it is seeking to hold down expenses to reduce the deficit. Reportedly, the government has offered Intel that it would receive the entire sum it is entitled to, but it would be spread out over 10 years.

Meanwhile, in an effort to ensure there will be enough silicon wafers to meet the expected huge demand for wafers over the next two years as scores of new fabs come on line, Sumitomo Sitix of Japan is building a US$400 million silicon wafer plant in Phoenix, Arizona.

Construction was scheduled to start in November and finish by the end of next year. The plant, Sumitomo's fourth in the United States, will make 200,000 8" wafers per month. Shipments will begin in September 1997 and will go to semiconductor makers such as Intel and Motorola, the company said.

Start-up launches 3D graphics chip

One of the hottest emerging markets in the PC field is that of chips and add-on boards that turn an ordinary PC into a 3D workstation.

Now a promising new Silicon Valley start-up company, Rendition of Mountain View, has joined the fray by announcing the development of a chip it says will turn a personal computer into a '3D graphics speed demon'.

Rendition said PCs with its Verite 3D chips won't be available until the first quarter of 1996. Rendition has signed up Number Nine, a board manufacturer in Cambridge, Massachusetts, to produce the boards, while the chip itself will be manufactured by Mitsubishi. But the company promised that the wait will be worth it, as it claims to have come up with a no-compromise, full-featured 3D technology that will be available in add-on boards that cost less than US$300.

HP rescues Convex for $150 million

Hewlett-Packard has agreed to help out Convex Computer, the financially struggling supplier of 'mini-supercomputers'. HP will pay US$150 million for the Richardson, Texas-based company whose ultra-fast machines are used in complex scientific and engineering calculations.

Four years ago, Convex was the leading manufacturer of mini supercomputers, but has suffered from competition from a new generation of low-cost computer workstations. In early 1992, Convex switched to using processors and software from Palo Alto-based HP's workstation group, but it wasn't able to make the transition fast enough to avoid heavy losses.

Sales at Convex tumbled from US$232 million in 1992 to $193 million in 1993 and $144 million in 1994. After earning US$2.8 million in 1992, the company posted losses of $64 million in 1993 and $61 million in 1994. Sales in the first half of 1995 have edged up slightly, to $70 million from $63 million in the same period of 1994, while losses narrowed to $15 million from $48 million.

The continued flow of red ink has scared away many potential customers, who were reluctant to buy expensive computer systems from a company that didn't appear to have much of a future. "We've really been suffering from the fear, uncertainty and doubt factor", said Robert Paluck, Convex chairman and chief executive officer. Analysts said HP should be able to immediately eliminate these concerns by taking over Convex.

Oracle chief plans US$500 PC device

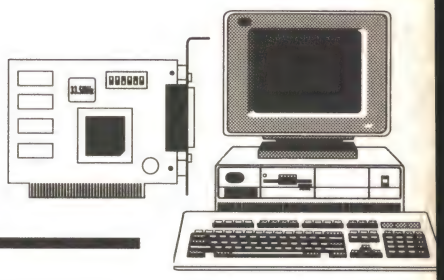
Oracle chairman Lawrence Ellison has announced that his firm is developing a new kind of network-based personal computer, one that would run powerful software but cost only around $500. Oracle is developing the system in cooperation with an unnamed computer manufacturer.

"This will be a powerful device offering fast access to the World Wide Web along with electronic mail and multimedia capabilities", Ellison told analysts. "Users will be able to do a lot of the common functions that are done with the PC, a lot more cost effectively, and a lot more reliably, and they'll do some things you can't do with a PC at all."

Oracle will be demonstrating the machine early in 1996. "The computer will be electronically linked to the Internet and will not have an individual data storage device such as a hard disk, floppy disk or CD-ROM drive," Ellision said. "The network computers will have two cords, one you plug into the wall for power, and the other you plug into the wall for data bits."

The operating system is under development at Oracle in the company's clear bid to become the Microsoft of networked PCs. "If we could make $10, or $20, or even $50 per appliance, we'd be thrilled", Ellison said, adding that PCs costs a business about US$4000 to $5000 a year in maintenance and depreciation. "These things are enormously expensive and they are enormously complicated." ❖

Computer News and New Products



68HC705 development system

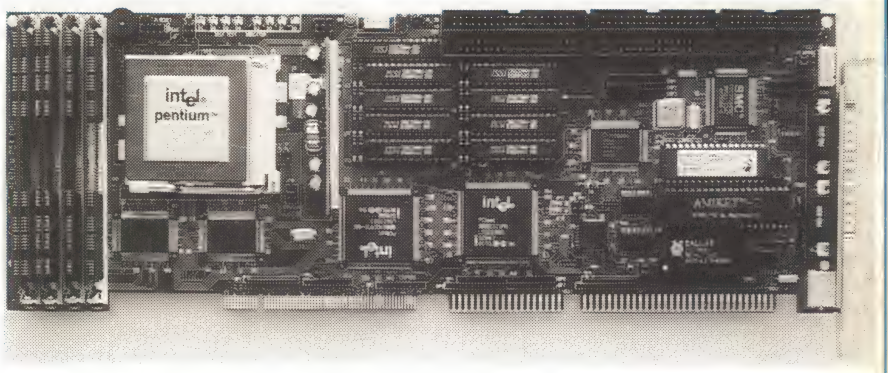
The Oztechnics 68HC705 development system is a low cost PC based development system for Motorola's range of 68705 microcontrollers. The system includes all the tools needed to develop both hardware and software applications.

The system consists of a programmer board, in-circuit simulator, cross assembler, programming software, disassembler, demonstration routines and a user manual. The programmer board connects to the parallel or serial port (optional) of an IBM compatible PC.

The text editor is the main working environment for developing code, and includes all the usual text editing features. It also has special features including on-line details of various microcontrollers.

The simulator is used to test and debug 6805 code on the PC before burning it into the microcontroller's EPROM. Debugging features include single stepping, undo instruction step, running to breakpoints and auto loading of I/O ports.

For further information circle 166 on the reader service coupon or contact Oztronics, PO Box 38, Illawong 2234; phone (02) 541 0310.



150MHz Pentium on a card

The new PCA-6157 from Advantech is a Pentium all-in-one CPU card. The industrial grade card combines an Intel Pentium P54C CPU (up to 150MHz) with the Triton chipset. It has both PCI and ISA expansion edge connectors, and can operate on either traditional ISA or PCI/ISA passive backplanes.

As well as the Pentium's 16KB on-chip cache memory, the card adds an extra 256/512KB of L2 memory write back cache. The card supports up to 128MB of DRAM and includes a PCI SCSI-2 controller and two PCI EIDE interfaces that connect up to four IDE devices, including large hard drives and CD-ROMs. The EIDE interfaces support PIO mode four operation, which transfers data at rates of over 16MB/s and allows drive capacities to 8.4GB.

The card provides an FDD interface, two RS-232 serial ports and one enhanced parallel port. It also has a range of mechanisms to overcome system failure, an on-board power-on self test, a 12-stage watchdog timer and CMOS data is backed up in EEPROM in case of battery failure.

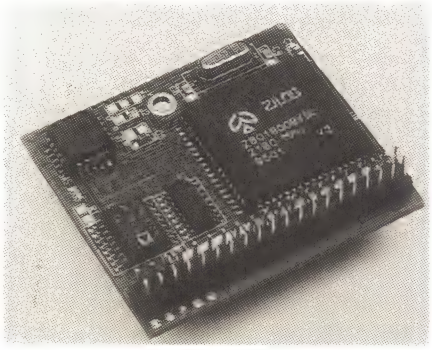
For further information circle 162 on the reader service coupon or contact Priority Electronics, 189 Bay Road, Sandringham 3191; phone (03) 9521 0266.

Microprocessor core module

The Smartcore module from Z-World Engineering is a 4.6 x 5.2mm PCB containing the common components needed in all microprocessor systems. These include the processor, memory, power control, watchdog and clock. The module can therefore be used as a plug-in component into a system that provides the interface and control logic.

The module is available in four configurations, giving a choice of 32KB or 128KB of RAM, optional parts (EEPROM, real time clock, 691 supervisor) and speed (9MHz and 18MHz).

The module is supported by Z-World's Dynamic C development system which includes an interactive compiler, editor and debugger, libraries, sample programs and a real time kernel. Price of the development system is $299, and the Smartcore module prices range from $99 (single) to $49 for large quantities. An evaluation kit is available for $199.



For further information circle 163 on the reader service coupon or contact Dominion Electronics, Suite 206, 6-8 Clarke Street, Crows Nest 2065; phone (02) 9906 6988.

Frame grabber for PCI bus

US manufacturer Coreco has released the Oculus TCi, a series of colour, 24-bit frame grabbers for the PCI bus. Available in four models, the series include on-board VGA, optional daughter cards for RGB acquisition and video

compression, single and dual screen operation and Windows compatibility.

The cards can perform high quality video scaling and have a video-in-a-window function. They are supplied with TCi-Pro (a Windows application) and support for a variety of popular software packages.

The optional daughter boards are field installable, and support the JPEG, MPEG and H.261 compression formats. The TCi series of cards are available in four versions.

For further information circle 164 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone 008 335 245.

Video converter has 1024 x 768 resolution

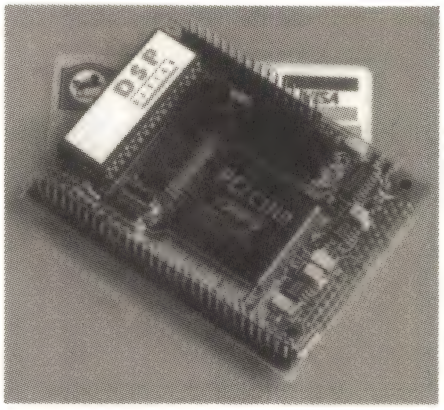
The Box-800 video converter from Skyvision, Finland can convert PC or Macintosh images into a PAL or NTSC video format in real time. It needs no special software and supports up to 1024 x 768 pixels with 32K colours.

The unit offers full control of picture size, and image freeze and flicker free functions, as well as RGB, composite and S-VHS outputs. Only those parts of the image which cause flicker are filtered, resulting in a sharp flicker free image. The RRP of the converter is $2390 (incl sales tax).

For further information circle 165 on the reader service coupon or contact Trace Pacific, 8 Prohasky Street, Port Melbourne 3207; phone (03) 9646 5833.

Embeddable PC

UK based company DSP has release the Gold Card AT (GCAT) range of miniature PCs. These products are a family of PC compatible computers and I/O cards, about the size of a credit card, that can be incorporated in a new design, such as a control system. Each card is supplied with comprehensive documentation and software utilities.



The newest processor board in the range is the GCAT-6000, a complete PC with up to 8MB of DRAM, keyboard port, two serial ports, LCD and CRT interface, ROM disk, SRAM disk, Flash EEPROM and an ADC. As well as providing a PC-bus interface, the board has an integral calender clock and a watchdog timer. It operates from a single 5V power supply and takes around 45mA when running, or 50uA in power down mode. It is suitable for use in extended temperature and low power applications.

The GCAT-3000 has the same functionality as the GCAT-6000, and includes a Type 1 PCMCIA connector. It also has a single RS-232 or RS-485 serial port.

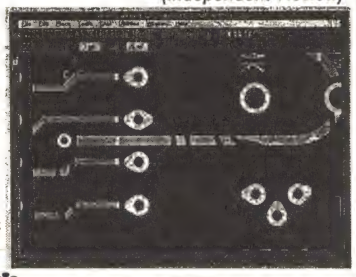
For further information circle 161 on the reader service coupon or contact DGE Systems, 103 Broadmeadow Road, Broadmeadow 2292; phone (049) 61 3311.

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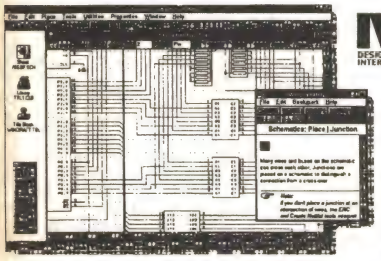
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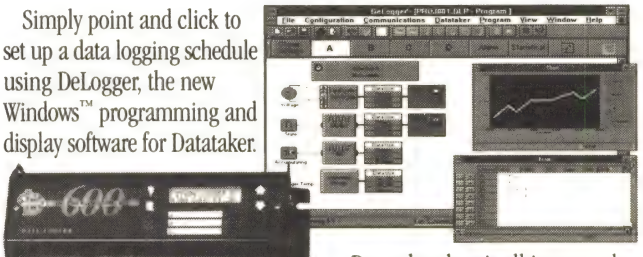
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READER INFO NO. 29

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READER INFO NO. 30

Scope card captures transients

Intelligent Instrumentation has released a new line of high speed transient capture/oscilloscope boards for the ISA bus. Five models are available, three that provide eight bit resolution at 40MHz, 50MHz and 100MHz respectively, and two high resolution 12-bit boards, with 20MHz and 60MHz sampling rates respectively. All boards contain on board memory for storing large transients and waveforms.

Each board has two channels and can function in single channel or dual channel mode. Inputs are standard BNC connectors to interface with oscilloscope probes. All boards also feature analog triggering on either channel A, channel B, or from an external source.

These boards are supported by Visual Designer, Intelligent Instrumentation's Windows based application generator for PC based data acquisition. Visual Designer allows custom programs to be developed by drawing block diagrams (Flowgrams).

For further information circle 170 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone 008 335 245.

Software for model robots

Harvard Associates has released a new version of PC-Logo for Windows called PC-Logo with Robotics. This software combines the full power of Logo with added commands to communicate directly with the robotic models from Fischertechnik.

PC-Logo can now be used to control motors, switches, lamps, electromagnets and buzzers. The procedural nature of Logo makes it an ideal language for managing robots and machines. Extending the control of the turtle on the screen to actual robots enhances the Logo learning environment of problem solving science, math and logic. Aimed at schools or home education, PC-Logo has been endorsed by the National Education Association and the National Parenting Center in America.

The Fischertechnik interface unit provides eight digital inputs, two analog inputs and four bi-directional motor outputs. The unit connects to any IBM-PC parallel printer port and allows a second unit to be attached for a total of 16 digital inputs and eight motor outputs (or 16 lamp/relay outputs). The analog inputs can be used with potentiometers (for position control), light dependent resistors (for measuring light), and thermisters (for measuring temperature).

The PC-Logo with Robotics software costs $195. The Fischertechnik kit costs $850, complete with PC-Logo software, interface and power supply.

For further information circle 171 on the reader service coupon or contact Procon Technology, PO Box 655, Mount Waverley 3149; phone (03) 9807 5660..

First MPEG generator/analyser

Tektronix has unveiled the MTS100 MPEG (Motion Picture Experts Group) Test System, the first product of its kind: a system with breakthrough integration of both signal generation and analysis of MPEG-2 transport streams.

The MTS100 is the first fruit of an OEM alliance between Tektronix and Matra Communication of France, which is part of Northern Telecom, a leading global supplier of telecommunications equipment.

The new MPEG test system satisfies the demands of customers in the multimedia, video, compressed digital video and telecommunications industries, for whom the technology is critical.

With market leading performance in MPEG test functions, the MTS100 is useful for applications in encoder/decoder compliance and stressing; multiplexer operation, repair and stressing; transmission system testing; manufacturing quality assurance; and MPEG system training.

A Windows NT workstation is the platform for the MTS100. Fully configured by Tektronix, the MTS100 includes a Data Store System and five application programs.

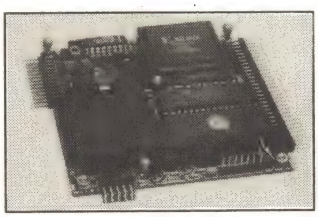
Transport stream I/O is provided on a variety of hardware interconnections including TTL serial and ECL parallel. Analysis of transport stream data (in files acquired by the Data Store System) is accomplished with a Windows-based MTS (MPEG Transport Stream) Analyser.

The MTS100 uses five 2GB SCSI hard drives with a custom I/O board capable of handling MPEG Transport Streams (MTS) at throughputs up to 45Mb/s.

Features of the system include an MTS Multiplexer which allows users to develop a variety of transport stream data files by using editable configuration files. Up to 20 programs with 10 elementary streams can be included in one transport stream. The MTS channel coder provides a digital video broadcast (DVB) channel coding and decoding capability.

For further information circle 176 on the reader service coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113; phone (03) 888 7066. ❖

Australian Computers & Peripherals from JED... Call for data sheets.

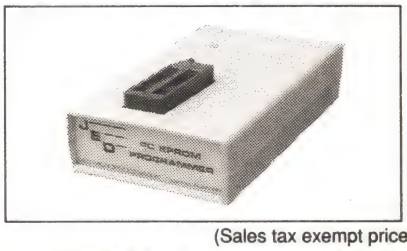


Australia's own PC/104 computers.

The photo to the left shows the JED PC540 single board computer for embedded scientific and industrial applications. This 3.6" by 3.8" board uses Intel's 80C188EB processor. A second board, the PC541 has a V51 processor for full XT PC compatibility, with F/Disk, IDE & LPT. Each board has two serial ports (one RS485), a Xilinx gate array with lots of digital I/O, RTC, EEPROM. Program them with the $179 Pacific C. Both support ROMDOS in FLASH. **They cost $350 to $450 each.**

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$300 PC PROM Programmer.



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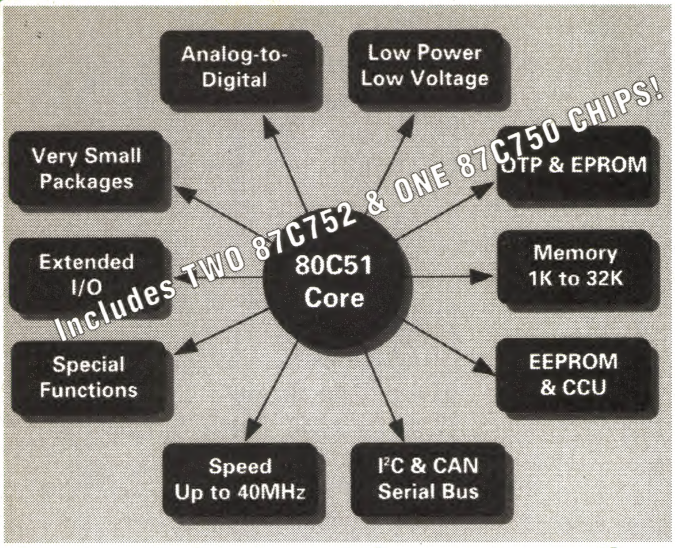
This little box simply plugs into your PC or Laptop's parallel printer port and reads, writes and edits PROMs from 64Kb to 8Mb. It does it quickly without needing any plug in cards.

JED Microprocessors Pty. Ltd

Office 7, 5/7 Chandler Road, Boronia, Vic., 3155. Phone: (03)9 762 3588 Fax: (03)9 762 5499

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R CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...



Ever wanted to try out the new generation of microcontrollers?

Well here's the low cost way to do it with the DS-750 Development Kit from Philips for only $159.90!!

It has the following features:

- **Emulates 87C750 Microcontrollers in Real-Time**
- **Programmable Clock up to 40MHz**
- **Built-in Programmer for 87C750/1/2**
- **High-speed Hardware Simulator**
- **Source-Level Debugger for C, PLM and Assembler**
- **24-pin DIP Emulation Header**
- **Serially linked to IBM PC at 115 KBaud**

The Ceibo DS-750 supports 87C750 Philips microcontrollers at any frequency allowed by the devices. It is serially linked to a PC/XT/AT or compatible systems and can emulate the microcontrollers using either the built-in clock oscillator or any other clock source connected to the microcontroller.
The clock oscillator generates 40MHz, 20MHz, 16MHz, 10MHz and 5MHz. Emulation is carried out by programming an 87C752 microcontroller with the user software and an embedded monitor program. The DS-750 provides the on-board programming capabilities and locates the monitor in the upper 1K that is not available for the 87C750.
Three working modes are available: real-time, simulator and simulator plus. In the real-time mode the user software is executed transparently and without interfering with the microcontroller speed. Breakpoints can be added to stop program execution at a specific address. In the simulator modes, an additional microprocessor is used to take control of the 87C750 lines and to simulate its operation but not in real-time.
This operating mode allows access to all the microcontroller functions (I/O, timers, etc.) and interacts with the hardware according to the user software execution or directly by means of emulator commands sent from the host computer. The combination of the two available working modes allows an easy way to debug hardware and software functions. The software includes C, PLM and Assembler Source Level Debugger, On-line Assembler and Disassembler, Software Trace, Conditional Breakpoints and many other features.

APPLICATIONS

The main applications of the DS-750 Kit are: -
Evaluation of Philips microcontrollers
Demonstration of microcontroller capabilities
Development of microprocessor based systems
Hardware and software debugging purposes
Training in the field of microprocessors
Programming of Philips microcontrollers

EXPERIMENTS

Five experiments demonstrate the capabilities and advantages of the 80C51 device and its derivatives. Completing each of the experiments will provide the user with more knowledge and experience.

1: Getting to know the DS-750

This experiment carries out several exercises to describe the functions of DS-750.

2: Data Transfer Instructions

This experiment helps you to understand the different addressing modes of the devices, writing programs that use the data transfer instructions, and transfer data and code to and from different memory types.

3: Input/Output Ports

This experiment shows how to manipulate Boolean variables, use the input/output capabilities of the microcontrollers, and how to assemble programs that use the ports of a microcontroller.

4: Arithmetic& Logic Functions

This experiment will help to make calculations with the microcontroller, replace logic circuits by microcontroller functions, and to write programs that use arithmetic and logic instructions.

5: Control Transfer Operations

After completing this experiment the user should be able to understand the stack operations, write programs that use the control transfer instructions and pass control to subroutines.
The DS-750 system is supplied with a User's Manual, debugger and application software (including Cross Assembler), microcontroller documentation (huge databooks!), two samples of the 87C752 and one of the 87C750 (all windowed EPROM microcontrollers), RS-232 and interfacing cables and a power supply.
All you need to get up and running for just **$159.90**

Special Shhhh!

DIC SC-7000 DeSolder Tool



- 100W ceramic heater
- Sensor feedback digital temperature control
- Special antistatic housing and zero crossover switching to protect sensitive components

- Suction/Hot air blow switch – suck for desoldering, blow for SMD removal
- Work on up to 12 layer boards

Last advertised at $630 But for DECEMBER ONLY

Includes FREE SMD Plunger for use with optional heads

$542.90 inc tax

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SILIVOLT Reinforced Insulated Silicone Cable		
HCK-7606-1/M	.75mm Silivolt per m	**$6.55**
HCK-7606-2/M	.75mm Silivolt per m	**$6.55**
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HCK-9265-2-110	2mm Red 1.0 m Lead	**$8.15**
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HCK-8234-2-000	2mm Red Hook Grip	**$10.85**
HCK-9217-1-100	2mm Blk Stackable Plg	**$1.95**
HCK-9217-2-100	2mm Red Stackable Plg	**$1.95**
HCK-9225-1-100	2mm Blk Test Prod	**$6.05**
HCK-9225-2-100	2mm Red Test Prod	**$6.05**
HCK-9229-1-100	2mm Blk Test Tweezers	**$23.25**
HCK-9229-2-100	2mm Red Test Tweezers	**$23.25**
4mm SILIVOLT 60V Leads (fig 1)		
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HCK-7288-4-105	4mm Yel 16A 0.5 m Lead	**$9.70**
HCK-7288-5-105	4mm Grn 16A 0.5 m Lead	**$9.70**
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HCK-9617-4-110	4mm Yel Stght 1.0 m Lead (fig 2)	**$14.10**
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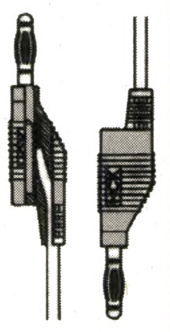


fig 1

fig 2 ***fig 3*** ***fig 4***



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KITS

1-CH UHF FOR CENTRAL LOCKING Our single channel UHF receiver kit has been updated to provide provision for central locking!! Key chain Tx has SAW resonator, see SC Dec 92. Compact receiver has pre-built UHF receiver module, and has provision for two extra relays for vehicle central locking function. Kit comes with two relays. **$36** Additional relays for central locking **$3** ea. Single channel transmitter kit **$18**

LOW COST 1-2 CHANNEL UHF REMOTE CONTROL compact keyring transmitter kit, 1/2 million codes, receiver has 2A relay contact output, PCB and all components kit. 1 channel Tx kit **$10**, 2 channel Tx kit **$16** Rx kit **$20** extra components for 2 channel Rx operation (extra decoder IC and relay) **$6**

ECG Solder masked and silk screened PCB and software on 3.5" disk (See EA July 95) **$9.**

MASTHEAD AMPLIFIER SPECIAL
High perfomance low-noise masthead amplifier covers VHF-FM-UHF and is based on a MAR-6 IC. Includes two PCBs, all on-board components. For a limited time we will also include a suitable plugpack to power the amplifier from mains for a total price of: **$25**

PROTECT ANYTHING ALARM KIT EA May 93, PCB and all on-board components *ON SPECIAL* **$20**

4-CHANNEL UHF REMOTE CONTROL KIT: Two Tx & 1 Rx **$96**.

LASER BEAM COMMUNICATOR KIT: Tx, Rx, plus IR laser: **$60**

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Poll our **(02) 9579 3955** fax number to find out how to get our item and kit lists. MANY MANY MORE ITEMS AND KITS THAN THOSE LISTED HERE! *Ask for these lists to be sent with your next order.*

FM TRANSMITTER KIT - MK1 This complete transmitter kit (miniature microphone included) is the size of an AA battery, and is powered by a single AA battery. Use a two AA battery holder (provided) as the case, and a battery clip (shorted) for the switch. Battery life is over 500 hours!! **$11**

BRAKE LIGHT INDICATOR KIT: 60 LEDs, two PCBs and ten resistors, makes a very bright 600mm long, high intensity red display **$25**.

GARAGE DOOR - GATE REMOTE CONTROL KIT: SC 4/94 Tx **$18**, Rx **$79**.

1.5-9V CONVERTER KIT: $6 ea. or 3 for **$15**.

PLASMA BALL KIT: PCB and components kit, needs any 240V light bulb *ON SPECIAL* **$20**.

STEREO SPEAKER KIT

Total of four speakers to make two 2-way speakers. Quality European cloth surround bass - midrange speakers, used in upmarket stereo televisions, rectangular, 80 x 200mm. Tweeters are good quality cone types, 85mm square. Two woofers & two tweeters. **$16**

HF FLUORO BALLASTS

European, new slimline high frequency fluorescent lamp ballasts, feature flicker-free start, better efficiency, no visual flicker. Strobing effect with machinery eliminated, no buzz, much reduced RF interference. Sinewave operation, similar design to that described in SC Oct 94, but more complex. Some models include a dimming option (needs external 100k pot or 0-10V DC source). Some use a separate filter choke (supplied, 16x4x3.2cm). Wattage ratings from 16 to 150W. Price **$20 to $26.**

COMPONENTS

HIGH VOLTAGE DISC CERAMICS 680pF/3kV **20 for $4,** 15nF/3kV **$2**, 1nF/15kV **$4**

HIGH VOLTAGE DIODES high speed 1kV/1A **10 for $5**, 8kV/20mA **$1.50**, 16kV/20mA **$2**

TRIACS 600V/60A *CLEARANCE* **$3**

HIGH INTENSITY RED LEDS 550 - 1000mCd @ 20mA, 100mA max, 5mm: **10 for $4 or 100 for $30**

BLUE LEDs 5mm **$2.50**

ELECTRET MIC INSERTS High output omnidirectional standard size **10 for $8** also some high quality unidirectional electrets removed from new equipment **$3**

DYNAMIC MICROPHONE INSERTS Unidirectional low impedance **$4**

EPROMS: 27C512, 512K (64K x 8), 150ns access CMOS EPROMs. Removed from new equipment, need erasing, guaranteed, **$4**.

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3.58MHz CRYSTALS 10 for $6

OP27 OP AMP Super op amp! **$3**

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IR LEDs 880nm 12º 30mW @ 100mA **10 for $9** 60º type **10 for $9**, 940nm 12º 16mW @ 100mA **10 for $5**

IR DETECTOR PIN DIODE 10 for $10

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LASERS

HELIUM-NEON 633nm red laser tubes from new and near new equipment. Suitable for light shows: Output power in the range of 2.5 to 7.5mW. Includes our 12V Universal Laser power supply MkIV. (No problems with our new transformers.) *ON SPECIAL* at a reduced price of **$80** for a 2.5-4mW tube and supply. **$130** for a 40-7.5mW tube and supply.

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AIR-COOLED ARGONS Used 30-100mW argon-ion head blue/green output. Includes details of power supply and other information: head only: **$350** *LIMITED SUPPLY*

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12V FLUORO CONVERTER

12V-350V DC-DC CONVERTER (with larger MOSFETS) plus a dimmable mains operated HF ballast. These will operate a 32-40W fluorescent tube from a 12V battery. Very efficient. See June 95 EA, **$36** for kit and ballast.

GEIGER COUNTER

Ready made Geiger counter detects dangerous Beta and Gamma rays. NEW
Two-modes: accumulates counts or terminates count after 1 minute. Alarm sounds if radiation exceeds a safe level, LCD display, 9V battery operation (15mW!). **$99**

MISCELLANEOUS

MAGNETIC CARD READERS back in stock **$80**

PELTIER DEVICES Solid state, can be used to make a thermoelectric cooler - heater. Basic information included. 12V-3.4A **$25** 12V-4.5A **$35**
We can also provide two thermal cut-out switches and a 12V DC fan to suit either device **$10**

12V STEPPER MOTORS SPECIAL
Type M-17 20 steps per rev, 55gcm holding torque, 740PPS pull in freq, 100PPS driving freq, 34gcm pullout torque, 6 wire, 100 ohm winding.
Type M-18: 100 steps per rev., 1500gcm holding torque, 440PPS pull in freq, 300PPS driving freq, 980gcm pullout torque, 6 wire, 10 ohm winding. *INTRODUCTORY PRICE* **$10**

LCD CHARACTER DISPLAYS standard 16 x 1 display, 5v **$20**

IEC EXTENSION LEADS: 2m, with IEC plug and IEC socket **$5.**

3" CONE TWEETERS Sealed back dynamic 8 ohm tweeters: **$5**

12V FANS Brand new 80mm, 12V 1.6W DC fans. **$10 ea or 5 for $40**

STEPPER MOTORS 6V 6 wire 1.8 deg, used **$4**

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New soldering iron tips for low voltage Weller soldering stations and mains operated Weller irons. Mixed sizes and temperatures. Specify mains or soldering station type: **5 for $10.**

LIGHT MOTION DETECTORS Small PCB assembly based on a ULN2232 IC. Can detect humans crossing a narrow corridor at up to 3 metres **$5** or **5 for $20**

12V-2.5W SOLAR PANEL

US amorphous glass solar panels only need terminating and weather proofing. Includes clips and backing glass. Very easy to complete. Size: 305x228mm, Voc 18-20V, Isc 250mA. *SPECIAL!* **$20 ea. or 4 for $60.** A very efficient switching regulator kit is also available: Suits 12-24V batteries, 0.1-16A panels, **$27**. Also available, a simple and efficient shunt regulator kit, **$5**.

CCD CAMERA-VCR SECURITY SYSTEM

Ready made PIR detector module and learning remote control combination can trigger any domestic IR remote controlled VCR to *RECORD* human activity within a 6m range with an 180º view. Starts VCR recording at first movement and ceases recording a few minutes after the last movement has stopped. Just like commercial CCD-video recording systems costing $1000's!! No connection needed to your existing VCR. IR detector module, control kit, IR learning remote control and instructions **$90** or **$65** when purchased with our CCD camera. Previous CCD camera purchasers can claim reduced price with proof of purchase. Why pay $1000s!

TINY PCB CCD CAMERA with auto iris lens, 0.1lux 320k pixels, IR responsive, has 6 IR LEDs on PCB, almost matchbox size! **$199**

LENS & PHOTOGRAPHICS

SLAVE FLASH - very small, simple and effective Triggers remote flashes from camera's own flash, to fill in shadows. Does not false trigger, but is very sensitive. Can be used in large rooms. PCB and components kit. **$7** NEW

SOUND ACTIVATED FLASH Adapted from ETI Project 514. Adjustable sensitivity & delay enable creation of fascinating photographs. Has LED indicator for easy setting up. PCB, components and microphone. **$13** NEW

PROJECTION LENS Brand new, precision angled projection lens. Overall size 210x136mm. High-impact Lexan housing with focal length adjustment. When disassembled yields three 4" diameter lenses convex-concave, convex-convex, concave. Very limited quantity. **$35**

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USSR LENS 100mm/f2 Pentax screw mount, for night viewers, has focus adj, but no iris adj **$60**

USSR LENS 58mm/f2 Pentax screw mount, used for cameras, has focus and iris adj **$60**

PRECISION FRONT SURFACE ALUMINIUM MIRRORS 200 x 15 x 3mm **$3** 50 x 72 x 3mm **$3**

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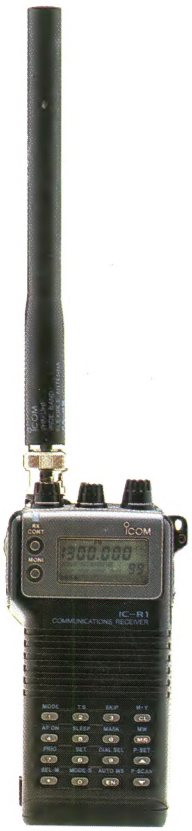
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